TESTING AGE-BASED STEREOTYPE THREAT ON ENVIRONMENT LEARNING

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TESTING AGE-BASED STEREOTYPE THREAT

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Dissertation

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ABSTRACT

The aim for this study was to broaden the current understanding of age differences in environment learning by taking a social cognitive lens. This new take on age differences in environment learning stemmed from the age-based stereotype threat (ABST) literature. ABST was explored by testing between Condition (Neutral and Stereotype Threat) and Age Group (young, middle-aged, older) from 244 participants. A significant main effect for Age Group for time taken in allocentric sections and time taken overall was found, with older adults taking longer to complete the task. All of the interactions, for all sections of the task, were nonsignificant. Additional analyses revealed significant main effects for Age Group and Condition on perceived threat and revealed that all perceived threat was higher in threat conditions for all age groups. This study adds to the literature by testing ABST effects on a new domain and across various types of environment learning. Furthermore, these findings highlight that older adults may take longer to complete environment learning tasks but may be just as accurate, depending on the task type. The main takeaways from this study were, when exposed to negative old age stereotypes older adults did not perform significantly worse. This suggests that the combination of blatant and subtle stereotypes do not result in ABST effects on environment learning. These findings should be further explored by testing subtle and blatant threat manipulations separately, measuring self-efficacy, and including a task that resembles everyday environment learning.

Keywords: *navigation, stereotype threat, age-based stereotype threat, self-concept threat*

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CHAPTER I

INTRODUCTION

The stigmatization of old age is common within many cultures, especially westernized societies, and is an overlooked issue within our culture (Barber & Mather, 2014). We are exposed to negative views of aging in commercials, television shows, and even birthday cards. These negative beliefs and stereotypes of old age are common and generally accepted. However, aging researchers have found that the stigmatization of aging and stereotyping of older adults has insidious negative consequences (Nelson, 2017; Swift et al., 2019). Butler (1969) coined the term ageism as the discrimination of older people. Later, other researchers, such as, Cuddy and colleagues (2005) have expanded on this construct with research focused on the discrimination and stereotyping of older adults. The overarching characterization of older people is that they are frail and less competent in comparison to younger people (Cuddy et al., 2005; Hummert et al., 1994). One surprising aspect is that older adults themselves can be endorsers of ageism. Stereotype embodiment theory suggests that older adults engage in negative self-stereotyping due to a lifetime of exposure to ageism and internalized endorsement of negative age stereotypes (Levy, 2009). Older adults have aged into their role as "older," but this means they were once in-group members (young adults) who were not the target of old age stereotypes. Thus, older adults are at risk of stereotyping themselves. For example, older individuals who believe that old age comes with poor memory may experience anxiety of being forgetful. Additionally, older people commonly credit simple mistakes to cognitive aging and endorse age stereotypes (Eibach et al., 2010).

Age stereotypes pertain to a vast range of domains and can easily become salient when individuals are engaging in everyday tasks (Eibach et al., 2010). For example, using the phrase "senior moment" when losing keys or forgetting a password. However, people of all ages have made these mistakes. These components make studying ageism and the older adult experience unique from studying other marginalized groups and isms (Shapiro, 2011). Research shows that when older adults are exposed to negative age stereotypes, blatant or subtle forms, their abilities are negatively affected (Chasteen et l., 2005). This process is termed age-based stereotype threat (ABST) and occurs across a range of scenarios and domains (Chasteen et al., 2005; Lamont et al., 2015; Steele & Aronson, 1995). ABST stems from the Stereotype Threat Framework developed by Steele and Aronson (1995). The general explanation is that when older people are primed with an age stereotype, they are confronted with the risk of confirming that stereotype and as a result, create a self-fulfilling prophecy (Steele & Aronson, 1995). Researchers have tested ABST effects across negative, neutral, and positive conditions and have found that performance is significantly reduced in negative stereotype conditions compared to other conditions (Chasteen et al., 2005; Hess et al., 2003; Kang & Chasteen, 2009; Lamont et al., 2015). The exact mechanisms leading to a poorer performance are still unclear, but many moderators have been found within the ABST literature. For example, age-group identification seems to play a key role in whether stereotype exposure is a detriment to performance (Kang & Chasteen, 2009). Age-group identification is defined as how much someone's age group is self-relevant and the degree that their age is a part of their identity (Abrams et al., 2006; Garstka et al., 1997). Group identification has shown to be a key moderator on stereotype effects for other stigmatized groups such as, African Americans and women (Nosek et al., 2002; Schmader, 2002). Additionally, those who highly identify within a group may be more susceptible to stereotype threat effects, however, identification shows to work as a buffer against negative affective outcomes associated with stereotype threat experiences (Branscombe et al., 1999; Kang & Chasteen, 2009). Work with middle-aged adults provides support for the importance of age-group identification. It has been found that middle-aged groups do not underperform when in negative age-stereotype conditions (Hess & Hinson, 2006). In this study, it was suggested that middle-aged adults may not identify as old or with the older adult age group, thus, old age stereotypes were not self-relevant. ABST effects have been tested across a range of domains and are found to affect older adult memory, gait, handwriting, and even workplace behaviors (Ben-David et al., 2018; Chasteen et al., 2005; Hess et al., 2003; Kang & Chasteen, 2009; Lambert et al., 2016; Lamont et al., 2015; von Hippel et al., 2019). There are more domains to be explored and it is necessary that researchers continue to explore moderating factors.

One area that has not received much attention in the ABST literature has been spatial ability. For example, how do beliefs about aging, environment learning, and navigation affect performance when older people are driving to a location and must remember new routes and landmarks? There has been one study, conducted by Meneghetti and colleagues (2014), that found a relationship between perceived stereotype threat and map drawing performance. However, a quasi-experimental approach has yet to be applied when investigating the influence of ABST on spatial ability of any kind. Findings from Meneghetti and colleagues (2014) study highlighted that ABST effects may occur within the spatial ability domain. One area of interest within the spatial ability domain is environment learning.

The environment learning and aging literature shows that older people struggle in comparison to younger people across a range of spatial ability tasks (Klencken, 2012; Lester et al., 2017; Meneghetti et al., 2022; Moffat, 2009; van her Ham & Claessen, 2020). These tasks include map drawing tasks, pointing to correct directions, and remembering routes across trials (Klencklen et al., 2012; Moffat, 2009). The most common explanation for older adults' difficulties in spatial ability tasks has been cognitive aging (Lester et al., 2017; Moffat, 2009) and visuospatial ability (Borella et al., 2014). Although both are plausible explanations with some evidence, there are other potential explanations for why older adults may struggle to successfully remember environmental information. It is known that cognitive loss occurs to some extent as we age, however, this process is not uniform or universal for everyone (Baltes, 1987; Baltes & Baltes, 1990; Glisky, 2007). Additionally, it is unclear the extent that older adults underperform in everyday settings despite evidence of age-related cognitive difficulties in research settings (Salthouse, 1990). Older participants are typically tested in laboratory settings, not the typical setting in which they would navigate. It is unclear if the age gaps in environment learning, and specifically navigation performance tasks, would remain as robust in natural settings. Additionally, researchers rely on cognitive aging as an explanation for age differences in many tasks, despite not testing cognitive functionality within their studies (Lester, et al., 2017). Findings from cognitive aging research, when taken out of context, can contribute to societies' negative views of aging (Eibach et al., 2010). Further, the prominent focus on age-related loss is indicative of the commonly held age stereotype of incompetence (Cuddy et al., 2005). Therefore, it is important that aging researchers continue to consider the influence of social cognitive processes on older adult performance within all domains, including environment learning. Within the past twenty years, aging researchers have begun to adopt a social cognitive lens for understanding age differences in performance. For example, researchers began to explore the possibility that older adults' exposure to memory stereotypes would negatively impact their memory performance (Hess et al., 2003; Lamont et al., 2015). The results show that ABST effects memory performance for older adult groups across a range of different memory tasks (Lamont et al., 2015). In congruence with these findings, I suspect that age differences within environment learning tasks can be partially explained by social cognitive processes as well. Thus, I am offering a different theoretical approach to understanding age-related environment learning and I am furthering the research of ABST by exploring ABST effects within a new area of ability.

With a steadily growing population of older adults (World Health Organization, 2021a), there is a need to further understand ABST and to shed light on explanations for age differences in ability. Most people who live long enough will eventually identify as old, with age stereotypes becoming self-relevant (Levy & Banaji, 2002). Additionally, we all may be recipients of old age discrimination and ageism if we too grow old. The likelihood is high that most people will experience ABST at some point in their lives. Thus, it is imperative that we understand the barriers faced by the current older adults and our future selves. It is my aim to contribute to the aging literature by addressing an overlooked domain as possibly affected by ABST and by highlighting those who may be most susceptible to experiencing this effect. Findings from this proposed study have practical implications by highlighting underlying reasoning behind older adults' difficulties to find their way in unfamiliar places and to learn new environments. This skill is important for independence and quality of life (Lester et al., 2017). Additionally, highlighting moderating factors on ABST effects allows for potential intervention work that could benefit older adults.

CHAPTER II

LITERATURE REVIEW

Age Stereotypes and Ageism

Ageism has been defined as "the prejudice of one age group towards another age group" (Butler, 1969, p. 243), however, even older adults can hold negative beliefs about old age. Aging researchers are ahead of society in their attention to the older adult experience of ageism and have found that the well-being of older people is negatively affected by experiences of ageism (Abrams et al., 2011; Nelson, 2017). However, the effect of ageism goes beyond well-being, it affects behaviors and abilities as well (Meisner, 2012; Lamont et al., 2015; von Hippel et al., 2019).

Age stereotyping is the cognitive component of ageism, with the most common and cross-culturally held stereotype being that older people are less competent than younger people (Cuddy et al., 2005, Hummert et al., 1994; Levy & Banaji, 2002; Swift et al., 2019). A stereotype is a constellation of traits and can be used to represent groups. This type of processing is an aspect of numerous forms of -isms, including but not limited to, racism, sexism, homophobia, and ageism. Additionally, stereotyping is often an implicit process and many times those endorsing the stereotypes are unaware of their harmful beliefs (Banaji et al., 1993). Overall, stereotyping can occur at a subconscious level, going unnoticed (Banaji et al., 1993). The offender may not intend to be hostile and can express age stereotypes without the intent to offend the recipient (Nelson, 2010).

Therefore, exposure to ageist behaviors and views can occur daily in everyday interactions with no attention given to the occurrence. Many of us could be exposed to age stereotypes without even noticing. Levy (2009) posits that age stereotypes are internalized during our childhoods, and we are exposed to them across the lifespan. The ageist beliefs are said to develop over time with repeated exposure to stereotypes over the course of the lifespan. These stereotypes are typically learned through behaviors and representations shown by media, television, family, and friends (Zhang et al., 2006). For example, in commercials, older adults are commonly shown as helpless, impaired, weak, and even lazy (Zhang et al., 2006). Overall, ageism and age stereotypes are embedded within western culture, found in many forms (Nelson, 2017). Another major distinction about age stereotypes is that they become self-relevant to everyone at some point in their lives, when people grow older. Thus, people age into the out-group (Whitebourne, 1986). This concept is key to Levy's (2009) Stereotype Embodiment Theory because the idea is that people internalize negative views of aging before they become self-relevant (Hummert et al., 1994; Levy, 1996, 2009). It is important to note, however, that depending on the individual's subjective age and age-group identification, age stereotypes may not be self-relevant to all older adults.

Age stereotypes consist of both positive and negative themes; however, negative stereotypes are more prominent (Hummert, 1990; Schmidt & Boland, 1986). Research conducted by Hummert and colleagues (1994), sought to identify the common age stereotypes. These stereotypes consist of both positive (e.g., the golden ager) and negative (e.g., frail) traits. Work in identifying the complexities of stereotypes has shown that older individuals are viewed as highly warm, yet low in competence (Fiske et al., 2002). This work, stemming from the Stereotype Content Model, highlights the "paternal stereotype" for old age. The common theme across many age stereotypes is low competence, whereby cognitive functioning is assumed to decline with age (Fiske et al., 2002). This aligns with the commonly held belief that older people, in general, are cognitively impaired. For example, many consider older individuals to be forgetful (Ryan et al., 2002). Lineweaver and Hertzog (1998) applied this theme of age stereotypes to further explore general beliefs of memory. They created a scale, the General Beliefs about Memory Instrument (GBMI) to examine memory efficacy beliefs for all ages across adulthood. Using ages 20 to 90 years of age (in increments of 10) as target ages, they found that participants rated memory efficacy to decrease with increasing age. Further, people of all ages, including older adults, held these negative beliefs about aging and memory decline. In this study, they were able to identify beliefs on efficacy across different memory scenarios and found a relationship between general beliefs of memory and self-efficacy.

As shown by the age stereotypes and age beliefs literature, low competence and impaired cognitive functioning are associated with old age. Although research shows agerelated changes in cognitive function within some domains (Glisky, 2007), this belief of older adult cognition is exaggerated and overgeneralized. In general, there is a lack of consideration of cognitive gains, compensation, and the multidimensionality of aging abilities (Baltes, 1987; Blanchard-Fields, 2007). Interestingly, the "forgetful" stereotype is commonly held by both younger and older adults (Hummert et al., 1994; Lineweaver & Hertzog, 1998). Along with this, older adults have feelings of anxiety surrounding memory ability and forgetfulness. For example, older adults have reported feelings of anxiety when taking cognitive tests (Gallo & Wittink, 2006). Other studies have found that older adults have stronger physiological arousal when taking cognitive tests compared to younger adults, and that variations in stress responses are related to performance (Neupert et al., 2006).

Additionally, individuals typically attribute memory mistakes made by older adults to dispositional rather than situational factors (e.g., “they are becoming more forgetful because they are older” rather than “they lost their keys because they were rushing” (Ryan et al., 2002). I argue that the aging literature is lacking because we need more research considering the influence of social aspects, in addition to cognitive. Ageism researchers have established the importance of this line of work and have shown that age stereotypes have harmful influences on health and performance outcomes (Hess et al., 2003; Levy, 2009; Swift et al., 2017, 2021). Thus, it is important that aging researchers continue to identify the range of influence of negative age stereotyping and uncover how and when ageism negatively affects the lives of older people.

Age-Based Stereotype Threat

Stereotype threat is a process that occurs in situations where people are at risk of confirming a negative stereotype of a group with which they identify (Steele & Aronson, 1995). Stereotypes must be self-relevant and can be brought forth blatantly or subtly in order to have a negative effect on an individual's performance (Steele & Aronson, 1995). In certain settings and scenarios, age stereotypes are salient. Exposure to stereotypes can lead to an individual's awareness of them but this is not always the case (Chasteen et al., 2005). In everyday situations, people find themselves confronted with self-relevant stereotypes and run the risk of confirming those stereotypes (Swift et al., 2017). In terms of age, this would be referred to as age-based stereotype threat (ABST; Chasteen et al., 2005; Steel & Aronson, 1995). Because poor cognitive functioning and memory issues are prominent age stereotypes, they are also the most tested domain for ABST effects (Barber & Mather, 2014; Lamont et al., 2015). A meta-analysis by Lamont and colleagues (2015) included 22 published and 10 unpublished articles focused on ABST. They found a significant small-to-medium effect of ABST (d = .28) in cognitive functioning tasks. Most of the studies in this meta-analysis focused on the influence of ABST on memory performance. In these studies, stereotype exposure was manipulated verbally, with instructions and/or with written passages.

Within the ABST literature, stereotype conditions are manipulated using varying approaches. Many times, researchers will include the stereotype exposure within the tasks themselves or as part of the procedure. For example, participants have been primed by reading stereotypical wording in tests or with interpersonal interactions with experimenters (Riboni & Pagnini, 2019). Some studies have included fake newsletters that endorse age stereotypes and intimidating instructions that state that older adults' ability will be tested (Hess et al., 2003; Hess & Hinson, 2006; Swift et al., 2013). Other studies have had participants take their tests with a younger adult in the room (Kang & Chasteen, 2009; Schmader & Johns, 2003). Recent findings have shown that in-person laboratory settings, particularly those on college campuses, can elicit age stereotypes (Barber & Lui, 2020). It has been posited that having older adults take tests on college campuses can elicit ABST. Stereotype exposure can occur in a range of forms and may occur in scenarios that we do not realize (Barber, 2020). For example, when older adults come to college campuses, they may be more aware of age stereotypes and experience perceived judgment by the young students. Stereotype exposure manipulations come in two forms, subtle or blatant. Subtle approaches tend to be most effective (Riboni & Pagnini, 2019). An example of a subtle stereotype manipulation would be incorporating stereotype wording in jigsaw puzzles (Hess et al., 2009).

Studies using a correlational approach for investigating ABST have found significant relationships among experiences of age discrimination, perceived stereotype threat, and performance. In a study by Shankar and Hinds (2017) older adults who reported higher experiences of age discrimination had more difficulty with verbal memory tasks. Thus, evidence of the impact of age stereotypes on performance has been revealed by significant relationships between reported experiences of ageism and memory performance. Perceived stereotype threat can occur chronically and has been tested as a trait in addition to being tested as an experience related to a scenario (Chasteen et al., 2005). Perceived stereotype threat (trait) refers to an overarching awareness of self relevant stereotypes and the participant's awareness of possible judgment based on their membership within the stereotyped group. Perceived stereotype threat (state) refers to a participant's awareness of stereotypes that are elicited within a condition and awareness of the relevance of the stereotype to the task on which they are being tested (Chasteen et al., 2005). Both perceived stereotype threat trait and state have been shown to moderate ABST effects on cued recall performance (Kang & Chasteen, 2009).

The ABST literature is a growing area of research and reveals how aspects of ageism can negatively impact the lives of older people. However, there are many inconsistencies within the ABST literature and many failures to replicate findings from earlier studies. These inconsistencies may be due in part to a lack of understanding of key moderating factors and the underlying mechanism for how ABST effects occur (Barber, 2020). Additionally, different domains are addressed across the ABST literature and moderating and mediating factors may be different depending on the domain. For example, researchers have attempted to replicate findings from Hess and colleagues' (2003) study of ABST effects on a memory recall task. In this study, researchers exposed participants to negative, neutral, or positive age stereotypes in fake newspaper articles. Results showed that older adults in the negative stereotype group had the poorest performance for a verbal memory task and that higher value of memory ability moderated the effect. Later studies have attempted to replicate these findings, but the ABST effects did not replicate (Hess & Hinson, 2006). To further the literature, some studies have revealed important moderating factors. For example, it has been shown that older adults with higher age-group identification are most susceptible to ABST (Kang & Chasteen, 2009). In this study, age-group identification moderated the ABST effect in a cued recall task. Age-group identification refers to the extent to which individuals identify with their age group (Garstka et al., 1997). As previously mentioned, older adults age into the out-group and may or may not find stereotypes as self-relevant depending on how old they subjectively view themselves (Barber, 2020; Levy, 2009). In a study conducted by Hess and Hinson (2006), results showed that middle-aged adults can perform better in negative stereotype conditions compared to neutral conditions. This effect is termed "stereotype lift" (Walton and Cohen, 2003) and occurs for in-group members when presented with negative stereotypes about out-groups. In this study, younger adults did not have a significant difference in memory performance across conditions. Middle-aged adults performed better in negative age stereotype conditions. It was suggested that age-group identification and self-efficacy played a role in these findings. Task difficulty and self-efficacy have been posited as two additional variables to consider when testing ABST. In addition to testing age-group identification as a moderator on ABST effects, Kang and Chasteen (2009) tested task difficulty. ABST was tested across three levels of tasks difficulty: recognition, cued recall, and free recall. The effect of negative age stereotype exposure on older adults' performance was only found in the cued recall task. It was suggested that the recognition task may have been too easy while the free recall task was too difficult for the older adult participants.

In addition to these important moderators, it has been posited that older adults who hold negative views of aging and endorse age stereotypes are most susceptible to experience ABST effects (Barber, 2017). The Multi-Threat Framework, developed by Shapiro and Neuburg (2007) and further explained by Barber (2017) suggests that older people experience a unique form of stereotype threat termed Self-Concept Threat. Self-Concept Threat occurs when the individual is the target of the stereotype and believes that the stereotype could be true. An example of this would be an older person being concerned that a negative stereotype will be true about them, and they judge their own abilities. This is a different type of threat that is said to be experienced by African Americans. For example, African Americans, when in stereotype-threat-eliciting environments are faced with concern for confirming stereotypes that others endorse and that out-group members are judging them on. Barber (2017) suggested that two precursory factors must be present for Self-Concept Threat to occur. These two factors are: stereotype endorsement and group identification. For example, older adults must believe to some extent the validity of an age stereotype and find the age stereotype relevant to themselves because they highly identify within the older adult age group. These perspectives align with the literature on age stereotypes, general beliefs about memory and stereotype embodiment (Hummert et al., 1994, Levy, 2009; Lineweaver & Hertzog, 1998). Based on the literature, it is apparent that older people endorse negative age stereotypes in addition to other age groups. Self-Concept Threat may be potentially unique to older adults because they are a highly stigmatized group of individuals who have aged into their stereotyped identity. Manipulating ABST effects can be complicated because the process is nuanced and may be contingent upon many factors that are continuing to change as a person ages. For example, age-group identification changes as we grow older and exposures to age stereotypes may have changing influence as identities shift (Abrams et al., 2006). Including moderators, such as age-group identification and stereotype endorsement may shed light on the process of ABST and may result in a clearer understanding of when ABST occurs. Investigating the relationship and influence of these factors on ABST effects may lend support to Shapiro and Neuberg's (2007) concept of Self-Concept Threat.

Thus far, the underlying mechanism explaining ABST is yet to be identified. Some researchers have suggested that older adults are motivated to counter age stereotypes with their own performance and this motivation results in heightened feelings of anxiety, stress, and worry (Schmader et al., 2008). It is also suggested that the heightened stress and concern of confirming the stereotype leads to increased cognitive load and poorer performance in cognitive tasks (Schmader et al., 2008; Barber and Mather, 2014). Work testing moderating factors, however, has been promising and has highlighted how nuanced ABST effects are. Additionally, ABST may work completely different than other types of stereotype threat experienced by other marginalized groups. This could be because older adults are individuals who age into their stigmatized identity and who likely endorse self-relevant stereotypes. Despite an unclear understanding of "how" ABST occurs, researchers have made great progress in identifying "when" these effects are most likely to occur. Those who identify as old, who value ability within the stereotyped domain, and who consciously experience threat are most susceptible to ABST effects (Chasteen et al., 2005; Hess et al., 2003; Hess & Hinson, 2006; Kang & Chasteen, 2009). Future studies should continue to test these moderators. With ABST effects being such a nuanced process, there are some issues with consistency within the literature. However, with continued testing of moderating factors, findings may become more consistent and the understanding of ABST may become clearer.

ABST and Environment Learning

As of now, ABST has been explored across domains including general cognition, memory, work behaviors, handwriting, and driving (Ben-David et al., 2018; Chasteen et al., 2005; Hess et al., 2003; Kang & Chasteen, 2009; Lambert et al., 2016; Lamont et al., 2015; von Hippel et al., 2019). However, environment learning or spatial ability in general has not been a popular topic of discussion in the ABST literature.

Environment learning requires the use of spatial knowledge and is a broad construct. It has been measured in various forms and is often reviewed under navigation abilities. A classification and overview of this construct was constructed by Meneghetti and colleagues (2022), as shown in Figure 1. Navigation is an umbrella term that refers to the process of getting to a destination but is further categorized as locomotion and wayfinding. Thus, many times researchers discuss navigation broadly but are really referring to one aspect of it. For example, many times researchers measure wayfinding processes only but state they are measuring navigation ability. Thus, navigation tasks sometimes do not involve locomotion, but other times do. Other studies have measured navigation ability by requiring participants to learn routes by moving through them physically or in virtual reality (VR) environments (Iaria et al., 2009; Moffat et al., 2009). After learning routes, participants are asked to repeat the route to demonstrate ability and overall environment learning. There are many inconsistencies of classification and terminology for navigation tasks, and it has been mentioned as a possible contributor to the inconsistencies within the literature (Lester et al., 2017). Overall, navigation can take place in familiar and unfamiliar environments and involves the acquisition and use of learned environmental features (Arthur & Passini, 1992; Tolman, 1948; Wolbers & Hegarty, 2010). Environmental learning involves the acquisition of landmarks, paths, and location information (Meneghetti et al., 2022). One major aspect of navigating is learning key aspects of an environment and remembering information about the route and landmarks to assist in locating a destination (Montello, 2005).

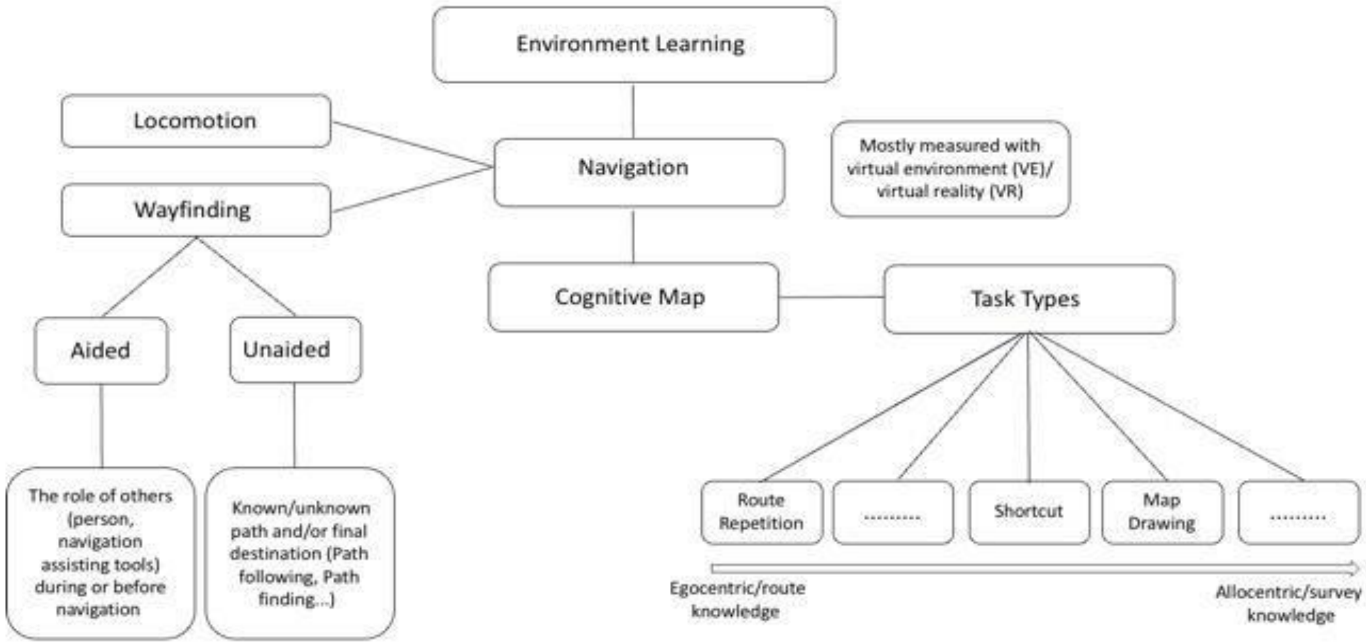

Figure 1. Categorization of Environment Learning and Navigation (Meneghetti et al., 2022)

Thus, navigation ability requires environment learning and is an aspect of the cognitive process. The ability to navigate efficiently and independently is an essential aspect of everyday life and when individuals have difficulty navigating it can negatively affect their lives and limit autonomy (Lester et al., 2017; O'Keefe & Nadel, 1978; Wolbers & Hegarty, 2010). Essentially, the ability to learn spatial information and use it for later navigation use is a necessary skill for most people. Although environment learning and navigating are common activities, they are complicated skills that require us to create mental maps and encode spatial information (Tolman, 1948). The mental maps that we create are based on aspects of learned environments (Wolbers & Hegarty, 2010).

As previously mentioned, ABST has been reviewed and tested across a diverse range of domains (Barber, 2020; Lamont et al., 2015; Riboni & Pagnini, 2019; Spencer et al., 2016). This could be because old age stereotypes are mostly negative and apply to many characteristics (Hummert et al.,1999). However, not much attention has been given to stereotypes of spatial ability or navigation ability specifically. Although, one could argue that the stereotype of low competence or poor memory applies to environment learning. It appears ABST effects on environment learning abilities has not been tested experimentally but there is evidence that ABST effects would apply to this domain.

In addition to the navigation ability stereotype study, there has been one study conducted by Meneghetti and colleagues (2014), that found a relationship between perceived stereotype threat and map drawing performance for older adults. They tested perceived stereotype threat as a mediator between the relationship between age and map learning. Results from this study showed that perceived stereotype threat concerning aging and spatial abilities mediates the relationship between age and map learning performance. The two studies discussed in this section have laid the groundwork for future experimental testing of ABST effects on spatial ability, such as environment learning.

Age differences in environment learning are well-documented and are found across a long range of task types (Coutrot et al., 2019; Gazova et al., 2012; Klencklen et al., 2012; Moffat, 2009; Wiener et al., 2013; van der Ham & Claessen, 2020). For example, tasks that require participants to learn a route across trials show large age differences, with older adults learning at a slower rate, making more errors, and taking longer times to find exits (Barrash, 1994; Kirasic, 2000; Moffat & Resnick, 2002; Moffat, 2009; Wiener et al., 2012; Wilkness et al 1997; Taillade et al., 2016). Across the many studies investigating individual differences in navigation performance, it is consistently found that older adults are poorer navigators (Klencklen et al., 2012; Moffat, 2009; Wiener et al, 2012). Further older adults, compared to younger groups, demonstrate poorer environment learning by making more incorrect direction choices at landmarks or intersections (Head and Isom, 2010; Liu et al., 2011; Wiener et al., 2012). These issues are true in tasks that do not require route repetition as well. Older adults have more difficulty, compared to younger adults, in describing learned environments, retracing routes on maps, and placing landmarks at correct positions within drawn maps (De Beni et al., 2006; Meneghetti et al., 2012).

However, not all findings are so bleak when it comes to older adults navigating. When researchers look at navigation perspectives, older people maintain their ability to navigate when using specific perspectives rather than others. Navigation perspectives are categorized as either allocentric or egocentric navigation (Burgess, 2006; Colombo et al., 2017). An allocentric perspective is when individuals use the location of landmarks to guide them when navigating. This approach of navigating is more difficult for older adults than others (Klencklen et al., 2012; Meneghetti et al., 2022). An egocentric perspective is when individuals focus on cardinal directions and use their starting point and first-person perspective to guide them. This way of navigating works best for older adults (Burgess, 2006; Ruggiero et al., 2016). An example of an egocentric task would be route learning, where participants navigate within the same route across trials. In further support of this pattern, age differences are larger for map drawing tasks that require knowledge of landmarks (Lester et al., 2017). It may be that the relationship between cognitive abilities and navigation ability is contingent upon task type (Muffato & Beni, 2020; O'Malley et al., 2018). Additionally, age differences may be dependent upon congruence between learning and testing conditions (Meneghetti et al., 2014). For example, learning a route by walking through it and being tested by navigating through the same route would be congruent learning and testing modalities. Some tasks require participants to watch videos of routes and then draw maps of them, which would be incongruent across learning and testing conditions and may increase age differences.

Overall, there are a range of different navigation tasks, and it is unclear how task type would moderate age differences in navigation performance (Lester et al., 2017). However, environment learning tasks have been categorized into different frames of reference and these separate frames have been understood to require distinct navigation skills (Lester et al., 2017). In a meta-analysis, conducted by me, 10 calculated effects from seven empirical studies were compared. Included were studies that tested navigation ability objectively and compared performance between younger and older adults. Results showed that the navigation perspective of the tasks moderated age differences in navigation ability. The overall effect for age differences were larger when tasks were allocentric (Cohen's *d* = 2.71, 90% CI [1.758-3.65], $p < .001$). Tasks that required participants to use landmarks and overview information were coded as allocentric. Larger meta-analyses, including more studies, are needed to further investigate the moderation of task type on age differences in navigation ability. Furthermore, more studies that include objective measures of both allocentric and egocentric tasks are needed. Thus, objective ability across the different frames of reference should be assessed across the same participants. Researchers have begun to include navigation tasks that include separate allocentric and egocentric sections within a task, such as the Leiden Navigation Test (LNT), created by van der Ham et al., 2020 For this reason, the LNT was used to measure navigation ability within the current study. Using the LNT allowed for measuring performance outcomes across different task types and testing the generalizability of ABST effects.

Thus far, the common explanation for age differences in environment learning has been cognitive aging (Lester et al., 2017; Moffat, 2009) and small-scale visuospatial ability (Meneghetti et al., 2012). However, very few studies have tested the relationship between cognitive abilities and environment learning within the same study (Muffato & Beni, 2020). Based on what is known from the cognitive aging literature, it is likely that cognitive aging explains age differences in navigation tasks to some extent. Visuospatial abilities have also been determined as underlying explanations for age differences in environment learning tasks (Meneghetti et al., 2022). Not enough review of metacognitive factors has been done. Although, researchers are beginning to test navigation self-efficacy, navigation behaviors and beliefs. For example, studies have highlighted that positive wayfinding attitudes are linked to older people's navigation skills, in terms of path knowledge (Meneghetti et al., 2015, 2019; Muffato & DeBeni, 2020). Additionally, older adults who have higher enjoyment for exploring places and less anxiety when learning environments perform better than older adults who do not (Pazzaglia et al., 2018).

Gender Differences and Stereotypes in Environment Learning

When reviewing group differences in environment learning, gender is a common topic of discussion. In fact, there is a large amount of research focused on gender differences in spatial cognition and on gender-related stereotypes (Coutrot et al., 2019; Ellmers, 2018; Miola et al., 2023; Nazareth et al., 2019; van der Ham & Koutzmpi, 2022). In a meta-analysis conducted by Nazareth et al. (2019), 266 studies were analyzed, and it was identified that men had a navigation advantage compared to women. The overall effect for gender difference was small to medium (d = 0.34 to 0.38). When looking further within the gender differences literature it seems that men have an advantage depending on the task type (Miola et al., 2023). Women have shown to prefer navigation tasks that involve landmarks and perform better in landmark tasks over geometric acquisition tasks (Saucier et al., 2003). Furthermore, gender differences are reduced when participants are given more time for spatial acquisition (Grön et al., 2000; Nori et al., 2018). It seems as though women benefit from taking their time on navigation tasks. In a study by Miola and colleagues (2023), men performed significantly better than women in a landmark recognition task, however, there were no gender differences in the mapping section. These results contrasted some of the earlier results showing that gender differences are pronounced for tasks that require landmark location on a map (Nazareth et al., 2019). More consistent findings are found regarding geometric tasks and with mental rotation (Castelli et al., 2008; Guizzo et al., 2019; Grön et al., 2000; Saucier et al., 2003). For these forms of environment learning, men consistently show an advantage.

In terms of gender-related stereotypes for spatial ability, it has been found that participants believe men to be better than women with environment learning and navigation (Allison et al., 2017; van der Ham & Koutzmpi, 2022). In a study by van der Ham and Koutzmpi (2022), results highlighted that participants endorsed gender stereotypes of spatial ability and navigation. These stereotypes favored men. Additionally, stereotype endorsement was strongest for men and younger participants. The men also reported higher self-efficacy. Thus, the men endorsed the gender stereotypes the most and had the highest self-efficacy. These findings align with earlier gender stereotype research that has shown that men hold implicit stereotyping beliefs regarding gender and mental rotation (Guizzo et al., 2019). Results showed that the implicit beliefs benefited men in mental rotation tasks but had a counter effect when they were exposed to stereotype nullifying information. The van der Ham and Koutzmpi (2022) study was innovative because individual differences for the magnitude of stereotype endorsement were highlighted. More work is needed in connecting self-efficacy, stereotype endorsement and objective performance in navigation (van der Ham & Koutzmpi, 2022).

Only a small handful of studies have went beyond gender stereotypes and have investigated gender related stereotype threat on navigation ability. There is some evidence that gender related stereotype threat effects occur and negatively influence spatial ability for women (Allison et al., 2017). Furthermore, some work has revealed that men are positively influenced by the exposure of gender-related stereotypes about navigation (Rosenthal et al., 2012). This stereotype lift experience is similar to what has been found with middle-aged adults when exposed to older adult stereotypes. With the considerable evidence of gender differences in environment learning, it is important to consider gender when investigating ABST on navigation ability. It is quite possible that older adult women would be most susceptible to ABST effects on environment learning. This could be especially true because women have reported lower self-efficacy for navigation and because of the gender stereotypes favoring men (van der Ham & Koutzmpi, 2022). In contrast to this hypothesis, older men could be more susceptible to ABST being that they would be unfamiliar with being viewed as poorer navigators. Thus, older men could be less resilient when exposed to self-relevant stereotypes. In the current study, gender stereotypes and self-efficacy were not measured. Thus, it is not possible to say whether the men from the sample endorse gender or age stereotypes and if they had higher self-efficacy. Despite this, it was important to explore possible gender, condition, and age group interactions. Posteriori analyses were included to explore ABST effects with consideration of gender. This component was added as a 7^{th} exploratory hypotheses within the study.

Measuring Environment Learning

As previously mentioned, one study conducted by Meneghetti and colleagues (2015) explored perceived stereotype threat in relation to spatial ability. In this study, they found that perceived stereotype threat mediated the relationship between age and performance on a map-drawing task. The most logical next step from these findings was to manipulate stereotype threat effects. To test ABST on environment learning, I used a web-based objective navigation measure created by van der Ham and colleagues (2020). This test was the objective portion of the LNT and has been given in person and more commonly online. Van der Ham et al. (2020) have established that performance for the LNT is similar when completed outside on a computer or within lab settings on a computer. This was not investigated across age groups, however. Thus, it is unclear if testing location would moderate LNT performance for older adults. Environment learning performance has been compared between in-person, hybrid, and online tasks. Participants have shown to have more difficulty learning overview information (survey) within online tasks, but not for hybrid tasks (van der Ham et al., 2015). Survey information requires an overview understanding of an environment. An example of a hybrid task would be physically walking in an environment and using GPS tracking with directional updates. The LNT has not been compared to "real world" navigation, however, other online navigation assessments have. From this, online navigation assessment scores have significantly correlated with navigation scores from congruent tasks within city streets (Coutrot et al., 2019). The relationship of these different test formats was stronger when the online task was more difficult.

The navigation test section of the LNT begins with a short first-person video showing a path from start to finish. Following the video, participants are asked a set of questions about landmarks, location, and direction choices. Each section of the test requires a different type of environment learning. The test includes five distinct sections that are categorized as different types of navigation. One of these sections, the egocentric location section, was not included in the present study. Thus, previous scores for the egocentric location section are not discussed. The four categories used in this study were as follows: landmark recognition, egocentric route, allocentric survey, and allocentric location (see Appendix E). For the landmark recognition questions, participants were shown 8 landmarks and choose (yes) for if they saw the landmark in the video or (no) for if they did not. For this section, 4 of the 8 items were distractors. The second set of questions were a test of egocentric route knowledge. For this section, participants had to choose directions at 4 of the landmarks (i.e., left, right, or straight). The third section was a test of allocentric survey knowledge. For this section, participants had to choose the correct order of landmarks based on the order they were seen in the video. The last section was a test of allocentric location knowledge, where participants chose where on a map the landmark was located. The participants had a choice of 4 locations (A, B, C, D) for each item. This section was a measure of mental representations of the route and required participants to switch from a first-person perspective to a bird's eye view of the route. The LNT includes 8 items in the first section (landmark recognition) and 4 items in each of the other sections.

The LNT is a new navigation task but has been used to measure navigation ability across ages 18 - 100 years old and across gender (*N* = 10, 865) (van der Ham et al., 2020). Additionally, researchers have used the LNT to test navigation performance of acquired brain injury patients and the task has been proposed as a useful tool for navigation impairment assessment (van der Ham & Claessen, 2022; van der Kuil et al., 2022). In a study by Van der Kuil and colleagues (2022), a control group of 435 participants were assessed. Of this group, 71.50% were women, and the average age was 54.56 (*SD* = 16.39). Unfortunately, overall average accuracy, average errors, and standard deviations have not been reported within earlier studies using the LNT. However, average accuracy in percentages have been reported for the separate sections, giving a range of average accuracy across the sections. The control group from the van der Kuil et al. (2022) study, had accuracy averages ranging between 48.00% to 85.50% across the four sections. Previous studies using the LNT have indicated that the highest average accuracy is typically found for the landmark recognition section of the task and that participants have the most difficulty with the map section. Van der Ham and colleagues (2020), split the age variable into seven groups starting from 18 to 100 years old. Results revealed main effects for Age Group and Gender on performance overall. Performance decreased with age and men had higher scores than women. Additionally, an interaction between Age Group and Gender was found for overall performance. Men performed better than women for some age groups but not all. Additionally, the trend of significantly worse performance with increased age was consistent for most of the task sections, excluding the allocentric survey section (landmark order). The 50 - 59 and 60 - 69 age groups had significantly higher accuracy in this sectioned compared to younger groups.

Many researchers have used tasks similar to the LNT to measure environment learning (Lester et al., 2017; Meneghetti et al., 2022, van der Ham & Claessen, 2020). While other studies have assessed age-related differences in environment learning by testing direction judgments and landmark locations within verification tests (Allen & Kirasic, 2003; Meneghetti et al., 2012; Shelton & McNamar, 2001). As previously mentioned, task type is suspected to moderate age difference in ability, with some tasks being particularly difficult for older adults (Colombo et al., 2017; Lester et al., 2017).

With much diversity in environment learning testing, it is challenging to compare performance outcomes across studies. Future studies should continue to explore approaches for testing environment learning as it occurs in everyday scenarios and measure multiple types of navigation within a study. Although, online navigation has shown similar results to everyday navigation (Coutrot et al., 2019), it is unclear if stereotype threat occurs for an online navigation test.

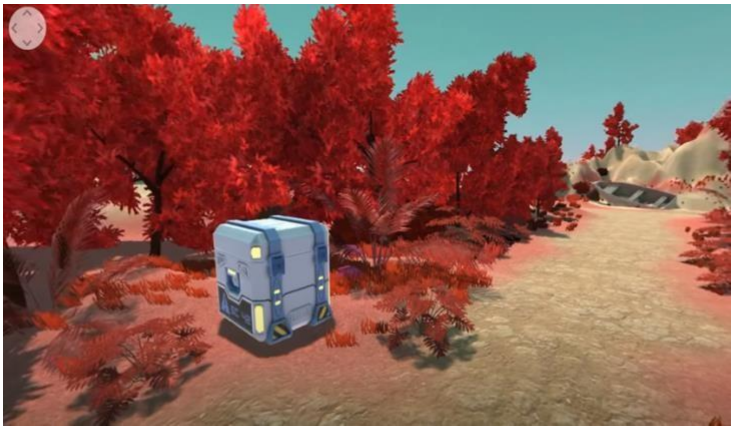

Figure 2. Image from the environment learning video of the LNT. The video and LNT were created by van der Ham and colleagues (2020) and can be found on the Navigation Lab Leiden website and on YouTube.

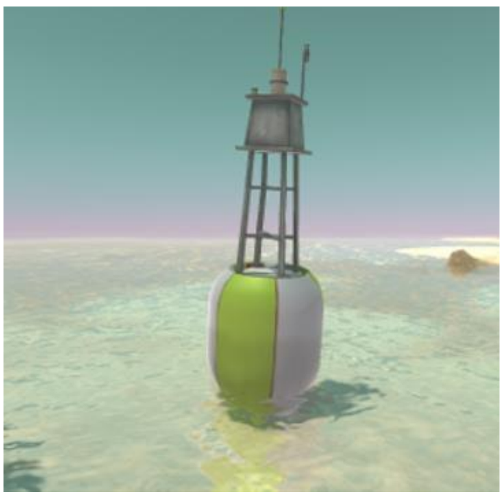

Figure 3. Landmark recognition item. This is 1 of 8 images used by van der Ham and colleagues (2020), to test navigation ability. The original test can be found on the Navigation Lab Leiden website.

Research Questions and Hypotheses

Thus far ABST effects have been explored across many domains, mostly for cognitive performance (Lamont et al., 2015). Although various domains have been tested and are impacted by ABST, spatial ability and environment learning have been left out of the conversation. The overarching goal of this proposed research project was to broaden the understanding of ABST by testing ABST effects within this overlooked domain. From this, I aimed to identify if older adults experienced stereotype threat effect for environment learning and to highlight whether age differences within this domain were partially explained by social cognitive processes. In addition to this, previously identified moderators needed to be included. The findings from this work support a more holistic understanding of age differences in cognitive domains and specifically for environmental learning. The main questions stemming from the ABST literature that were addressed in this study were:

1. Do older adults experience age-based stereotype threat effects for environment learning?
2. Do age-group identification and negative views on aging moderate ABST effects and explain (in tandem) performance outcomes for those exposed to negative age stereotypes?

Hypothesis 1: I expected a significant main effect for age, where older adults performed overall worse in environment learning compared to younger and middle-aged adults. This hypothesis aligned with earlier findings on age differences in spatial ability and navigation (Klenklen et al., 2012; Lester et al., 2017; Moffat, 2009).

Hypothesis 2: I expected that there would be a significant interaction for Age Group by Condition on environment learning performance. It was expected that only the middle-aged group and older adult group would have significantly different performances across negative stereotype and neutral conditions. The middle-aged adult group would perform better in the negative stereotype condition compared to neutral. This hypothesis stems from earlier work showing "stereotype lift" outcomes (Hess & Hinson, 2006) for middle-aged participants when exposed to negative old age stereotypes. Additionally, older adults would have longer time taken scores and more errors for environment learning in the stereotype threat condition than in the neutral condition. This hypothesis was based on ABST effects, meaning lessened performance resulting from negative age stereotype exposure. This hypothesis aligned with the large body of literature showing ABST effects on older adult cognitive performance (Armstrong et al., 2017; Lamont et al., 2015).

Hypothesis 2a

I expected that there would be a significant interaction for Age Group by Condition on environment learning for the four sections of the task. Older adults in the stereotype condition were expected to have higher scores for time taken and errors for each of sections of the task compared to older adults in the neutral condition. These differences across conditions were not expected for the younger adult group. Middle-aged adults in the stereotype condition were expected to have lower scores for errors and time taken for all sections compared to middle-aged adults in the neutral.

<u>Hypothesis 3:</u> To further explore ABST effects across distinct types of environment learning, I compared mean level scores across each section of the environment learning task. I expected that older adults would have significantly different scores for errors and time taken across the sections. The scores for the egocentric section were expected to have the least time taken and least number of errors, compared to the allocentric task sections

specifically. This hypothesis stemmed from the navigation perspectives literature, showing that older adults struggle with allocentric perspectives and task types compared to egocentric (Colombo et al., 2017; Moffat, 2009).

Hypothesis 4: I expected that age-group identification would moderate the ABST effects on environment learning. For the threat condition, age with increased time taken and errors would depend on levels of age-group identification. Further, higher age-group identification would lead to poorer performance as age increased. This test stemmed from earlier work by Kang and Chasteen (2009) and O'Brien and Hummert (2006).

Hypothesis 5: I expected that both higher age-group identification and negative attitudes towards aging (lower scores) would have a combined significant prediction above and beyond age on environment learning in the threat condition. This was a statistical test of Self-Concept Threat (Barber, 2017; Shapiro & Neuberg, 2007).

Exploratory Hypothesis *6*: The literature is mixed on mediators of ABST effects. It is posited that older adults engage in a prevention focus mindset and attempt to avoid errors when exposed to negative age stereotypes (Seibt & Förster, 2004). Depending on the type of task, this approach is not beneficial for older adults. Some findings have aligned with this hypothesis, where older adults within stereotype threat conditions had lower intrusion rates during free-recall tests (Barber & Mather, 2013). The majority of ABST studies have focused on errors only and have found that older adults make more memory errors in negative stereotype conditions compared to neutral and/or positive (Lamont et al., 2015). Thus, to expect that older adults will perform significantly worse in the stereotype condition compared to older adults in the neutral condition may be too broad of a hypothesis. Expecting more errors in stereotype conditions compared to neutral, aligns with the larger body of ABST effects (Lamont et al., 2015). However, expecting less errors and more time taken in stereotype conditions compared to neutral aligns with the prevention loss hypothesis. To test these opposing views, I tested ABST on the combination of task time and errors. I expected that older adults in the stereotype condition compared to the neutral condition would make less errors overall, however, would take longer to complete the task. This hypothesis aligns with the prevention loss perspective on ABST, where there is a speed - accuracy tradeoff (Seibt & Förster, 2004). The speed - accuracy tradeoff may only occur for specific types of memory tasks; thus, it is unclear if this occurs for environment learning.

Exploratory Hypothesis 7: After conducting initial hypothesis testing, Exploratory Hypothesis 7 was added to identify any possible differences in ABST effects across gender identification. Evidence suggests that navigation performance, task preferences and self-efficacy differ between men and women (Miola et al., 2023; Nazareth et al., 2019). Additionally, recent studies have identified a gender stereotype for spatial ability and navigation, favoring men. Additionally, women have reported lower self-efficacy for navigation (van der Ham & Koutzmpi, 2022). For this hypothesis, it is expected that older adult women would be most susceptible to threat effects when exposed to stereotypes about environment learning. Although older men would be unfamiliar with out-group stigmatization, they may be more likely to focus on the gender stereotypes. Men have been found to demonstrate implicit gender stereotyping for mental rotation ability, a type of spatial ability (Guizzo et al., 2019). Further, men strongly endorse gender stereotypes for spatial ability (van der Ham & Koutzmpi, 2022). Gender stereotype beliefs may be protective against ABST effects for older men. From this, it is expected that older adult women would experience ABST effects, while older adult men would not.

CHAPTER III

METHODS

Introduction

The following section addresses the research questions outlined in Chapter II. To address research questions 1 and 2, *do older adults experience age-based stereotype threat on environment learning and do age-group identification and attitudes towards aging together contribute to ABST effects for older adults,* I tested the environment learning performance of younger, middle-aged, and older adults within two distinct conditions (stereotype threat and neutral). For this study, there were six groups: a younger threat group, a younger neutral group, a middle-aged threat group, middle-aged neutral group, an older threat group, and an older neutral group. To test ABST effects, I manipulated stereotype exposure across the two conditions. The threat condition included both subtle and blatant approaches for stereotype exposure. The subtle exposure was a video with age stereotype topics and wording. The blatant exposure was stereotypical instructional wording. The instructions included the statement, "You will be tested on your environment learning ability. Research suggests that environment learning, and navigation skills decline with age." Including age stereotyping information in this format is a common approach for stereotype threat manipulations (Hess et al., 2009; Swift et al., 2013). Explicitly telling older adults that ability is thought to decline has shown some evidence of influencing older adult performance (Hess et al., 2009; Lamont et al., 2015). The subtle exposure video was a new story of a young couple that discovered an old man who was lost. They decided to direct him and lead him to his destination. Additionally, the couple discussed the importance of helping old people and the responsibility of taking care of older parents. Words like “elderly” “lost” and assistance” were said within the video. Participants in the neutral condition watched a video too, but it showed newscasters playing a GPS (Global Positioning System) game exploring which navigation system worked best. In the GPS video, all individuals were seemingly middle-aged, and age was not discussed. Overall, the procedure and design of the study was the same for both the stereotype threat and neutral conditions, however, the wording of instructions and beginning videos differed. These approaches for manipulating negative age stereotype exposure were adaptations of methods from earlier ABST studies (Chasteen et al., 2005; Hess & Hinson, 2006; Hess et al., 2009; Kang & Chasteen, 2009; Lamont et al., 2015).

Procedure and Design

The design of this study was quasi-experimental with two independent variables (Age Group and Condition) and multiple measures of environment learning. Performance on the dependent variable was calculated as seconds taken and on accuracy (i.e., incorrect item choices/errors). The dependent variable was measured as overall scores and scores for each of the four sections of the task. Participants from the three age groups (young, middle-aged, and older) were randomly assigned to one of the conditions (stereotype or neutral), resulting in six separate groups. The participants were provided with a link to the Qualtrics survey. When they clicked on the survey link, they were taken to the stereotype threat or neutral (control) condition survey. Participants who completed one section of the study could not access other sections and sections were made live at different times. All participants provided informed consent at the beginning of the Qualtrics survey. After consent completion, participants began the survey by providing demographic information. Participants who reported that English was not their primary language, that they were less than 18 years of age, or that they were using a phone to take the survey were directed to the end of the survey and thanked for their time. After watching one of the 4-minute (approximately) condition videos, participants completed a free response text entry explaining what they thought the video was about. For example, one participant in the threat condition wrote, “It's a feel-good story about a young couple helping an elderly man drive to see his son. The man had trouble finding his way, so this couple decided to help”. Another participant in the neutral condition wrote, “The video was about seeing what GPS got a person to the destination the fastest. Turns out Waze had the best information to get to the location with the fastest route”. Responses to this item indicated that participants were paying attention and engaged during the survey. For example, a blank response or non-sensical response led to the observation being removed. The responses were not coded for accuracy. However, responses to this item gave insight into any perceptions of age stereotypes within the stereotype threat condition video. Most importantly, the responses to this item were necessary for the exclusion process of the older adult threat group. Further detail on the exclusion process can be found in Figure 7. After the condition video, participants read the environment learning instructions and watched a second video that showed a route. The wording of the instructions depended on the condition, but all instructions explained environment learning. Participants were instructed to watch the environment video closely and to take this section of the survey without any distractions or breaks because it was timed. Directly after completing the environment learning task, participants rated the difficulty level of the task and answered questions about perceived threat. Two age-related measures and a subjective age item followed the perceived threat items. The age-related measures were needed for the age group identification and attitudes towards aging variables. These measures, along with the subjective age item were placed after the environment learning task for both conditions. All age-related measures were placed after the environment learning task, for both conditions. Earlier ABST studies have included similar tactics of intentionally placing measures that may prime stereotype threat after the dependent variable (Chasteen et al., 2005). The survey ended with a free response item asking participants "What they thought the study was about" and the last page explained ABST with debriefing information. All age-related measures were placed after the environment learning task, for both conditions. Earlier ABST studies have included similar tactics of intentionally placing measures that may prime stereotype threat after the dependent variable (Chasteen et al., 2005).

Participants

Eighty-three young adults (19–34 years), 81 middle-aged adults (35–58 years, and 80 older adults (60–80 years) were included for the analysis portion of this study, a total of 244 participants. The sample age ranged from 19 to 80 (M_{age} = 46.30, years, SD_{age} = 16.10 years). In terms of gender identification, the sample included 119 men (48.77%), 120 women (49.59%), 2 participants who preferred not to say (.82%) and 3 gender nonconforming participants (1.23%). The overall demographic characteristics of the sample are provided in Table 1 and demographic information within each age and condition are provided in Table 2. The sample age range for younger adults was 19-34 (M_{age} = 28.61, SD_{age} = 3.72), for middle-aged adults 35-58 (M_{age} = 45.14, SD_{age} 6.58) and older adults was (M_{age} = 65.76, SD_{age} = 5.11). Overall, participants were healthy (*M* = 3.47, *SD* = .99), rated on a scale from 1 = *poor* to 5 = *excellent*) and well-educated (*M* =15.91$_{years}$, SD_{years} = 1.92). Education was converted into years, thus, analyzed as an interval variable. For descriptive data by age group and condition for chronological age, subjective age, health, SES, and education (years), see Table 2.

Participants were recruited through Cloud Research's online research platform Connect and paid 2 dollars and fifty cents for participation. A power analysis was conducted using G*Power software (Faul et al., 2009) with an expected small-to-medium effect size for a two-way analysis of variance gave a total needed sample size of 211 participants. The sample size of 211 was necessary to achieve power = .80 and to detect statistically significant effects with the alpha set to .05. Decisions in processing the power analysis were based on findings from Lamont and colleagues' (2015) meta-analysis on ABST effects in cognitive functioning studies. Meta-analyses of stereotype activation effects have reported effect sizes of *d* = 0.34–0.38 (Armstrong et al., 2017; Lamont et al., 2015; Horton et al., 2008; Walton & Cohen, 2003). To be eligible for the study, participants had to be 18 years old or above, have English as their primary speaking language, and passed through the connect vetting process. Connect is CloudResearch's new online platform separate from Mturk. The Connect platform includes technical checks to make sure participants only operate one account, and do not complete a survey multiple times from the same IP address. Additionally, with Connect, I was able to set age group criteria a priori for each study session before making the sections live. Further, participants that took part in other sections of the study were excluded from participating again in another section. Those who reported age ranges of under 18, who did not consent to participate, who reported taking the survey on their phone, and whose primary language was not English were directed to the last page of the Qualtrics survey. Additionally, participants that left the attention checks blank were directed to the end of the survey and excluded from the analyses. For details on the exclusion process see Figure 7.

Existing research suggests that data obtained using online research platforms, such as MTurk and CloudResearch's Connect, are comparable to data obtained from the general population, including older adults (Mortensen & Hughes, 2018). Although some studies have shown that participants from MTurk may not be legitimate (Webb & Tangney, 2022). Using online platforms for testing ABST has been suggested because in person testing can elicit ABST effects, particularly campus settings (Barber & Lui, 2020). Thus, an online approach was best but consideration of the pitfalls of data quality was kept in mind. Thus, multiple survey attention checks were included.

Overall, CloudResearch's Connect platform was advertised as a response to issues with Mturk and claimed to have a more rigorous vetting process. This platform did have new features that were not available in Mturk. For example, Connect allowed for technology restrictions within the recruitment settings. This was useful because cell phones were not compatible with the survey environment learning video. Connect provided information on survey completion and duration times. Lastly, with Connect participants could message me about their experiences, issues, or concerns that they may have had during the survey. For example, one participant messaged that their computer froze, and they did not finish the survey.

For this study, I included three attention check items. The first item was based on attention to the survey (manipulation) video. Participants who typed in nonsensical answers or left the item blank were directed to the end of the survey. The second attention check item was based on the environment learning video. The item required participants to state what the last landmark was at the end of the video. Within the task instructions, the last landmark was stated and was shown at the end of the video. Participants who left the answer blank or who wrote a nonsensical response were excluded. For example, responses that had a number as the item response were excluded. The accuracy of responses was not relevant. Lastly, the third attention check required participants to write in a few short sentences about what they thought the study was about. All items were important for screening purposes and provided some insight on observations with extreme values. Another step to prevent poor data quality was retrieving IP addresses and Connect ID numbers. Towards the end of the survey, participants were asked to type in their Connect ID numbers. Duplicate numbers within the data were not found, however 12 participants were excluded because of blank attention checks, or nonsensical responses to attention checks (see Figure)

.

Table 1
Participant Demographic Information

	Total (*N*=244)	**Young (*n* = 83)**	**Middle (*n* = 81)**	**Older (*n* = 80)**
Age (years)	46.28 (16.11)	28.61 (3.72)	45.14 (6.58)	65.76 (5.11)
Subjective Age (years)	42.61 (15.12)	29.23 (8.15)	42.59 (12.58)	56.52 (9.46)
Gender				
Women	49.18%	37.35%	56.79%	53.75%
Men	49.18%	57.83%	41.98%	46.25%
Gender Nonconforming	1.23%	2.41	1.23%	0.00%
Preferred Not to Say	0.82%	2.41	0.00%	0.00%
Health (5-point scale)	3.47 (.99)	3.81 (.92)	3.20 (1.02)	3.39 (.93)
SES (10-point scale)	4.49 (1.77)	4.57 (1.82)	4.42 (1.81)	4.49 (1.71)
Education (years)	15.91 (1.92)	15.91 (2.06)	15.90 (1.85)	15.93 (1.85)

Table 2
Participant Demographic Characteristics Within Age and Condition Groups

Total (*N*=244)	**Young (*n*=83)**		**Middle (*n*=81)**		**Older (*n*=80)**	
	Threat	Neutral	Threat	Neutral	Threat	Neutral
Age (years)	28.19 (4.11)	29.05 (3.26)	44.26 (6.85)	46.08 (6.23)	65.61 (4.62)	65.90 (5.57)
Subjective Age	28.43 (6.74)	30.05 (9.40)	42.55 (13.67)	42.64 (11.48)	56.61 (10.24)	56.45 (8.83)
Health	3.76 (.96)	3.85 (.88)	3.21 (1.02)	3.18 (1.02)	3.42 (.89)	3.36 (.98)
SES	4.52 (1.93)	4.61 (1.73)	4.31 (1.81)	4.54 (1.82)	4.66 (1.74)	4.33 (1.68)
Education	14.90 (2.19)	14.90 (2.57)	14.90 (2.12)	15.20 (2.02)	15.50 (2.17)	15.50 (1.89)

Measures

Demographics

Demographic variables included age (in years), subjective age (in years), gender identity, primary language, highest level of educational attainment converted to years, socioeconomic status (SES), and self-reported health. The interrelationships, means, standard deviations of all of the study variables are presented in Table 3. With longstanding socially relevant disparities within the United States, it is important to consider social factors within psychological research (Diemer et al., 2013). It is imperative that these demographics were considered because group differences in health and social status could contribute to navigation behaviors and experiences in learning new environments. Thus, some participants may have had more experiences with learning novel environments and found the environment learning task easier based on social differences. Additionally, demographic information such as education (years) was included because education has shown to be a moderator on ABST effects on memory performance (Hess et al., 2009). Participants who reported that English was not their primary language, or who were under the age of 18 were not included. Some of the environment learning task graphics only work on laptops or desktop computers. Thus, I included technology restrictions within the recruiting credentials section. Within the online instruction, I included information explaining the exclusion criteria. Being that the Connect platform had rigorous and well-organized inclusion guidelines, I did not have participants that reported being under the age of 18, that English was not their primary language, or that they were using a cellular device to take the survey.

Table 3
Interrelationships and Descriptive Statistics

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Age	—	.78***	.05	-.18**	-.05	.09	.19**	.12	-.02	.18**	-.06
2.SubAge		—	-.00	-.31***	-.12	.08	.26***	.03	-.02	.12	-.03
3.Education			—	.16	.35***	-.06	-.05	-.06	.04	.07	.03
4. Health				—	.39***	-.06	-.18**	.26***	.32***	-.03	.06
5. SES					—	.00	-.03**	.19	.18**	.04	.08
6. DR						—	.07	-.01	-.02	-.13*	.23***
7. PT							—	-.28***	-.14*	-.10	.20**
8. AA								—	.58***	.14*	-.01
9. AI									—	.25***	.03
10. Time										—	-.22***
11.Errors											—
M	46.3	42.6	7.13	3.47	4.49	4.15	2.26	19	4.95	156	5.87
SD	16.1	15.1	1.68	.99	1.77	.93	1.08	3.42	1.26	89.7	3.28

Note. N=244. SES = Socioeconomic Status. DR = Difficulty Rating. PT = Perceived Threat. AA = Attitudes Towards Aging. AI = Age-Group Identification.

* correlations are significant at the .05 level (2-tailed).

** correlations are significant at the .01 level (2-tailed).

*** correlations are significant at the .001 level (2-tailed)

Subjective Age Identity

Subjective age identity reflects how old people feel (Montepare, 2009) and was included in addition to chronological age. This variable was necessary in examining significant mean differences of subjective ages between stereotype threat conditions and neutral conditions. Mainly because subjective age has shown to predict outcomes such as health beyond age itself (Westerhof et al., 2014). Thus, if older adults in the threat group had a significantly higher subjective age than older adults in the neutral condition, I would want to include the subjective age variable within analyses for hypothesis testing. Participants read a prompt stating "*Many times, people feel younger or older than they actually are, in chronological years. How old people feel is their subjective age. During the last month, what age did you feel most of the time*?" This approach has been used by other studies that have included subjective age (Rubin & Bernsten, 2006). For this study, I measured subjective age, as the reported subjective age in years.

Age-Group Identification

The age-group identification scale (Abrams et al., 2006) consisted of five items assessing an individual's identification with their age group (e.g., My age group membership is central to who I am"). Age-group identification is the measure of how much a person's age is an aspect of their identity. Stereotype threat is tied to the threat of one's identity thus, it was necessary to include aspects of age identity when reviewing threat effects (Abrams & Hogg, 1990; Tajfel & Turner, 1979). Items on the scale were rated from 1 (*strongly disagree*) to 7 (*strongly agree*). Scores were averaged across items, with higher scores being higher age-group identification. This measure held good reliability overall (α = .89), for the young adult group (α = .88), the middle-aged group (α = .88), and older adult group (α = .90).

Attitudes Towards Aging Questionnaire

To measure attitudes of aging, I used five items from the psychological growth subscale of the Attitudes to Ageing Questionnaire (AAQ) created by Laidlaw and colleagues (2006). The original measure was a 24-item that has been used and tested internationally and has shown adequate reliability (α =.62 to .72) based on a review of currently used self-report measures for aging attitudes (Klusmann et al., 2020). The original measure included a three-factor model encompassing psychological growth, psychosocial loss, and physical change. An assessment of the measure by Ayalon and colleagues (2019), included nine studies and found that the quality of the structural validity, internal consistency, and construct validity were adequate. However, some items were described as ambiguous with regards to age group (e.g., "I feel excluded from things because of my age"). For this study, only items from the psychological growth subscale were used and items that referenced growing old in general were included. Participants were given 5 items of the psychological growth subscale of the AAQ and rated on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*). An example item would be, "There are many pleasant things about growing older." The numbers from the questionnaire were summed for an overall total. Higher scores were equivalent to more positive attitudes about aging. The highest possible score was 25 and lowest possible score was 5. This measure held good reliability overall (α = .79), for the young adult group (α = .75), the middle-aged group (α = .81), and older adult group (α = .78).

Leiden Navigation Test (LNT)

To test environment learning (the dependent variable), participants watched a video of a web-based route. The link for this video can be found in section C of the Survey Measures Appendices. The environment video was approximately 2 minutes long and showed an animated route though a forest from a first-person viewpoint. The LNT was created by van der Ham and colleagues (2020) and can be found on the Navigation Leiden website. An assessment of the navigation test has shown a younger adult advantage on performance with a linear decline of performance with increased age for the landmark knowledge sections (van der Ham et al., 2020). The environmental route video was embedded into the Qualtrics survey. Within the video, there were multiple landmarks and at some landmark there was a direction choice to reach the end of the route. Participants read a prompt asking them to imagine that they were in a forest on a different planet and were walking to get back to a spaceship. Within the prompt, participants were informed that they should pay close attention to aspects within the video and to not take breaks for that section of the survey. The instructions varied slightly, however, depending on the condition. The threat condition included a statement about earlier research and that younger adults typically perform better on environment learning tasks. Environment learning was defined in both conditions. Underneath the prompt was the video where the participants were asked to press play. Following the video, participants began the environment learning test.

The task had 24 questions, split into four sections. The items included visuals of landmarks and scenes within the environment learning video. The video and items were created and made available by van der Ham and colleagues (2020). The environment learning questions were divided into four distinct aspects of ability. In earlier studies using this task, five aspects of navigation ability were included. However, one of these tasks could not be formatted into Qualtrics. Additionally, the unused section had a chance level of 16.7% (van der Ham et al., 2020). Findings show that performance on tasks that are most difficult (e.g., free recall) are not affected by negative stereotype exposure manipulations (Kang & Chasteen, 2009). Thus, using four of the five sections was not a concern. The 4 categories used in this study were as follows: landmark recognition, egocentric route, allocentric survey and allocentric location (see Appendix E). For the landmark recognition questions, participants were shown 8 landmarks and choose (yes) for if they saw the landmark in the video or (no) for if they did not. For this section, 4 of the 8 items were distractors. The second set of questions were a test of egocentric route knowledge. For this section, participants had to choose directions at 4 of the landmarks (i.e., left, right, or straight). The third section of the environment learning test was allocentric survey knowledge. For this section, each item included 3 landmarks and participants had to choose the correct order that the landmarks from the video. The last section was a test of allocentric location knowledge, where participants chose where on a map the landmark was located. The participants had a choice of 4 locations (A, B, C, D) for each item. This section was a measure of mental representations of the route. There were 8 items in the first section (landmark recognition) and 4 items in each of the other sections. Overall, there were 20 items categorized into 4 sections of ability. Scoring was based on errors made and time in seconds. A perfect score for errors would have been 0 out of 20. The original navigation test was scored based on accuracy only. A perfect total score for the landmark recognition section was 8. In all other sections, a perfect score of 4 could be obtained. For the present study, time taken, and errors (accuracy) were used for scoring, with lower numbers equating to better performance. I added time as a dependent variable to provide more clarity in how ABST effects could influence performance. ABST has shown to induce a prevention focus state, leading individuals to prevent losses rather than to maximize their gains (Seibt and Förster, 2004). In some cases, stereotype exposure can result in attention to loss prevention and can enhance accuracy (Barber & Mather, 2014). Therefore, older adults may perform slower but more accurately in a task after being exposed to negative age stereotypes (Pompham & Hess, 2015).

In previous work using the LNT, accuracy is the only measurement of performance. Therefore, the time taken scores from the current study could not be compared to earlier studies using the LNT. However, the average time to complete the LNT in earlier studies has been reported as approximately 10 minutes. Unfortunately, no details regarding the time taken for the objective portion or the separate navigation sections have been reported in earlier work. Adding a time measurement to the LNT was informative because time taken, and accuracy were related ($r = .22$, $p <.001$). It is hypothesized that exposure to negative age stereotypes can result in a loss prevention strategy (Seibt & Foster, 2004). Reliability of errors was acceptable overall ($\alpha =.74$) and when reviewed within each age group (young adults $\alpha =.63$, middle-aged adults $\alpha = .60$, and older adults $\alpha = .75$).

Task Difficulty Rating

Participants were asked how difficult they thought the task was on a scale from 1 (very easy) to 5 (very difficult). Within the stereotype threat literature, it is found that task difficulty is a moderator of age-based stereotype threat (Kang & Chasteen, 2009;

Lamont et al., 2015). Kang and Chasteen. (2009) found that task difficulty moderated ABST effects, with only cued recall having ABST effects. Higher scores were indicators of higher perceived difficulty of the environment leaning task.

Perceived Stereotype Threat (state)

Participants completed a three-item measure to assess their perceptions of stereotype threat while completing the study. The perceived stereotype threat measure was initially adapted by Chasteen and her colleagues (2005) from Steele and Aronson (1995). Later the scale was adapted by Kang and Chasteen (2009) to include both state (situational) and trait (dispositional) perceptions of stereotype threat. In a ABST study conducted by Kang and Chasteen (2009), perceived stereotype threat fully mediated the effect of age on memory performance, and it was later found to moderate stereotype threat effect. Thus, the memory performance was poorer for those in the stereotype group who also reported higher perceived stereotype threat. Outcomes with this perceived threat measure have revealed that it is age sensitive but does not always differ across conditions (Swift et al., 2013). It has been suggested that older adults, even in neutral conditions, may be threatened by additional characteristics of testing procedures outside of stereotype exposures (Strickland- Hughes & West, 2021). For this study, I included and reworded the state items to align with the experiences within the study. Therefore, items that originally pertained to interactions with experimenters were reworded to address the participants reactions to the videos watched in this study and the instructions they read. For example, the three items addressed performance expectations and concerns (e.g., "After watching the news video, I felt more likely to perform poorly because of my age. The Responses for the Perceived Stereotype Threat Scale were on a scale from 1 (*strongly disagree)* to 5 (*strongly agree*). Scores were averaged across the three items and higher scores indicated higher perceptions of stereotype threat. The measure held good reliability, with α =.86 overall. Additionally, reliability was good when reviewed within each age group (young adults α =.87, middle-aged adults α = .89, and older adults α = .82). Perceived threat was particularly important for the manipulation check of stereotype exposure across the stereotype threat and neutral conditions

. Table 4

Descriptive Statistics for Measures by Age Group

Measures	**Young**	**Middle**	**Older**	**P-Value**
Subjective Age	29.23 (8.15)	42.59 (12.58)	56.52 (9.46)	<.001
Difficulty Rating	4.16 (.92)	4.00 (1.04)	4.29 (.82)	.15
Perceived Threat	2.05 (1.00)	2.22 (1.15)	2.52 (1.04)	.02
Attitudes Towards Aging	18.54 (3.31)	18.77 (3.81)	19.63(3.03)	.10
Age-Group Identification	5.08 (1.13)	4.69 (1.38)	5.08 (1.23)	.07

Note. Significance values assessed by one-way ANOVAs. The significant effect for Age Group on Subjective Age is a significant difference between all age groups (young compared to middle-aged, younger compared to older and middle-aged compared to older). The significant effect for Age Group on Perceived threat is a significant difference.

Pilot Testing

To gain insight on the use of the environment learning task, I conducted a small pilot test before beginning the study. In this pilot test, 11 younger (18-34 years old), 9 middle-aged (35-59 years old) and 5 older adults (60-80 years old) completed the full survey. 14 women (56%), 10 men (40%), and 1 non-binary (4%) participants completed the survey. Participants were friends of the lab and recruited through word of mouth and online posting. There was a mean age of 44 (*SD*=15.7), with the youngest participant being 25 and the oldest 76. Participants were randomly assigned to threat or neutral conditions and completed distinct versions of the Qualtrics survey. Additionally, participants completed text entry statements about the survey and issues they may have had. From these data, I examined the descriptive statistics of errors made in the environment learning task, time taken, perceived stereotype threat and task difficulty ratings. Tables including this information can be found below (Tables 1-4). This information provided me with an understanding of how difficult the task was and allowed me to detect possible skewness for errors and time taken. Further, I examined means and standard deviations for errors, time taken and perceived stereotype threat (state) across age groups and conditions. Perceived age-based judgement has shown to be precursory to negative ABST effects (Steele, 2010). However, in earlier studies it has shown to not significantly differ across conditions yet still predict poorer performance in cued recall performance. Thus, as perceived stereotype threat (state) increased, cued recall performance decreased for participants in threat conditions (Kang & Chasteen, 2009). In addition to this, the work by Kang and Chasteen (2009) found that task type moderated ABST effects on memory performance.

For the environment learning test, there are 20 items categorized into 4 sections of ability. However, only overall performance was investigated. The score was based on errors made. Thus, a perfect score would be 0 out of 20. The average score overall was 4.28 (*SD*= 3.09). This was across both conditions and all age groups. The poorest score was 10 errors out of 20 and only 2 participants had 10 errors. I checked distributions and was most interested in histograms and skewness output. Skewness and kurtosis were calculated by dividing the statistical output from the standard errors. Scores over 3.29 were considered skewed and kurtotic. As shown in Table 3 and Figure 4, the error scores were not skewed. Additionally, duration time showed no evidence of skewedness with the quickest time taken being 16 minutes approximately. The participant with the fastest time taken also made 10 errors on the environment learning task. The duration time taken was 40 minutes approximately.

In terms of the errors made for the environment learning task, it was surprising that the younger adults in the neutral condition shared the highest mean for errors (*M* = 5.50, *SD* = 3.00) with the middle-aged adults in the threat condition. The older adults in the threat condition had the lowest mean for errors (*M* =3.00, *SD*=4.24) but older adults also had the longest times taken overall. Thus, it appears that the older adults performed the best in terms of errors. There were only 5 older adults included in the study, thus, results from this data are limited.

Furthermore, perceived stereotype threat was highest among the older adults in the threat condition (*M* = 4; *SD* =1.41). The task difficulty ratings had a mean of 4.12

(*SD*=.833). The perceptions of task difficulty did not align with the actual scores, however. Although most participants rated the task as more difficult than not (see Figure 6), the mean for errors made was 4.28, when 20 errors were the maximum possible amount.

Data from this pilot test was informative for multiple reasons. From this pilot test, it was decided that performance should be measured for all sections of the task in addition to examining overall performance. Some portions of the task were stated as particularly difficult in the text entry statements. For example, one participant stated that not having a map in the video but being tested on landmark locations on a map was particularly challenging. Further, each section of the task is a different type of environment learning (i.e., allocentric location) and research shows that some forms of environment learning are more difficult for some age groups than others (Colombo et al., 2017). Therefore, it may be more insightful to examine ABST effects on all sections of the task and for overall performance. In addition to this, the data from the pilot test confirmed the importance of measuring accuracy (errors) for the environment learning test. The older adults did not have the highest mean for errors but did have the highest means for time taken. This aligns with the research on prevention loss, motivation and ABST effects (Pompham & Hess, 2015; Seibt and Förster, 2004). Data from this pilot test are not used in the proposed study, however, was informative in how to test environment learning within the proposed study.

Table 5
Descriptive statistics of errors on environment learning overall.

						Skewness		Kurtosis	
	N	**Mean**	**SD**	**Minimum**	**Maximum**	**Skewness**	**SE**	**Kurtosis**	**SE**
Errors Score	25	4.28	3.09	0	10	0.29	0.46	-0.93	0.90

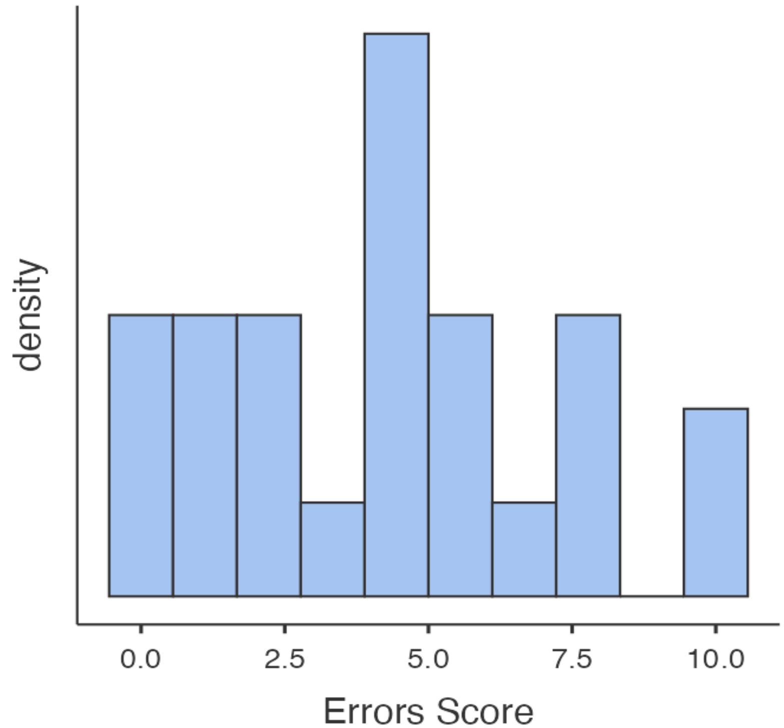

Figure 4. Histogram of the distribution of the errors made in the environment learning task.

Table 6
Descriptive Statistics for Time Taken

	N	Mean	SD	Minimum	Maximum	Skewness		Kurtosis	
						Skewness	**SE**	**Kurtosis**	**SE**
Time	25	1591	396	944	2437	0.22	0.46	-0.25	0.90

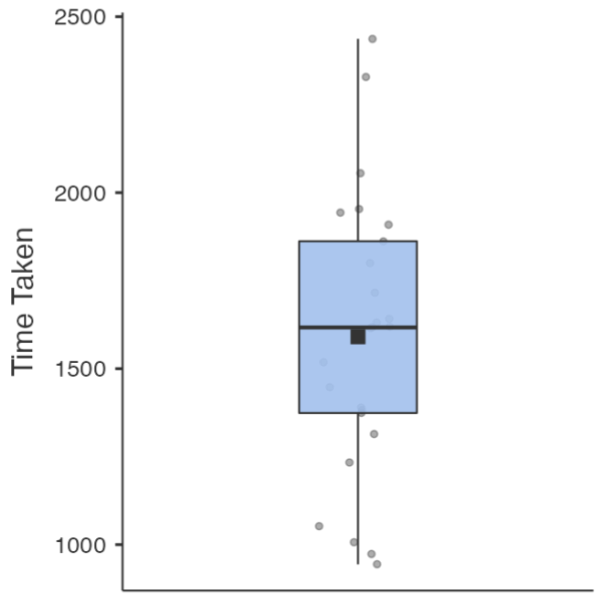

Figure 5. Box Plot for Time Taken

Table 7
Descriptive statistics for perceived stereotype threat across age groups and conditions

	N	Mean	SD	Minimum	Maximum	Skewness	SE
Difficulty Rate	25	4.12	0.833	2	5	-0.709	0.464

Table 8
Descriptive statistics for task difficulty overall

	Age Group	Condition	N	Mean	SD	Minimum	Maximum
Perceived ST	Middle	Neutral	5	2.00	0.70	1	3
		Threat	4	3.25	0.96	2	4
	Older	Neutral	3	2.33	0.58	2	3
		Threat	2	4.00	1.41	3	5
	Younger	Neutral	4	3.25	1.26	2	5
		Threat	7	2.71	1.50	1	5

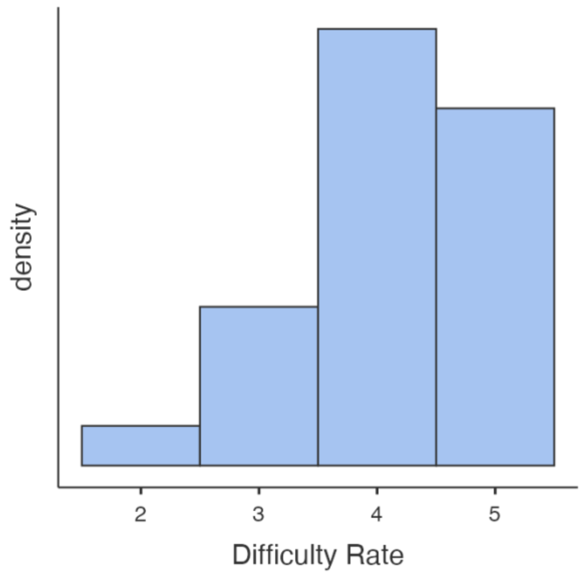

Figure 6. Histogram of the distribution of task difficulty ratings

CHAPTER IV

ANALYSES AND RESULTS

Introduction

The following chapters outline the analyses and findings based on the seven hypotheses of this project. The main goal of this study was to explore ABST effects by testing for an Age Group by Condition interaction on environment learning performance outcomes. The second aim of this project was to explore the role of age-related factors that could influence ABST effects. These age-related variables were age-group identification and attitudes towards aging. My approach for testing ABST mimicked earlier ABST studies on memory performance (Armstrong et al., 2017; Lamont et al., 2015). My examination of age-related variables in predicting older adult performance within a stereotype threat condition was an empirical approach to exploring Self-Concept Threat. I tested precursors of this concept as predicting factors on older adult's performance when in a stereotype threat condition. In addition to these goals, I wanted to expand the current understanding of age differences for environment learning and explore ABST on domains outside of memory. This study was unique in exploring threat manipulation outcomes on a new domain and across four separate environments learning tasks. The LNT includes five sections but four of these sections were included in the current study

These sections included landmark recognition, egocentric route, allocentric survey, and allocentric location. Performance was operationalized as accuracy (errors) and time taken. These approaches allowed for testing the generalizability of ABST effects in the environment learning domain. Overall, scores on the LNT were similar to the averages from the van der Ham et al. (2020) study (45.06% to 83.50%) (see Table 11). Additionally, studies using the LNT have indicated that the highest average accuracy is typically found for the landmark recognition section of the task and that participants have the most difficulty with the map section. This was true for the results of the present study as well. van der Ham and colleagues (2020), used the LNT to test navigation performance between age groups and gender. Previously found age differences were replicated for only one section of the task. It is thought that the older adults in this study were unique in their navigation abilities, self-efficacy, and familiarity with technology.

Data Screening

Data were screened and cleaned prior to analysis. This section outlines the exclusion process that resulted in a final sample of 244 participants from the original recruitment of 280 participants (see Figure 7). Firstly, the original data from 280 participants was examined for missingness. The dataset had no missing values after removing participants that did not begin the environment learning task and removing observations with nonsensical responses to the attention checks. The survey was designed so that participants could not move on to the next page unless all items were answered, however, if the attention checks were left blanked they were directed to the end of the survey. Thus, some participants did not reach the environment learning task because they did not respond to the attention check items. In the survey, there were two attention checks before the environment learning task began and one at the end. The first attention check required participants to state what they thought the 1st video was about. This video was either a neutral or stereotype threat video. This item was as follows, “Please write in 2-3 sentences what the video was about”. The second attention check was put in place to confirm that participants watched the environment learning video before starting the task. The item was as follows, “Please write what the last landmark was in the environment learning video.” Participant responses were not reviewed for accuracy. For example, one participant responded “boat” but was not excluded, although this was not the actual landmark at the end of the video. The third and last attention check was put in place to review participants' impression of the survey. This item was as follows, “Please write in 2-3 sentences what you thought this study was about”. There were four participants that left the first attention check blank. Two of these participants were older adults in the threat condition and two were younger adults in the neutral condition. There were four participants that left the second attention check blank. One of these participants was an older adult in the threat condition and three were middle-aged adults in the neutral group. Additionally, observations with nonsensical responses to attention checks were removed. Nonsensical responses were any responses with numbers instead of words or responses that did not give any evidence that they watched the videos. For example, one participant wrote “it is good” as their response for the first attention check. Another participant wrote “ California” as their response to the second attention check. Two older adults in the threat condition and one older adult in the neutral condition had nonsensical responses to the first attention check. One older adult in the threat condition wrote a nonsensical response to the second attention check.

In a two-step exclusion process, one research assistant and myself coded the responses of the older adults in the stereotype threat condition. Responses that did not have age-related statements in their first attention check response, were coded as 0. For example, one participant stated " *The video was about a couple helping a man who got lost on his way to see his son. The couple decided to drive the man to Madison and then drive him back to Arizona*." Although, this response described most of the story shown in the video, there were no references to age. Most participants used the phrasing "young couple", "elderly man", "old man" or stated exact age. The second part of the coding process was based on perceived threat scores. Participants with perceived threat scores lower than 2 and who did not mention worries about their performance or age-related concerns in the third attention check response were marked as 0. This resulted in nine older adults being removed from the dataset based on 0 coded responses to either the first or second part of the exclusion process. Five participants received a 0 for the first attention check and four participants received a 0 for the third attention check. For example, if an older adult typed a statement that reflected worry about their performance and age, they were not excluded. The 49 responses (older adults in the threat condition) were coded and tested for reliability using Cohen's Kappa. The Kappa formula measures inter-rater agreement with consideration of the probability of agreement by chance. The coding schemes were discussed between the research assistant and myself. In these discussions, we focused on any discrepancies found in our coding and came to an agreement. I calculated a kappa score (κ) = 0.94 for the first coding scheme including all 49 older adults in the threat condition and (κ) = 0.75 for the second coding scheme for the

9 older adults with perceived threat scores lower than 2. These scores met acceptable levels of agreement (Landis & Koch, 1977).

Following this, univariate outliers were examined for duration time for the survey and for dependent variables within the six groups of age group by condition. All univariate outliers were examined by computing z scores and checking for values greater than +/-3.29 (Tabachnick & Fidell, 2013). Additionally, outliers were examined within the descriptive statistics boxplots. Observations that were outliers in a boxplot and that were at or beyond the z score cut off were considered outliers and removed. Five outliers were found for duration time and were removed. These five outliers included one older adult in the threat condition, two older adults in the neutral condition, and two middle-aged adults in the neutral condition. These outliers had duration times well over the expected survey time of 20 to 45 minutes. I then checked the distributions and boxplots for the other dependent variables within each of the six groups by splitting the variables by age group and condition. Following this, 10 outliers were identified based on z scores and box plots. These were outliers for the task times overall and time scores for the separate sections. Of the outliers for task times, there was one older adult outlier in the threat group, three middle-aged adults in the threat condition, one middle-aged adult in the neutral condition, three young adults in the threat condition, and two young adults in the neutral condition. The outlier scores were further reviewed in relation to data from the pilot test and expectations for how long the environment learning task would take. For example, one participant took 10 minutes to complete the egocentric section of the task. The task was only four items and had three answer options (left, right, keep straight). Multivariate outliers were checked using Cook's D, with a cut off at 1. There were no multivariate outliers found in the data. Following this, the data were examined for normality issues using histograms, calculations of skewness and kurtosis, and checking for *p* values less than .05 for all the Shapiro-Wilks columns. These approaches revealed that all of the variables, excluding the errors variables, were heavily skewed with statistics well over the absolute value of 1.5 (Tabachnick & Fidell, 2013). The time variables were all positively skewed, along with perceived threat. Task difficulty and the age-related measures were negatively skewed. To fix issues of normality, I conducted log transformations of all of the variables. Based on suggestions for best transformation practices (Osborne, 2002), negatively skewed variables were reflected by subtracting from the largest value plus 1 and then transforming after a reflection. However, after all of the variables were transformed, the statistics indicated skewedness remaining outside the cut off and Shapiro-Wilks tests with *p* values below .05. Given that transformations did not improve skewedness, it was decided that the original forms of the variables would be maintained for analyses despite not meeting the normality assumption. The main analyses for this study were ANCOVAs, an analysis that has shown to be robust against non-normal data (Mena Blanca et al., 2017). Additionally, it has been suggested that t-tests are robust even to heavily skewed distributions with sample sizes above 200 (Fagerland, 2012).The sample of the present study was 244. Lastly, steps were taken within the analyses to address issues of normality (i.e., bootstrapping, Welch's t-tests).

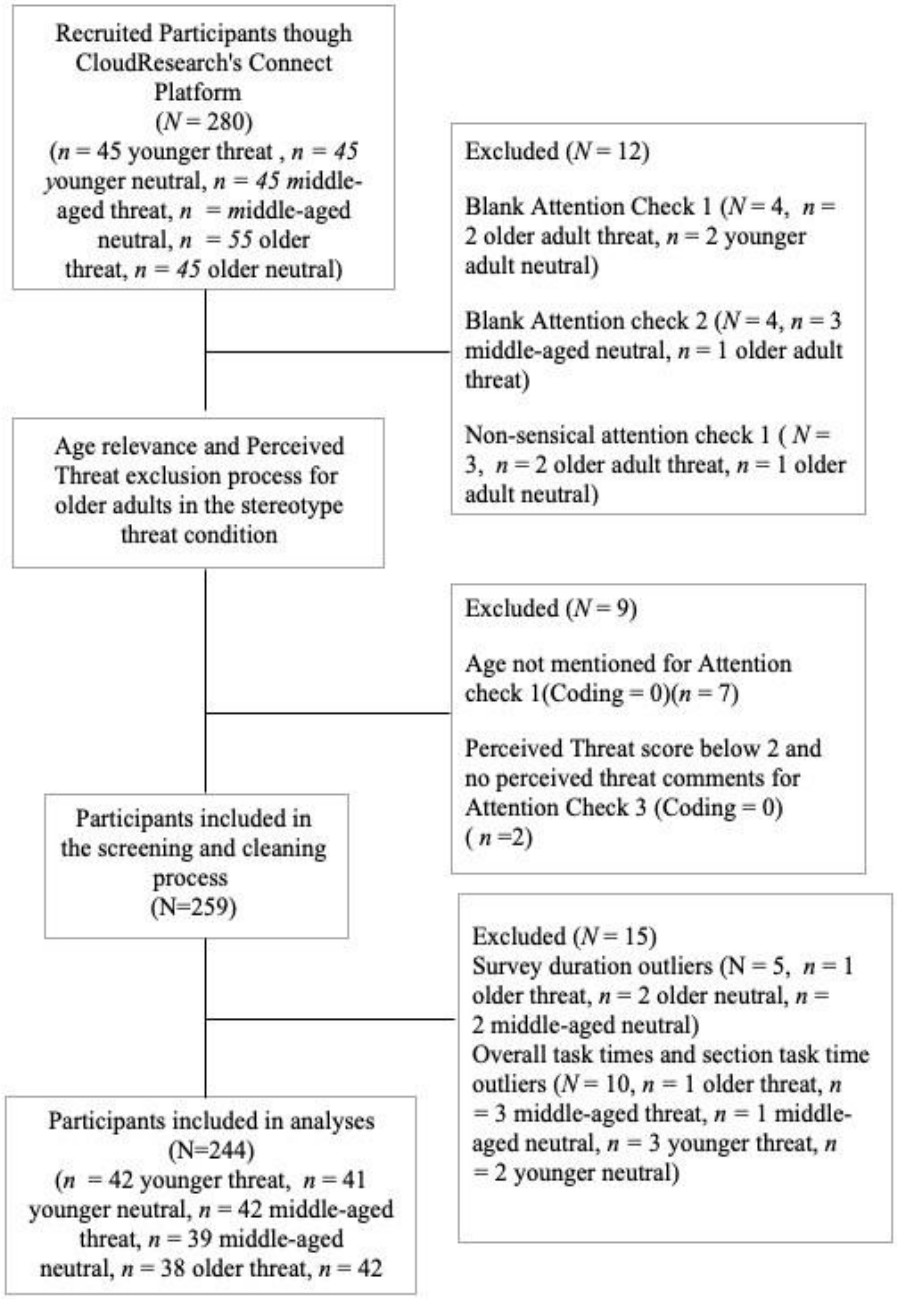

Figure 7. Flowchart of participant exclusion process

For the overall sample the average for perceived threat was 2.26 (*SD* = 1.08) on a scale from 1 (*strongly disagree)* to 5 (*strongly agree*). This average was relatively low but that has shown to be true in a previous study that has used a similar perceived threat (state) measure. Kang and Chasteen (2009), had an overall sample mean of 1.89 (SD = 1.03) for perceived threat. However, this study included older adults only. Kang and Chasteen (2009), used subtle forms of stereotype exposure. Thus, it was not surprising that perceived threat did not significantly differ across threat conditions in their study. Higher perceived threat did, however, moderate cued recall performance in the threat condition. The original perceived threat (state) measure has yet to be compared across age groups, but perceived threat (trait) has. Trait perceived threat refers to the overarching or chronic experience of feeling stereotyped. For this, older adults (*M* = 2.62, *SD* = .74) have shown significantly higher perceived threat scores compared to younger adults (*M* = 1.59, *SD* = .57) (Chasteen et al., 2005). To test the stereotype threat manipulation across the threat and neutral conditions in the current study, I conducted a two-way between subjects ANOVA for Age and Condition on Perceived Threat. The Levene's test for the homogeneity of variances assumption was met ($p < .05$). Being that most variables were not normally distributed; it was expected that the normality assumption would not be met. However, the ANOVA is generally robust against issues of normality (Blanca Mena et al., 2017; Norman, 2010). There was a main effect for age ($F(2, 238) = 4.84$, $p = .01$, $\eta^2_p = .04$). Post Hoc Tukey's comparisons revealed that significant age differences were between the older adults (*M* = 2.05, *SD* = 1.00) and younger adults (*M* = 2.52, *SD* =1.04), $t(238) = 3.06$, $p = .01$, $d = .48$). Additionally, there was a main effect for condition, $F(1, 238) = 18.87$, $p < .001$, $\eta^2 p = .07$, $d = -.55$.

However, the interaction was not significant, $F(2, 238) = .58$, $p = .56$, $\eta^2 p = .01$. With the stereotype manipulation including negative old age stereotypes only, it would be expected for only the older adults to have significant mean level differences of perceived threat across the conditions. Further, the items of the perceived threat measure were written to highlight age-related concerns to perform well after encountering old age stereotypes. For example, item 1 of the perceived threat measure was as follows, "*Were you worried that your ability to perform well on the test was affected by your age?*". To better understand the main effect for condition for perceived threat and non-significant interaction, I went a step further by conducting a series of independent samples t-tests for perceived threat scores across conditions for each age group. Independent samples t-tests revealed that middle- aged adults and older adults had significantly higher mean levels of perceived threat in threat conditions compared to their same level counterparts in neutral conditions. Although younger adults did not have significantly higher mean level of perceived threat in the stereotype threat condition, the levels were larger. The subtle age-related stereotype exposure and blatant statements of age-related expectations for performance seemed to influence higher perceived threat to some extent. The results from these independent samples t-test can be found in Table 7. The older adult t-test met the homogeneity of variances assumption. However, the middle-aged and younger adults t-tests had Levene's statistics with p values less than .05. For these tests, I ran Welch's t-tests (Delacre et al., 2017). The main takeaway from these findings is that the environment learning age stereotype threat manipulation was successful, but the influence of the threat manipulation expanded beyond the older adult group. Younger adults in the neutral condition (M =1.85, SD=.91) had lower but not significantly lower perceived stereotype threat scores than younger adults in the threat condition (*M* = 2.24, *SD* = 1.05), $t(81) = -1.78$, $p = .08$, $d = -.39$). Middle-aged adults in the neutral condition (*M* = 1.85, *SD* = .97) compared to those in the threat condition (*M* = 2.57, *SD* = 1.21) reported significantly less perceived threat, $t(79) = -2.97$, $p < .01$, $d = -.66$. It was expected that older adults would have higher perceived threat in the threat exposed condition (*M* = 2.84, *SD* = .87) compared to neutral (*M* = 2.24, *SD* = 1.10) being that the stereotypes were geared towards older adults. The mean level differences across conditions were significantly different for perceived threat when looking at the older age group ($t(78) = -2.69$, $p = .01$, $d = -.60$). See Table 9 and 10 for an outline of these results. A follow up analysis of a one-way ANOVA with only the neutral condition revealed that the means across the age groups were not significantly different, $F(2, 119) = 2.10$, $p = .13$, $\eta^2_p=.03$. Perceived stereotype threat has shown to moderate recall performance for older adults in threat conditions (Kang & Chasteen , 2009). Higher perceived threat was linked to more errors in a recall memory task. The relationship between perceived threat and performance outcomes (time and accuracy) was reviewed for each age group independently. There was no relationship between perceived threat and performance for younger adults. For the middle-aged participants, higher perceived threat was related to lower accuracy (r = .32, p <.001) and less time taken (r = -.32, p <.001). This indicates a rushed and more distracted approach when perceived threat was higher for middle-aged participants. The relationship between time and accuracy was positively related as well (r = .26, p = .02). Thus, performance was better when middle-aged people took their time, but perceived threat may have influenced the time they took and ultimately their accuracy. It was expected that middle-aged adults would experience a stereotype threat lift, but they trended more towards a stereotype threat experience. This may have been because the domain itself was more difficult for middle-aged adults than typical memory tasks. Additionally, the middle-aged adults may have experienced a “choking under pressure” response to the high expectations. For older adults, perceived threat did not correlate with performance outcomes. Additionally, task time did not significantly predict accuracy. Thus, the older adults in this sample were not influenced by perceived threat, it did not moderate performance as seen with earlier studies. Although, the perceived threat levels raised in the threat condition, the perception of threat had no impact on performance for older people. This leads me to believe that the older adults were resilient and not susceptible to threat effects.

I conducted a series of 3 (Age Group) × 2 (Condition) ANOVAs on SES, subjective health, years of education, subjective age, chronological age, and task difficulty to determine if there were any significant main effects or interactions. There was a main effect for Age Group for health ($F(2,238) = 8.65$, $p < .001$, $\eta^2_p = .07$), however, there were no significant interactions for any of the demographic variables. Although health differed across the age groups, it has not been linked to navigation performance within the environment learning literature. I conducted a correlation matrix that revealed statistically significant relationships between some variables. The largest correlation was, as expected, between chronological age and subjective age (Pearson’s r = 0.78, $p < 0.001$; Table 3). Additionally, the health variable significantly correlated with years of education, SES, age, age-group identification, attitudes towards aging, perceived threat, and subjective age. Studies that have had a focus on health disparities have highlighted that demographic variables, such as, education and SES influence health outcomes (Zajacova & Lawrence, 2018).Interestingly, age, subjective age and perceived threat had significant negative correlations with health. These correlations suggest that the health of the participants may have some influence on their views on their age, aging in general and their susceptibility to worry about age-related abilities. The participants of this sample had above average health score (*M* = 3.47, *SD* = .99) on a scale from 1 (poor) to 5 (excellent). Time taken on the task negatively correlated with errors made in the task.

This indicated that there was an overall speed-accuracy tradeoff for the sample. Seemingly those that sped through the task made more errors. Attitudes towards aging had a significant positive correlation with age-group identification. Therefore, participants were more likely to identify with their age group when they had a positive outlook on the aging process. Lastly, perceived threat had a negative relationship with the attitudes towards aging variable and a positive relationship with errors made. Thus, a positive attitude about aging may have been a buffer against being influenced by negative age stereotypes, however, when perception of threat was high more errors were likely made. This result was interesting because the correlations were from the sample in whole, including all age groups.

Table 9
Independent samples t-tests for perceived threat across conditions

	t	*p*	*Cohen's d*	**Neutral**		**Threat**	
				Mean	***SD***	***Mean***	***SD***
Younger	-2.15	.04	-.47	1.78	.88	2.24	1.05
Middle	-3.00	.00	-.66	1.85	.96	2.57	1.21
Older	-2.69	.01	-.60	2.24	1.10	2.84	.87

Table 10
Perceived Threat Across Groups

	Sum of Squares	***df***	**Mean Square**	***F***	***p***	$\eta^2 p$
Age Group	10.28	2	5.14	4.84	0.01	0.04
Condition	19.87	1	19.87	18.71	<.001	0.07
Age Group * Condition	1.23	2	0.61	0.57	0.56	0.01
Residuals	252.78	238	1.06			

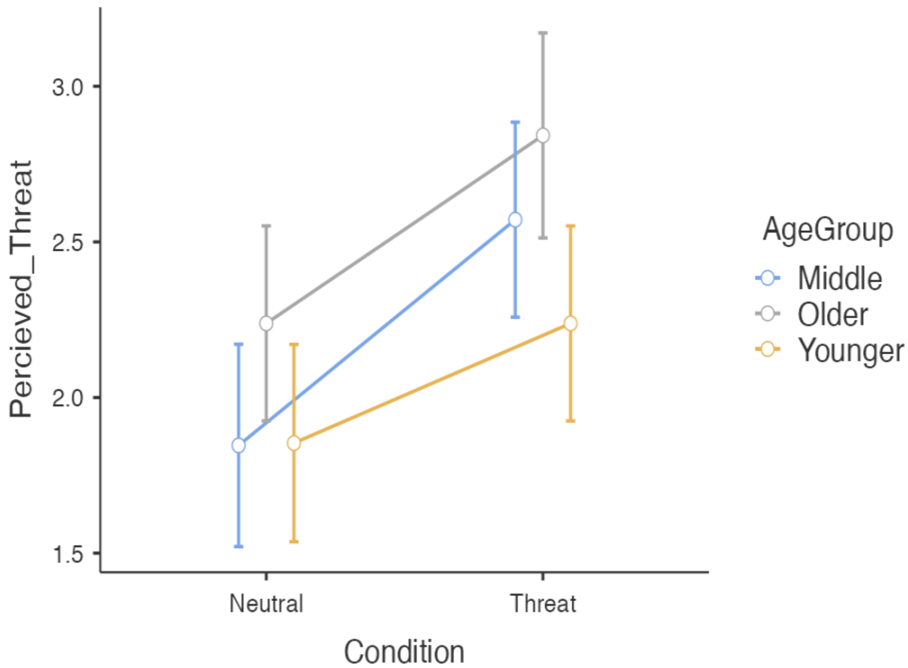

Figure 8. Age Group by Condition ANOVA on Perceived Threat with a main effect for Age Group, main effect for Condition and a non-significant interaction. Image from Jamovi Version 2.3.26.0.

Hypothesis 1

I expected a main effect for age, with older adults performing significantly worse than the middle-aged and younger adult groups in environment learning performance. Evidence for this hypothesis stemmed from earlier findings that have consistently resulted in significant age differences for navigation and spatial ability tasks (Klencklen et al., 2012; Moffat, 2009). To test this hypothesis, I conducted a series of two-way between-subjects analysis of covariances (ANOVAs) with Age Group by Condition on performance outcomes. I conducted 10 ANOVAs, with overall accuracy and time taken as separate dependent variables and for time taken and accuracy for each section of the test separately. I tested the dependent variables separately with ANOVAS rather than one MANOVA because I was not interested in the combination of the dependent variables. Typically, ABST studies and age-related navigation studies separately measure performance as accuracy, errors, or speed separately. Many of these studies only measure one of aspects of performance (Klenklen et al., 2012; Lamont et al., 2015). Reviewing performance as a combination of these variables would not provide enough clarity on how performance could be influenced by threat exposure. Hypothesis 6, however, addresses the relationship between errors and time taken together. Thus, the two separate scores were tested in combination for Hypothesis 6. Furthermore, the separate sections of the test were tested as different types of environment learning. It was important to test the results overall but also for each section separately. This approach has been taken with ABST studies that have highlighted differences in ABST effects across different episodic memory types (Kang & Chasteen, 2009). Lastly, errors were converted from errors into percentages of accuracy for interpretation purposes. Thus, the original tests on the dependent variable of errors will be reported as accuracy and discussed in terms of accuracy for clearer interpretation. Earlier studies that have used the LNT have reported performance outcomes as percentages of accuracy across the separate task sections (van der Ham et al., 2020; van der Ham & Claessen, 2022; van der Kuil et al., 2022).

It was hypothesized that older adults, compared to the other age groups, would have significantly poorer performance for each section and overall. To explain further, poorer performance was considered taking longer or making more errors (poorer accuracy). The main effect for task accuracy overall, was not significant, $F(2, 238) = .86$, $p = .42$, partial eta squared (η^2_p) = .01, indicating no significant differences across age groups. Of the sections, only the allocentric survey (landmark order) section indicated significant differences across the age groups ($F(2, 238) = 3.58$, $p = .03$, $\eta^2_p = .03$). The younger adults had the lowest percentage of accuracy ($M = 66.30$, $SE = 2.86$), with significantly lower performance compared to the middle-aged adults ($M = 76.70$, $SE = 2.89$), ($p = .03$, 95% C.I. = [-.71, -.09], $d = .40$, Figure 9). Results indicated a significant main effect of Age Group for time taken overall with older adults ($M_{seconds}$=182, $SE = 9.95$) performing significantly worse than middle-aged adults ($M_{seconds}$=146, $SE = 10.00$) and younger adults ($M_{seconds} = 140$, $SE = 9.96$), $F(2, 238) = 5.26$, $p = .01$, $\eta^2_p = .04$. Tukey's HSD Test for multiple comparisons found that the mean value of task time taken overall was significantly different between middle-aged and older adults ($p = .03$, 95% C.I. = [-.72, -.09], $d = -.40$) and significantly different between older and younger adults ($p = .01$, 95% C.I. = [.15, .79], $d = -.47$; Figure 10). When looking at time for each of the task sections, only the allocentric survey (landmark order) and allocentric location (landmark mapping) sections had significant main effects for Age Group on time taken. Older adults (*M* = 76.70, *SE* = 4.60) had a significantly higher mean level completion time for the allocentric survey section compared to middle-aged adults (*M* = 48.10, *SE* = 4.56) and younger adults (*M* = 46.80, *SE* = 4.51), ($F(2, 238) = 13.66$, p <.001, $\eta^2p = .10$); Figure 11). Tukey's HSD test indicated that older adults had a significantly higher mean level score for time taken on this section compared to middle-aged (*p* <.001, 95% C.I. = [-1.02, -.38], *d* = -.70) and younger adults (*p* <.001, 95% C.I. = [-1.05, -.41], *d* = -.73).

Lastly, the allocentric location (landmark mapping) section had a main effect for Age Group on time taken scores, where the older adults (*M* = 49.50, *SE* = 3.67) took significantly more time to complete the section compared to the younger adults (*M* = 35.00, *SE* = 3.60), $F(2, 238) = 4.45$, $p = .01$, $\eta^2p = .04$); Figure 12. Tukey's HSD comparisons indicated that older and middle-aged adults did not differ, nor did middle-aged adults and younger adults on time taken for this section. Only the older and younger adults differed for time taken for the allocentric location (landmark mapping) section, *p* = .01, 95% C.I. = [-.76, -.13], *d* = -.44.

The main findings from these results are that older adults were significantly worse in performance when looking at time taken overall and for allocentric (landmark association) sections. There was not a main effect for Age Group for accuracy overall and for most of the task sections. However, the middle and youngest age groups significantly differed on the allocentric survey (landmark order) section, with middle-aged adults performing the best and younger adults making the most errors of the age groups. These findings align with the van der Ham et al (2020) results that highlighted that middle -

aged adults (50-59) performed significantly better than younger age groups for this section. Surprisingly, the older adults were not the worst performers in terms of accuracy. The older adults, although not significantly higher, had higher percentages of accuracy overall and for the landmark recognition, direction choices, and landmark order sections. The only section that they had lower accuracy, compared to the younger adults, was the landmark mapping section. These results from the current study did not correspond with found age differences from earlier work using the LNT. For example, the younger adults in the current study ($M = 28.60_{age}$, $SD = 3.72$) did not perform significantly better than the older age groups (middle-aged; $M = 45.10_{age}$, $SD = 6.58$, older; $M = 65.80_{age}$, $SD = 5.11$). In fact, the older adults were more accurate than the younger age group overall and for all four sections. This may have been due to differences in recruitment.

For the allocentric location section, the middle-aged adults performed the worst. It is typical for older adults to have difficulty with sections that have different formats of learning and testing, such as the landmark mapping section (van der Ham et al., 2020; Meneghetti et al., 2014). The participants learned the route and landmarks from a first-person view within a video and were tested on landmark locations from a two-dimension view of a map. As previously mentioned, there were non-significant main effects for Age Group for accuracy in the landmark recognition section ($F(2, 238) = 1.94$, $p = .15$, $\eta^2_p = .02$), for the egocentric route (direction choices) section ($F(2, 238) = 1.17$, $p = .31$, $\eta^2_p = .01$) and the allocentric location (landmark mapping) section ($F(2, 238) = .74$, $p = .48$, $\eta^2_p = .01$). Therefore, the age groups only differed in performance for time taken in some instances and for accuracy in the allocentric survey (landmark order) section. As mentioned, it was surprising that the youngest age group made the most errors for most sections and had significantly lower accuracy compared to the middle-aged adults in the landmark order section. The time taken results mostly aligned with the hypotheses of this study. However, the accuracy (errors) findings were not expected and did not support the hypotheses for the dependent variable of errors. Results from an one-way ANOVA on task difficulty ratings, however, did parallel the accuracy results. All of the age groups rated the task similarly difficult, with no significant differences in task difficulty ratings. Being that older adults took significantly longer to take the test but did not make significantly more errors, it was suspected that the older adults had a different and beneficial approach for the task. Additionally, overall time taken, and task accuracy were positively correlated ($r = .22$, $p < .001$). Considering these results, an analysis of covariance (ANOCA) was conducted with the time taken overall variable included as a covariate for tests on the dependent variable of accuracy (errors). Including the covariate did not change outcomes in interactions, focused on for Hypothesis 2. Therefore, the initially planned ANOVAS remained for hypotheses testing and were interpreted. For more details for mean level accuracy percentages for time across sections and age groups, see Table. 10 and 11.

Table 11
Averages, Standard Deviations, and Age Group Differences for the Accuracy Dependent Variables

Measures	Young	Middle	Older	P-Value	$\eta^2 p$
Accuracy Overall	69.28 (17.41)	70.12 (17.23)	72.56 (14.32)	.42	.01
Landmark Recognition	83.89 (19.08)	80.40 (20.05)	86.09 (15.53)	.14	.02
Egocentric Route	61.75 (31.07)	68.21 (29.32)	67.19 (25.34)	.30	.01
Allocentric Survey	66.27 (28.81)	76.54 (24.79)	74.06 (24.01)	.03	.03
Allocentric Location	50.60 (27.04)	45.06 (31.23)	49.38 (30.55)	.46	.01

Note. Significance values were assessed by one-way ANOVAs. Accuracy was measured in percentages. Egocentric Route = Direction Choices; Allocentric Survey = Landmark Order; Allocentric Location = Landmark Mapping.

Table 12
Averages, Standard Deviations, and Age Group Differences for Time Taken Dependent Variables

Measures	Young	Middle	Older	P-Value	η^2p
Time Taken Overall	139.94 (94.82)	146.35 (90.81)	181.78 (77.82)	.01	.04
Landmark Recognition	34.37 (29.48)	34.79 (33.55)	29.81 (12.22)	.43	.01
Egocentric Route	23.74 (23.95)	25.57 (20.49)	25.82 (18.12)	.80	.00
Allocentric Survey	46.79 (43.09)	48.03 (33.71)	76.53 (44.90)	<.001	.10
Allocentric Location	35.04 (37.37)	38.00 (29.23)	49.59 (31.72)	.01	.04

Note. Significance values were assessed by one-way ANOVAs. Time Taken was measured in seconds. Egocentric Route = Direction Choices; Allocentric Survey = Landmark Order; Allocentric Location = Landmark Mapping.

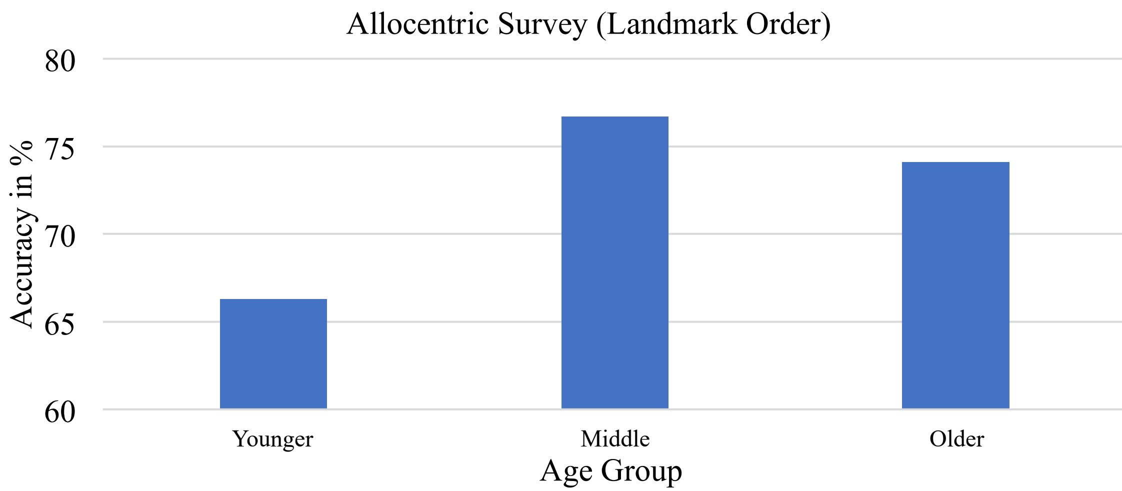

Figure 9. Main effect for Age Group for Accuracy in the Allocentric Survey Section

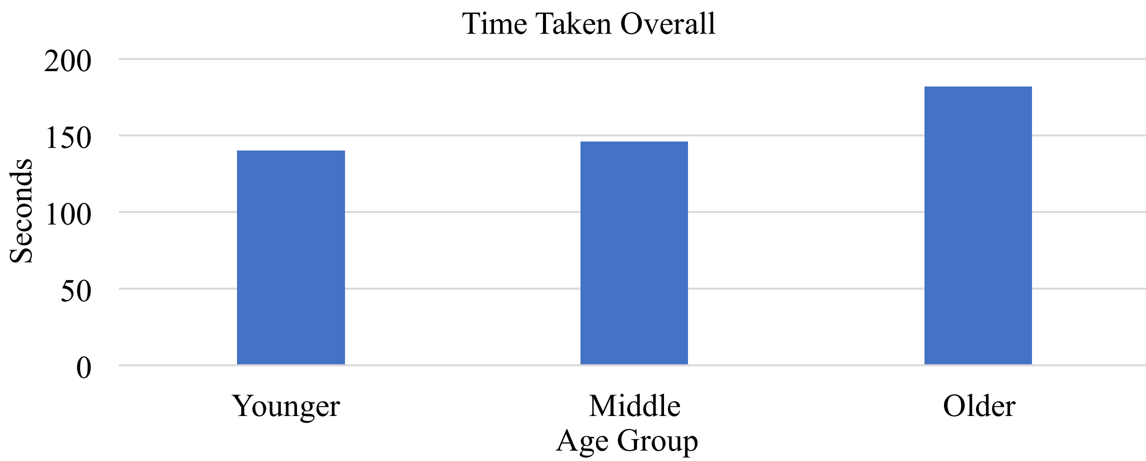

Figure 10. Main effect for Age Group for Time Taken Overall

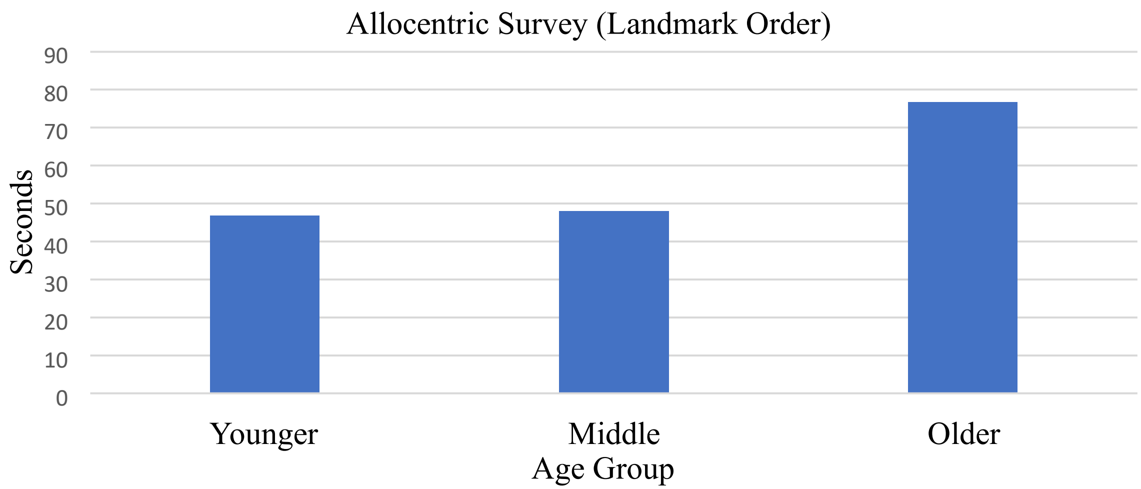

Figure 11. Main Effect for Age Group for Time Taken in the Allocentric Survey Sections

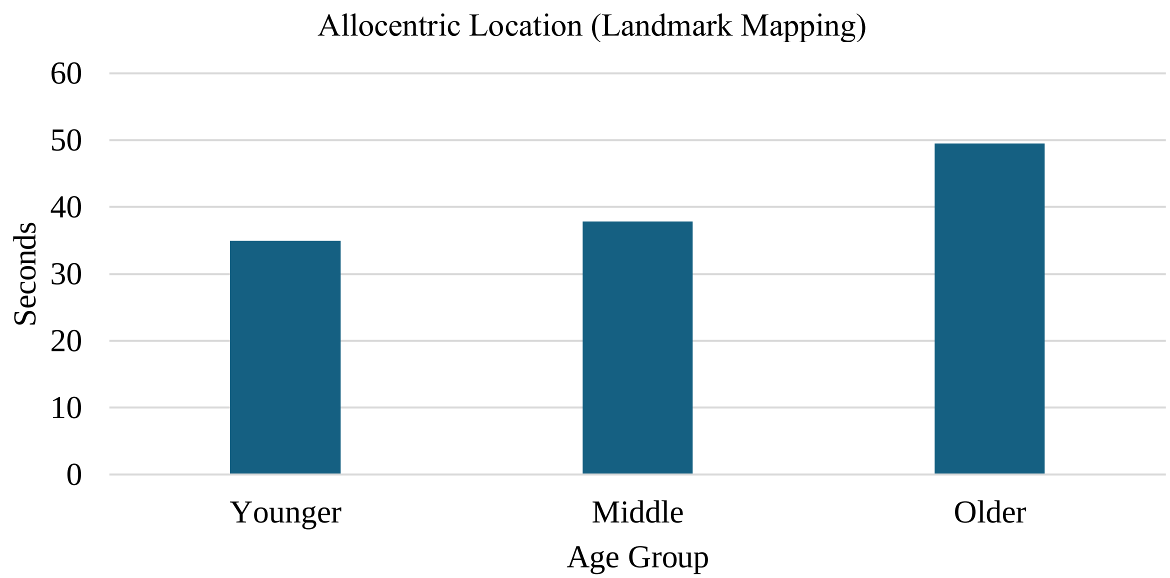

Figure 12. Main Effect for Age Group for Time Taken in the Allocentric Location Section

Hypothesis 2 and 2a

My main interest was the impact of negative age stereotype exposure on environment learning performance (i.e., ABST). Based on earlier studies, my approach was to conduct a series of two-way between subjects ANOVAs with Age Group and Condition as the independent variables on performance outcomes (Hess et al., 2003; Hess & Hinson, 2006; Kang & Chasteen, 2009; Lamont et al., 2015). In these studies, it was expected that threat manipulations would result in differences in performance across conditions for older age groups but not for the younger age group. Very few ABST studies have included middle-aged participants, but it has been found that middle-aged adults perform better within negative stereotype conditions (Hess & Hinson, 2006; Strickland-Hughes & West, 2021). This process is termed stereotype lift and occurs when in-group members are presented with negative stereotypes about groups they do not identify with (Walton & Cohen, 2003). Typically, ABST studies have compared younger and older age groups. Many studies have resulted in only older adults differing in performance across stereotype conditions (Armstrong et al., 2017; Lamont et al., 2015). For this hypothesis, I conducted a two-way between subjects ANOVA with three levels of Age Group (younger, middle-aged, older) and 2 levels of Condition (neutral and threat). As previously mentioned, time taken overall was reviewed as a possible covariate. This change did not affect the interactions; thus, the simple two-way ANOVAs were kept for hypothesis testing. An Age Group × Condition interaction was expected, where younger adults' performance would not differ across stereotype threat and neutral conditions, middle-aged adults would perform significantly better in stereotype threat conditions compared to the neutral condition, and older adults in the threat condition would perform worse compared to the older adults in the neutral condition. I conducted a series of the 3 × 2 (Age Group × Condition) ANOVAS on time taken overall, errors (accuracy) overall, time taken for all task sections separately, and errors (accuracy) for all task sections separately. The performance outcomes for errors were converted into accuracy percentages for simpler interpretation and comparison to previous studies using the LNT to measure navigation ability. Surprisingly, none of the Age x Condition interactions reached significance in any of these analyses (ps > .05). Thus, hypotheses 2 and 2a were not supported. See figures 13 and 14 for visual depictions of performance outcomes across conditions for each age group. These findings did not align with the preliminary analysis on perceived threat, where perceived threat was significantly higher in the threat condition compared to the neutral condition for older adults. Perceived threat has shown to moderate ABST effects (Kang & Chasteen, 2009). However, The older group experienced significantly higher perceived threat in the threat condition compared to the neutral condition, however, this did not influence performance. The discrepancy of perceived threat and performance highlights that the older adults in this study may have had a protective factor for ABS

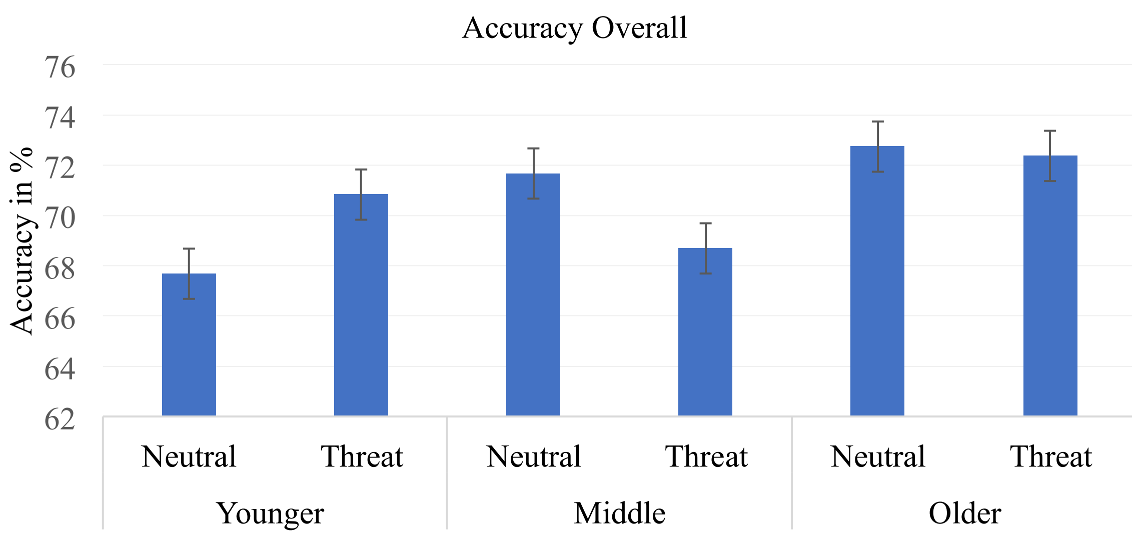

Figure 13. Mean Levels for Accuracy Between Condition and Age Group

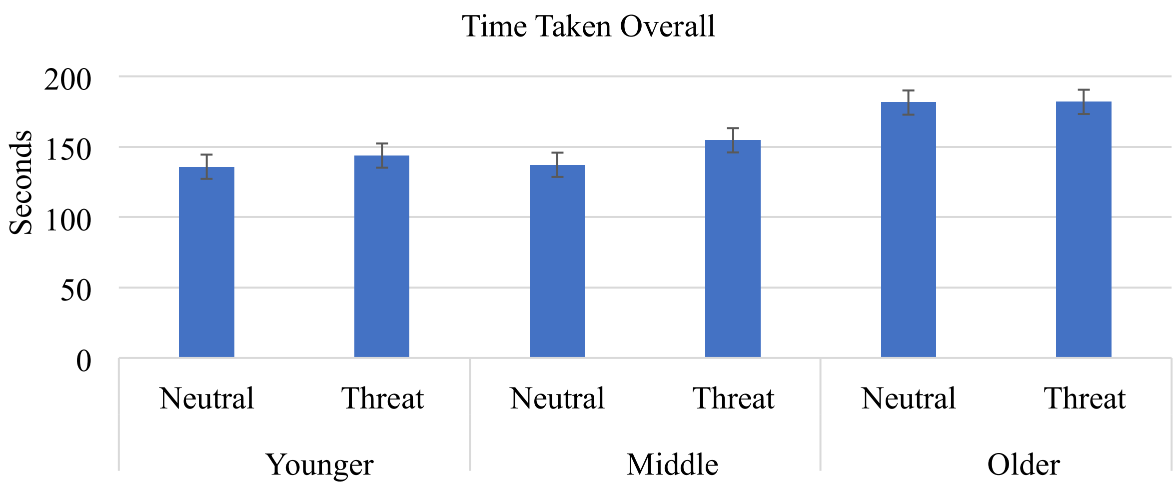

Figure 14. Mean Levels of Time Taken Across Condition and Age Group Hypothesis

To further explore older adult performance across task types of environment learning, I conducted a paired samples t-tests to test the mean levels of accuracy and time taken scores for older adults across all 4 sections of the environment learning task. These 4 sections represented distinct task types. First, was landmark recognition where participants had to choose yes or no to whether a landmark was present in the environment learning video that they previously watched. Second, was an egocentric route section, where participants had to decide the correct direction (left, right, or straight) based on the route taken in the video. Third, was an allocentric survey section, where participants had to choose the correct ordering of landmarks from the path that was taken in the video. Lastly, there was an allocentric location video, where participants needed to choose the correct placement of landmarks from a bird's eye view of the route. This section included a map where letters were placed, these letters represented landmarks that were in the video. The last two sections were allocentric task types, meaning that they required the acquisition of landmark placements and relationships between landmarks in the environment. I expected significant mean level differences across the 4 sections, with the egocentric route task (direction choices) taking the older adults significantly less time compared to the other sections. Further, I expected older adults to make less errors (higher accuracy) for the egocentric section compared to the allocentric sections specifically. Egocentric perspective taking (i.e., a focus on directions) has been shown to be easier for older adults compared to allocentric. Thus, there is evidence that older adults perform better in egocentric tasks and that age differences are less robust when the dependent variable is an egocentric task type (Colombo et al., 2017).

The results from the paired samples t-test on time taken across the sections showed that older adults took significantly less time for the egocentric (direction choices) section compared to the landmark recognition section ($t(79) = -2.20$, $p<.05$, $d = -.25$), the allocentric survey (landmark order) section ($t(79) = -10.54$, $p<.001$, $d = -1.18$), and the allocentric location (landmark mapping) section ($t(79) = -6.61$, $p<.001$, $d = -.74$). Additionally, I conducted this analysis on errors (accuracy) across the sections and found that the egocentric section mean level for errors was only significantly different compared to the allocentric location section (landmark mapping) ($t(79) = 4.06$, $p <.001$, $d = .45$) and the landmark recognition section, $t(79) = -6.25$, $p <.001$, $d = -.70$. The older adults had the highest accuracy in the landmark recognition section. This section has shown to be easiest for older adults in earlier studies that have used the LNT (van der Ham et al., 2020). Accuracy averaged around 85% for the 60-69 age group, the highest mean level accuracy across all of the task sections (van der Ham et al., 2020). The landmark recognition section may have been the least difficult for participants, regardless of age. The allocentric location (landmark mapping) section was a change from first-person learning to a birds-eye view of testing. This change in display may have played a role in difficulty. In terms of the time taken variable, Hypothesis 3 was supported. For accuracy, the hypothesis was partially supported. The main takeaway from these findings is that older adults showed less difficulty for the egocentric section compared to the allocentric sections, as shown in earlier navigation studies. However, the egocentric task advantage differed depending on the operationalization of the task (i.e., errors or time). Averages of older adult performance across the 4 sections can be found in Figures 15 and 16. These graphs depict the converted error scores as accuracy in percentage.

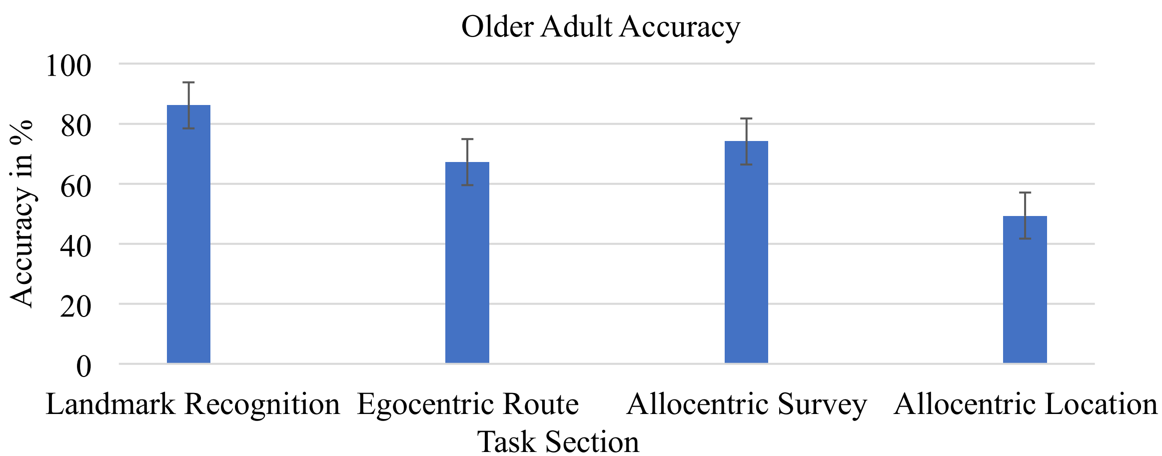

Figure 15. Older Adult Mean Levels of Accuracy Across LNT Sections

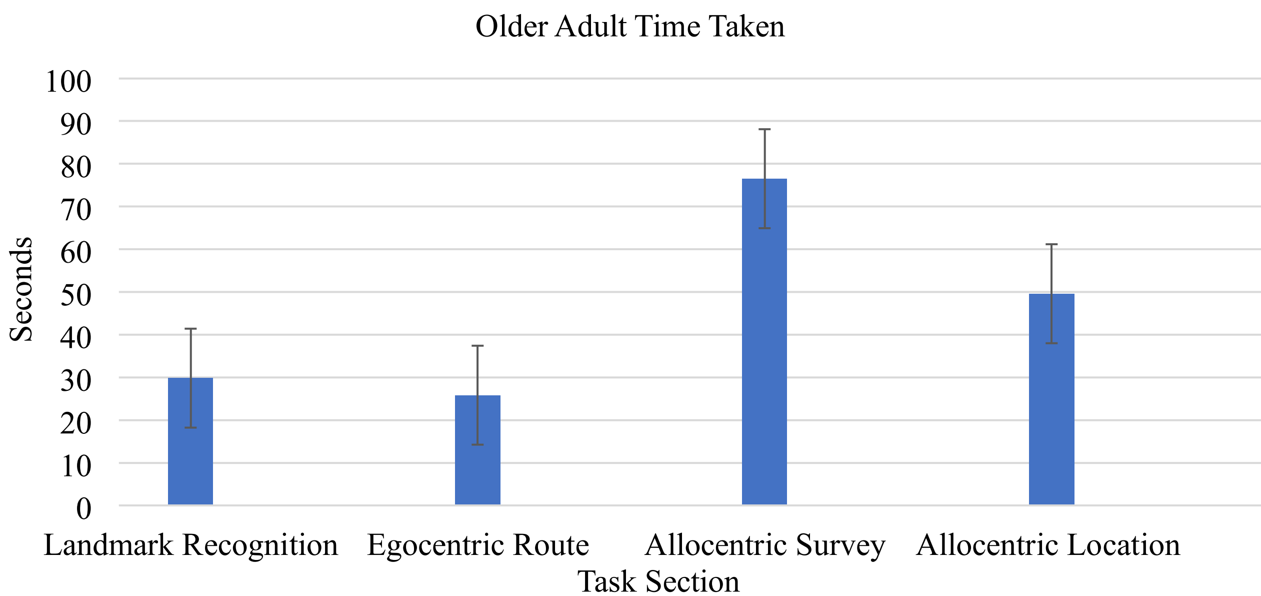

Figure 16. Older Adult Mean Levels of Time Taken Across LNT Section

Hypothesis 4

Earlier work exploring possible moderating factors found that age-group identification moderates ABST effects on memory performance (Kang & Chasteen, 2009). Therefore, older adults who view themselves as part of the older adult group and see themselves as representing this group (Garstka et al., 1997) are more susceptible to ABST effects. Thus, performance in stereotype exposure conditions depends on age but additionally depends on age-group identification. I ran a moderation through the MedMod package in Jamovi, this package included a bootstrapping option for models, with the initial setting at 1000 samples. Given the model variables were non-normal in the descriptive statistics, I chose the 1000 samples bootstrapping option. With nonnormal data, bootstrapping would provide more accurate estimates of standard errors and confidence intervals than the standard estimation method (Wilcox, 2014). I conducted a moderation of age-group identification on older adult threat performance. For the analysis, age-group identification was tested as a moderator on the relationship between Age(continuous) and performance outcomes (errors and task time) in the threat condition. I conducted 2 moderations, one with errors as the dependent variable and one time taken as the dependent variable. The data were filtered, thus only the threat conditions were included. The interaction between age and age-group identification was significant ($b = 1.06$, $SE = 4.71$, $z= -2.25$, $p < .05$), indicating that the relationship between age and time taken was moderated by age-group identification. The simple slope of age on time taken was significant at low levels of age-group identification ($b = 2.34$, $SE = 0.69$, $z = 3.38$, $p < .05$) and average levels of age-group identification ($b=.96$, $SE = .46$, $z = 2.07$, $p <.001$) but not at high levels of age-group identification ($b = -0.41$, $SE = 0.85$, $Z = -.48$, $p > .05$)

(See Fig. 17). These results indicate that older participants in the threat condition were taking longer on the task when they did not identify as older. Thus, the significant linear relationship between age and time taken in the threat condition depended on participants not identifying with their age-group. One explanation for this is that older adults whose age was a major aspect of their identity may have had a stereotype reactant response to threat exposure and were more motivated to quickly finish the task. This explanation would align with the non-significant ABST effects as well. The participants were told they would be timed on the task and that younger people were expected to finish quicker based on earlier research. These findings contrast with some explanations of how ABST effects occur (Kang & Chasteen, 2009). However, there are some ABST studies that have found that older participants in threat conditions perform slightly better depending on resources and if they have a reactance response to blatant stereotype exposure. Further interpretations of these findings can be found in the discussion section. To further explore these findings, I conducted an identical moderation with the neutral condition groups. The moderation analysis for the neutral condition did not have comparable results. The interaction between age and age-group identification was not significant (estimate = -.52, SE = .36, $z = -1.44$, $p > .05$), indicating that the relationship between age and time taken did not depend on age-group identification. Thus, the role of age-group identification has was only relevant in the threat condition, when participants were exposed to negative age stereotypes. Lastly, the moderation of age-group identification on threat performance applied to task time only. The interaction of age and age-group identification was not significant in the moderation analyses on errors (estimate=.00, SE=.02, Z=.08, P>.05).

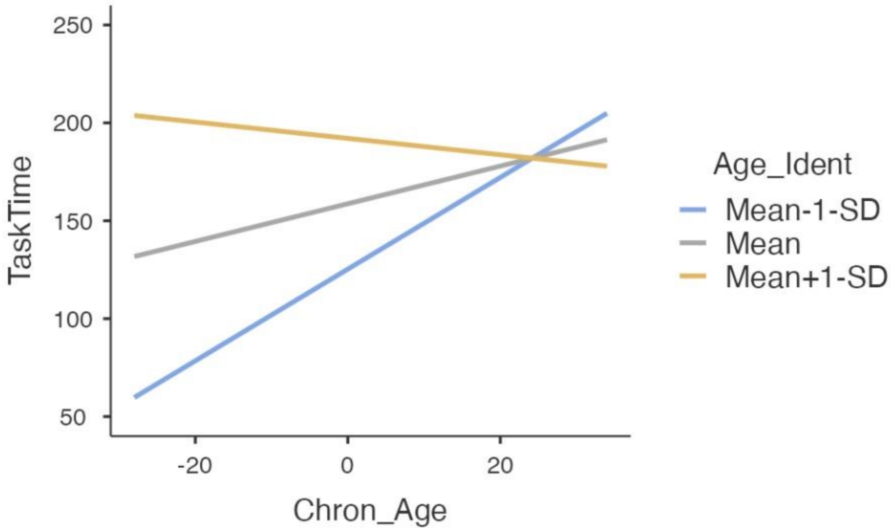

Figure 17. Simple Slope plots For the Moderation of Age-Group Identification on the Relationship Between Age and Task Time in the Threat Condition. Image from Jamovi Version
2.3.26.0.

Hypothesis 5

Self-Concept Threat has been posited as the type of threat experienced by those who fear that their behavior will confirm negative stereotypes that are endorsed by others and endorsed by themselves (Shapiro & Neuberg, 2007). The precursors of this type of threat are age-group identification and stereotype endorsing beliefs (Barber & Mather, 2014; Barber, 2017). Before conducting the regression, I examined whether age-group identification and attitudes towards aging correlated with task time and errors for older adults in the threat condition group. Both variables had non-significant correlations with the dependent variables. This pattern was found for middle-aged adults as well. Interestingly, when I looked at the correlations of the predictor variables on the dependent variables for the younger adults in the threat condition, age-group identification was positively related to task time ($r = .50$, $p < .001$). Thus, only younger adults had a significant relationship between how much they identified with their age and how long the task took them when exposed to threat. This may be because the navigation domain and or environment learning task was not an area that younger adults felt they would perform best at, and the blatant stereotype exposure contrasted self-efficacy issues. Further interpretation of these findings will be discussed in the discussion section. Although the interactions for examining ABST effects were non-significant, I went on to test the Self-Concept Threat hypothesis (Hypothesis 5). In this model, age was a continuous variable and predictor on the performance variables. To test Self-Concept Threat, I included age-group identification and attitudes towards aging as added predicting variables for performance above and beyond age. I conducted 2 hierarchical multiple regressions in Jamovi on time taken and errors for participants in the threat condition. Age was the first predictor and variable for the model. Next, I added an interaction term of age-group identification and attitudes towards aging to the model. The interaction was added and not the variables individually because it was the combination of high age-group identification and low (negative) attitudes towards aging that truly explain Self-Concept Threat. Age was found to explain 1.1% of the variance of time taken overall for the threat group participants, $R^2 = .01$, $F(1, 120) = 1.38$, $p > .001$, nonsignificant. The age-group identification and attitudes towards aging interaction term contributed a significant increment of 8.4% variance explained when added to the model, $R^2_{\text{change}} = .08$, $F_{change}(1, 119) = 11.0$, $p = .001$. All predictors accounted for 9.5% of variance in time taken overall, adjusted $R^2 = .08$, $F(2,119) = 6.24$, $p < .05$. Based on the variance inflation coefficient cut off of 2.5 (Johnston et al., 2018), the VIF statistics for the variables were both acceptable at 1.00. Thus, there were no multicollinearity issues with the variables used in the regression. Additionally, the Dubin-Watson test for autocorrelation was non-significant with a value of 1.98. Thus, autocorrelation was not suspected. The hierarchical regression of age with the interaction of attitudes towards aging and age-group identification on errors indicated that none of the variables had significant explained variance on errors made for those in the threat group. Table 10 includes further regression details with the model coefficients.

Table 13
Model Coefficients for Hypothesis 5 Predictors on Task Time

					95% Confidence Interval		
Predictor	**Estimate**	**SE**	**t**	**p**	**Lower**	**Upper**	**VIF**
Intercept	57.69	33.67	1.71	.09	-8.98	124.35	
Age	.59	.53	1.11	.27	-.047	1.65	1.00
AI*AA	.79	.25	3.31	.001	.32	1.26	1.00

Note. AI = Age-Group Identification. AA= Attitudes Towards Aging. SE = standard error; VIF = Variance Inflation Facto

Exploratory Hypothesis 6

Hypothesis 6 was an exploratory hypothesis based on the prevention loss theory of ABST (Seibt & Foster, 2004). The concept was that older adults exposed to negative age stereotypes could take longer on a task, however, make less errors. This concept has also been termed as a speed-accuracy tradeoff. It was expected that the Age Group*Condition interaction would result in older adults in the threat condition having significantly longer time taken and less errors compared to older adults in the neutral condition. To test this, I was interested in the linear combination of errors and time, not the results of these scores separately. To look at these scores in tandem, I took a multivariate approach with a Multivariate analysis of covariance (MANCOVA). The two DVs for the MANCOVA were time taken overall and errors overall. The IVs were Age Group and Condition, and health was included as a covariate, the same as the previously conducted ANOVAS for hypotheses 2 and 2a. The interactions were non-significant ($ps < .05$). Further details including Wilk's Lambda and Pillai's Trace values can be found in Table 14. The homogeneity of covariance assumption was met based on Box's M p value less than .05.

Table 14
Multivariate Tests for Hypothesis 6

		value	***F***	***df1***	***df2***	***p***
Age	Pillai's Trace	0.04	2.65	4	476	0.03
	Wilks' Lambda	0.96	2.67	4	474	0.03
Condition	Pillai's Trace	0.00	0.30	2	237	0.74
	Wilks' Lambda	0.99	0.30	2	237	0.74
Age* Condition	Pillai's Trace	0.00	0.50	4	476	0.73
	Wilks' Lambda	0.99	0.49	4	474	0.73

Exploratory Hypothesis 7

To test exploratory hypothesis 7, I conducted a series of three-way ANOVAs with Gender, Age Group, and Condition as independent variables. The study sample consisted of 119 men, 120 women, 3 gender non-conforming participants, and 2 participants that preferred not to report any gender. With the large differences in gender identity, the gender non-conforming and participants that did not report a gender were not included in the analyses for this hypothesis. I conducted independent t-tests for Gender on the demographic variables. There were no significant differences between men and women for these variables. Additionally, men and women did not differ on difficulty ratings of the task, age-group identification, aging attitudes, or perceived threat. There were gender differences for time taken on the task. Thus, the ANCOVAs for the accuracy (errors) dependent variables were conducted with time taken as a covariate. The ANOCAs did not result in differences in the interactions, thus, the initial ANOVAs were kept for hypothesis testing. The reported results are from the series of three-way ANOVAS.

Results indicated non-significant main effects for Gender for the dependent variables for accuracy. Thus, men and women did not differ in their accuracy overall or for the separate sections. However, there was a significant Gender by Age Group interaction for the allocentric survey (landmark order) accuracy, $F(2, 227) = 3.70$, $p = .03$, $\eta^2 p = .03$ (Figure 19). Post hoc comparisons revealed that the significant mean level differences were between the younger ($M = 59.90$, $SE = 3.72$) and middle-aged ($M = 81.09$, $SE = 4.55$) men for accuracy in this section, $p = .001$, 95% C.I. = [-1.23, -.37], $d = -.82$. Seemingly, the younger adult men struggled to accurately choose the correct order of landmarks, regardless of the condition. The effect size between the younger and middle-aged men accuracy was considerably large (*d* = -.82), suggesting an increase of learning landmark order with age. When looking beyond accuracy and at time taken, Gender seemed to play more of a role on performance. There was a significant main effect for Gender on overall time taken, $F(1, 227) = 4.63$, $p = .03$, $\eta^2p = .02$. Women (M =168.77, SE = 8.19) took significantly longer to complete the LNT compared to the men (M = 143.73, SE = 8.26), p =.03, 95% C.I. = [-.55, -.02], d = -29. The effect was relatively small for this age difference, however. Additionally, there was a significant Gender by Condition interaction, $F(2, 227) = 5.95$, $p = .02$, $\eta^2p = .03$. Regardless of age group, the gender differences were significantly different for the threat condition and not for the neutral condition (Figure 20). In the threat condition, women (M = 187.92 , SD = 10.99) took significantly more time to complete the task compared to men (M = 134.2 , SD = 12.68), (p = .01, 95% C.I. = [-.99, -.23, d = -.61). This could be interpretated as women being influenced by stereotype exposure, despite the stereotype being geared towards older individuals. Earlier work has highlighted that women are stereotyped as poor navigators and expected to struggle with spatial ability (Miola et al., 2023; van der Ham & Koutzmpi, 2022). When exploring the separate sections, the landmark recognition and egocentric route (directions) sections did not indicate significant main effects or interactions of Gender. However, gender differences were found for the allocentric survey (landmark order) and the allocentric location (landmark mapping) sections. There was a main effect for Gender on time taken in the allocentric survey (landmark order) section, $F(1, 227) = 4.90$, $p = .03$, $\eta^2p = .02$. Women (M = 64.40, SE = 3.86) took significantly longer than men (M = 52.25, SE = 3.90) to complete this section. Similar to the overall scores for time taken, there was a significant Gender by Condition interaction on time taken in the allocentric location section, $F(1, 227) = 11.38$, $p<.001$, $\eta^2p = .04$. This section required an overview understanding of the learned environment and was seemingly the most difficult of the sections. For this section, the women in the neutral condition ($M = 34.00$, $SE = 4.47$) took significantly less time than the women in the threat condition ($M = 55.44$, $SE = 4.05$),), $p = .003$, 95% C.I. = [-1.04, -.29], $d = .67$. The men did not show this trend of increased time in the threat condition (Fig. 23). In fact, the men in the threat condition took less time than men in the neutral condition. This difference for men, was not significant but trending towards a stereotype lift. Lastly, gender differences were only significantly different in the threat condition and not the neutral condition. The women ($M = 55.44$, $SE = 4.05$) took significantly longer than men ($M = 32.85$, $SE = 4.67$) in the threat condition, $p = .002$, 95% C.I. = [-1.09, -.32], $d = -.70$. In the neutral condition women took slightly less time than men, although this was not a significant gender difference (Fig. 23). In conclusion, threat exposure seemed to influence how long women took to complete the most difficult section and to complete the environment learning task overall. There were no significant Age Group by Condition by Gender interactions for any of the dependent variables. Thus, it appears that differences between women and men for the separate conditions did not vary by age. Older women did not seem to appear more susceptible to threat effects, however, women in general did.

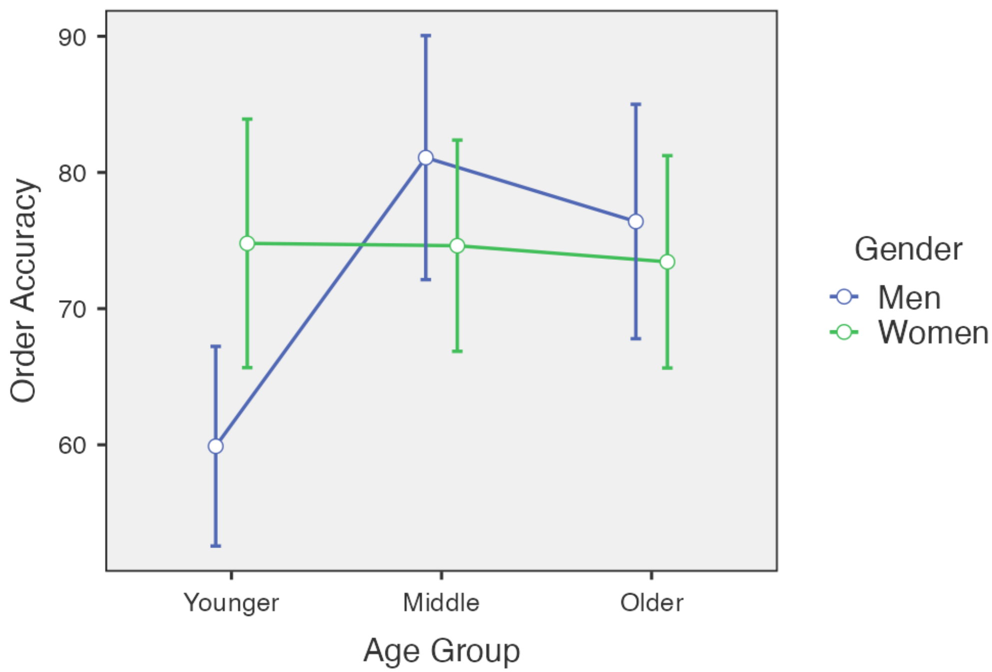

Figure 18. Age Group by Gender Interaction for Allocentric Survey (Landmark Order) Accuracy. Image from Jamovi Version 2.3.26.0.

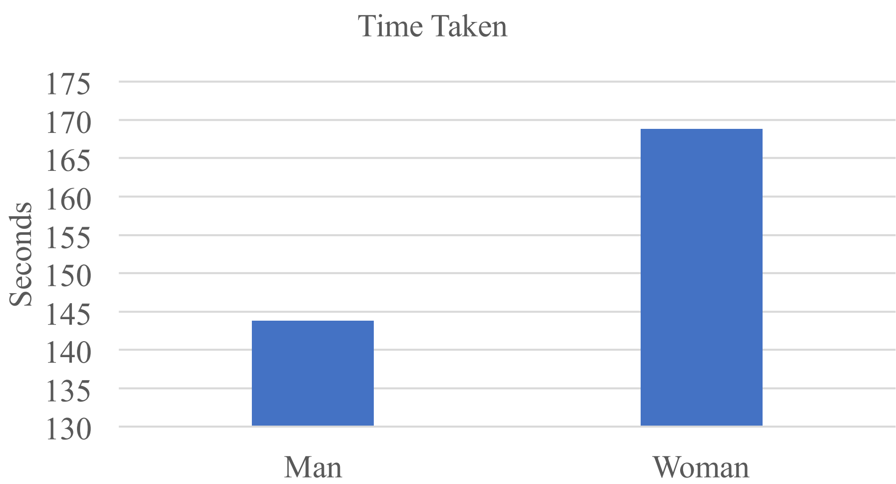

Figure 19. Main Effect for Gender for Overall Time Taken

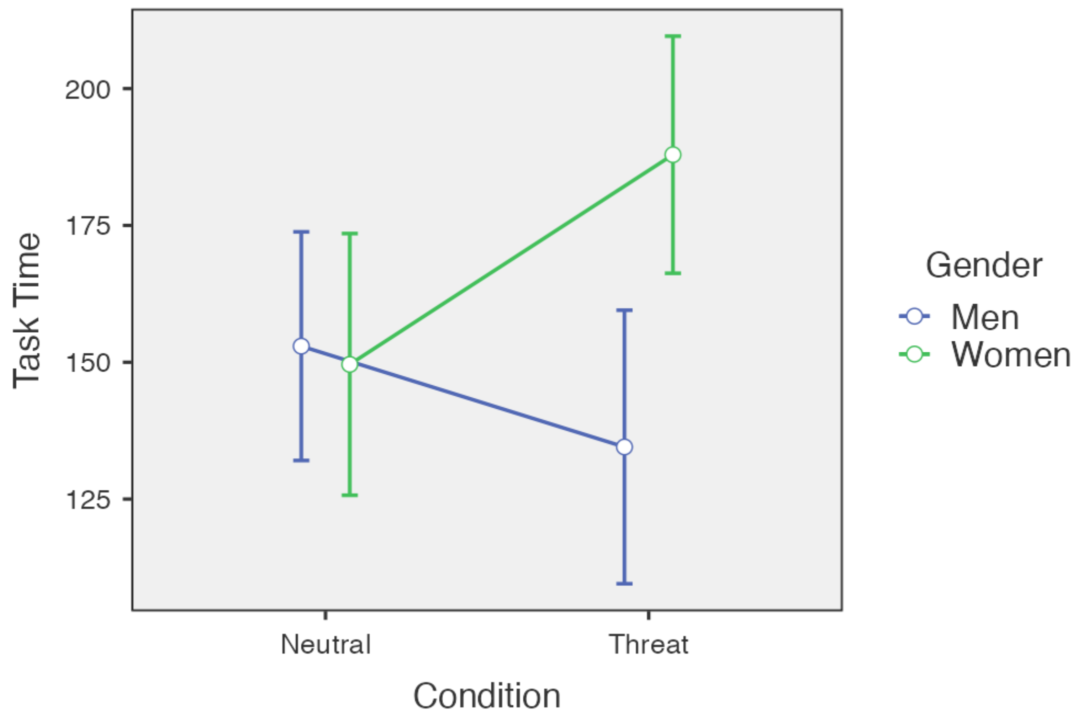

Figure 20. Gender by Condition Interaction for Time Taken Overall

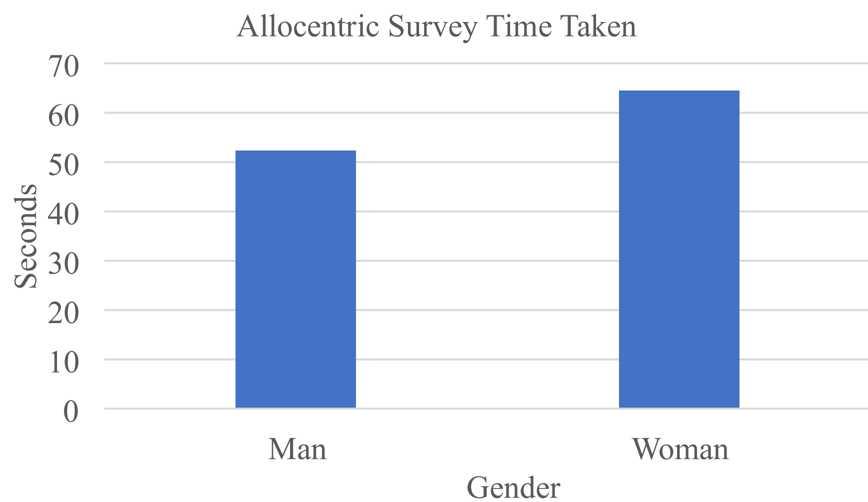

Figure 21. Main Effect for Gender for Time Taken in the Allocentric Survey (Landmark Order) Section

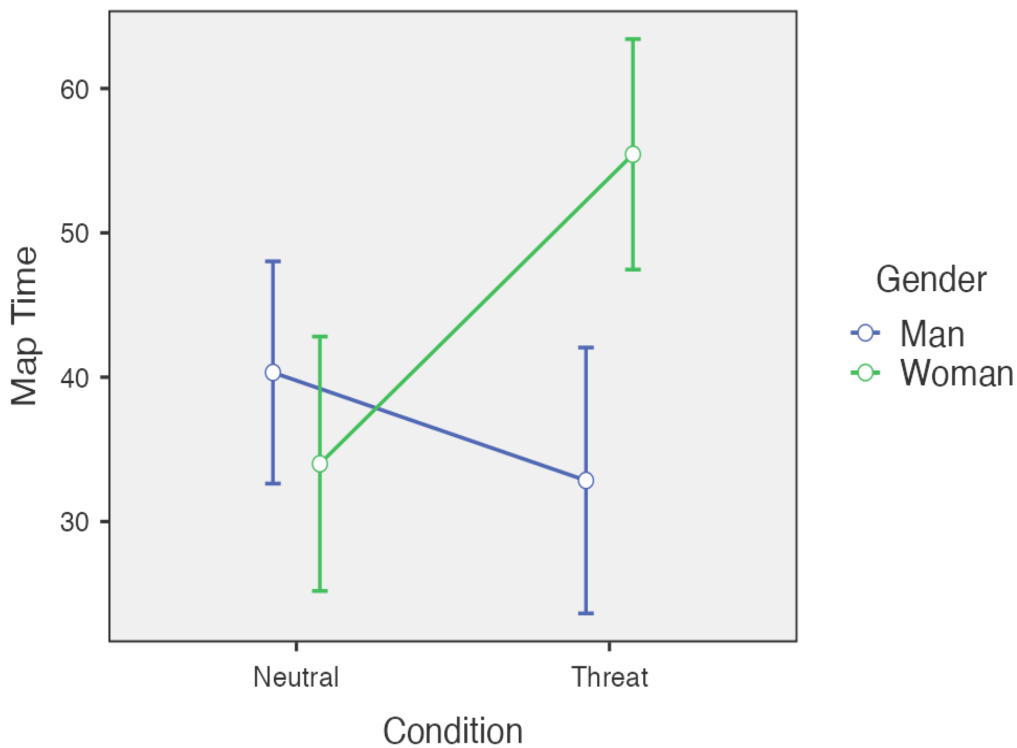

Figure 22. Gender by Condition Interaction for Time Taken in the Allocentric Location (Landmark Mapping) Section

Table 15
Summary of Results

Hypothesis		Result
Hypothesis 1	I expected a main effect of Age, where older adults would have significantly poorer performance compared to the young and middle-aged groups.	Hypothesis 1 was partially supported with older adults having longer time taken scores overall and longer time taken scores for allocentric sections.
Hypothesis 2, 2a	I expected older adults to display a stereotype threat effect and the middle-aged adults to display stereotype lift.	Hypothesis 2 and 2a were not supported.
Hypothesis 3	I expected significant performance differences for older adults across the environment learning sections, with older adults performing best in the egocentric navigation perspective section compared to the allocentric sections.	There was convincing evidence in support of Hypothesis 3 in terms of time taken. For the older adults, egocentric sections had significantly shorter time taken compared to the other sections.
Hypothesis 4	I expected age-group identification to moderate the relationships between age and performance outcomes in stereotype threat conditions.	Hypothesis 4 was partially supported, with a significant moderation of age-group identification on the relationship between age (continuous) on time taken.

Hypothesis 5	I expected the combination of age-group identification and attitudes towards aging to provide significant explanation on performance outcomes above and beyond age, evidence of Self-Concept Threat.	Hypothesis 5 was partially supported with the combination of age-group identification and attitudes towards aging adding significant explanation on task time.
Exploratory Hypothesis 6	I expected older adults in the stereotype threat condition to have a combination of longer time taken with less errors compared to older adults in the neutral condition, evidence of the speed-accuracy tradeoff argument for ABST effects.	Hypothesis 6 was not supported.
Exploratory Hypothesis 7	I expected older adult women to experience ABST effects while older adult men would not display poorer performance when in threat conditions.	Hypothesis 7 was partially supported. Women displayed stereotype threat effects, but this occurred regardless of age group.

CHAPTER V

DISCUSSION

The ability to successfully explore and navigate in unfamiliar places is a necessary skill within everyday scenarios. Unfortunately, a lengthy line of existing evidence suggests that older adults in comparison to younger adults, take longer to learn routes and make more errors in navigation tasks (Klenklen et al., 2012; Lester et al., 2017; Moffat, 2009; Wilkness et al., 1997; Tallide et al., 2016; van der Ham et al., 2020). The collective understanding for these found age differences has been given to biological explanations mainly, with little consideration of social influences. Environment learning is an aspect of cognition and includes aspects of memory processes (Lester et al., 2017). Thus, I suspected that social cognitive influences that have shown to affect older adult memory performance, mainly episodic, would also affect environment learning performance. Further, older adults are often tested for environment learning ability in college settings, around younger people and aware that their ability is being tested. It would be important to know if age differences on these tasks were partly explained by unintentional ABST. Furthermore, it could be beneficial to many older people if research findings brought to light how aspects of ageism could influence their ability to take on everyday tasks within their lives. This project is the first of possibly many studies that experimentally tests the influence of age-related social cognitive factors on environment learning ability.

The main goal of this study was to explore ABST effects on environment learning. Stereotype threat exposure was demonstrated with subtle and blatant cues of negative old age stereotypes for environment learning. The design and approach for the threat manipulations were inspired by a combination of earlier ABST studies that have explored ABST on memory and general cognition (Barber, 2017; Hess & Hinson, 2009; Chasteen et al., 2005; Kang & Chasteen, 2009; Strickland-Hughes & West, 2021). To test if threat exposure would affect older adult performance, I needed to test the performance outcomes across conditions and age groups. Most ABST studies have compared younger and older adults only, however, I included middle-aged adults as well. Middle-aged adults have been typically unaccounted for in regard to ABST. Mixed findings suggest that in some cases middle-aged adults experience stereotype lift. Including middle-aged adults was especially important for understanding how stereotype exposure would affect people of all ages across the adult lifespan. In line with earlier findings, I expected that threat exposure would not have a significant influence on the younger adult's performance. I expected middle-aged adults to perform better when exposed to negative old age stereotypes. Lastly, I expected ABST effects, where older adults performed significantly worse in threat conditions compared to neutral.

It is important to note, however, that ABST is a nuanced process that has shown to be contingent upon many factors. Thus, ABST may only occur under very specific circumstances. Many moderating factors are shown to influence ABST effects, such as, value of ability, age group identification, perceived threat, task difficulty, and self-efficacy (Barber, 2020; Chasteen et al., 2005; Hess et al., 2003; Kang & Chasteen, 2009; Lamont et al., 2015).

Additionally, ABST effects have shown to be difficult to replicate (Barber, 2017) and do not generalize to all task types (Kang & Chasteen, 2009). The inconsistencies within the literature could be partially due to the complexity of the ABST process. Further, mediating factors for ABST are still unclear. With these points in mind, it is not surprising that there was no clear evidence of ABST effects within this study. Although, the old age stereotype exposure did not influence older adult environment learning performance, there were interesting findings that suggest that all age groups have difficulties within this domain. Further, stereotype exposure seemed to influence the time taken on the environment learning task, regardless of age. This was surprising, being that the stereotypes were geared towards older adult abilities. Additionally, many participants discussed the aspect of age in the third attention check and no participants mentioned gender. One of the most surprising findings was that all age groups had higher perceived threat scores in threat conditions, with middle-aged having significantly higher perceived threat scores in the threat condition. Additionally, the younger adults did not excel in the environment learning task, despite the expectation that the younger age groups would perform the best. The following sections will outline my in-depth interpretations of the results and provide plausible explanations and suggestions for disentangling remaining questions.

Age Differences in Environment Learning

For Hypothesis 1, I expected older adults to perform poorly compared to the other age groups. This hypothesis stemmed from earlier studies that have provided ample evidence of age differences for navigation tasks (Klenklen, 2012; Moffat, 2009). Hypothesis 1 was partially supported because there was a main effect for Age Group for time taken overall and for time scores for the allocentric task types. These findings were interesting because they revealed that in terms of accuracy older adults performed similarly to the other age groups. Surprisingly, the younger adult group was less accurate, although there were no significant age differences for accuracy (errors) overall. Furthermore, the younger adult accuracy average was significantly lower compared to the middle-aged adults for the allocentric survey (mapping) section. This was a small to medium effect between younger and middle-aged adults (d = .40). The older adults were slightly more accurate than younger adults. These findings revealed that older adults were not the worst performers in all circumstances. The significant age gaps, with older adults performing the worst, applied to time taken and for the allocentric sections only. Older adult time was longer than younger (d = -47) and middle-aged adults (d =.40). For the allocentric survey (landmark order) section the age gaps were relatively large. Older adults took much longer to complete the section compared to younger (d = -70) and middle-aged adults (d = -73). For the allocentric location section (landmark mapping), there were small to medium effects. With older people taking longer than younger (d = 44). Based on the literature on task types and navigation perspectives, the time taken findings were to be expected. However, it was not expected for that older adults to display comparable accuracy to the other age groups. This finding is especially important for the navigation literature because it reveals that operationalization of environment learning tasks can moderate age differences in performance. One explanation for why older adults had significantly longer time taken scores and comparable accuracy would be that older adults took on a precautious approach. Thus, I suspect their approach was time consuming but prevented more errors. Furthermore, this approach seemed to occur mainly for tasks that were more difficult (i.e., allocentric). Another key takeaway from these results is that younger adults had their own share of difficulties with the environmental learning task. They made a comparable number of errors and sometimes more, depending on the section. These findings for accuracy were the first indicator that I may not find ABST effects within this domain, using the LNT.

ABST on Environment Learning

To explore Hypothesis 2 and 2a, I conducted a series of 10 ANOVAS for Age Group by Condition on performance outcomes. Significant interactions were expected for the overall scores of time taken and accuracy (errors) and for the 4 sections of the task. However, there were no significant interactions for any of the conducted ANOVAS. To further explore the performance outcomes across threat conditions, I looked at mean level differences across conditions for each age group separately. None of the age groups has significantly different performances across conditions, revealing that threat manipulations did not have an effect on performances. Additionally, the changes that were seen moved in unexpected directions. The middle-aged adults had a small drop in accuracy in the threat condition, trending towards a stereotype threat effect (see Figure 13). This was surprising because previous findings show that middle-aged adults benefit from old age stereotype exposure. Results from the preliminary analyses indicated that middle-aged adults had significantly higher perceived threat in the threat condition compared to the neutral (d = -60). Perceived threat differed across conditions for the older adults as well (d = -66). Thus, there were medium effects for perceived threat across conditions but non-significant performance differences. Although, there was a slight drop in performance for middle-aged adults when exposed to negative old age stereotypes.

Younger adults did have higher mean levels of perceived threat in the threat condition, but this was not a significant increase. The first and most probable explanation for why the age groups did not differ in their performance scores across the conditions but did differ in perceived threat could be that they had opposite reactions to the threat exposure. I suspect that the middle-aged adults were threatened by the blatant stereotype statements. The statement claimed that younger participants typically do better and were expected to outperform the older adults. However, the younger and middle-aged participants may not have felt confident that they could live up to the stated expectations. Additionally, the overall task difficulty ratings were high (M = 4.15 , SD =.93) and age groups did not differ in their difficulty ratings. With the pressure to perform well, the younger age groups may have experienced the "choking under pressure" phenomenon (Beilock & Carr, 2005). This occurs when people experience anxiety and worry about satisfying high performance expectations. The younger participants were aware they were being judged based on age to do better, but their performance did not align with expectations. This was evident regardless of condition. I suspect that the younger adults and middle-aged adults struggled just as much as the older adults and had self-efficacy issues. Self-efficacy has been shown to moderate ABST effects on memory performance (Chasteen et al., 2005; Fresson et al., 2017), however, it is usually seen as an issue for older adults in ABST studies on memory tasks. Environmental learning, however, is an area that all people may lack confidence in, especially without having GPS. There is evidence of a relationship between increasing age and lower use of GPS (Muffato et al., 2022). Younger people and middle-aged adults may rely heavily on GPS and may not have much experience navigating without it. Thus, the older cohort could have had an advantage on the task or even higher self-efficacy. There is evidence that beliefs about one's ability to take on an environmental learning task can influence spatial learning of an unfamiliar environment (Miola et al., 2021). Taken this together, the middle-aged and younger participants in the threat condition were aware of the grand expectations for performance based on their age but may not have had the self-efficacy to meet expectations.

For older adults, I suspect there was an opposite reaction to the threat exposure. The older adults had relatively high age-group identification, positive attitudes about aging and did not always perform worse compared to the other age groups. Additionally, the recruited older adults had an average subjective age of 56.5 and were recruited through an online research database. I suspect the blatant stereotype exposure had a motivating influence on older adults. Research shows that participants that feel they have the resources and high self-efficacy can have a reactance response to blatant stereotype exposure (Strickland-Hughes & West, 2021). This is often referred to as stereotype reactance. Thus, sometimes older adults can perform better and combat the age stereotype that they are perceiving. The perceived threat scores indicated that the participants were aware of performance expectations in the threat condition and concerned about performance outcomes. In future work, self-efficacy should be measured before and after the task, qualitative data about task challenges should be collected and the threat manipulation types should be separated. From this, the role of self-efficacy would be clear and specific aspects of the conditions that were influencing perceptions would be highlighted. Age-related performance outcomes may have differed in a subtle only manipulation condition compared to blatant only manipulation condition. Some earlier ABST studies have shown that older adults can experience motivation to do better and disprove stereotypes when in blatant stereotype conditions but not with subtle stereotype exposure (Barber et al., 2017; Lamont et al., 2015; Miron and Brehm, 2006; Strickland Hughes & West, 2021). The older adult sample had higher (more positive) means for attitudes towards aging compared to the other age groups however not significantly higher. Further, the older adults had a significantly higher age-group identification mean compared to the middle-aged adults. Both attitudes towards aging and age group identification were negatively skewed across all ages, with scores being closer to the maximum possible scores. Thus, the older adults in this sample, highly identified with their age group and had relatively positive attitudes about aging. Within the ABST literature, perceived stereotype threat sensitivity ranges (Barber et al., 2017) and with such positive attitudes about aging, this sample, despite perceiving threat were not affected by it in their performances. This counteractive response when faced with negative age stereotypes is believed to occur when older adults have positive beliefs about aging (Strickland-Hughes & West, 2021).

The other explanation for the lack of evidence of ABST effects or even stereotype lift effects may have been due to ecological validity issues. Perceived threat may not result in poorer performance in circumstances that occur stickily online. The value of a domain has shown to moderate ABST effects (Hess et al., 2003), however, I doubt participants highly valued getting a good score on an online environment learning task. A study by Hess (2014) found that older adults taking an abstract memory test did not find the task important and were not motivated to partake in the task. It is reasonable to assume that most people do not perceive an online environment learning task as important as they would environment learning within everyday scenarios where they could get lost. Furthermore, participants were recruited though an online research platform, where they receive compensation for survey completions. Compensation was not based upon performance. In conclusion, the attention check responses and perceived threat scores highlighted that that participants were aware of age expectations and somewhat concerned. However, sensitivity to perceived threat may have been mitigated because the study was strictly online, and the task was not in a natural setting. From this, it seems that ABST effects do not occur for online environment learning tasks but that does not mean that ABST does not occur within everyday navigation scenarios. Future work is needed to address this topic.

Older Adult Performance Across Task Types

There was partial support for my hypothesis that older adults would perform the best at the egocentric task compared to the other tasks, particularly the allocentric sections. Results of the paired samples t-tests showed that the egocentric section (direction choices) took significantly less time for the older adults than the other three sections. These effect sizes were relatively large. Older participants took a much longer time in the allocentric survey (landmark order) section compared to the egocentric route section (*d* = -1.18). There was a medium to large effect for time differences between the egocentric route section and the landmark location (landmark mapping) section *(d* = .74). For these sections, it is clear that the older participants took their time. Older adults were most accurate in the landmark recognition section. When comparing egocentric route accuracy to the landmark accuracy section, the effect was medium to large (*d* = 70). Earlier studies that have used the LNT have shown similar patterns. The landmark recognition task appears to be the least difficult. Egocentric route accuracy was slightly better compared to the allocentric location section (*d* = .45). The egocentric advantage mainly applied to time taken. In line with previous studies, these findings highlight that older adults struggle mainly with landmark location and landmark association (Colombo et al., 2017). These findings highlight that older adults have an advantage in some areas of environment learning and that older people may change strategy for more difficult tasks. It is important that researchers who measure older adults' navigation are aware of the egocentric advantage and that it may not apply to accuracy.

Age-Group Identification as a Moderator

Despite no evidence of ABST effects on environment learning performance, age group identification did moderate the relationship between age and time taken for participants in the threat condition. This moderation was not found for the neutral condition or for errors. The simple slope results revealed that only average and low age group identification played a role on time scores increasing with age. However, this linear relationship did not occur when age-group identification scores were high. These findings fall in line with my earlier explanation for the older adult responses to threat exposure. It is plausible that when older adults highly identified as older, they had a motivated reaction to the blatant threat statements. Thus, this group was aware of the negative expectations, however, was motivated to quickly finish the task and combat the stereotype. Participants were told they would be timed for the task. With subtle manipulation only studies, older adults have not shown to have a boost in performance in threat conditions (Lamont et al., 2015). Subtle manipulations have been posited as more insidious in their influence on threat condition performances (Hirsh et al., 2012; Kray et al., 2001; Lamont et al., 2015). Thus, older adults with average or low identification old age may have not felt the motivation to go against the old age stereotypes, based on stereotype reactance theory (Brehm, 1966). It is important to note, however, that this hypothesis was originally based on ABST effects. Thus, it was expected that older adults who highly identified as old would be most susceptible to ABST effects and take longer. This hypothesis was based on the moderation of age-group identification on ABST in earlier studies that used subtle manipulations (Kang & Chasteen, 2009). In the Kang and Chasteen (2009) study, the stereotype exposure was less salient (subtle) and had the typical ABST outcomes. Because the current study had subtle and blatant manipulations combined within the threat condition, the saliency of threat was very high. Future studies should compare performance outcomes between blatant stereotype exposure, subtle stereotype exposure and neutral conditions separately. With this suggested approach, it may be found that the role of age-group identification differs depending on type of threat manipulations. Furthermore, the aging attitudes of the older adults were high overall

(*M*=19.6, *SD*= 3.03, with the highest possible score of 25. This leads into the next section on age-group identification in combination with attitudes towards aging.

Empirical Evidence of Self-Concept Threat

It has been posited by Barber (2017) and Shapiro and Neuberg (2007) that older adults experience a unique type of stereotype threat, termed Self-Concept Threat. Self-Concept Threat is thought to occur because individuals age into the out-group (old) and continue to hold negative self-stereotyping appraisals (Barber, 2017, Levy, 2009). This theory aligns with other areas of social cognitive research. For example, Stereotype Embodiment Theory by Becca Levy (2009) explains that older people can engage in negative self-stereotyping because they have internalized ageist beliefs due to many years of exposure to age stereotypes. For Self-Concept threat, the line of thought is that older adults who endorse a negative age stereotype may be fearful of confirming it to be true of themselves (Barber, 2017). However, in this study there was no evidence for ABST effects on environmental learning performance. Thus, interpreting the influence of high age-group identification with negative attitudes about aging on threat performance was complex. The interaction of age-group identification and attitudes towards aging had significant added explanation on threat condition performance above and beyond age. In this model, age was included as a continuous variable and was the first predictor. Age did not have a significant explanation of task time performance in the threat condition when accounting for the interaction of the other two variables. Being that there were no ABST effects, I am hesitant to say that these findings are evidence of Self-Concept Threat. Further, with the generally high scores for age-group identification and attitudes towards aging, I suspect that the older adults overall did not have negative attitudes to lead them into a self-fulfilling prophesy of negative performance. They may have been negatively influenced by the subtle threat exposure but took on a counteractive response to the blatant stereotype statements in the condition. Although age-group identification and attitudes towards aging explain task performance in threat conditions, it cannot be interpreted as Self-Concept Threat.

ABST on Speed-Accuracy Tradeoff

Hypothesis 6 was an exploratory hypothesis based on the prevention loss theory of ABST (Seibt & Foster, 2004). I was interested in the linear combination of errors and time, not the results of these scores separately. Results from the conducted MANOVA were in line with the findings from Hypotheses 2 and 2a. The scores did not differ across the conditions and age groups. Further, the scores did not differ across conditions but there was a main effect for Age Group. Older adults may have taken an overall precautious approach to the task compared to the other age groups and were able to mitigate errors. Additionally, this may be why younger adults and middle-aged adults had comparable scores for errors. In the threat condition older adults may have focused on finishing the task quickly to combat the age stereotype but generally, across the conditions, they took their time on the task. With ABST effects not occurring for time separately or errors separately, it makes sense that there was also a non-significant interaction for this analysis.

Navigation Stereotype Threat Across Gender Identity

Attention to gender differences was a necessary inclusion in order to fully understand the effect of the stereotype threat manipulations within the study. Gender differences in spatial ability and navigation are commonly found (Nazareth et al., 2019). Additionally, navigation gender stereotypes are found to favor men and may impact performance outcomes (Allison et al., 2017; Guizzo et al., 2019; van der Ham & Koutzmpi, 2022). The results indicated that women took longer compared to men to complete the navigation task. This finding was to be expected because earlier findings have shown that women benefit from having more time to complete navigation tasks (Nori et al., 2018). For the exploratory hypothesis, I expected that older aged women would be most susceptible to ABST effects. Thus, the older adult women in the threat condition would have poorer performance compared to older adult women in the neutral condition. I believed that this trend would not occur for the older adult men. Surprisingly, age did not play a factor. This was unexcepted because the stereotype was about an older man getting lost and gender was not emphasized. Further, poor older adult performance was stated within the study instructions. For time taken overall and for the map section there was a Gender by Condition interaction. Women took longer than men in only the threat condition. The gender differences in the threat condition for time taken overall was medium (d = -61). This findings, specifically, highlights that women in the threat condition were more likely to take their time. It seems as though, the stereotyping of older adults influenced women participants to take a precautious approach for the task.

Men are not negatively stereotyped to be poorer navigators and the threat condition didn't seem to affect their task approach. The allocentric location section is the only section that requires participants to switch viewpoint perspectives in order to answer questions. This section was arguably the most difficult. For this section, women in the threat condition took longer than women in the neutral condition. The effect size was medium (d = -67). For men, slightly less time was taken in the threat condition, but this was not a significant difference. Furthermore, the men's time to complete the task decreased in the threat condition and the women's time increased in the threat condition compared to the neutral condition. This result highlights what the earlier studies suggested regarding gender related self-efficacy and susceptibility to threat effects. Although, the threat condition was geared towards older people, stereotyping at all may have motivated the women participants to take their time in order to accurately answer the questions. These findings highlight three important points. First, that stereotypes geared to one out-group may affect another group if there is a shared stereotype. Secondly, the gender stereotype for navigation may be more salient than the age stereotype. Further, work is needed in identifying the magnitude of an age-related stereotype for navigation. Lastly, in some cases stereotype exposure may affect task strategy but not the accuracy.

Limitations

This study was novel with the exploration of ABST on a new domain and has furthered the exploration of social cognitive influences on older adult environment learning. However, the findings of this study have highlighted the complexity of ABST. Further, this study is not without limitations and some of these limitations may have reduced the ability to detect ABST effects. Firstly, the threat manipulation included blatant and subtle stereotyping. However, research shows that different manipulation approaches can lead to opposite responses to threat exposure (Armstrong et al., 2017; Lamont et al., 2015). Some evidence has shown that providing either a subtle or a blatant message leads to stereotype threat, but a combination of both lead to stereotype lift for out-group members. This improvement of performance is thought to be stereotype reactance. In a study by Moè (2018), women performed better on a mental rotation task when subtle and blatant stereotype exposures were combined. The women demonstrated stereotype threat when the stereotype exposures were separate. For future work, it will be useful to manipulate stereotype exposure separately and in combination. This would be the same approach as previously taken by Moè (2018). The second major limitation of this study was that there were several skewed variables. Overall, the participants did not take much time on the task and did not make many errors. For example, the longest time taken on the task was about 10 minutes with 2.5 minutes as the average ($M_{seconds}$= 156, *SD*=89.7). It is difficult to conclude that the participants rushed through the survey because all of the participants passed all three attention checks and wrote complete responses to all three attention check items. In addition to the dependent variables, the age-related variables were negatively skewed before and after log transformations. The mean for age-group identification was 4.95 (*SD*= 1.26), with 7 as the maximum possible score and attitudes towards aging had a mean of 19 (*SD*= 3.42), with the maximum possible score of 25. Overall, the participants had positive attitudes about aging. The sample in this study may not represent the general population of people who hold more negative views on aging and older adults. In terms of the sample demographics, SES was skewed with participants having relatively low SES (*M*=4.49, *SD*=1.77) on a scale of 1(lowest) to 10 (highest) for rating where that stand in society based on money and education. With higher SES comes more opportunities to explore new environments and take on environment learning. Thus, this sample may have lacked environment learning experience. It is also possible that there was a restriction of range for the LNT sections with only four items. The minimum observed score for all of the 4-item sections was 0 and the maximum was 4. I do not suspect this issue of the overall accuracy scores. The observed scores ranged from 0 to 14 errors with the lowest accuracy at 30% and the highest accuracy at 100%. The maximum number of errors possible was 20. The average for errors was 5.87 (*SD*= 3.28), that is an average of 70.64% accuracy. Although the participants reported the task as relatively difficult (*M*= 4.15, *SD*= .93) on a scale of 1 to 5, (1) being very easy and (5) being very difficult, the mean for errors was relatively low.

The third limitation was that the LNT may have been too easy to detect ABST effects. Despite participants perceiving the task as difficult, it may have been actually too easy. The fourth limitation within this study was that a race demographic measure was not included. Most work on stereotyping focuses on one group identity at a time, however, this ignores the complexity of intersectionality (Remedios et al., 2015). Little is known about the interaction of ABST linked to multiple aspects of identity. Older people and racial minorities are highly stigmatized groups. Based on the "double- jeopardy hypothesis", older adult minorities would face double the stereotyped disadvantages (Dowd & Bengston, 1978). It is unclear if older adult minorities would be more susceptible or resilient against ABST. Additionally, little is known about race differences in environment learning. If a race demographic was included it would have allowed for testing for interactions on performance. Thus, there was a missed opportunity to test differences in environment learning across race and to identify if ABST effects differed for older adult minorities. Lastly, it cannot be said with confidence that the six groups did not differ in racial demographics. The last limitation within this study was that ABST was explored strictly online . Thus, the participants may have not valued the test outcome enough for perceived threat to result into performance effects. Despite evidence that participants perceived threat, this was not impactful enough to influence performance. In earlier ABST studies, memory performance may have been valued because poor performance is said to be predictive of cognitive issues. Thus, older adults may experience more anxiety in stereotype conditions because they view memory test performance as diagnostic. I suspect that older adults would be more influenced by stereotype exposure if the navigation test was set in person and required physical navigating. One could argue that the importance of navigating in everyday situations would be higher than doing well on a navigation test online. Further, stereotype exposure may occur on an implicit level in natural settings, with participants completely unaware of the stereotype exposure. Subtle threat exposure is thought to have a stronger impact on outcomes (Lamont et al., 2015). It has been argued that the ABST literature is lacking in scope because the effect is mostly tested on performance in research labs and stereotyping is too obvious (Lamont et al., 2021).

Future Directions

Results from this study were surprising and brought forward exciting questions about perceptions of environment learning ability. To further our understanding why ABST effects did not occur for the task, there are a few suggested steps. Firstly, ABST effects should be tested across difficulty levels of environment learning. Including a task with GPS aiding and a task with ought may provide some clarity. One next step is to include environment learning tasks that include aiding tools such as GPS, a similar unaided task, and a simple memory task within the same study. Thus, differences in ABST effects across tasks can be attributed to aspects of the task and domain differences. Further, including a simple episodic memory task would be beneficial. If ABST effects were found for the memory task but not the environment learning tasks, it could be assumed that ABST does not generalize to the environment learning domain. Secondly, there are a few important variables to include for future studies. These measures include frequency of GPS usage and self-efficacy. Measuring self-efficacy could shed light on the discussed explanation for the lack of ABST effects. Self-efficacy could be a covariate and could mitigate stereotype lift when very low. Additionally, higher self-efficacy in tandem with positive age beliefs could result in stereotype reactance. Self-efficacy could be measured in multiple ways, including qualitative responses. Lastly, future studies should test ABST across 4 conditions (negative subtle threat, negative blatant threat, positive age stereotypes, and neutral). Results from this work could contribute to our understanding of age differences in responses to distinct types of stereotype stimuli and highlight differential impact of stereotype manipulations that are subtle versus blatant.

Conclusion

This study was consistent with past work on navigation and age-related environment learning. Consistent with the environment learning literature older adults performed best in egocentric tasks. However, the results highlighted that age differences depended on the measurement of the task. Additionally, older adults seemed to take on a loss prevention approach for the task. The environment learning task in this study was an adapted version of Van der Ham and colleagues (2020) navigation test and included distinct sections. The inclusion of the separate sections was beneficial for teasing apart age differences across distinct task types and testing ABST across different levels of difficulty. Thus, there was significant triangulation within the study, with the varying measures of environment learning included. This gave confidence in the lack of ABST effects because there were no interactions across the board for any of the performance outcomes. A major contribution of this study was the evidence that stereotype threat exposure about navigation and environment learning led to higher perceived threat. The increases in perceived threat gave confidence that the neutral condition did not include subtle age stereotyping. Surprisingly, this exposure affected participants of all ages. The results highlighted that people of all ages may stress about their navigating ability, especially with unfamiliar routes. These findings span across ages 19-80 years old, including middle-aged participants. ABST studies have typically left middle-aged adults out and compared the youngest and oldest age groups. This was the first ABST study to experimentally test stereotype threat exposure on environment learning. This was a major step in broadening the scope of ABST to other cognitive areas outside of episodic memory. With this study, I have taken what we know about ABST effects and explored this process experimentally for a new domain. To this date, only a handful of studies consider the role of social cognitive factors on environment learning. For example, perceived stereotype threat and wayfinding attitudes have been linked to spatial ability and environment learning (Lawton, 1994; Meneghetti et al., 2015) performance. However, until this study, social cognitive factors have not been manipulated and tested as a direct impact on environment learning performance outcomes. From this study, it has been highlighted that all age groups may be affected by age-related pressures to perform well in navigating and environment learning tasks. Additionally, younger adults and middle-aged adults struggled with tasks within this domain and not just older adults. The unexpected findings from this study call for further review. Although, it seems that ABST effects may not occur for the specifically used task, future work is needed for exploring ABST various environment learning formats.

This work is important because it benefits the population of older people in knowing that age differences in this domain are not universal and strictly biologically influenced. Further, awareness of ABST stimuli and moderators of susceptibility allows for research that can highlight ways to mitigate ABST effects. Although there are a few competing theories about the explanatory mechanism for ABST (Barber and Mather, 2013; Schmader et al., 2008), broadening the scope of this process helps sheds light on how ABST occurs. Age stereotypes can be found in many forms therefore it is possible that ABST applies within naturalistic everyday contexts (Ellis & Morrison, 2005; Lamont et al., 2021). For example, negative age stereotype exposure can occur in casual conversations, at birthday parties, with self-help books, and when watching commercials. We are living in a highly ageist society, the westernized culture, where physical and psychological changes with age are thought to occur uniformly and dramatically (Richeson & Shelton, 2006). It is likely that older people are exposed to age stereotypes often and when navigating in everyday situations. For example, when older people are driving with younger co-workers or family members in the car.

My aim with this research was to further the scope and understanding of domains where ABST can occur and set the stage for future work. In this study, I revealed that perceived threat can be influenced with traditional ABST manipulation approaches for the environment learning domain. Furthermore, this effect occurred across all age groups, something not typically seen in other domains. From this, it seems that other age groups have age-related concerns for environment learning performance.

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APPENDICES

APPENDIX A

DEMOGRAPHIC INFORMATION

1. Is English your primary language?

o

Yes

o

No

2. Chronological Age.

Type how old you are, in chronological years.

____

3. Gender Identity o Man, male, or masculine o Transgender o Woman, female, or feminine o Gender nonconforming, genderqueer, gender questioning o My gender is not listed (please specify)_________

- Prefer not to answer
-

4. What is the highest degree or level of school you have completed? If currently enrolled, the highest degree received.

o No schooling completed o Nursery school to 8th grade o Some high school, no diploma

o High school graduate, diploma or equivalent (for example GED) o Some college credit, no degree o Trade/tech/vocational training o Associate degree o Bachelor's degree o Master's degree o Professional Degree o Doctorate degree

o Prefer not to say

5. How would you rate your health at present?

(1) Poor (2) Fair (3) Good (4) Very Good (5) Excellent

6. *MacArthur Scale of Subjective Social Status – Adult Version (Adler et al., 2000)*

The image below is a ladder that represents where people stand in society.

Standing in the United States

Think of this ladder as representing where people stand in the United States. At the top of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the bottom are the people who are the worst off – those who have the least money, least education, the least respected jobs, or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

Where would you place yourself on this ladder?

On a scale from 1 to 10 of rungs on this ladder, where do you think you stand?

1 2 3 4 5 6 7 8 9 10

Lowest Highest

APPENDIX *B*

CONDITION VIDEO

Below is a video from YouTube. Please watch the video and in 1-2 sentences explain what the video was about.
Stereotype Threat Condition video: https://youtu.be/VSsyl7jK27c
Neutral Condition video: https://youtu.be/lwXOVNdiNKQ

Attention Check I

1. In 1-2 sentences, please describe what the video was about.

____

APPENDIX C

LEIDEN NAVIGATION TASK

Note: Size and image quality differ from the Qualtrics survey.

Stereotype Threat Condition Instructions:
Below is a video of a route on a new planet. In this route the destination is a spaceship. Watch the video carefully, giving attention to all aspects of the route. Your environment learning ability will be tested. Environment learning is the process of remembering spatial information of an environment. Research suggests that environment learning, and navigation skills may decline with age. Thus, we are testing ability across all adult age groups.

Neutral Condition Instructions:
Below is a video of a route on a new planet. In this route the destination is a spaceship. Watch the video carefully, giving attention to all aspects of the route. You will be quizzed on this video.

Environment Learning Video: https://youtu.be/1O13IHuCnBk

Attention Check II
What was the final object that was walked up to at the end of the route?

____

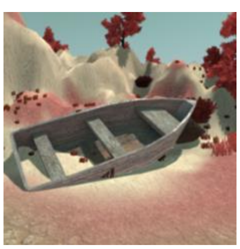
Landmark Recognition

1. Was the landmark above in the environment video that you just watched?

- Yes
- No

2. Was the landmark above in the environment video that you just watched?

- Yes
- No

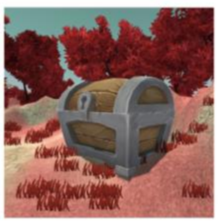


3. Was the landmark above in the environment video that you just watched?

- Yes
- No

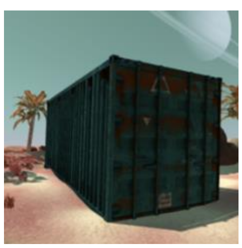
4. Was the landmark above in the environment video that you just watched?

- o Yes
- o No



5. Was the landmark above in the environment video that you just watched?

- o Yes
- o No



6. Was the landmark above in the environment video that you just watched?

- o Yes
- o No

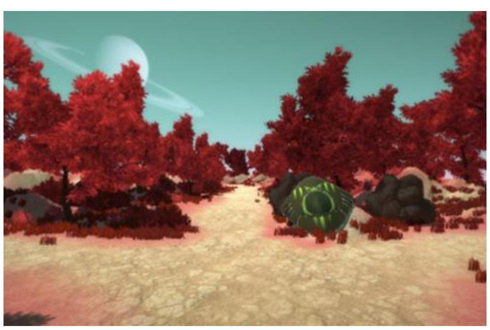
7. Was the landmark above in the environment video that you just watched?

- o Yes
- o No

8. Was the landmark above in the environment video that you just watched?

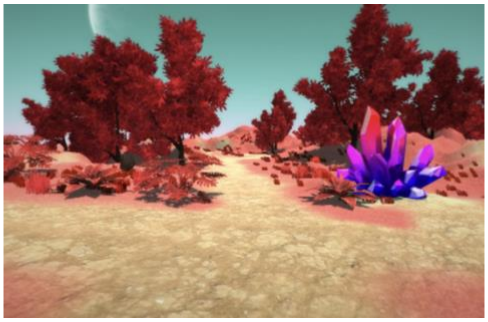
- o Yes
- o No

Egocentric Route



9. What was the direction choice at this landmark?

- o Left
- o Right
- o Keep Straight



10. What was the direction choice at this landmark?

- o Left
- o Right
- o Keep Straight

11. What was the direction choice at this landmark?

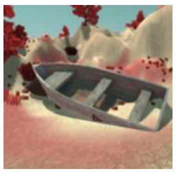
- o Left
- o Right
- o Keep Straight

12. What was the direction choice at this landmark?

- o Left

- Right
- Keep Straight

Allocentric Survey

1. 

2. 

3. 

13. In what order are these landmarks along the route? These landmarks may not be directly next to each other but were passed by some before others along the route. Think of where they would be along the path if you were to look at a map of the route.

- 1, 2, 3
- 3, 1, 2
- 1, 3, 2

1. 

2. 

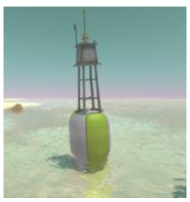
3. 

14. In what order are these landmarks along the route? These landmarks may not be directly next to each other but were passed by, some before others along the route. Think of where they would be along the path if you were to look at a map of the route.

o 1, 2, 3
o 1, 3, 2
o 3, 2, 1

1. 

2. 

3. 

15. In what order are these landmarks along the route? These landmarks may not be directly next to each other but were passed by some before others along the route. Think of where they would be along the path if you were to look at a map of the route.

- o 1, 2, 3
- o 3, 1, 2
- • 2, 1, 3

1. 

2. 

3. 

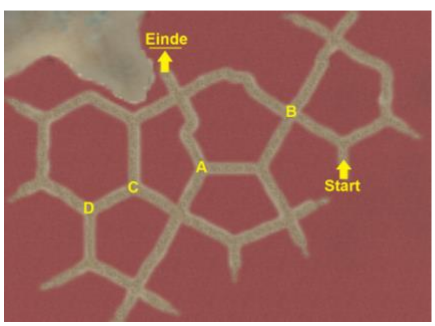
16. In what order are these landmarks along the route? These landmarks may not be directly next to each other but were passed by some before others along the route. Think of where they would be along the path if you were to look at a map of the route.

- o 2, 3, 1
- o 1, 3, 2
- o 3, 2, 1

Allocentric Location

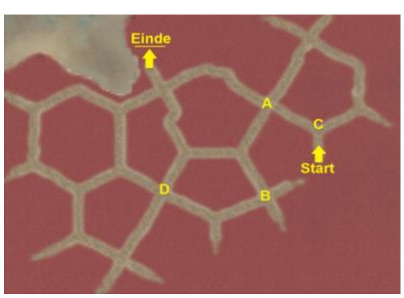
17. The map below corresponds with the route from the video. Where on the map is this landmark? "Einde" is Dutch for End.

o A
o B
o C
o D



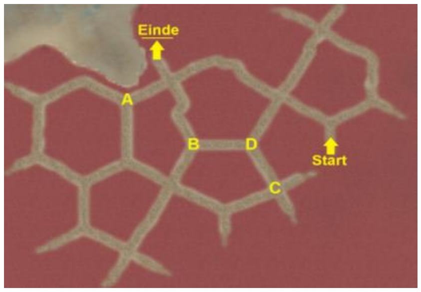
18. Where on the map is this landmark?

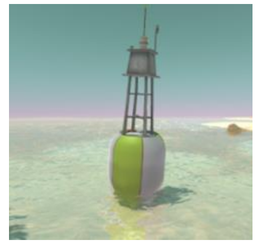
o A
o B
o C
o D



19. Where on the map is this landmark?

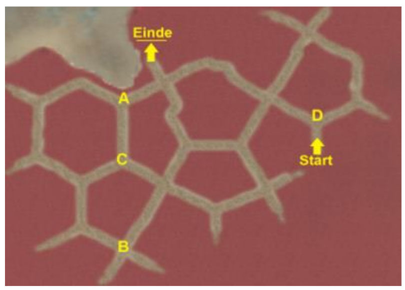
o A
o B
o C
o D





20. Where on the map is this landmark?

o A
o B
o C
o D



APPENDIX D

TASK DIFFICULTY

1. On a scale of 1 to 5, (1) being very easy and (5) being very difficult, rate the environment learning task that you just took.

1	2	3	4	5
Very Easy				Very Difficult

APPENDIX E

PERCEIVED STEREOTYPE THREAT (STATE) ADAPTED

1. After watching the news video about the older man being helped, did you feel more likely to perform poorly because of your age?

1	2	3	4	5
Strongly Disagree				Strongly Agree

2. Were you worried that if you performed poorly on the environment learning test, the research would attribute your poor performance to your age?

1	2	3	4	5
Strongly Disagree				Strongly Agree

3. Were you worried that your ability to perform well on the test was affected by your age?

1	2	3	4	5
Strongly Disagee				Strongly Agree

APPENDIX F

AGE-GROUP IDENTIFICATION SCALE

Please indicate your degree of agreement from 1(strongly disagree) to 7(strongly agree).

1. **I like being a member of my own age group.**

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

2. **I am proud to be a member of my own age group.**

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

3. **My age group membership is central to who I am.**

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

4. **I believe that being a member of my age group is a positive experience.**

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

5. **I have a clear sense of my age group identity and what it means to me.**

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

APPENDIX G

ATTITUDES TOWARDS AGING PSYCHOLOGICAL GROWTH SUBSCALE

Please indicate your degree of agreement from 1(strongly disagree) to 5(strongly agree).

1. **As people get older, they are better able to cope with life.**

1	2	3	4	5
Strongly Disagree				Strongly Agree

2. It is a privilege to grow old.

1	2	3	4	5
Strongly Disagree				Strongly Agree

Agree

3. **Wisdom comes with age.**

1	2	3	4	5
Strongly Disagree				Strongly Agree

4. **There are many pleasant things about growing older.**

1	2	3	4	5
Strongly Disagree				Strongly Agree

5. **I am more accepting of myself as I grow older.**

1	2	3	4	5
Strongly Disagree				Strongly Agree

APPENDIX H

SUBJECTIVE AGE.

Many times, people feel younger or older than they actually are, in chronological years. How old people **feel** is their subjective age.

During the last month, what age did you feel most of the time? Type the age you mostly felt in the past month. Please type a number.

APPENDIX I

ATTENTION CHECK III

In 1 to 2 sentences, what do you think this study was about?

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