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The effects of caregiving robots on mortality salience with the elderly

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The Effects of Caregiving Robots on Mortality Salience with the Elderly

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Abstract

As the world's population of elderly persons rises (He, Goodkind, & Kowal, 2016), there is an increasing demand for people to care for the elderly. Caregiving robots are a potential solution to this problem. Research (i.e. MacDorman, 2005) suggests that uncanny, humanlike robots may elicit death anxiety, but it remains unclear whether non-humanlike caregiving robots also elicit death anxiety. This study expands on MacDorman's study and investigates the effects of caregiving robots on death thought accessibility (DTA) and death anxiety in the institutionalized elderly. This research focuses on how caregiving robots affect the close relationship buffer against death anxiety, as well as looking at self-esteem and locus of control as potential covariates of DTA and death anxiety. A video of a non-humanlike caregiving robot as a mortality salience induction and a video of a human caregiver as a control video are used as stimuli. The results showed no significant differences in death anxiety and DTA between the human and robot caregivers. There were no interactions involving self-esteem and locus of control. Implications are discussed.

Chapter 1: Introduction

What was once the subject of science fiction horror may soon be coming to a household near you. Although the implications of care and companion robots have been explored in works such as E.T.A. Hoffmann's *The Sandman* (1816) and Ira Levin's *The Stepford Wives* (1972), the recent advancement of robots as potential caregivers and companions suggests an increased need for attention from the scientific community. Robots as companions or caregivers may someday be commonplace in many households, but perhaps the most imminent use is to care for the elderly. With advancements in technology and medicine, people can live longer than ever before. By 2050, 17% of the world's population (nearly 1.6 billion people) will be age 65 or older compared to 8.5% of people today (617 million people) (He et al., 2016). This dramatic increase is likely to present new challenges for healthcare industries and communities as the demand for people to care for the elderly increases. With falling global fertility rates (He et al., 2016), the number of children being born is declining, and for the first time in history, people age 65 and older outnumber children under age 5 (and by 2050, it is estimated that the elderly will more than double the number of children under age 5) (He et al., 2016). The aging population faces the challenge of who will help care for them as fertility rates decline worldwide (UN Population Division, 2017) as fewer and fewer young people are available to care for an increasingly elderly population.

The field of robotics offers a potential solution to this problem; robots can be the new caregivers for this population. Given the novelty of using robots as caregivers, there are still many questions left to be answered regarding the psychological and ethical implications of caregiving robots. Robots designed to care for people or otherwise work in a domestic setting fall under the category of 'social robots.' Social robots are generally defined as robots that elicit

social responses from their human users because they follow the rules of behavior expected by their human users (de Graaf et al., 2016; Bartneck & Forlizzi, 2004). Compared to robots that do not work in domestic and social settings, the design of social robots is especially important when considering how these robots interact with those that use them. Prior research indicates that people can establish some kind of emotional or social bond with socially interactive robots (de Graaf et al., 2016). Humans are easily able to bond with nonhuman objects because of a fundamental 'need to belong' that induces a desire for relationships with other social beings (Cacioppo & Patrick, 2008). This desire to form relationships with nonhuman objects is likely to increase when these objects possess lifelike abilities and are endowed with humanlike capacities (de Graaf et al., 2016). For these reasons, people who use and interact with social robots often become attached to them, the same way one might become attached to a significant other, caregiver, or friend.

Countries that are especially susceptible to the consequences of an aging population and declining fertility rates are setting the groundwork for the use of social robots in caregiving roles. As of 2015, Japan had the highest percentage of the population age 65 and older (approximately 26.6%) (He et al., 2016) and has projected a shortfall of 380,000 specialized workers to care for the elderly by 2025 (Foster, 2018). Though other countries, such as the United States, are implementing social robots in caregiving roles, Japan has most notably been implementing the use of this technology (Petrecca, 2018). In Japan, robots are being used in elder care facilities to support staff and provide companionship to the elderly (Foster, 2018). The three main ways in which robots might be used in elder care are: (1) to assist the elderly, and/or their caretakers in daily tasks; (2) to help monitor their behavior and health; and (3) to provide companionship (Sharkey, 2010). This thesis will primarily focus on the use of robots as companions and

caregivers, as opposed to robots whose primary function is to monitor patients' health. As robots take over the traditionally human roles of companionship and caregiving, it is important to consider the psychological relationship between the nonhuman robot and the person for whom it cares for.

Although caregiving robots may be more efficient than traditional methods of caregiving (i.e. human caregivers), research suggests that the use of these robots may negatively impact the well-being of those in need of care. The primary cause for concern about using these social robots in caregiving settings lies in existential psychology research. Existential psychology is a branch of social psychology that studies how humans cope with the omnipresent reality of death and dying (Pyszczynski et al., 2004). Terror Management Theory (TMT) lies within existential psychology and posits that certain behaviors help manage this death anxiety (Rosenblatt et al., 1989). TMT examines how different aspects of the human experience may affect existential concerns (Rosenblatt et al., 1989). Death anxiety can generally be defined as the fear of and anxiety related to the anticipation and awareness of the reality of dying and death (Lehto & Stein, 2009). A handful of studies that employ TMT methods indicate that robots may affect death anxiety and that those most likely to use these social robots (e.g. elderly persons) may already be at risk for higher levels of death anxiety. For example, one study suggests that humanlike robots may increase the anxiety one feels about his or her death (MacDorman, 2005). Research indicates that elderly people traditionally have less death anxiety compared to younger adults (Sinoff, 2017), but that elderly people in institutional settings (i.e. those who are most likely to one day use a social robot) tend to have higher levels of death anxiety compared to those living in their community (Azaiza et al., 2010; Missler et al., 2012). This is likely because

those living in institutional settings have decreased levels of social support, which has been shown to help manage existential concerns (Mikulincer et al., 2002).

If the psychological effects of using robots do more harm to the overall well-being of patients than good, then their use should be discontinued because they are creating the opposite effect they are trying to produce. Furthermore, if research identifies certain aspects of robots that are significantly harmful to patients, then it may be possible to adjust the robots accordingly without discontinuing their use outright. Research on the specific ways in which caregiving robots might affect the elderly allows for a better understanding of how we might design future robots to best help populations in need of care and what kinds of roles robots ought to fill in peoples' lives.

The following chapters explore this topic further. Chapter 2 provides more information on Terror Management Theory, focusing on death anxiety in the elderly, past research on robots and their influence on death salience, and outlines the goals and hypotheses of the thesis. Chapter 3 outlines the methods used, including details about participants, materials, and the procedure. Chapter 4 reports the findings of the thesis, and finally, Chapter 5 discusses the conclusions of the thesis, limitations, theoretical implications, and directions for future research.

Chapter 2: Literature Review

This chapter provides an in-depth literature review of past research. This chapter begins

with an overview of Terror Management Theory (TMT), which is the primary theory used in this

thesis's investigation of the psychological effects of caregiving robots. Next, this chapter gives

more information about the relationship between the elderly and death anxiety. In particular, this

section covers various factors influencing death anxiety in the elderly, such as physical health,

religiosity, and institutionalization. The chapter then discusses MacDorman's (2005) flagship

study on robots, death salience, and the uncanny valley while discussing additional research on

robots and social connection. Finally, the chapter explains the goals of the thesis and lists the

hypotheses.

Terror Management Theory

Terror Management Theory (TMT) falls under the domain of existential psychology, a

subfield of social psychology that speculates about how humans confront and come to terms with

the nature of existence and the meaning of life (Greenberg et al., 1986). Before the development

of TMT and existential psychology in the 1980s, social psychology seldom focused on the role

death played in one's everyday life. Contrary to the field of social psychology at the time, TMT

offered a new perspective on existential questions—the inevitability of death has a profound

effect on many domains of human behavior (Darrell & Pyszczynski, 2016).

TMT is derived from the work of cultural anthropologist Ernest Becker, who in his book,

The Denial of Death, noted an important paradox in humans: humans are the only species to

have both an awareness of the inevitability of death and a fundamental desire for survival and

life (Becker, 1973). According to Becker (1973), this awareness of death leads to an omnipresent

fear of death that must be overcome if humans are to function normally. Becker, and

consequently TMT, posit that humans overcome this omnipresent fear of death by adhering to a cultural worldview. Culture provides both a 'literal immortality' and a 'symbolic immortality' that allow for the belief that human existence is meaningful and unending (Dechesne et al., 2003). 'Literal immortality' refers to the belief in an afterlife promised by many organized religions, whereas 'symbolic immortality' refers to the idea that culture endures past a lifetime, and that by becoming part of one's culture, one symbolically lives on after death (Dechesne et al., 2003). Thus, if someone adheres to the standards of a cultural worldview, they can overcome the paralyzing realities of death (Solomon et al., 2004). In addition to one's cultural worldview, TMT stresses the importance of self-esteem in overcoming a fear of death. According to TMT, self-esteem is the belief that one is a person of value in a world of meaning (where this meaning comes from the standards of value prescribed by one's culture) (Greenberg et al., 1986). Adhering to the standard set forth by one's culture increases self-esteem, and thus self-esteem acts as a buffer against death anxiety (Rosenblatt et al., 1989). At the forefront of the empirical assessments of TMT is the *mortality salience hypothesis* and the *anxiety buffer hypothesis*.

Mortality Salience Hypothesis

The *mortality salience hypothesis* suggests if one's cultural worldview and self-esteem act as psychological structures that provide protection against death anxiety, then reminding people of their mortality (mortality salience; MS) should increase a need for these psychological structures (Pyszczynski et al., 1997; Solomon et al., 2004). In one notable study, participants in the MS condition (i.e. people who were reminded of their death) were more likely to judge moral transgressors (i.e. challengers of the participants' cultural worldviews) more harshly compared to participants in the control condition (Rosenblatt, et al., 1989). In another study, Christian participants in the MS condition reported more positive evaluations of a Christian (in-group)

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target and more negative evaluations of a Jewish (out-group) target, while participants in the control condition reported no significant differences in their evaluation of the Christian and Jewish target (Greenberg et al., 1990). This propensity to respond positively toward that which upholds one's cultural values and to respond especially negatively to that which violates one's cultural values is known as 'worldview defense' (Rosenblatt et al., 1989). Further experiments suggest that worldview defense in response to MS is not mediated by physiological arousal, anxiety, or mood (Rosenblatt et al., 1989). This discovery gives additional support to the MS hypothesis since it suggests that thinking about one's death, as opposed to other psychological factors such as arousal, is responsible for an increased worldview defense. These studies, along with an additional 160 published studies on MS (Solomon et al., 2004), have played a crucial role in establishing the MS hypothesis as an empirically valid component of TMT.

Proximal and Distal Defenses

In addition to creating a theoretical framework for why people experience death-related anxieties, TMT explains certain behaviors and attitudes observed after a MS induction. In response to a MS induction, people respond by engaging in proximal and distal defenses. Proximal defenses involve mostly rational and cognitive defense mechanisms in an attempt to push conscious death-related thoughts out of consciousness (Pyszczynski et al., 1999). For example, attempting to distract oneself from the death-related thoughts or denying one's apparent vulnerability of dying (e.g. "I'm only 20, young people hardly ever die) are proximal defense mechanisms. Since the primary purpose of a proximal defense is to remove death from conscious awareness, these defenses occur immediately after MS, and then subside (Darrell & Pyszczynski, 2016). Whereas proximal defenses help to eliminate conscious thoughts of death, distal defenses help to eliminate subconscious thoughts of death. Research indicates that people

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engage in these distal defenses only when death-related thoughts are pushed below conscious awareness (Pyszczynski et al., 2000). Immediately after the MS induction, proximal defenses are activated to push thoughts of death out of consciousness (Pyszczynski et al., 2000). After a delay, death thoughts are out of consciousness but still highly accessible. Distal defenses are then enacted and address the death-related thoughts indirectly and symbolically, thus creating the effect that one is a contributor to a meaningful and eternal universe (Pyszczynski et al., 1999). These indirect, distal defenses occur after a delay (i.e. when death-related thoughts are no longer in conscious awareness but remain subconsciously active) (Greenberg et al., 1994). Adherence to one's cultural worldview, maintaining self-esteem, and engaging in close relationships with others are all ways in which people engage in distal defenses, and thus attempt to keep omnipresent fears of death out of conscious awareness.

Anxiety Buffer Hypothesis

Another fundamental hypothesis in TMT is the *anxiety buffer hypothesis*. This hypothesis states that if a psychological structure protects against anxiety (particularly death-related anxiety), then strengthening that structure should lead to decreased anxiety while weakening that structure should lead to increased anxiety (Greenberg et al., 1986). The three primary structures that serve as a buffer against death anxiety are adherence to one's cultural worldview, self-esteem, and close relationships (Darrell & Pyszczynski, 2016). In their important study, Schmeichel and Martens (2005) found that participants in the MS condition who had first affirmed an important self-value evaluated a worldview violator less harshly compared to participants in the MS condition who had *not* first affirmed an important value. The study also found that those in the value-affirmation condition had significantly less death anxiety compared to those who had not affirmed a value, suggesting that adhering to one's cultural worldviews can

serve as a potential buffer against death anxiety. Another study (Greenberg et al., 1992) showed that participants who received positive feedback on a personality test (i.e. received a self-esteem boost) prior to watching a video with death-related scenes reported less anxiety than participants who received neutral personality feedback before watching the video.

The last structure that serves as a buffer against death anxiety is close relationships with others. Prior psychological research proposes that close relationships play a crucial role in regulating distress (Bowlby, 1969) and are an important source of self-esteem (Leary, 1999; Leary & Downs, 1995). Florian et al. (2002) hypothesized that since close relationships help alleviate anxiety and boost self-esteem (which is itself a death anxiety buffer), close interpersonal relationships may also serve as a death anxiety buffer. In support of their hypothesis, a series of studies found that increasing mortality salience resulted in higher reports of romantic commitment, thinking about romantic commitment reduced the effects of MS when participants were asked to judge social wrongdoers, and being promoted to think about problems in romantic relationships led to higher accessibility of death-related thoughts compared to a control group (Florian et al., 2002). These results indicate that close relationships play a crucial role in reducing death anxiety. The present thesis aims to explore what role social robots play in the close-relationship buffer against anxiety, and a more complete literature review of social connections as a buffer against death anxiety will be conducted in ensuing pages.

Death Anxiety in the Elderly

Although the effects of thinking about death are relevant across all age demographics, studying how older adults (who are statistically speaking, closer to death) is of particular interest to many TMT researchers. In addition to being "closer" to death, the elderly face additional challenges, such as being institutionalized, that are less prevalent for younger adults (Fortner &

Neimeyer, 1999). Studying how the elderly experience death anxiety is especially important when considering therapeutic, institutional, and healthcare practices.

Empirical research on the death attitudes of older adults first began in the 1950s with the work of Herman Feifel (Neimeyer et al., 2003). Feifel (1956) found that older American veterans of World War I reported only thinking of death occasionally or rarely and displayed less fear of death than middle-aged or young adults (Feifel & Branscomb, 1973). Interestingly, even though participants in this study showed less fear of death, the participants still believed that fear of death peaks in old age when asked to describe when "people in general" fear death (Feifel, 1956). Contrary to what one might intuitively theorize about older adults and death anxiety, Feifel's research, along with many more recent studies, has generally found that death anxiety is lower in older adults, and that death anxiety decreases from middle to old age (e.g. Fornter & Neimeyer, 1999; Bengtson et al., 1977; Neimeyer, Wittkowski, & Moser, 2003). Despite this overarching trend for the elderly to experience reduced death anxiety, some studies indicate that the relationship between age and death anxiety is not strictly linear. For example, Gesser and colleagues (1997-1988) observed that older adults had a lower fear of death compared to middle-aged adults, but not young adults. Furthermore, there may be differences in what *exactly* about death and dying is precipitating death anxiety in younger versus older adults. Thorson and Powell (1994) found that younger adults had more fear surrounding decomposition, immobility, pain, uncertainty, helplessness, and isolation, whereas older adults had more fear surrounding the loss of control and the existence of the afterlife.

It is also important to note that elderly persons of different ethnicities may vary in their fears of death. Depaola and colleagues (2003) found that elderly White participants displayed a higher fear of dying compared to elderly Black participants. When looking at more specific

constructs of fear of death, Black participants displayed higher levels of fear of the unknown, fear of conscious death, and fear for the body after death, while also placing less social value on the elderly compared to White participants (Depaola et al., 2003). This study, along with the fact that the majority of research on death and the elderly has focused on Western, Christian populations (Azaiza et al., 2010), suggests that future research ought to look at the fear of death in the elderly across different cultures and races.

Confounding Variables in Death Anxiety and the Elderly

Age alone is not sufficient for predicting death anxiety, and multiple factors play a role in one's level of death anxiety. In their meta-analysis of death attitudes in older adults, Fortner and Neimeyer (1999) identified ego integrity, physical health problems, psychological problems, religiosity, and institutionalization as factors that affect death anxiety in older adults.

Erik Erikson, who is best known for his theory of psychosocial development, noted eight distinct developmental stages a person goes through throughout his or her life. In each stage, a person encounters a different psychosocial crisis (i.e. when the individual's needs conflict with society) that must be resolved if the person is to continue developing normally (Erikson, 1963, 1982). In middle age (approximately 40 to 65 years), an individual goes through the "generativity versus stagnation stage" in which people experience a need to create or nurture things that will outlive them (McLeod, 2018). Erikson predicted that it is an awareness of one's death that triggers this stage (Erikson, 1963, 1982), and successive research on the relationship between age and death awareness (as noted in the aforementioned studies) appears to support Erikson's prediction. The next and final stage of psychosocial development, ego integrity versus despair, involves contemplating life's accomplishments. If an individual successfully goes through this stage, they experience heightened "ego integrity" which involves acceptance of

one's life and a sense of wholeness. Failure in this stage results in despair, depression, and hopelessness (McLeod, 2018) while successful resolution of this stage (i.e. increased ego integrity) is negatively correlated with death anxiety (Fortner & Neimeyer, 1999).

Research points towards a complicated relationship between physical health problems and death anxiety in the elderly. In their meta-analysis, Fortner and Neimeyer (1999) noted that greater physical health problems predict higher levels of death anxiety in the elderly. Fortner and Neimeyer (1999) hypothesized that those who suffer from illness may be closer to death, thus precipitating increased thoughts of death. Fortner and Neimeyer (1999) used only global measures of physical health problems in their review, which begs the question that the specific type of illness might moderate death anxiety in elderly patients (i.e. illness that is terminal or causes chronic pain). However, another study found there was no difference in levels of death anxiety among terminally ill heart disease and cancer patients (Feifel et al., 1973). Interestingly, while terminally ill elderly patients do not display significantly more death anxiety on a conscious level compared to controls, they do display significantly increased death anxiety on the non-conscious level (Feifel et al., 1973). This may indicate that elderly persons enact distal defense, rather than proximal defenses, against death anxiety related to their terminal illness. Similarly, elderly patients with more psychological problems (at least when looking at global measures of psychological problems and global measures of depression and anxiety) tend to show higher levels of death anxiety (Fortner & Neimeyer, 1999).

Religiosity also appears to have a complicated relationship with death anxiety and the elderly. Although early studies on this relationship indicate that religious people are more afraid of death than nonreligious people due to the cessation of earthly experience and concerns about the afterlife (Feifel, 1959), more recent research yields contradictory results (e.g. Feifel &

Brascomb, 1973; Feifel, 1974, Azaiza et al., 2010). Differences in findings seem to reflect variations in how religiosity is measured and much of the later research looks at how intrinsic religiosity versus extrinsic religiosity relates to death anxiety. Intrinsic religiosity involves the centrality of religious faith in one's life, whereas extrinsic religiosity reflects a more utilitarian view of religion (Neimeyer et al., 2003). One study found that only intrinsic religiosity and age is negatively correlated with death anxiety (Thorson & Powell, 1990), and another study found that fear of death was negatively correlated with intrinsic religiosity, but positively correlated with extrinsic religiosity (Bivens et al., 1995). Some researchers have theorized that a more genuine religious commitment (i.e. the kind of commitment found in intrinsic religiosity) mediates fear of death by giving meaning to a transcendent afterlife (Rigdon & Epting, 1985).

Finally, institutionalization appears to have the greatest impact on death anxiety for the elderly and is especially important for the present thesis, since caregiving robots are most likely to be used in institutionalized settings. Institutionalized elderly people (including those living in nursing homes, hospices, and other kinds of long-term institutionalization) are typically frailer, more likely to be surrounded by other elderly people, and are more likely to be confronted with death and dying than noninstitutionalized elderly people (Azaiza et al., 2010). With these factors in mind, it makes sense that death is more salient for the elderly in institutionalized settings. Not much research has been done comparing death anxiety for institutionalized and noninstitutionalized elderly persons, although the few studies that have looked at this relationship found that elderly persons in institutionalized settings have a high risk for death anxiety. Caregiving robots may exacerbate this death anxiety for institutionalized elderly since research suggests that robots may elicit death anxiety (e.g. MacDorman, 2005), and caregiving robots may not be able to stand in for the close relationship buffer against death anxiety.

In a study of elderly Arab Muslims in Israel, Azaiza et al. (2010), nursing home residents showed higher death anxiety than community residents, although the two groups did not show any significant difference in *dying* anxiety compared to community residents. The researchers note that this may be due to low rates of institutionalization in Arab societies, so people are more used to experiencing ill people in the community, as well as elderly institutionalized people thinking of the dying process as an extension of the challenges they already face (Azaiza et al., 2010). This study also observed that being female and having no education were predictors of higher death anxiety, whereas higher levels of social support and self-esteem were predictors of lower death anxiety. However, social support and self-esteem were only negatively correlated with death anxiety for those in institutionalized settings and not for those living in the community. Those living in their community, even when they are ill, are more likely to have an extensive support network, whereas those living in an elder care facility may lack this social support. In contrast to this study, Moreno et al. (2008) conducted a study of elderly persons in Spain and found lower death anxiety of those living in institutions compared to those that lived in their community. In their review, Missler et al. (2012) noted that this difference could be due to Moreno et al.'s (2012) failure to account for age as a confounding variable. In Moreno et al.'s samples, the elderly in care institutions were noticeably older (*M*=83.28, *SD*=6.72) than those living in the community (*M*=70.65, *SD*=6.00). As previously noted, death anxiety tends to decrease with age (e.g. Forntner & Neimeyer, 1999), which could explain the difference in results between Azaiza et al. (2010) and Moreno et al. (2008). In light of these studies and the apparent lack of research in this area, Missler et al. (2012) employed a multidimensional approach (i.e. fear for significant others, fear of the dying process, and fear of the unknown were separate constructs) to death anxiety and identified recent loss of a significant other, social

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support, purpose in life, physical and mental health, and self-esteem as potential correlates of death anxiety of institutionalized elderly persons in the Netherlands. Like other research, Missler et al. (2012) found that elderly persons in care institutions scored higher on all the death anxiety subscales compared to the noninstitutionalized elderly persons in Cicirelli's (2001) similar study. Fear for significant others was correlated with worse physical health, and fear of the unknown was correlated with low self-esteem, possibly due to uncertainty surrounding resources or coping mechanisms. Fear of the dying process was correlated with low self-esteem, lower senses of purpose in life, and worse physical health. These results indicate that death anxiety is a complex, multidimensional construct and that higher death anxiety appears to be correlated with frailty (Missler et al., 2012). Overall, the study found no significant differences in gender on death anxiety, although women showed higher levels of fear for significant others.

Undoubtedly, the relationship between death anxiety and older adults is complicated and multidimensional. Despite the apparent murkiness of past research on this subject, some general conclusions regarding this relationship can be made. Compared to young and middle-aged adults, older adults tend to show decreased death anxiety, likely due to an acceptance of their mortality. Despite this decrease in death anxiety as one ages, it is crucial to note that the elderly living in institutionalized settings are likely to experience higher levels of death anxiety compared to their elderly counterparts living alone in the community or with their families. Institutionalization is generally associated with increased physical and mental health problems, as well as a decreased social network and lowered self-esteem, meaning that these elderly persons are most at risk for death anxiety. A better understanding of how and why elderly people experience death anxiety is crucial for improving the quality of life for this subset of the population.

Robots and Their Influence on Death Salience

This thesis seeks to expand on the handful of studies that propose robots may elicit death anxiety and the call that the use of robots in social settings ought to be thoroughly investigated, especially if research suggests that robots are psychologically harmful to those that use them. Although many studies have sought to examine the psychological and social effects of robots through a variety of perspectives, only a handful of studies have sought to examine the psychological implications of robots through a TMT perspective.

Robots, the Uncanny Valley, and Death Salience

Perhaps the most notable TMT robot study is one conducted by MacDorman (2005). In this study, MacDorman investigates potential explanations for the 'uncanny valley.' Though the uncanny valley has now become commonplace when discussing humanlike robots and computer animation, the term was originally proposed by Masahiro Mori in 1970 to explain people's reactions to robots that appeared and acted almost human (MacDorman & Kageki, 2012). In his essay, Mori proposed that as robots appear more and more human, the perceiver's affinity for them increases until we reach a valley where the perceiver experiences an eerie, uncanny sensation when viewing the humanlike robot (Mori, 1970). In his later study, MacDorman gives one explanation for the eeriness felt as robots approach human likeness yet fail to appear completely human: humanlike robots act as a reminder of our mortality (MacDorman, 2005).

The study hypothesized that humanlike robots (which the study refers to as 'androids') may look like dead humans, which subliminally remind the perceiver that they will also someday be dead (MacDorman, 2005). The study predicted that viewing humanlike robots would result in the distal defense of showing an increased preference for stimuli that support the person's worldview and decreased support for stimuli that threaten the person's worldview (MacDorman,

2005). That is, the humanlike robot with an uncanny appearance elicits the same distal defenses as other reminders of death do (MacDorman, 2005). Participants were randomly assigned to view either an uncanny picture of a female humanlike or a picture of a young human female, and each picture was then followed by three 'neutral' pictures (MacDorman, 2005). Next, participants were asked a series of questions that served as a delay and then read passages describing either charismatic or relationship-oriented political candidates as well as passages describing a foreign student's experience that either praised or criticized the participant's home country. Finally, participants were asked to complete word completions, in which some of the word completion puzzles were intended to detect any subconscious activation of death (e.g. SK--L, SKULL) or any subconscious activation of uncanniness (e.g. WEI--, WEIRD) (MacDorman, 2005). The results showed that the experimental group showed a statistically significant preference for worldview supporters (i.e. the charismatic candidate and foreign student that gave praise) and against worldview threats (i.e. the foreign student who gave criticism) (MacDorman, 2005). Note that this result was only significant when all of the worldview questions were summed together, but no single question showed strong significance. For the word completion task, there was a statistically significant increase in the amount of uncanny and uncanny plus death-related words for the experimental condition compared to the control condition, but no significant difference for death words alone. While the study indicates that humanlike robots elicit distal defenses against death anxiety, it remains unclear whether it is the uncanniness of the robot or other factors (such as a fear of being replaced) that generates death anxiety. It is also unclear whether non-humanlike robots can also serve as reminders of death, or if this phenomenon is limited only to humanlike, uncanny robots. Another study attempted to empirically reproduce Mori's uncanny valley and found that there is indeed an observable

'valley' of eeriness and strangeness for humanlike robots (MacDorman & Ishiguro, 2006). This study gradually morphed together an image of a non-humanlike, mechanical robot with an image of a human, with the intersection between the two images (i.e. halfway between mechanical robot and human) being the uncanniest. This suggests that more mechanical, non-humanlike robots are not typically perceived with the same eeriness compared to humanlike robots; however, since MacDorman's 2005 study only tested if *uncanny* humanlike robots elicit death anxiety, whether non-humanlike, canny robots can elicit death anxiety merits further study.

Robots and a Loss of Social Connection

Although future research is necessary to help confirm MacDorman's (2005) finding that humanlike robots elicit death salience, current research suggests that the use of caregiving robots in institutional settings may result in effects known to increase death anxiety, such as increased social isolation (Sharkey, 2010). In traditional elderly institutions, those in need of care often receive social interaction through physical assistance from their caregivers, such as bathing, fetching food and drink, assistance with cleaning, and lifting those who are bedridden (Sparrow & Sparrow, 2006). These physical tasks are often accompanied with aspects of companionship such as conversation (Sparrow & Sparrow, 2006). Replacing these tasks with robots may reduce the need for specialized care workers for more physical and menial jobs but may result in decreased caring human interaction (Sharkey, 2010). Social isolation tends to increase death anxiety (e.g. Case & Williams, 2004), so it is imperative to understand if social robots can truly replace this crucial human interaction. Replacing human caregivers with robots may also make elderly persons feel objectified, unwanted, and that they have even less perceived control over their care (Sharkey, 2010). Currently, no research has investigated the effects of specifically caregiving robots on death anxiety, although research on the effects of caregiving robots on

social isolation provides some support for the hypothesis that these robots increase death salience.

Despite the possible increase in social isolation that caregiving robots bring, these kinds of robots may be able to help empower the elderly by increasing communication and mobility, while decreasing the need for another person in tasks like going to the bathroom (Sharkey, 2010; Borenstein & Pearson, 2010). Research suggests that companion robots may, to a certain extent, alleviate loneliness in nursing home patients (Banks et al., 2008). In one study, interaction with a robotic dog improved patients' scores on a loneliness scale compared to the control group who received no interaction, although there was no significant difference between using a robotic dog and a real dog (Banks et al., 2008).

The current research on the effects of using social robots in caregiving roles seems to point to a general conclusion: robots should be used as tools to increase the quality of care and to meet the demands of an increasing elderly population, although robots ought not to be used as complete replacements of human caregivers.

Goals and Hypotheses of the Thesis

This thesis aims to investigate whether social robots (specifically caregiving social robots) can fulfill the same role of acting as a source of social support and connectedness that serves as a buffer against death anxiety while also examining whether any potential increase in death anxiety can be explained by the robot *itself* eliciting death anxiety (as suggest by MacDorman, 2005). To better understand the relationship between caregiving robots and death anxiety, this thesis examined the differences in MS effects of non-humanlike caregiving robots compared to a human caregiver/companion. Due to the lack of specific research on this topic, it

remains unclear whether robots will result in increased death salience, and the results of this thesis will help further the investigation of robots and death salience.

Based on the current understandings of how social isolation, close relationships, and institutionalization affect death salience, it is plausible that non-humanlike robots will elicit heightened death thought accessibility (DTA) and death-related anxieties compared to human caregivers. Prior research suggests that viewing uncanny, non-humanlike robots produces similar distal defenses as other MS inductions as well as evidence of DTA in a word-stem completion task (MacDorman, 2005). This prediction is also based on research suggesting that replacing human caregivers with robotic caregivers may lead to increased social isolation (Sharkey, 2010), which may negatively impact the close-relationship buffer against death anxiety. Since no prior research has investigated whether non-humanlike robots elicit death anxiety, the present thesis's predictions are based solely on MacDorman's (2005), research on caregiving robots and social isolation (Sharkey, 2010), and the anxiety-buffer hypothesis (Greenberg et al., 1986).

Self-esteem and locus of control (LoC) are also measured to observe how self-esteem and LoC may act as moderators in robot-related death anxiety. Since terror management research indicates that self-esteem plays an important role in buffering death anxiety (Greenberg et al., 1992), it is plausible that participants with high levels of self-esteem are more resistant to robot-induced death anxiety, while those with low self-esteem are more vulnerable to robot-induced death anxiety. Since it is uncertain how the robot video will serve as a MS induction, the hypothesis for self-esteem is non-directional. For LoC, research indicates that having a more external LoC is a significant predictor of death anxiety in older adults (Hashemi Razini et al., 2017). Caregiving robots may exacerbate an individual's external LoC since the user might feel that they are not in control of how the robot behaves or they are unsure of how to use this new

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technology. Thus, someone with a more external LoC (i.e. someone who perceives their outcomes are due to factors beyond their control), might be more susceptible to robot-induced death anxiety. The hypothesis for LoC is non-directional because it is uncertain how robots would serve as a MS induction.

Thus, it is predicted:

H1: Non-humanlike caregiving robots will elicit more a) death thought accessibility and b) death anxiety compared to human caregivers.

H2: There will be a difference in a) death thought accessibility and b) death anxiety after a mortality salience induction between participants with a high and low level of self-esteem

H3: There will be a difference in the amount of a) death thought accessibility and b) death anxiety after MS induction between participants with an internal and external locus of control.

Chapter 3: Method

Participants

Participants were elderly persons ($N = 42$) who did not have any acute cognitive impairments. Participants had a mean age of 74.05 years with a standard deviation of 7.87 years. The age of participants raged from 55 years to 94 years. Age, sex, race, and living situation (independent living facility, assisted living facility, nursing home, or other) were measured for demographics (see Appendix A). The demographics for living situation are as follows: independent living facility – 45.2%, assisted living facility – 2.4%, other (living in private residence) – 52.4%. For race, 95.2% of the participants were White and 4.8% were other. For sex, 42.9% of the participants were male and 57.1% were female.

Participants were sampled from two local elder care facilities ($n = 13$) and online ($n = 29$). For participants in elder care facilities, consent was obtained from the participant (with a clear willingness to participate) and site permission was granted from the heads of the facilities. We collaborated with the facility workers to ensure that the participants were comfortable and prepared for the interview process. Online participants had to first consent to participating in the study before they could proceed to the survey. The study was reviewed and granted approval by James Madison University's Institutional Review Board, by way of a full-board review due to the vulnerability of the population.

Recruitment Process

Participants at the local elder care facilities were recruited through flyers posted at the facility (see Appendix B), research orientations which were advertised for via a section in the facilities' newsletters (see Appendix C), and through a "Tech Faire" (see Appendix D). For flyers, participants were able to contact the researcher directly via phone or email to arrange a

time to participate. Individuals at the research orientations were given a presentation on caregiving robots and were given more information about the study. After the orientation, participants could sign up for a time to participate in the study. At the "Tech Faire" the researcher had a poster giving information about caregiving robots and the study, and individuals interested in participating could sign up for the study.

Participants were also recruited online through posts on Facebook, Twitter, and various church and synagogue listservs (see Appendix E for an example post). The researcher also encouraged other lab members to share the information about the study on their social media and with their friends and family.

Materials

Independent Variables

The main independent variable was the type of caregiver (non-humanlike caregiving robot or human caregiver). Self-esteem and LoC were measured as covariates.

Videos. Participants viewed a short video that was either the robot MS induction video or the human caregiver control video (see Appendix F). The robot condition was a video of two robots, Lio and Guido, that were developed by F&P Personal Robotics. The video showed Lio and Guido supporting elderly people throughout their day in their homes.

The control condition was a video of a human caregiver. The video showed various caregiving activities (e.g. bathing, helping with medication) in a "day in the life" of a caregiver. The video was created by the American Association of Retired Persons (AARP).

Self-esteem. Self-esteem was assessed using Rosenberg's Self-Esteem Scale (Rosenberg, 1965) (see Appendix G). The scale has 10 items and measures global self-worth by measuring positive and negative self-evaluations such as "On the whole, I am satisfied with myself." The

scale is uni-dimensional, and all of the items are answered using a 4-point Likert Scale ranging from strongly agree to strongly disagree. The scores on the 10 items are summed, and the higher the score, the higher the self-esteem. The scale produced an alpha of .78 in the present study.

Locus of Control. Rotter's Locus of Control Scale (1966) (see Appendix H) was used to measure LoC. This scale measures the extent to which individuals believe they can control events and outcomes in their lives (Rotter, 1966). This is a 29-item, forced-choice scale with questions such as "many of the unhappy things in people's lives are partly due to bad luck or "people's misfortunes result from the mistakes they make." The non-filler items are then summed (items 1, 8, 14, 19, 24, and 27 are fillers). A high score indicates an external LoC and a low score indicates an internal LoC. The scale produced an alpha of .97 in the present study.

Dependent Variables

The primary dependent variables were death thought accessibility (DTA) and death anxiety.

Death Thought Accessibility. To assess DTA, participants completed a word stem completion task created by Greenberg, Pyszczynski, and Solomon (1986) (see Appendix I). Participants were asked to complete 25 word stems such as "BUR _ _". Each questionnaire contained 6 possible death-related words. The summed number of death salient words for each participant served as a MS manipulation check.

Death Anxiety. Death anxiety was measured using Thorson and Powell's (1992) Revised Death Anxiety Scale (RDAS) (see Appendix J), a 25-item questionnaire containing questions regarding the individual's feelings and thoughts about death such as "I fear dying a painful death." Each item is answered on a 6-point Likert Scale ranging from "strongly disagree" to

"strongly agree." A higher summed score indicates a higher level of death anxiety. The scale produced an alpha of .89 in the present study.

Procedure

In-person participants were randomly assigned to either the robot experimental condition or the control condition. Participants first completed Rosenberg's Self Esteem Scale questionnaire and Rotter's Locus of Control Scale. For the self-esteem and LoC scales, the participant received a paper copy of the questionnaire to fill out while a trained interviewer read the questions aloud. Participants then watched their assigned video on an iPad provided by the interviewer. After the video, participants completed the word search puzzle as a delay (see Appendix K) before moving on to the word stem completion task that served as a manipulation check. The participant completed the delay task and the word stem completion task on paper while the interviewer read the questions aloud. Next, participants completed the RDAS to assess his/her level of death anxiety. Finally, participants answered demographic questions for their age, sex, race, and living situation. For the RDAS and the demographic questions, the participant filled out a paper copy of the questionnaire while the interviewer read the questions aloud. The interviewer then debriefed the participants and gave participants the option of contacting the researcher if they had future questions. For the online version, participants completed the survey, which was designed using Qualtrics, an online survey tool. The online survey was completed in the same order as the in-person survey. Participants completed the survey on their computer and at the time of their choosing. The data was analyzed using SPSS.

Chapter 4: Results

Hypothesis 1

The first hypothesis predicted that non-humanlike caregiving robots will elicit more a) DTA and b) death anxiety compared to human caregivers. For DTA, an independent samples t-test was run to test the differences between the experimental (M = 1.50, SD = .86) and control (M = 1.55, SD = .89) groups; $t(40)$ = -.19, p = .864. For death anxiety, an independent samples t-test was run to test the differences between the experimental (M = 3.19, SD = .87) and control (M = 3.50, SD = .77) groups; $t(39)$ = -1.22, p = .229. While the same pattern was seen in both DTA and death anxiety, H1 was not supported. Differences in degrees of freedom are due to participants not completing all the questions.

Hypothesis 2

The second hypothesis predicted there would be a difference in a) DTA and b) death anxiety after the MS induction between participants with a high and low level of self-esteem. Self-esteem was dichotomized; 0.00-2.76 served as a low self-esteem score, and 2.77-4.00 served as a high self-esteem score. A one-way ANOVA was used to test Hypothesis 2. For DTA, $F(3, 41)$ = .24, p = .63, R^2 = -.001. For death anxiety, $F(3, 40)$ = 5.78, p = .511, R^2 = .26. Differences in the degrees of freedom are due to a participant dropping out.

Hypothesis 3

The third hypothesis predicted there would be a difference in the amount of a) DTA and b) death anxiety after the MS induction between participants with an internal and external LoC. LoC was dichotomized; 4.00-9.66 served as a low (internal) LoC score, and 9.67-17.00 served as a high (external) LoC score. A one-way ANOVA was used to test Hypothesis 3. For DTA, $F(3, 40)$ = .05, p = -.07, R^2 = .007. For LoC, $F(3,40)$ = 1.60, p = .551, R^2 = .04.

Chapter 5: General Discussion and Conclusions

Hypothesis 1

The first hypothesis predicted that non-humanlike caregiving robots will elicit more a) DTA and b) death anxiety compared to human caregivers. There was no significant difference in DTA and death anxiety between the experimental robot condition and the human control condition. Though the results were not significant, the means for both DTA and death anxiety were higher in the human condition compared to the robot condition, something that is both interesting and unexpected. Despite the lack of significance, the fact that the means for *both* DTA and death anxiety leaned toward the human caregiver suggests there may be some kind of relationship between the type of caregiver and death-related cognitions. The lack of significance may be due to the small sample size, thus leading to low statistical power. The researcher has identified three possible explanations for why the human video elicited more DTA and death anxiety compared to the robot video.

First, the human video shows elderly persons who are frailer and sicker than the elderly persons in the robot video. The frailness/sickness may have served as a reminder of death, thus causing DTA and death anxiety. Research suggests that ageism and self-ageism (i.e. negative attitudes toward elderly persons when the individual is themselves elderly) derives from existential threats (Martens et al., 2005). Viewing an elderly person reminds one of the inescapability of their death, as well as reminding them that the body is fallible and the means by which we manage death anxiety (e.g. self-esteem) is not permanent (Martens et al., 2005). Since aging is the process by which individuals get closer to death, those closest to death, the elderly, serve as direct reminders of mortality (Martens et al., 2005). In their study, Martens and colleagues (2005) found that negative attitudes toward the elderly after a MS induction are a

function of the similarity between oneself and an elderly individual. Though the study looked at the similarity between non-elderly and elderly individuals, it is plausible that elderly individuals (who are indeed very similar to other elderly individuals) exhibit the same negative attitudes toward other elderly persons under MS conditions. Additionally, older adults are more likely to negatively view adults who are older and more disabled than themselves (Dobbs et al., 2008). In this thesis, the human caregiver video showed elderly individuals receiving high degrees of care (e.g. being dressed by a caregiver, being fed by a caregiver), whereas the robot video showed more independent and active elderly individuals. Thus, it is likely that the chosen human video elicited death anxiety and DTA either to a much higher degree than the robot video or elicited death anxiety and DTA while the robot video did not.

Second, it is possible that unlike uncanny, humanlike robots, non-humanlike robots (i.e. the robot in Video 1) do not elicit DTA or death anxiety. If this is true, then this thesis only supports this conclusion for visual displays of robots, and it remains unclear if physically interacting with a robot elicits death anxiety. Additionally, this thesis serves as an important quasi-reproduction of MacDorman's (2005) study. Whereas MacDorman (2005) used uncanny, eerie robots, this thesis used canny, non-humanlike robots that are not thought to produce feelings of eeriness (Mori, 1970). Given this distinction, it is important to note that the present thesis is not an exact replication of MacDorman's (2005) study, rather it aims to apply elements of MacDorman's methodology and theory to caregiving robots. Additionally, MacDorman's (2005) study used worldview adherence as a distal measure of death anxiety instead of a death anxiety scale like the one used in this thesis. In juxtaposition to MacDorman (2005), the results of this thesis indicate that non-humanlike robots may not serve as reminders of death, at least in the sense of not appearing like dead humans thus conveying the idea that an individual will

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someday die. Future research is necessary to examine if robots elicit death anxiety for other reasons such as by creating a fear of being replaced, a fear of social isolation, or by failing to buffer close-relationship-related death anxiety.

Last, and perhaps most interesting, many anti-robot elderly persons declined to participate in the study. In various in-person recruitment attempts, multiple individuals expressed initial interest in the study but refused to support robot research or anything promoting the use of robots. However, this may be due to miscommunications about the intent of the research (i.e. mistakenly believing the researcher was trying to sell the individual a robot). In general, this apparent disdain for robots in some elderly individuals suggests that there may be some underlying anxiety about robots. Individuals who agreed to participate in the study typically expressed more positive attitudes toward robots or technology in general. Perhaps more pro-robot individuals do not have robot-related anxiety, thus causing the MS manipulation to fail. Also, perhaps these individuals would prefer to be cared for by a robot rather than a human caregiver, thus contributing to lower death anxiety in the robot condition. Finally, it is possible that the lack of robot-related anxiety in combination with the human video eliciting DTA and death anxiety contributed to the surprising findings. Nevertheless, this interesting distinction between pro- and anti-robot elderly individuals warrants further study, especially if caregiving robots are becoming more popular in elder care facilities.

Hypothesis 2

The second hypothesis predicted that there would be a difference in a) DTA and b) death anxiety after a MS induction between participants with a high and low level of self-esteem. That is, participants with low self-esteem would exhibit a different amount of DTA and death anxiety after a MS induction compared to participants with high self-esteem. The study found no

significant interactions between self-esteem and the experimental condition. This may be because non-human robots do not elicit death anxiety, or the chosen robot video was not a strong enough MS induction to elicit death anxiety, so participant self-esteem made no difference in death anxiety.

Another possible explanation is that being cared for by a robot does not affect self-esteem in the same the way being cared for by a younger, more able human caregiver may affect self-esteem. This may be because a robot caregiver does not evoke the same temporal comparison and/or social comparison as does a human caregiver and/or because the individuals in the robot video did not serve as a threat to one's self-esteem. Temporal comparison refers to the process by which an individual compares themselves to, and evaluates themselves against themselves at two different points in time (Albert, 1997). Social comparison refers to the process by which an individual compares themselves to and evaluates themselves against another individual (Festinger, 1954). In the case of the human caregiver video, witnessing the younger, more able person care an elderly person may have evoked a temporal or social comparison (e.g. "I remember when I could help someone else like that" or "that person needs just as much help as I do"), while the robot video did not evoke such comparisons. In turn, these comparisons may evoke negative attitudes toward the self (Albert, 1997; Festinger, 1954), thus leading to a decrease in self-esteem. This is possible based on the idea that similarity is a key feature in the comparison process (Martens et al., 2005). In the case of a non-humanlike robot, there may not be enough of a similarity between the individual and the robot to evoke a temporal or social comparison, though future research is necessary to test this idea. If the robot video did not evoke a temporal or social comparison, then no negative comparison-based evaluations of the self could be made. Since self-esteem functions as a buffer against death anxiety (Greenberg et al., 1992), if

the robot caregiver *did* evoke death anxiety, we would expect participants with higher levels of self-esteem to be less susceptible to this temporal or social comparison process while participants with low self-esteem would be more susceptible to this comparison. Thus, participants with low self-esteem would be more likely to make negative self-evaluations, resulting in an inability to buffer against robot-induced death anxiety. However, if non-humanlike robots do not evoke these comparisons, then differences in self-esteem would not affect death anxiety. In this explanation, self-esteem did not moderate robot-induced death anxiety because the robot did not foster any cognitions in which self-esteem was relevant.

Hypothesis 3

The third hypothesis predicted that there would be a difference in the amount of a) DTA and b) death anxiety after the MS induction between participants with an internal and external LoC. In other words, participants with an external LoC would display different levels of DTA and death anxiety after a MS induction compared to participants with an internal LoC. Contrary to the prediction, there were no significant interactions between LoC and the experimental condition. Like with self-esteem, this may be because non-human robots do not elicit death anxiety, or the chosen robot video was not a strong enough MS induction to elicit death anxiety, so participant LoC made no difference in death anxiety.

It is also possible that watching a video of a caregiving robot (as opposed to actually interacting with one) did not strongly enough express the potential challenges of using a robotic caregiver. This is relevant because using a robotic caregiver may be more anxiety-provoking for someone with a more external LoC compared to someone with a more internal LoC. In turn, a more external LoC may lead to higher levels of death anxiety (Hashemi Razini et al., 2017). Since the chosen robot video was likely designed as a promotional video, the video showcased

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the user easily interacting with the robot. It is plausible that the daily, actual use of a caregiving

robot would involve technological difficulties and accessibility concerns, especially for older

adults who are more likely than younger adults to need help when using new technology and

who are less confident than younger adults in their technology use (Anderson & Perrin, 2017).

Accessibility concerns include worries about a lack of knowledge to use the robot and concerns

that the technology is too complex to use or learn to use (Young et al. 2009). However, robotic

caregivers may also help users feel more in control and empowered by allowing the user to

engage in tasks they would otherwise need another person for, such as going to the bathroom or

bathing (Sharkey, 2010). Regardless of whether robotic caregivers actually contribute to a more

external or internal LoC (which future research is necessary for figuring out), the video of the

robot likely did not facilitate concerns related to LoC (video limitations are discussed further in

the "Limitations" section). If this is the case, then it makes sense that participant LoC did not

play an important role in moderating death anxiety. Future research involving actual human-

robot interaction is necessary for investigating this further.

Living Situation May Affect Death Anxiety

During data analysis, it occurred to us that since participants ended up being recruited

from places besides the two independent living facilities, living situation might have affected

death anxiety. A between-subjects ANOVA showed significant differences between living

situation and death anxiety; $F(2, 40) = 13.68$, $p<.05$, $R^2 = .39$. The study found that those living

in private residencies ($M = 3.84$, $SD = .65$) had the highest death anxiety followed by those

living in independent living ($M = 2.82$, $SD = .65$) and assisted living ($M = 2.32$). Note that this

death anxiety was not directly related to the experimental manipulation.

These results may have occurred because those living in facilities have more immediate care available to them, and thus the threat of death/dying is less prevalent. Additionally, older people tend to live in facilities with increasing degrees of care, and older elderly people traditionally have less death anxiety compared to younger elderly people (Fornter & Neimeyer, 1999; Bengtson et al., 1977; Neimeyer, Wittkowski, & Moser, 2003). It is plausible that the combination of heightened care in independent and assisted living facilities and the increased age for individuals in these facilities contributed to these results. It is also important to consider that only one participant reported living in an assisted living facility, thus limiting the sample size. Another consideration is that those living in private residencies may vary in their specific living situation. For instance, a participant could be living by themselves, with a spouse, or with their family. Living with a spouse or family provides a close relationship, which serves as a buffer against death anxiety by alleviating the anxiety and boosting self-esteem (Florian et al., 2002) (though someone may also live with a spouse or other family at a facility). Living by oneself (and in lieu of other close relationships such as close friends) may contribute to higher levels of death anxiety without close relationships to serve as a buffer (Florian et al., 2002).

This is an interesting finding because some literature suggests that living in an elder care facility increases death anxiety due to being around death and increased social isolation (Azaiza et al., 2010). However, another study (Moreno et al., 2008) found lower death anxiety for those in institutions, presumably due to the older age of individuals living in institutions and increased degree of care. Evidently, the relationship between death anxiety and the institutionalized elderly is complex and various factors go into determining how living in an elder care facility affects death anxiety.

Limitations

Videos. One of the major limitations in the study was the use of videos as the experimental manipulation and control. Since the videos were not self-produced, but rather were found on YouTube, the videos contained confounding variables such as varying actions performed by the caregiver, the elderly person being cared for, the language in the videos, and the music in the videos. The researcher attempted to choose similar videos, especially in terms of general content and length of the video, but many factors could not be controlled for. It is possible that any one or more of these factors could have affected participant responses. For example, the high degree of fragility of elderly persons in the control video (see "Hypothesis 1" in the discussion section for more information). Additionally, the results only reflect *viewing* a robot or human caregiver with an elderly person, not the actual use of a robot or human caregiver. It may be the case that interacting with a robot or human may produce different degrees of death anxiety. Also, being cared for on a daily basis for an extended period of time by the given caregiver may produce different results. It is important that future research examine the actual and extended use of robotic caregivers.

Participant bias. Based on observations from the in-person data collection, many of the participants expressed more pro-robot and/or pro-technology attitudes compared to individuals who declined to participate in the study, as discussed earlier. The apparent bias in participants may have caused a biased, non-random sample. Thus, the results of this thesis are not likely a representative sample of the elderly. A larger sample size may have mitigated this concern by capturing a representative distribution of the population in question.

Demographics. Most participants (95.2%) were White. Some research suggests that while race is not a main predictor of death anxiety, determinants of death anxiety vary by race (Assari & Moghani Lankarani, 2016). For example, Assari and Moghani Lankarani (2016) found

that self-rated health and perceived control over life are associated with death anxiety for White but not Black elderly individuals. Another study suggests that elderly White individuals have more fear about the dying process whereas elderly Black individuals have more fear about what comes after death (Depaola et al., 2003). The study also posits that the differences in one's culture that come with differences in one's race may contribute to the differences in death concerns (Depaola et al., 2003). Given the lack of variability of participant race, the results may differ from other races.

Sample size. The relatively small sample size ($N = 42$) is another limitation of the study. A larger sample size may have given a greater ability to detect significant differences. In general, finding participants was quite difficult. The researcher was only able to recruit from two independent living facilities, and individuals in the facilities often declined to participate. It seemed that some potential participants were wary that the researcher was trying sell them a robot or they did not want to support robot-related research. While these apparent anti-robot attitudes made it difficult to find participants, it does suggest some interesting underlying anxiety that some elderly people have about robots, and that individual differences may affect attitudes toward robots. Other potential participants declined to participate due to the time commitment or they were not physical well enough to participate. Due to the lack of interest at the facilities, the researcher brought the study online and shared it via social media and listservs. While this was more successful than in-person data collection, it was still extremely difficult to recruit participants.

Theoretical Implications

This thesis has interesting theoretical implications for TMT. First, robots may have a unique effect on death-related thoughts and anxieties, specifically among the elderly. Though

this study did not look at how the elderly perceive robots in general, it appears that some elderly persons show signs of anxiety when thinking about robots. The observation that only *some* elderly persons show signs of robot-related anxiety suggests that individual differences play an important role in this anxiety. Second, it remains unclear whether all robots serve as reminders of death, and it is plausible that only uncanny, humanlike robots serve as death reminders, while non-humanlike robots do not. It also remains unclear whether being cared for by a robot or living with a social robot, in general, affects the close-relationship buffer against death anxiety and how living with and being cared for by a robot affects self-esteem. This thesis and MacDorman (2005) introduce a new facet of terror management research that warrants further study, especially as robotic technologies become more popular in the workplace, healthcare, and social settings.

Future Research

There remains much to be explored regarding robots and death anxiety. While the results of this thesis and similar studies do not conclusively show if robots affect death anxiety, future research on long-term use of a caregiving robot is crucial for further understanding this buffer. The use of general companion robots (for the elderly or any age) ought also to be studied in this close-relationship context. If robots are standing in for human social relationships, it is important to know if robots can fulfill the same need for belonging and self-esteem as humans.

It would also be beneficial to study how robots in non-social settings affect death-related anxieties. For example, as robots become more popular in industrial and manufacturing settings, thus replacing human workers, how does this affect the death anxiety of these workers? As MacDorman (2005) suggests, the fear of being replaced may contribute to death anxiety. This line of research extends toward jobs in healthcare, especially for workers in caregiving roles.

Replacing human caregivers with robots may affect how nurses and other caregiving workers view themselves and produce a similar fear of being replaced.

Given the limited demographic variability in this thesis, future research should examine the use of caregiving robots with more diverse populations as well as with populations not living in the United States. It would be especially interesting to compare attitudes towards caregiving robots between individuals living in areas where caregiving robots are not common and individuals living in areas where caregiving robots are more popular and mainstream (e.g. Japan). This research might help explore how differences in culture, elder care practices, and attitudes toward technology affect robot-related anxieties.

Conclusions

A terror management approach in Human-Robot Interaction (HRI) provides an interesting view of how interacting with this increasingly popular technology affects the omnipresent fear of death. The use of TMT in the study of caregiving robots for the elderly is especially important considering that the institutionalized elderly are potentially at a higher risk for death anxiety than their non-institutionalized counterpart. Though this thesis did not find a significant effect of caregiving robots on death anxiety, past research (i.e. MacDorman, 2005, Sharkey, 2010) suggests that robots may increase death anxiety and lead to social isolation. Furthermore, the researcher's interactions with potential participants point towards underlying robot-related anxiety. Future HRI research should consider looking at interactions from a terror management perspective, and future terror management research should further the investigation of robots and existential concerns.

Please answer the following questions:

1. What is your age in years? _____

2. What is your sex? (please check one)

_____ Male   _____ Female

3. What is your ethnicity? (please check one)

_____ White/Caucasian

_____ Hispanic or Latino

_____ Black or African American

_____ Native American or American Indian

_____ Asian/Pacific Islander

_____ Other (please specify)

4. What term best describes your current living situation? (please check one)

_____ Independent living facility

_____ Assisted living facility

_____ Nursing home

_____ Other (please specify)

Appendix C: Newsletter

Robots as Caregivers Research Orientation

Date

Presented by researchers Mira Gruber and Dr. Lindsey Harvell-Bowman, James Madison University Department of Psychology

Would you be okay with a robot living with you? Would you talk to the robot? What if the robot administered your medication or took your vitals? We are interested in what you think! To meet the increasing demand for caregivers, robots are being implemented in elder care facilities to assist with daily tasks and to provide companionship. And, we want to know how you feel about that! If you are interested in participating in our research and/or want to learn more, please attend this orientation session and/or if you would like to participate in the research, please contact Mira Gruber via email at █████████████████ or phone: ███████████

Robots as Caregivers
Mira Gruber
James Madison University Department of Psychology

TERROR MANAGEMENT LAB

What is a Caregiving Robot?

- Caregiving robots are **social robots**
- Social robots are robots that elicit social responses from their human users because they follow the rules of behavior expected by their human users
- Three uses of caregiving robots:
  - Assist in daily tasks
  - Help monitor behavior and health
  - Provide companionship
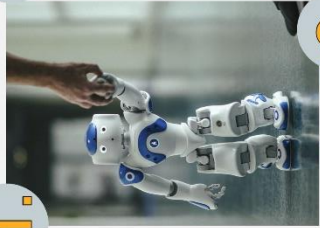
Why Study Caregiving Robots?

- The aging population faces the challenge of who will help care for them as fertility rates decline worldwide
- Progressively fewer young people are available to care for an increasingly elderly population
- Robotic caregivers are a potential solution to this problem

Potential Concerns

- Could create a loss of social connection and lead to feelings of isolation and loneliness
- Overcoming a "technical hurdle" as both users and human caregivers learn how to use this new technology
- Cost barrier: humanoid caregiving robots currently cost between $1000-$10,000
- **Essential question**: can robots fulfill the human need for social connection?

Examples of Caregiving Robots

1. **Zora**
   - Software designed for NAO and Pepper robots, created by Zora Bots
   - Designed as a companion and entertainer in residential healthcare facilities
   - $10,000 to purchase NAO robot with Zora software installed

2. **RUDY the Robot**
   - INF Robotics Inc.
   - Can pick things up and deliver them to its user, give medication reminders, and allow doctors and family members to "check in" with the user via a digital screen
   - Can also play games and provide social interaction
   - $99/day or up to $5,000 to purchase

3. **ACTROID-F Android Robot**
   - Developed by Kokoro Co.
   - Not yet autonomous, but can interact with patients as a human

4. **Robear**
   - Created by Dr. Toshiharu Mukai
   - Experimental nursing robot
   - Helping patients stand up
   - Lifting from bed to wheelchair
   - Helps caregivers with physical tasks

Participate in Our Study!

- We are conducting a study on the psychological implications of caregiving robots
- Whether you love robots or hate them, we would love to have you participate in our study
- 1-hour, one-on-one session with a lab member
- Conducted at your place of residence
- Watching a short video
- Responding to a series of questions on various psychological measures

Interested? Contact Mira Gruber
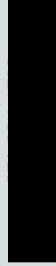
Appendix E: Social Media Recruitment

Mira Gruber
Nov 5, 2019 at 1:11 PM · 🌐

Are you age 65 and older? If so, please help me with my senior honors thesis project investigating caregiving robots for the elderly. This brief survey should take approximately 20 minutes. Please share with all of your 65+ family and friends!

JMU.CO1.QUALTRICS.COM
Online Survey Software | Qualtrics Survey Solutions

Appendix F: Videos

Experimental condition/Non-humanlike robot: https://youtu.be/Z-DEFDjOBVc

Control condition/human caregiver: https://youtu.be/bs_7jWqSeIM

Appendix G: Rosenberg's Self-Esteem Scale

Instructions: Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle **SA**. If you agree with the statement, circle **A**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

1.	On the whole, I am satisfied with myself.	SA	A	D	SD
2.	At times, I think I am no good at all.	SA	A	D	SD
3.	I feel that I have a number of good qualities.	SA	A	D	SD
4.	I am able to do things as well as most other people.	SA	A	D	SD
5.	I feel I do not have much to be proud of.	SA	A	D	SD
6.	I certainly feel useless at times.	SA	A	D	SD
7.	I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8.	I wish I could have more respect for myself.	SA	A	D	SD
9.	All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10.	I take a positive attitude toward myself.	SA	A	D	SD

Appendix H: Locus of Control Scale

Rotter's Locus of Control Scale

For each question select the statement that you agree with the most

1.   a. Children get into trouble because their patents punish them too much.

      b. The trouble with most children nowadays is that their parents are too easy with them.

2.   a. Many of the unhappy things in people's lives are partly due to bad luck.

      b. People's misfortunes result from the mistakes they make.

3.   a. One of the major reasons why we have wars is because people don't take enough interest in politics.

      b. There will always be wars, no matter how hard people try to prevent them.

4.   a. In the long run people get the respect they deserve in this world

      b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries

5.   a. The idea that teachers are unfair to students is nonsense.

      b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

6.   a. Without the right breaks one cannot be an effective leader.

      b. Capable people who fail to become leaders have not taken advantage of their opportunities.

7.   a. No matter how hard you try some people just don't like you.

      b. People who can't get others to like them don't understand how to get along with others.

8.   a. Heredity plays the major role in determining one's personality

      b. It is one's experiences in life which determine what they're like.

9.   a. I have often found that what is going to happen will happen.

b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10.   a. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.

     b. Many times exam questions tend to be so unrelated to coursework that studying in really useless.

11.   a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.

     b. Getting a good job depends mainly on being in the right place at the right time.

12.   a. The average citizen can have an influence in government decisions.

     b. This world is run by the few people in power, and there is not much the little guy can do about it.

13.   a. When I make plans, I am almost certain that I can make them work.

     b. It is not always wise to plan too far ahead because many things turn out to-be a matter of good or bad fortune anyhow.

14.   a. There are certain people who are just no good.

     b. There is some good in everybody.

15.   a. In my case getting what I want has little or nothing to do with luck.

     b. Many times we might just as well decide what to do by flipping a coin.

16.   a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.

     b. Getting people to do the right thing depends upon ability. Luck has little or nothing to do with it.

17.   a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.

b. By taking an active part in political and social affairs the people can control world events.

18.   a. Most people don't realize the extent to which their lives are controlled by accidental happenings.

    b. There really is no such thing as "luck."

19.   a. One should always be willing to admit mistakes.

    b. It is usually best to cover up one's mistakes.

20.   a. It is hard to know whether or not a person really likes you.

    b. How many friends you have depends upon how nice a person you are.

21.   a. In the long run the bad things that happen to us are balanced by the good ones.

    b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22.   a. With enough effort we can wipe out political corruption.

    b. It is difficult for people to have much control over the things politicians do in office.

23.   a. Sometimes I can't understand how teachers arrive at the grades they give.

    b. There is a direct connection between how hard 1 study and the grades I get.

24.   a. A good leader expects people to decide for themselves what they should do.

    b. A good leader makes it clear to everybody what their jobs are.

25.   a. Many times I feel that I have little influence over the things that happen to me.

    b. It is impossible for me to believe that chance or luck plays an important role in my life.

26.   a. People are lonely because they don't try to be friendly.

    b. There's not much use in trying too hard to please people, if they like you, they like you.

27.   a. There is too much emphasis on athletics in high school.

b. Team sports are an excellent way to build character.

28.   a. What happens to me is my own doing.

       b. Sometimes I feel that I don't have enough control over the direction my life is taking.

29.   a. Most of the time I can't understand why politicians behave the way they do.

       b. In the long run the people are responsible for bad government on a national as well as on a local level.

Appendix I: Word Stem Completion Task

We are interested in seeing how well you can complete word stems. Please complete the following by filling letters in the blanks to create words. Please fill in the blanks with the first word that comes to mind. Write one letter per blank. Some words may be plural. Thank you.

1. BUR _ _ D

2. PLA _ _

3. _ _ OK

4. WAT _ _

5. DE _ _

6. MU _ _

7. _ _ NG

8. B _ T _ LE

9. M_ J _ R

10. P _ _ TURE

11. FL _ W _ R

12. GRA _ _

13. K _ _GS

14. CHA _ _

15. KI _ _ ED

16. CL _ _ K

17. TAB _ _

18. W _ _ DOW

19. SK _ _ L

20. TR _ _

21. P _ P _ R

22. COFF _ _

23. _ O _ SE

24. POST _ _

25. R _ DI _

Appendix J: Death Anxiety Scale

We are interested in your feelings and thoughts about death and things associated with death. Please circle the number that best fits how you think or feel about the following statements. It is important that you are honest in your answers.

1. I fear dying a painful death.

0	1	2	3	4	5

Strongly Disagree   Strongly Agree

2. Not knowing what the next world is like troubles me.

0	1	2	3	4	5

Strongly Disagree   Strongly Agree

3. The idea of never thinking again after I die frightens me.

0	1	2	3	4	5

Strongly Disagree   Strongly Agree

4. I am not at all anxious about what happens to the body after burial.

0	1	2	3	4	5

Strongly Disagree   Strongly Agree

5. Coffins make me anxious.

0	1	2	3	4	5

Strongly Disagree   Strongly Agree

6. I hate to think about losing control over my affairs after I am gone.

0	1	2	3	4	5

7. Being totally immobile after death bothers me.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

8. I dread to think about having an operation.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

9. The subject of life after death troubles me greatly.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

10. I am not afraid of a long, slow dying.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

11. I do not mind the idea of being shut into a coffin when I die.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

12. I hate the idea that I will be helpless after I die.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

13. I am not at all concerned over whether or not there is an afterlife.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

14. Never feeling anything again after I die upsets me.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

15. The pain involved in dying frightens me.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

16. I am looking forward to new life after I die.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

17. I am not worried about ever being helpless.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

18. I am not troubled by the thought that my body will decompose in the grave.

| 0 | 1 | 2 | 3 | 4 | 5 |

Strongly Disagree   Strongly Agree

19. The feeling that I will be missing out on so much after I die disturbs me.

| 0 | 1 | 2 | 3 | 4 | 5 |

20. I am worried about what happens to us after we die.

0   1   2   3   4   5
Strongly Disagree   Strongly Agree

21. I am not at all concerned with being in control of things.

0   1   2   3   4   5
Strongly Disagree   Strongly Agree

22. The total isolation of death is frightening to me.

0   1   2   3   4   5
Strongly Disagree   Strongly Agree

23. I am not particularly afraid of getting cancer.

0   1   2   3   4   5
Strongly Disagree   Strongly Agree

24. I will leave careful instructions about how things should be done after I am gone.

0   1   2   3   4   5
Strongly Disagree   Strongly Agree

25. What happens to my body after I die does not bother me.

0   1   2   3   4   5
Strongly Disagree   Strongly Agree

Appendix K: Delay Task

<u>Word Search Puzzle</u>

Circle as many words as you can in the puzzle below.

Book	Computer
Desk	Phone
Movie	Train
Paper	School
Grass	Beer
Music	Actor

S	R	E	T	U	P	M	O	C	O
W	P	H	O	N	E	R	E	E	B
A	M	U	S	I	C	P	Z	S	N
B	T	N	R	O	T	C	A	S	K
B	M	R	K	S	E	D	E	A	O
R	F	O	A	G	O	L	B	R	O
E	L	G	V	I	Z	B	O	G	B
P	A	N	U	I	N	E	L	W	Q
A	G	T	A	B	E	T	G	D	O
P	S	C	H	O	O	L	N	I	T

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