EMOTIONAL AND COGNITIVE RESPONSES TOWARD MORTALITY IN LIFE HISTORY STRATEGY

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Emotional and Cognitive Responses Toward Mortality in Life History Strategy

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CERTIFICATE OF ORIGINALITY

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Abstract

This dissertation, consisting of four papers, examines the effects of Life-History (LH) strategy and the current environment on emotional and cognitive responses toward mortality. Given the unavoidable death and limited lifespan, a fundamental problem faced by all living organisms is the resource allocation among various tasks associated with survival and reproduction. LH framework deals with the trade-offs in allocating finite time and resources over a life course, and an individual's LH manifestations remain flexible and sensitive to environmental signals. Due to the resource constraints and trade-offs among LH traits, humans fall along a continuum of slow to fast LH strategies. Across four studies, hypotheses are proposed to explain why specific LH predictors are more or less likely to influence the intensity of death fear and the cognitive judgment toward death-related decisions in a given environment. By employing different operations for the current environment (e.g., having participants report the perceived current environmental adversity and examining the participants under different ecological settings), the findings provide preliminary evidence for an association between LH strategy and fear-induced implicit avoidance of death and the perceived current environment moderates this association (Study 1). These findings are replicated in the natural settings of a death-salient versus non-death-salient environment (Study 2). Specifically, slow LH is associated with more intense death fear at lower than higher levels of mortality threats in individuals' current environment (Study 2). Further, based on the assumption that experiencing fear activates appraisal tendencies, influencing cognitive processes, judgment, and decision outcomes; hence, death fear is proposed as a mediator in the relationship between LH and subjective judgment of life-ending decisional scenarios (Study 3). The results suggest that slow LH is associated with more intense death fear, which in turn predicts the lower subjective justification of life-ending behaviors (Study 3). The findings further indicate that the fear of death partially mediates the relationship between

slow LH and the subjective justification of life-ending behaviors (Study 3). Specifically, slow LH is negatively linked to the justification of end-of-life behaviors (Study 3 & Study 4), and the current environmental adversity moderates this relationship (Study 4). The interaction result suggests that current environmental harshness and unpredictability influence LH strategy in the same direction directly through interaction effects on the attitudes toward ending a life or by shaping LH strategy that regulates an individual's cognitive judgment (Study 4). The four papers extend the findings in the LH framework by demonstrating that the variations in emotional and cognitive processing regarding death information are contingent on LH strategy, and this association is influenced by the current environmental status that further calibrates an individual's LH manifestations.

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Chapter One: Introduction

Death, though it is the counterpart of life, is a fundamental aspect of living. Moving from life as a general phenomenon of conscious existence to how we live, we see death lurking in the shadows of each decision we make, each emotion we experience, each social tie we form and break, and each piece of information we receive. Natural disasters, pandemic disease, war, famine, terror attacks, and other hostile ecological contexts or events are ecologically unfriendly for living and thriving and cause many deaths. Particularly in recent decades, the environment and ecology system has worsened regarding resource availability and sustainability, which brings survival pressure to each individual. Death is the fundamental definition of conscious life; it is the experience and psychology that guides, influences, and even determines what forms our lives and how to adapt to the changing environment (Yalom, 1980). Research regarding death and dying should not be overlooked because it is a critical living component.

Terror management theory (TMT) posits that human awareness of the inevitability of death exerts a profound influence on diverse aspects of human thought, emotion, motivation, and behavior (Pyszczynski et al., 2015). A growing body of evidence supports that the subliminal death reminders or stimuli that increase death thought posit that sophisticated cognitive abilities are unique to humans because they facilitate our ability to survive and reproduce (e.g., Becker, 1971; Pyszczynski et al., 1999). These cognitive abilities may increase the flexibility inherited from ancestors to respond to diverse and rapidly changing environments (Pyszczynski et al.,2015). Accordingly, humans' sophisticated intellectual capacities, including death awareness and awareness of the long-term inevitability of death, serve as monitors that signal the need to adjust behavior to keep it on track in pursuing important goals (Becker, 1971). Despite the fear in response to clear and present danger, managing the fear of death produced by the cognition and knowledge of the inevitability of death may make particular biological features of the brain more adaptive (Tritt et al., 2012).

Given the unavoidable death and limited lifespan, a fundamental problem faced by all living organisms is successfully allocating time, energy, and resources among the various survival tasks (Griskevicius, 2011a). A large body of research (e.g., Charnov, 1993; Griskevicius, 2011a; Kaplan & Gangestad, 2005; Stearns, 1992) seeks to understand how and why different organisms allocate their resources across the lifespan. Life History (LH) theory deals with the trade-offs in allocating time and resources over an organism's life span. It analyzes the costs and benefits of possible LH strategies resulting from natural selection without the genetic and developmental constraints within a particular ecological environment (Kaplan & Gangestad, 2005). Looking at it through an evolutionary lens, we can understand why these pathways exist and how they can be adaptive. Organisms better fitted to their environment or better 'adapted' to their environment have a higher chance of surviving (Kaplan & Gangestad, 2005). Using an LH framework provides a means to study human evolutionary responses to a rapidly changing world. Investigating the psychological mechanism explained by an LH framework in terms of emotional and cognitive processing of mortality can lead to novel hypotheses or ways of integrating evidence through an evolutionary lens that would not naturally be integrated from previous theoretical perspectives.

The LH framework could guide the development of interventions to focus on LH trade-off variations in emotional and cognitive processes that are more consistent with an adaptive psychological mechanism when facing changing ecological contexts. LH theory suggests species fall along a slow-to-fast LH continuum due to resource constraints and trade-offs among LH traits (Nettle, 2010). In general, a fast LH strategy emphasizes current over future reproduction and is characterized by rapid growth, early maturation, and high reproductive effort at the cost of elevated mortality; a slow LH strategy emphasizes future reproduction over current reproduction by doing the opposite of fast LH (Stearns, 1992). Additionally, the choice of fast or slow LH strategies significantly affects many aspects of people's lives (Mittal & Griskevicius, 2014). Recognizing a continuum of short-term (fast) versus long-term (slow) LH strategies is a notable step in developing the LH model. This LH trade-off on the fast and slow continuum is contingent on how individuals gain energy and optimize resource expenditures under environmental risk and mortality threats. Correlational selection can be expected between the fast-slow LH trade-off and its manifestations regarding emotional reactions and cognitive processes toward mortality information.

At the heart of LH theory's adaptiveness concern is understanding the energetic conditions (e.g., the availability of energetic resources associated with the level of competition for getting these resources), environmental harshness (e.g., the age-specific rate of mortality and morbidity), and environmental unpredictability (e.g., the consistency of harshness from one period to another) are signaled by observation cues. These cues function as crucial environment dimensions that affect the development of fast-versus-slow LH strategies (Belsky et al., 2012; Ellis et al., 2009). Of the two major environmental constraints determining LH, namely resource constraint or food shortage and safety constraint or extrinsic risk, food shortage has become less relevant in contemporary human life because of sufficient food supplies that exceed the survival threshold (Chang & Lu, 2018). As the energetic threshold is satisfied or crossed over, environmental factors linked to different LH strategies are manifested in modern human environments by environmental cues such as the local mortality rate and the availability of local resources (Chisholm et al., 1993), and environmental adversity (e.g., environmental harshness and unpredictability; Ellis et al., 2009). Environmental contingency in LH theory refers to the environmental factors influencing LH strategies (Ellis et al., 2009). Rather than being anchored for life, the LH strategy shows environmental contingency in response to particular mortality cues during adulthood (Nettle et al., 2014). Species, including humans, tend to adopt different LH strategies depending on the variations of ecological factors, such as the level of mortality threats, resource availability, and other environmental factors (Cabeza de Baca & Ellis, 2017). Hence, individuals strategically adjust their LH trait values according to their environments (e.g., temperature, nutrition, and environmental conditions; Ellis et al., 2009).

This dissertation explores emotional and cognitive responses toward mortality using the Life History (LH) framework and quantitative study design. The variation of allocation "decisions" made by individuals has generalized patterns on the fast-slow LH continuum. Several proposed environmental and psychological factors likely shaped by LH strategy over time could further influence the emotional and cognitive processing of death and dying. Traditional approaches to understanding death attitude focus on highly personal and reflexive studies – dealing with mortality (e.g., Woodthorpe, 2007), end-of-life care (e.g., Barnett, 2001), pertinent to a specific sub-field suicide research (e.g., Boden et al., 2016), and theoretical underpinnings (e.g., Walter, 1994). This dissertation will address the research gap in a micro-focus on individual differences in psychological mechanisms (emotion & cognition) to process mortality cues by offering a new evolutionary perspective on LH. Hypotheses are proposed to explain why specific LH predictors of emotional and cognitive responses toward mortality cues are more or less likely to influence the intensity of death fear and the related judgment of end-of-life decisions in a given environment. The design and development of the proposed studies were critical in supporting a thorough, multi-dimensional examination of the participant's emotional and cognitive process of death and dying (see Figure 1.1).

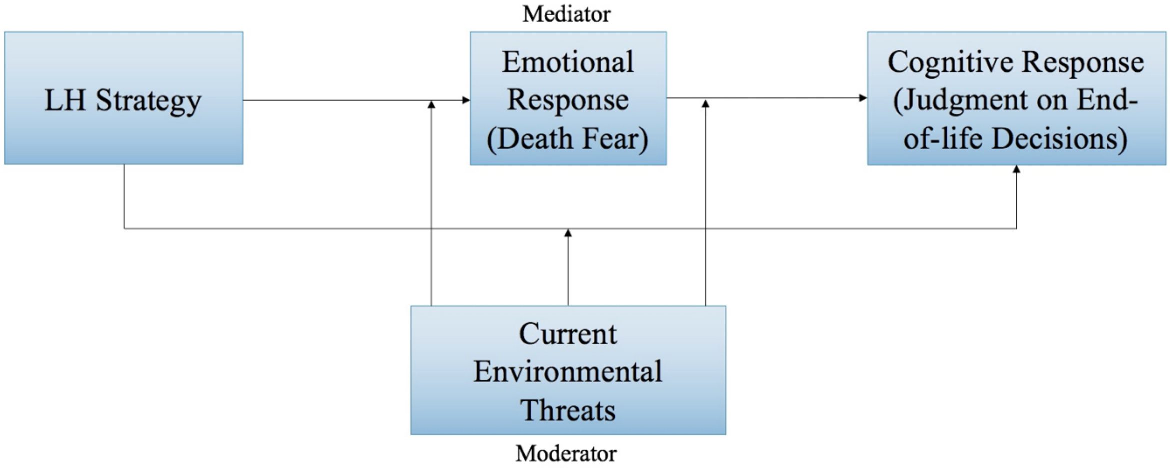

Figure 1.1 Conceptual flow for the proposed studies.

Although the four papers are independent, the conceptual flow for linking these four papers are based on the assumption that emotions influence people's attitudes, which in turn influence subjective judgment and decision-making (Forgas, 2004). Emotions could indirectly affect our behaviors by implicitly shaping our attitudes and judgments – as cognitive representations of the world (Gutnik et al., 2006). In addition, emotion may have different effects on attitudes and judgment depending on the negative or positive valence of the emotion, or specific negative or positive emotions, such as fear (Forgas, 2004; Lerner & Keltner, 2000). In particular, when making decisions, there exists a tension between a desire for immediate gratification and delayed gratification (Mcclure et al., 2004), which supports the idea that emotion influences decision-making processes, which may vary by the LH manifestation of forgoing versus delaying gratification. Hence, when responding to mortality cues, emotions may interact with the perceptions of the situation, environmental and situational factors, and with the cognitive representations of past experiences, perceived risks, and benefits (Gutnik et al., 2006).

Emotions also influence how information is processed. Several scholars have found that individuals differ in regulating their affective experience and its broader consequences in their judgments, choices, and behaviors (e.g., Erber, 1991; Gohm, 2003; Larsen, 2000). Fear has been associated with appraisals of danger or threat, low certainty, and a shared sense of situational control (Lerner & Keltner, 2001). Experiencing fear activates appraisal tendencies, influencing cognitive processes and decision outcomes when dealing with emotion-eliciting events (Lerner & Keltner, 2000). According to Tversky & Kahneman (1983), cognitive judgments occupy a position corresponding to the evolutionary history between the automatic operations of perception and the deliberate operations of reasoning. Fear and anxiety can create cognitive overload and impede performance on cognitively demanding tasks (Zinbarg & Mineka, 2007), potentially making it essential to regulate when considering complex ethical issues (Kligyte et al., 2013). The proposed studies explore the perception-emotion and thinking-judging components of information processing regarding mortality and specify the individual variations that underlie emotional sensitivity, the intensity of emotions, cognitive styles, and subjective judgment influenced by LH strategy and the current environment.

The first paper proposes that death fear is associated with the tendency to avoid potential safety threats and environmental mortality cues. LH strategies evolve in response to such ecological information, and optimal LH strategies vary across individuals to facilitate specific adaptive emotional responses (death fear) to extrinsic mortality threats (see figure 1.2). In this study, the Approach–Avoidance Task (AAT) is employed to investigate avoidance reactions to stimuli of potential death threats indirectly. The findings reveal that slow LH individuals showed an automatic avoidance tendency in response to death-relevant stimuli, but no effect was found for fast LH individuals. In contrast, the negative-valence stimuli did not differ between the LH groups. The current environment showed a marginal effect on death fear-induced implicit avoidance for individuals adopting different LH strategies. Our findings indicate that LH variation is uniquely associated with implicit avoidance of mortality threats.

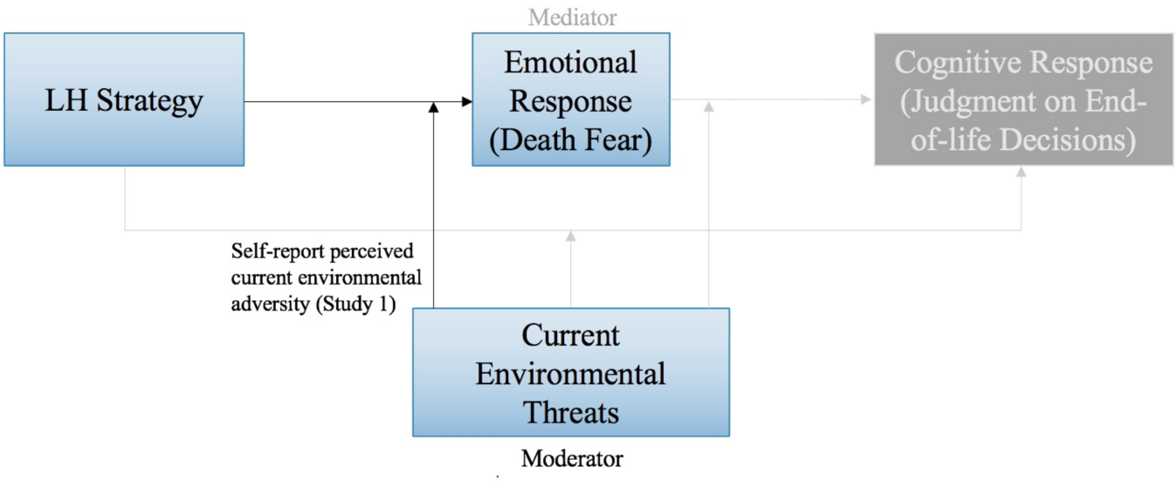

Figure 1.2 Proposed study 1

The second paper examines whether the fear of death varied according to individual distinctions in LH strategy and current environmental status under the COVID-19 pandemic (see Figure 1.3). The outbreak of the COVID-19 pandemic and the spread of the deadly virus globally compels individuals to re-evaluate death and dying, and this forced awareness of death influences adaptation to a changing environment. Several studies have employed artificial laboratory settings of mortality salience or subliminal death primes to increase mortality awareness and threat perception. However, few studies have used natural settings to activate a more extensive ecological network of perceived mortality threats. In this study, residents of Hubei, China report their fear of death scores once during and after the mandatory lockdown period. The results reveal that LH is associated with fear of death, and the current environment moderated this association, suggesting that a slow LH strategy is predictive of more intense death fear at lower levels of mortality threat in a given environment than at higher levels of this threat.

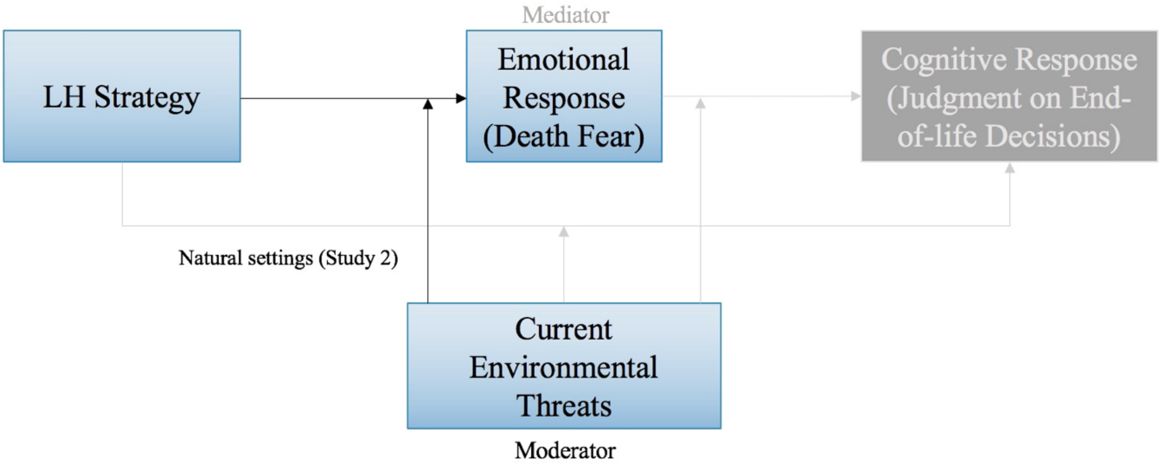

Figure 1.3 Proposed study 2

The third paper investigates the effects of LH strategy, death fear, and current mortality threats on hypothetical end-of-life decisional scenarios and the subjective justification of life-ending behaviors. Recent works point out that emotions can influence both rapid, intuitive subconscious judgments and conscious, intentional aspects of decision-making (Haidt, 2001). End-of-life decision-making and acceptability judgment can involve more cognition, emotion, or interactively. Faster versus slower LH strategies may exhibit some variations in environmental adaptations, affecting decision-making and judgment by relying more on deliberate thinking (rationality) versus emotion (affection) and/or interactively. In this study, participants include college students and staff members from two universities in Guangxi, China, and are randomly divided into two groups (enhanced mortality information; no information). The results suggest that slow LH predicts more intense death fear, predicting a lower justification and acceptability of life-ending behaviors. The results further reveal that the fear of death partially mediates the relationship between slow LH and the justification of life-ending behaviors. Furthermore, the strength of the association between slow LH and death fear depends on perceived current mortality threats.

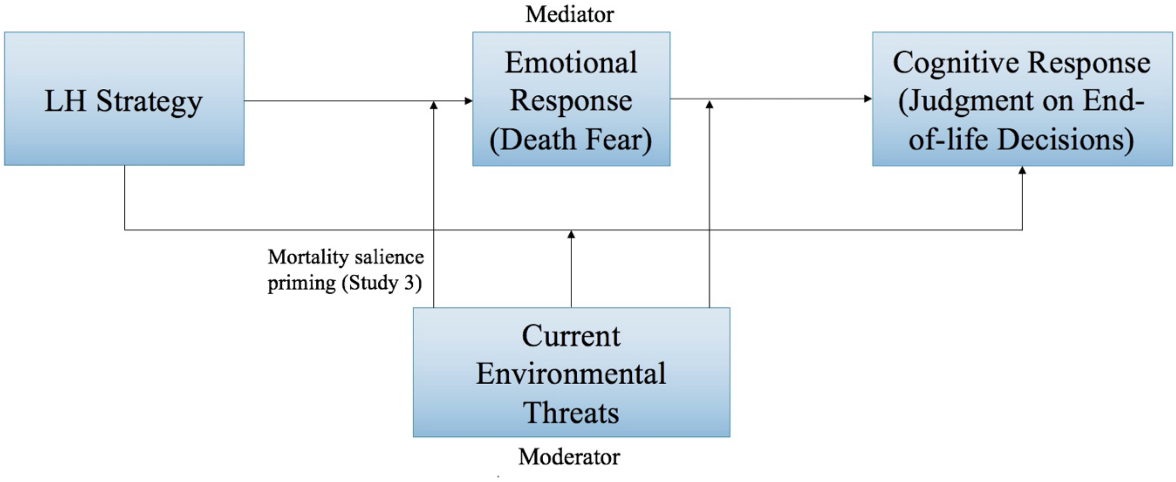

Figure 1.4 Proposed study 3

The fourth paper analyses the relationships among LH, adverse environment, and the subjective justification of life-ending behaviors, focusing on the hypothesis that a variant of LH may play a key role in influencing the subjective justification of end-of-life behaviors (see Figure 1.5). The present study further proposes that the relationship between LH and the subjective justification of end-of-life behaviors is moderated by the current adverse environment (i.e., harshness and unpredictability). The present study employs structural equation models on two datasets: a survey sample (study 4.1) and the World Values Survey data (WVS; study 4.2). The results show that slow LH traits are negatively linked to the justification/acceptability of end-of-life behaviors, and current environmental adversity moderates this relationship. Specifically, data from study 4.1 and study 4.2 confirms that the interaction between LH and adverse environment influences individuals' cognitive judgment about end-of-life behaviors.

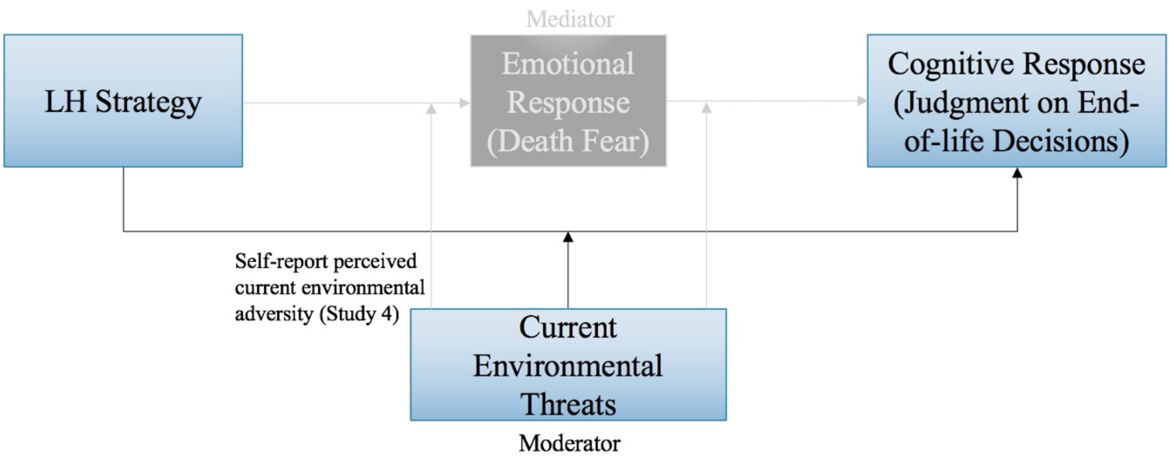

Figure 1.5 Proposed study 4

This thesis explores the emotional and cognitive responses toward mortality, applying the perspectives of the LH theory. Using the LH framework was advantageous in helping to frame and develop the research hypotheses, study goals & questions in investigating the perception-emotion and thinking-judging components of environmental information processing regarding mortality and further specifying the processes and structures that underlie individual differences influenced by LH strategy. The emotional responses to death (e.g., death fear) are multi-dimensional constructs, and human cognition related to death and dying is also complicated. With the proposed approaches in mind, this thesis aims to comprehensively understand the participants' emotional responses and cognitive judgment toward mortality, how their emotions are aroused, and how their cognitive thinking styles differ. All four studies consider the impact of individuals' current ecology and environmental cues reflecting high mortality threats and environmental adversity on LH calibration and emotional and cognitive patterns. By showing the evidence, these four papers stress the importance of environmental, psychological, and emotional influences, providing a multi-dimensional examination of the participant's emotional and cognitive information process of death and dying through an evolutionary lens.

Chapter Two
Fear-avoidance of mortality in life-history variations: An approach avoidance task investigation

2.1 Introduction

Humans have naturally become aware of dangerous threats to preserve their lives and continue their genes to future generations. The existential fear of death that comes with that knowledge is a by-product of this evolutionary advantage, and it is the experience and psychology that guides and influences how to adapt to the changing environment (Yalom, 1980). Throughout history, humans have contemplated the meaning of mortality and developed elaborate defense mechanisms against the terror of death (Wong & Tomer, 2011). According to the terror management theory (TMT; Pyszczynski et al., 1999), awareness of death is a death-related attitudinal construct that derives from the realization that death is inevitable and unpredictable, forcing an individual to adapt to it and makes emotional and motivational responses. Evolutionary thinking can further deepen the understanding of how behaviors, bodily responses, and psychological beliefs develop for 'adaptive' reasons, which are essential for survival and reproduction (Buss, 1997; Swanepoel et al., 2016). Life history (LH) strategies evolve in response to the environment (i.e., extrinsic factors such as mortality cues), and due to continual changes in the environment, optimal LH strategies vary across individuals influenced by environmental variations (Ellis et al., 2009). Safety constraints and mortality hazards in the form of extrinsic threats are the primary drivers of human LH (Chang et al., 2019; Ellis et al., 2009). From an evolutionary point of view, emotion has evolved to guide behavioral responses in specific ecological contexts (Luo & Yu, 2015). For example, immediate danger elicits fear, encouraging avoidance of close or looming environmental threats (Mobbs et al., 2007). Thus, when people are made aware of their eventual death, they may experience emotional and motivational responses, such as fear-avoidance responses, as an environmental adjustment (Greenberg et al., 1994; Lang et al., 1990). Species, including humans, tend to adopt different LH strategies depending on variations in ecological factors, such as the level of mortality threats, resource availability, and other environmental factors (Cabeza de Baca & Ellis, 2017; Ellis et al., 2009). The goal of the present study was to provide a detailed investigation of how fear-induced avoidance tendencies are developed and influenced by clusters of psychological traits characterized by the LH strategy, which facilitates specific adaptive responses to extrinsic mortality threats.

2.1.1 Death Awareness in an Evolutionary Perspective

Awareness of death has emerged in a long evolutionary history as a side effect of the evolution of sophisticated cognitive capacities that provide advantages for survival and reproduction (TMT; Pyszczynski, 2019). The experience of mortality salience and awareness of the inevitability of death exerts a profound influence on diverse aspects of human thought, emotion, motivation, and behavior (Landau et al., 2007; Pyszczynski et al., 2015). A growing body of evidence supports that the subliminal death reminders or stimuli that increase death thought to posit that the sophisticated cognitive abilities are unique to our species because they facilitate our ability to survive and reproduce (Becker, 1971). These cognitive abilities may increase the flexibility inherited from ancestors to respond to diverse and rapidly changing environments (Pyszczynski et al.,2015). Accordingly, these sophisticated intellectual capacities include death awareness and awareness of the long-term inevitability of death, serving as monitors that signal the need to adjust behavior to keep it on track in pursuing meaningful goals (Becker, 1971). Despite the fear in response to clear and present danger, managing the fear of death produced by the knowledge of the inevitability of death may make particular biological features of the brain to be more adaptive (TMT; Tritt et al., 2012) by reducing the fear or terror of inevitable and unavoidable future death.

Organisms that are better fitted to their environment or better adapted to their environment have a higher chance of surviving and producing offspring (Kaplan & Gangestad, 2005), facilitating group living, and adapting to aspects of the physical environment involving parasites, predators, and food sources (Simpson et al., 2012). LH theory is a branch of theoretical evolutionary biology and a mid-level theory derived from general evolutionary theory (see MacArthur & Wilson, 1967), which deals with trade-offs in the allocation of time and resources enacted by a suite of biological and psychological systems organized over a life circle (Belsky et al., 1991). The LH trade-off also analyzes the costs and benefits of possible LH strategies resulting from the natural selection without genetic and developmental constraints within a particular ecological environment (Kaplan & Gangestad, 2005). According to recent LH theory research, humans tend to adopt various LH strategies depending on variations in environmental factors, such as environmental harshness (e.g., age-specific mortality and morbidity rate; Ellis et al., 2009), environmental unpredictability (e.g., harshness constancy from one period to another; Ellis et al., 2009). Based on the LH theory, environmental factors linked to different LH strategies manifest in modern human environments through environmental cues, such as the local mortality rate and threats. These mortality cues build up natural selection pressures for psychological mechanisms to adaptively adopt fast or slow LH strategies (Chisholm, 1993). In essence, the LH strategies examine how environmental cues to either fast or slow LH orientations affect major events in one's life (e.g., development and survival), and these clusters of psychological traits may facilitate certain adaptive behaviors such as the avoidance of danger (Simpson et al., 2012). Additionally, LH predicts that behavioral and personality traits should cluster non-randomly as adaptations to solve survival tasks when facing environmental threats (Rushton, 1985). To survive in a changing environment, humans follow these evolved biological and psychological systems to increase the flexibility and adaptability of behavioral responses to remain sensitive to environmental signals (Becker, 1973) and to increase the likelihood that our genes will survive in future generations (Pyszczynski, 2019). Hence, it is valuable to research and explores death with its emotional responses, which are relevant to understanding how we actively internalize its impact to adapt to environmental threats and mortality risks based on LH variations.

2.1.2 Individual Differences in Death Fear as a Function of LH

Emotional responses and reactions to mortality hazards may vary as a function of LH strategies. Evolved death awareness may lead to chronic vigilance for potential threats, thus contributing to the development of fear that is future-oriented, unfocused, and extended to threatening situations (Barlow, 2002; Rossi et al., 2020). Individual differences in LH strategies could influence the awareness of death accompanied by emotions, such as fear and anxiety. Accordingly, slow LH strategies are associated with delayed immediate gratification in the pursuit of future eventualities (Figueredo et al., 2005), a characteristic of preserving life and conserving energy (Chang et al., 2019), and a general psychological disposition for long-term planning (Gladden et al., 2009). These slow LH traits may reinforce emotional responses such as fear and anxiety due to the perception of future disruptions that evoke aversive arousal. As future-oriented, long-term planners, slow LH individuals might express more worries regarding future outcomes when their current environment is considered dangerous and unpredictable (Del Giudice & Belsky, 2010). Compared to fast-LH individuals, slow-LH individuals require greater ecological and social stability to formulate optimal adaptive strategies (Gladden et al., 2009). By contrast, fast LH individuals focus on more immediate payoffs (Chisholm et al., 1993), are more aggressive, chase short-term outcomes/benefits, and tend to be risk-takers and opportunistic (Nettle, 2010). These fast LH traits may mitigate emotional responses such as fear and anxiety because fast LH strategies that prioritize immediate gains and discount future benefits are more adaptive in environments that reflect high mortality rates (Bereczkei & Csanaky, 2001). Hence, these LH manifestations constitute intra-individual calibrations across emotional and behavioral tendencies in various environments.

2.1.3 Environmental Contingency in Processing Mortality Cues

The aversive emotional responses to mortality cues and avoidance behavior toward potential safety threats are adaptive for survival, with the activation of the threat avoidance system producing fear (Pyszczynski, 2019). Death remains one of the biggest and most significant challenges to survival. The threat protection system that evolved in response to mortality threats (e.g., predation, disease, and intraspecific violence) enhances reproductive fitness (Thornhill & Fincher, 2014). LH theory predicts that these mortality threats build up selection pressures for psychological mechanisms to adaptively adopt fast or slow LH strategies on a continuum of short-term (fast) versus long-term (slow) LH end. Previous research has found that faster LH strategies are adopted in perilous, threatening, and resource-limited ecologies such as predation, injury, disease, or starvation (Simpson et al., 2012). Because fast LH individuals may have shorter life spans under these ecologies, they are more prone to pursuing immediate rewards than long-term benefits. Conversely, slow LH individuals prevail in safe and predictable environments (Griskevicius, 2011a); therefore, they are more prone to pursuing long-term eventualities. These LH manifestations on the fast and slow continuum are contingent on how individuals optimize resource expenditure under environmental risk and mortality threats (Stearns, 1992). Accordingly, a correlational selection can be expected between fast and slow LH variations and the induced fear of mortality.

Species, including humans involved in various environmental contingency/conditions (e.g., mortality threats and environmental unpredictability), would adopt and adjust different LH strategies. Local mortality rates should have been a critical ecological cue in evolutionary history (Chisholm et al., 1993). Recent works in animal points to epigenetic changes set in motion by environmental cues during prenatal and early postnatal development as playing a role in the setting of LH strategy (Cameron et al., 2008). Humans also follow this critical developmental window during which the organism's biology remains flexible and sensitive to environmental signals. The environmental signals during development include harshness characterized by a high mortality rate and unpredictability that reflects stochasticity in harshness over time (Ellis et al., 2009). The empirical research on LH theory has suggested that humans can discretionally adjust their LH strategies in response to various ecological conditions during development (e.g., Brumbach et al., 2009; Belsky et al., 1991; Chisholm, 1993; Ellis et al., 2009). A stressful environment can be harsh and/or unpredictable, and each environment dimension may have particular effects on future behavior patterns (Simpson et al., 2012).

2.1.4 Approach-Avoidance Tendencies Induced by Emotions

The perception of environmental threats triggers behavioral schemata of approach and avoidance (Dual-Process Models; Strack & Deutsch, 2004). According to the dual-process models, automatic processes are considered to operate automatically and to be built on representations of objects and concepts which are correlated to each other (Strack & Deutsch, 2004); in this proposed study, this automatic process is referring to the death fear and behavioral schemata of approach and avoidance. The stimuli that trigger death awareness (e.g., a picture of a graveyard) could be associated with the concept of danger and mortality threats, which in turn trigger obsessive thoughts or, according to dual-process models, behavioral schemata of avoidance. Thus, the impulse to avoid objects is considered dangerous and threatening by individuals who experience death-related fear. This avoidance tendency might result from the association between fear of death and behavioral schemata of approach and avoidance with the respective objects.

Emotions are assumed to be organized into two different motivational systems that direct the organism to approach positively valenced stimuli while avoiding negatively valenced stimuli, which prepares the organism to respond appropriately to emotionally significant stimuli in the environment (Lang et al., 1990). Evolutionary reasoning suggests that positive emotion serves as a neutral code for fitness-enhancing conditions, whereas negative emotion acts as a neural code for fitness-reducing conditions (e.g., Johnston, 2003; Phaf et al., 2014). Darwin (1872) proposed that emotion adapts to the context of attributes, such as stimuli and emotional states, which affect behavior. Hence, the tendency to respond to positive or negative stimuli enhances how living organisms adapt to changing environments (Phaf et al., 2014). To survive, organisms need to approach rewards (e.g., food supplies, money, and other resource-plentiful situations) and avoid punishment or danger (e.g., predators, disease, and any resource shortage situation). Specifically, approach tendency is associated with an appraisal of something beneficial; in contrast, avoidance behavior is naturally associated with an appraisal of something dangerous. Consequently, there is a general tendency to approach positive and avoid negative cues with more accurate and quick responses to embodied meanings (Casasanto & Dijkstra, 2010). Fear of death is a strong emotional cue that may trigger an automatic avoidance tendency by avoiding potential threats. Hence, we propose that emotional sensitivity may be associated with fear of death. Research and exploration of death with its emotional responses in terms of fear, anxiety, and emotional sensitivity is valuable and worthwhile, particularly from an evolutionary perspective.

2.1.5 The Approach-Avoidance Task

This study employed the approach-avoidance task (AAT, Rinck & Becker, 2007) to capture specific emotional responses more precisely. AAT aims to assess automatic behavioral tendencies employing arm movements associated with positive stimuli that may activate approach tendencies and negative stimuli that may activate avoidance tendencies (Carlbring et al., 2007; Weil et al., 2017). Previous research has used direct and indirect measures to assess emotional processes influenced by fear. Direct measures include survey questionnaires or qualitative methods, such as interviews and focus groups, in which participants are asked about their feelings of fear and anxiety about certain stimuli. Nonetheless, approach-avoidance tendencies are difficult to measure using direct measures because they may influence behavior within a few seconds after a stimulus is presented. It has been found that there is a close relationship between the emotional valence of stimuli and arm movements, in which arm flexion and arm extension affect evaluative reactions to stimuli (Rinck & Becker, 2007; Solarz, 1960). Using the AAT, specific behavioral tendencies can be measured by detecting both the direction and reaction time of each stimulus.

2.1.6 Present Study

This study recruited a random sample of college students and staff members to complete an online visual approach/avoidance by self-task (VAAST; Aubé et al., 2019). There were three stimulus types: (a) stimuli that represented death and fatal threats (i.e., pictures of death-related concepts); (b) stimuli that represented certain non-fatal environmental threats and were negatively valenced but unrelated to the death concept (i.e., pictures of negative feelings-arousal or non-fatal danger); and (c) stimuli that were non-death-related and neutral (i.e., pictures of a neutral subject). Our hypotheses were based on previous AAT research (e.g., Carlbring et al., 2007; Rinck & Becker, 2007) that behavioral responses observed in the AAT were associated with approach responses to reward/neutral subjects and avoidance responses to potential fear. Regarding response times in the AAT, we proposed that the two LH groups (fast vs. slow) would differ. Presumably, slow LH individuals are expected to show faster avoidance than approaching, given that they exhibit a comparable automatic avoidance tendency concerning the stimuli that trigger fear of death.

We predicted both groups' evolutionary-based fear-avoidance tendency for negative stimuli arousing negative emotions (e.g., anxiety, disgust, representing non-fatal threats). We further tested whether the effects of the VAAST depended on the current environment. Finally, neutral stimuli should have no affective valence for either LH group, as reflected by avoidance minus approach differences close to zero.

2.2 Material and Method

2.2.1 Participants

A random sample of college students and staff members was recruited from three universities in Guangxi, China. After the consent forms were completed, 109 participants were enrolled in the study. G*Power (Faul et al., 2007) was used to calculate a priori sample size. This sample size exceeded the minimum required sample size of 68 to detect a medium effect size with a power of .8 at a 0.05 α level in mixed-model analyses of variance (ANOVA: 2×2×2, G-power = .8, level = .01). The research protocol was approved by the institutional review board of the authors' affiliated university, and informed consent was obtained for participation in the study. The participants received monetary (either cash or gift cards) compensation for completing all tasks.

2.2.2 Materials

Material selection was supported by a pilot test with 44 (21 female) participants who did not participate in the VASST study. Seventy-five pictures showing death-concept/fatal threats, negative valence/non-fatal threats, and neutral valence were selected from 160 pictures after extensive pre-testing. All pictures were judged to be easily perceivable (mean ratings of above three on a 5-point rating scale ranging from 1 to 5). Participants then rated all pictures in three dimensions: negative, death-concept, and fatal/non-fatal, on a 6-point rating scale. The first dimension asks participants to rate negative emotion, where one represents ‘no emotion,’ and six represents ‘the strongest negative feeling;’ the second dimension asks participants to rate death-concept relation, where one represents 'non-relatable to death concept' and six represents 'strongly relatable to death concept;' and the third dimension asks participants to rate fatal threat, where one represents not fatal, and six represents strongly fatal.' The two scales for death-concept and fatal threat were combined into one death-related rating. In the death/fatal dimension, all selected death/fatal pictures received an average rating higher than three (M = 3.73, SD = 1.49), which was higher than neutral pictures (M = 1.37, SD = 1.19, t = 8.24, $p < .05$) and negative/non-fatal pictures (M = 2.68, SD = 1.33, t = 7.48, $p < .05$). In the negative dimension, all selected negative/non-fatal pictures received ratings higher than three (M = 3.82, SD = 1.11), which was higher than neutral pictures (M = 1.37, SD = 1.19, t = 8.73, $p < .05$) and death/fatal pictures (M = 3.37, SD = 1.18, t = 7.26, $p < .05$). All pictures were open-source, in color, and non-human (see Figure 2.1 for examples). Pictures were selected based on participants' ratings in a separate pre-testing survey. Pictures depicted stimuli related to death-concept or fatal threats, including animal bodies, cemeteries, and nuclear explosions; negative stimuli, including non-poisonous snakes, damaged land, and landfills; and neutral stimuli, including office objects, household objects, and architecture.

Figure 2.1 Example of pictures used in the VAAST (Death-related, Negative, and Neutral)

2.2.3 Procedure

The study was set up as a VAAST experiment using the PsyToolkit program (Aubé et al., 2019). All participants were randomly assigned to one of two versions of the VAAST. Data were obtained from three web-based sessions: VAAST Task 1, surveys, and VAAST Task 2. The first part of the web session was randomly assigned to one of two VAAST versions: (1) the mortality-neutral version of the task that involved images of death-relevant concepts/fatal threats and images of neutral content; and (2) the negative-neutral version of the task that involved images that triggered negative emotions/non-fatal threats and images of neutral content. After the first VAAST, participants reported their demographic characteristics and answered questions about their LH and current environment, followed by the second VAAST. All stimuli were presented in a randomized order, but no more than three stimuli of the same type were presented consecutively. For both tasks, participants went through a compatible block (i.e., approaching neutral pictures) and an incompatible block (i.e., approaching death/fatal or negative/non-fatal pictures). We counterbalanced the task and block orders between the participants, with the block order being the same across tasks for a specific participant. Each of the 50 pictures (25 images of death-relevant concepts/fatal threats and 25 images of neutral content in the mortality-neutral version; 25 images of negative valenced/non-fatal threats and 25 images of neutral content in the negative-neutral version) was randomly presented once within each block of the two tasks so that each task comprised 100 trials. Before each block, the participants performed a training phase consisting of 10 trials over five approach images and five avoidance images that were not presented in the main experiment.

Participants were informed that a single picture would be presented on the computer screen randomly. All stimuli were displayed on a background, giving an impression of depth. We generated a 3D regular street for a visual environment (see Figure 2.2). We used a keyboard to set the distance to the screen to approximately 85–100 cm. The keyboard was positioned between the participant and the screen, and the participant was seated in front of the screen with two remote keys, which ensured that the motions were directed toward or away from the dominant hand. Three keys were used: the middle 'G' key to start each trial and the other two keys to perform approach ('A' key) and avoidance ('L' key) responses. When participants pressed the start button, the white circle displayed in the center of the screen was replaced by a fixation cross (for a random duration of 800–2000 ms), which was followed by a target picture of medium size appearing on the screen (see Figure 2.3 for the VAAST setting). The participants were encouraged to respond as quickly and accurately as possible. Their task was to respond to every picture by pressing the corresponding keys from a separate keyboard placed vertically on the computer, either by pressing the 'A' key toward themselves or by pressing the 'L' key away from themselves with their dominant hand. Upon movement, the picture changed in size, such that it grew upon approaching and shrank upon avoiding, creating the visual impression that the picture itself was being pulled closer (approach) or pushed away (avoidance); see Figure 2.4. To achieve this, different sizes of each stimulus were created using Photoshop. All picture stimuli were presented randomly on a computer screen with an initial 350 × 263-pixel resolution; with each movement made, the pictures were then presented with either a larger 420 × 315-pixel resolution of the 'approach' version or a smaller 280 × 210-pixel resolution of 'avoid' version.

Figure 2.2 Background used in VAAST tasks

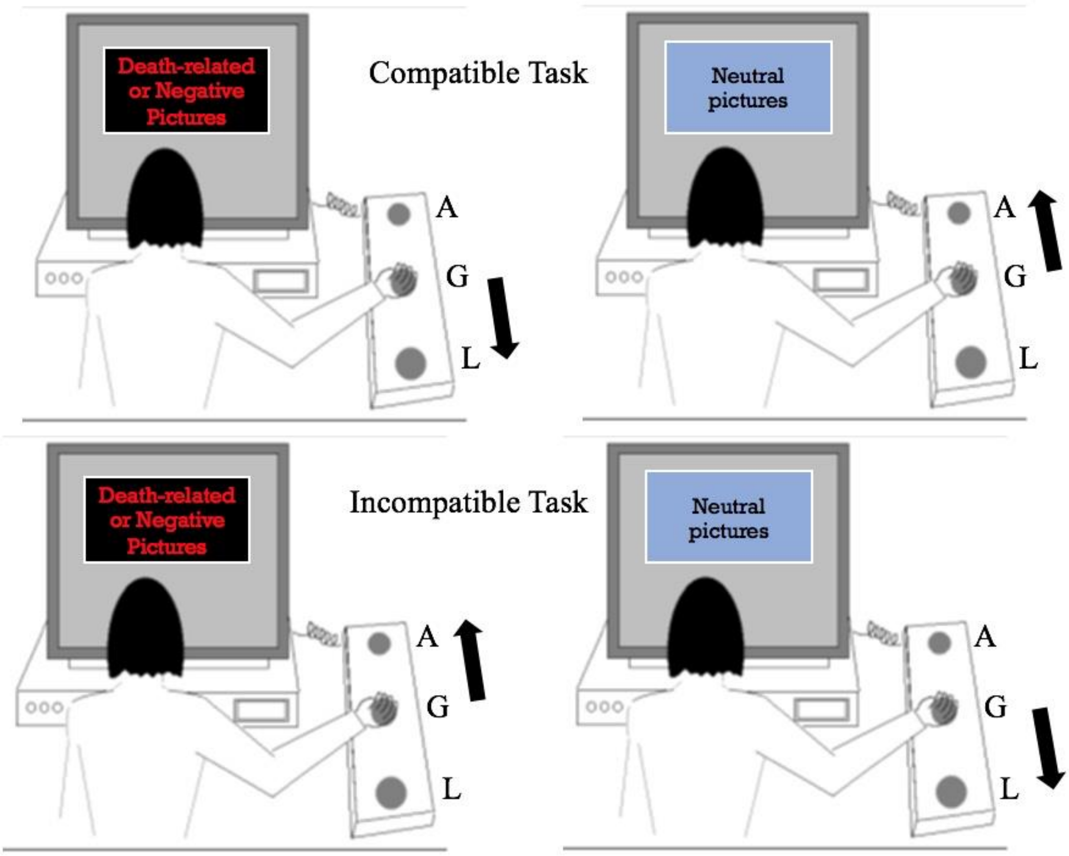

Figure 2.3 VAAST setting

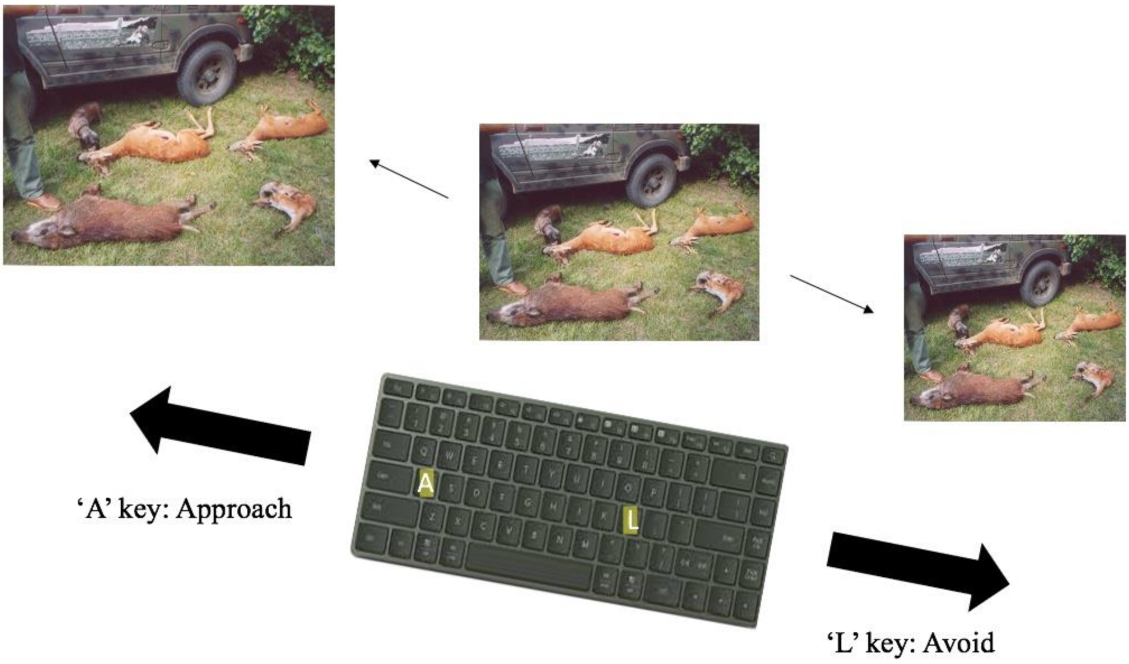

Figure 2.4 VAAST trial

2.2.4 Measures

LH Strategy

The participants completed a 20-item scale measuring the behavioral and cognitive aspects of LH strategies on a single continuum in the direction of slow LH (Mini-K scheme; Figueredo et al., 2005). The items were rated on a 7-point Likert scale (1 = very strongly disagree; 7 = very strongly agree). Participants were divided into either a slow LH group or a fast LH group based on their questionnaire response scores. The response scores for the Mini-K scheme were categorized into two groups using a median split. The estimated internal consistency reliability of the results was 0.77, which meets the standard for internal consistency reliability.

Current Environmental Unpredictability

Four global items on perceived environmental unpredictability were obtained by Luo et al., 2020. Participants were asked, ‘To what extent do you believe the environment is becoming more dangerous?’, ‘To what extent do you believe the environment is becoming more unsafe?’, ‘To what extent do you believe the environment is becoming more unpredictable?’ and ‘To what extent do you believe the environment is getting more uncertain?’. All four items were rated on a 7-point scale (1 = very strongly disagree; 7 = very strongly agree), with higher scores indicating higher perceived levels of environmental unpredictability. The response scores for perceived environmental unpredictability were categorized into two groups using a median split. The alpha coefficient was reported as .94, suggesting that these results meet the standard for internal consistency reliability.

Reaction Time (RT)

The VAAST was used to assess the participants’ fear-related avoidance tendency when confronted with mortality-relevant/negative pictures compared with neutral pictures. The computer automatically recorded the reaction time from the appearance of the image to its disappearance. The reliability of the AAT is relatively high for a reaction time task with a = .70 (Reinecke et al., 2010).

2.2.5 Data Analysis

We applied a two (LH, between-subject: fast LH versus slow LH) × two (current environment, between-subject: unpredictable versus predictable) factorial design, with the VAAST effect score as the dependent variable. The median reaction times (RTs) were determined for each participant for each of the four combinations of picture type and response direction. VAAST effect scores were computed by *avoidance-approach RTs* for each stimulus type by subtracting each participant's median RT in the approach condition from the median RT in the corresponding avoid condition. A positive avoidance-approach score indicated that individuals were slower to avoid than to approach a stimulus, which was interpreted as an implicit approach. A negative avoidance-approach score indicated that individuals were faster at avoiding a stimulus than approaching it, which was interpreted as implicit avoidance.

2.3 Results

2.3.1 Descriptive

To reduce the influence of outliers in the dataset, all trials with RTs differing by more than two SD from the median were removed (Fleurkens et al., 2014). Error rates (i.e., avoiding instead of approaching, and vice versa) were low in this dataset (5.0% of all trials). Based on the standard deviation (SD) method, the RT, which is 3 ($\alpha = 3$) SD away from the mean, is considered an error. An additional 15 participants were removed because they made too many errors (more than 40% errors in any one of the blocks or more than 30% errors overall) on the VAAST (cf. Macy et al., 2015). Consequently, the data of 94 participants (43 men and 51 women) were used in subsequent analyses. In terms of sample characteristics, 84% ($N = 79$) had some college education or higher, 22.4% ($N = 21$) were married, and 48.81% ($N = 44$) were living in a city/town. Their mean age was 23.8 (range: 18–38 years).

2.3.2 VAAST Results

The VAAST effect scores for every block were calculated, and only the RTs for correct responses are reported below. In the death-neutral picture task, there was a significant main effect of the LH group ($F[1, 93] = 5.92$; $p = .02$), nor the current environment ($F[1, 93] = .82$, $p > .05$). The predicted two-way interaction between the LH group and the current environment was marginally significant ($F[1, 93] = 3.02$, $p = .08$). This interaction, displayed in Figure 2.5, indicated that the overall difference in response speed to death-related pictures differed according to the current environment, resulting from generally slower RTs in a predictable environment among slow LH individuals. Interestingly, the difference in death-related avoidance-approach scores was more prominent for individuals who adopted slow LH at different levels of environmental unpredictability. As expected, the current environmental status moderated the association between slow LH and fear of death, suggesting that the slow LH strategy was predictive of a more intense death fear at lower environmental unpredictability levels than higher environmental unpredictability levels. In a more predictable environment, slow LH group individuals responded more slowly to death-related pictures by avoiding than by approaching, yielding negative avoidance-approach scores of -169.09 ms, compared to fast LH group individuals who yielded slightly positive avoidance-approach scores of 18.11 ms. In a more unpredictable environment, the avoidance approach scores of the two LH groups did not differ significantly, yielding negative avoidance-approach scores of -27.40 ms and -54.31 ms, respectively. In summary, the slow LH group was associated with more substantial implicit avoidance in response to death-related pictures than the fast LH group; however, the current environmental unpredictability weakened this association.

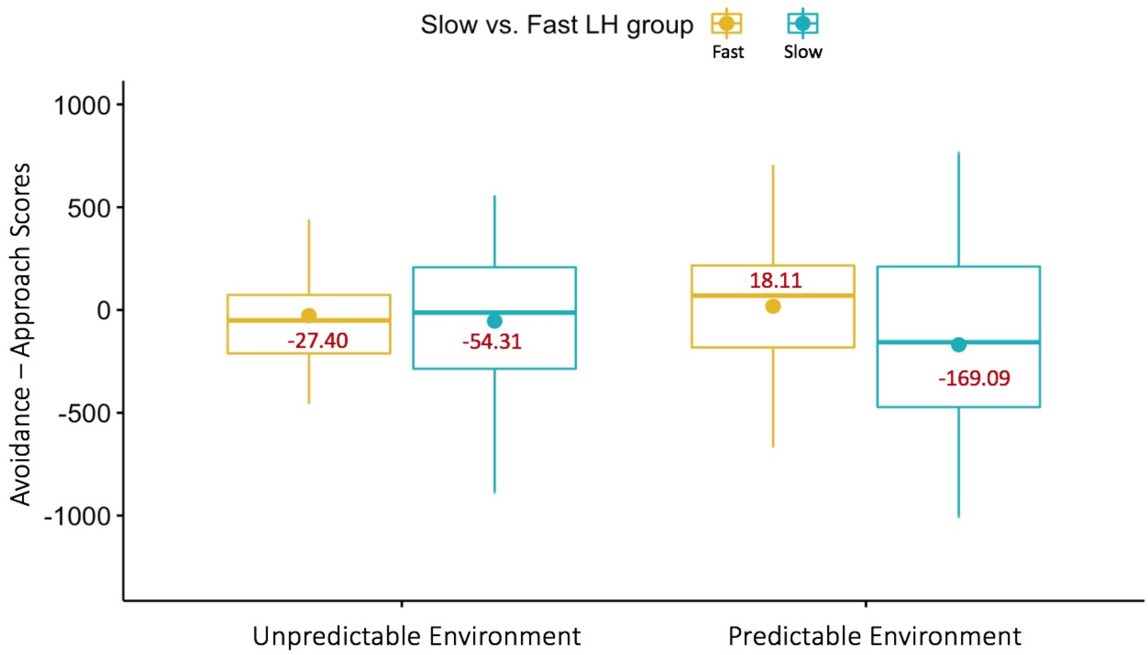

Figure 2.5 VAAST death-related effect scores for those in different environment by Life History (LH) grouping

Notes: Negative scores indicate an avoidance tendency because avoiding is faster than approaching; positive scores indicate an approach tendency because approaching is faster than avoiding.

In the negative-neutral picture task, there was no significant main effect of the LH group ($F[1, 93] = 0.89$, $p > .05$) nor the current environment ($F[1, 93] = 0.16$, $p > .05$). As expected, the predicted two-way interaction between the LH group and the current environment was not significant ($F[1, 93] = .28$, $p > .05$; see Figure 2.6). In summary, both LH groups showed some degree of avoidance in response to negative pictures, and the current environment did not moderate this association.

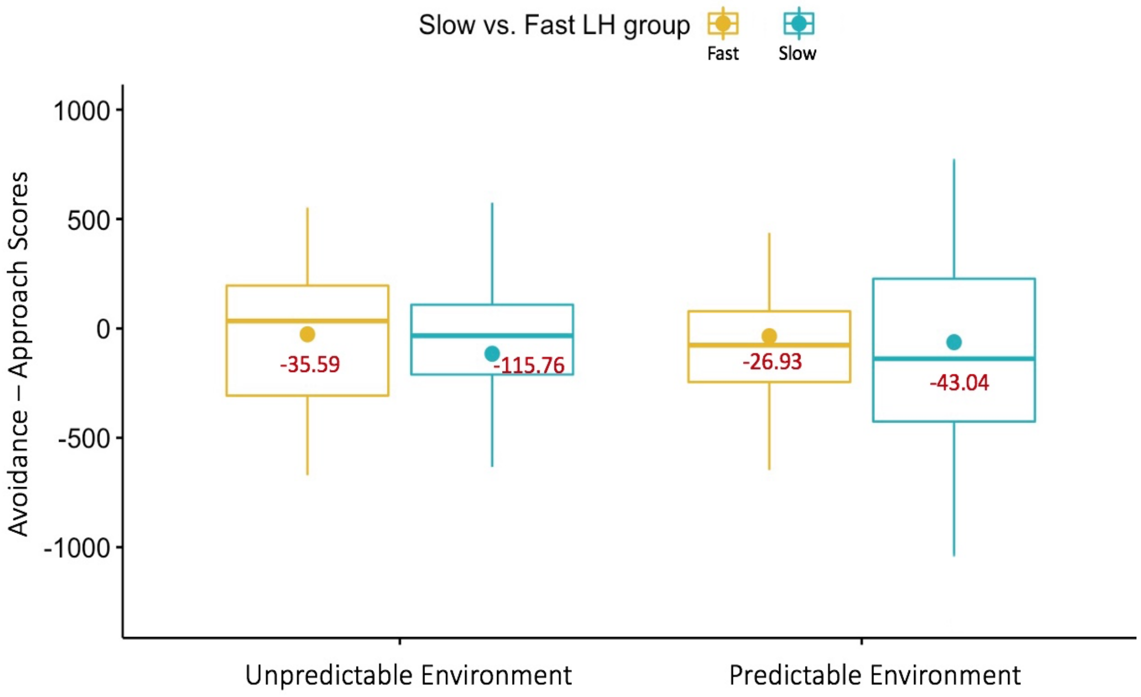

Figure 2.6 VAAST negative-concept-related effect scores for those in different environment by Life History (LH) grouping

Notes: Negative scores indicate an avoidance tendency because avoiding is faster than approaching; positive scores indicate an approach tendency because approaching is faster than avoiding.

2.3.3 Regression Analysis

In order to further predict the fear-induce avoidance tendency measured by the death-concept-related VAAST, we applied a linear regression on the effect of the current environment and LH strategy. The death-concept-related VAAST effect score (*avoidance-approach RTs*) was used as the dependent variable, and the predictors were the current environmental unpredictability scores and LH strategy scores in a slow direction. The regression results showed that LH strategy (β = -.18, *SE* = .07, *t* = -2.56, *p* = .011) and the two-way interaction between slow LH and current environment (β = -.17, *SE* = .07, *t* = 2.48, *p* = .014) each had a significant effect. As displayed in Figure 2.7, current environment status moderated the association between slow LH and fear-induced avoidance tendency, and slow LH was more strongly related to fear-induced avoidance tendency in a more predictable environment.

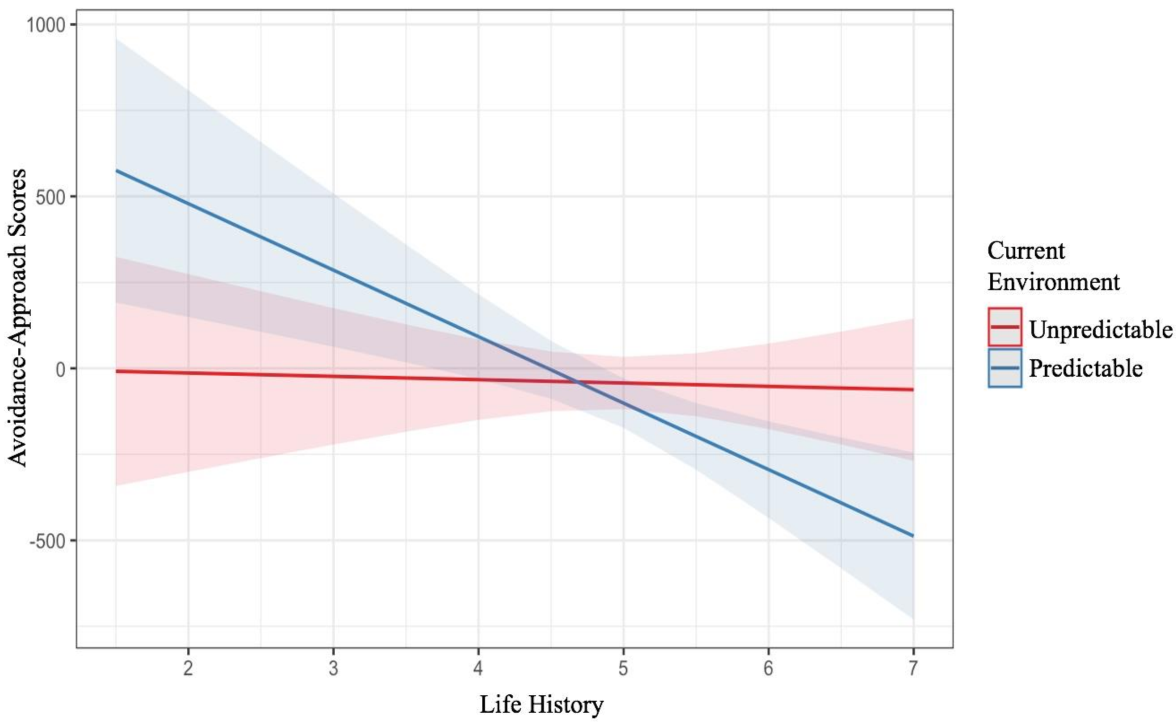

Figure 2.7 Simple slopes and 95% confidence bands from VAAST (death versus neutral tasks) scores regression on LH and current environment status

Notes: Higher LH values indicate the presence of a greater inclination of slow LH; Negative score indicates an avoidance tendency.

2.4 Discussion

This study aimed to examine the associations between LH strategy, the current environment, and implicit approach and avoidance tendencies to measure death fear-induced avoidance. The findings provide a comprehensive understanding of how the LH variations affect emotional sensitivity toward mortality by using the VAAST. Consistent with the expectations, individuals who are highly fearful of death-related concepts should show automatic avoidance with a negative VAAST effect score (*avoidance-approach RTs*). In comparison, non-fearful individuals are also expected to avoid death-related pictures but not to the same degree as fearful individuals. The results indicate that individuals who adopted slower LH strategies demonstrate a more substantial automatic avoidance of death-related concepts and fatal threats but not to the same extent of general negative concepts and non-fatal threats. On the other hand, individuals who adopted faster LH strategies demonstrate no automatic avoidance of death-related concepts and fatal threats; but show some degrees of automatic avoidance of general negative concepts and non-fatal threats. As expected, the observed results indicate that the LH variations exhibit a significant difference in automatic avoidance reaction in response to mortality-related concepts/threats but not neutral or negative contents. Moreover, the current environment shows a marginal effect on death-fear-induced implicit avoidance in different LH groups, with the overall difference in response speed to death-related stimuli being more significant for slow LH individuals in different environmental conditions. Hence, the results from two versions of VAAST (death/fatal versus general negative/non-fatal contents) imply that LH variation is uniquely associated with implicit avoidance of mortality threats but not with other negative contents that are less related to death concepts (i.e., abandoned vehicles, wastelands, and landfills).

The VAAST results suggest that implicit approach and avoidance tendencies may provide more information about the association between LH strategy and emotional responses toward mortality. As expected from previous work on LH theory, mortality threats elicit psychologies (e.g., emotions, cognition, and behavior) that are consistent with different LH strategies (Griskevicius et al., 2011b). The positive avoidance-approach scores are consistent with the notion that mortality-related stimuli signal potential threats and activate avoidance mechanisms (Lang et al., 1997), particularly in the slow LH group. Compared to present-focused fast LH strategists, future-oriented slow strategists are expected to be long-term oriented (Nettle, 2010) and are, therefore, more fearful of environmental adversities and future uncertainty caused by extensive mortality threats. Because slow LH is favored in stable and predictable environments that signal resource investment in somatic effort, parental effort, and the future is likely to result in fitness payoffs (Belsky et al., 2012), the disruption of future investment and plans may cause psychological distress, such as anxiety and fear. Consistent with LH predictions, fast LH strategists tend to behave in ways that prioritize immediate gains while avoiding any substantial long-term investment (Brumbach et al., 2009), less risk aversion, a focus on the present (Chen & Chang, 2016), and showing more impulsivity, boldness, or risk-taking orientations (Copping et al., 2013). These contingent expressions of fast LH strategy might be more adaptive in discounting potential future losses and mitigating current fear and anxiety in an environment that reflects high mortality rates (Guo & Lu, 2022). Rather than attempting to overcome the fear of death, fast LH strategists may outgrow these mortality threats and environmental adversities by focusing more on current development and discounting future outcomes (Chang et al., 2021). Thus, to slow LH strategists, stimuli may be associated with death threats or concepts and will therefore be avoided both at the spontaneous and automatic levels.

Furthermore, our results indicate that the slow LH group reports a more evident death fear-induced avoidance tendency than the fast LH group. Because stimulus valence is supposed to underlie approach and avoidance behavior (Lang et al., 1997), we pre-assessed valence ratings for all pictures in the VAAST. In line with previous findings that one might have expected an evolutionary-based avoidance tendency for negatively valenced stimuli representing specific threats (Phaf, 2014), both LH groups showed some non-significant avoidance tendencies in the negative-picture task. More importantly, slowed LH individuals showed stronger avoidance tendencies specific to death-related pictures to a different extent and did not occur for neutral pictures. The results suggest that automatic avoidance tendencies are more likely to be observed in death-related and fatal threats than in other negatively valenced content and non-fatal threats among slow LH individuals. This discrepancy may be attributed to the differences in processing death threats versus other negative attributions varied by the LH group, as reaction time paradigms like the AAT or VAAST are considered to measure more automatic processes (Reinecke et al., 2010). At this point, the VAAST can be regarded as a promising task for the indirect measurement of fear-induced avoidance tendencies. As expected, avoidance of the feared situation is a common coping strategy, and particularly it reduces the mortality threat for individuals in fatal threatening situations. Our results confirm that the evolved death awareness, such as death fear that has been shown to influence diverse aspects of human adaptive behavior to extrinsic threats (TMT; Pyszczynski, 2019), and these extrinsic mortality threats should have been a critical ecological cue in evolutionary history that influence individual's LH (Chisholm et al., 1993). If such variation in LH strategies was stably recurring, natural selection might have favored developmental mechanisms that use cues to the environmental state to calibrate levels of vigilance and emotional sensitivity responsivity for processing the mortality information (e.g., Boyce & Ellis, 2005; Del Giudice et al., 2011). Additionally, perceived environmental unpredictability showed a marginal effect on approach-avoidance tendencies for different LH groups in the death-neutral VAAST. This implies that LH is uniquely associated with implicit death fear-induced avoidance tendencies measured by the VAAST responses, and this association is partially influenced by current environmental status. Individuals may adjust LH strategies to remain flexible and sensitive to environmental signals. It should often be adaptive for organisms to adjust their LH allocations based on cues about the state of the environment and/or their own ecological conditions (Stearns, 1992). Future studies could conduct a longitudinal study with direct measures to examine the prospective associations between LH, various dimensions of death fear, and current environmental status.

The awareness of death and its psychological entities through which people control existential fear could change the motives of life meaning, future certainty, and control (Pyszczynski, 2015). Recent studies have shown that thoughts of being uncertain (van den Bos & Miedema, 2000) or not having control (Fritsche et al., 2008) may produce effects parallel to those of mortality threats (Pyszczynski, 2015). Notably, the mortality salience hypothesis suggests that reminders of death could increase the need for protection of one's worldview and self-esteem (TMT; Greenberg et al., 1990), and it expands to various constructs, including attachment motivation (Mikulincer et al., 2003); intimacy in romantic relationships (Mikulincer & Florian, 2000); and closed parental relationships (Cox et al., 2008). These constructs are conceptually similar to the slow LH manifestations, including parental relationship quality (Figueredo et al., 2006) and close relationship quality (Figueredo et al., 2005). Beyond the core ideas of the TMT, the empirical support examined an expanding array of phenomena and psychological constructs that death-related thoughts may influence diverse aspects of human behavioral reactions toward mortality. Moreover, these psychological and behavioral constructs, including fear management and avoidance tendency, may be varied and shaped by an individual's LH. Future research may extend beyond the pragmatic function of maintaining one's awareness of death to the survival purpose of death avoidance, providing an alternative explanation for other lines of evidence regarding the evolutionary perspectives.

Analyzing these results from a broader perspective, it is essential to consider the possible implications of these findings for understanding the fear of death as an adaptive response to environmental threats. Similarly, environmental factors linked to different LH strategies are manifested in modern human environments, such as mortality rates related to survival (Chisholm et al., 1993). Natural selection often results in risk-sensitive organisms choosing among options based on outcome expectations and variability (Frankenhuis & Giudice, 2012). Species, including humans, tend to adopt different LH strategies depending on variations in environmental factors such as mortality hazards, resource supplies, and environmental unpredictability and harshness. The perception of environmental information (sources of mortality) and how to process this information may be characterized and shaped by an individual's LH. To illustrate how different LH strategies may result in various emotional processes of mortality information, such as fear, we would consider the effects of fast versus slow LH strategies on adaptations to the environment. The general objective of this study is to show that developmental mechanisms in terms of LH strategies may influence emotional responses toward mortality. Given the potential theoretical implications of the avoidant function of mortality threats, investigating the link between LH and automatic avoidance of death-related stimuli across different populations is critically important. Implementing reaction time tasks like the AAT in future research may also clarify therapeutic issues concerning thanatophobia or coping with death fear and anxiety.

This study has several limitations. First, AAT (or VAAST) considers automatic/implicit behavioral tendencies, which are limited to approach and avoidance behaviors that do not distinguish between different behavioral associations. For example, implicit approach-avoidance tendencies do not distinguish between the fear of mortality threats and other emotions toward mortality (e.g., anxiety and disgust of dead bodies). Second, the sample predominantly consisted of college students. This may be due to the relative overrepresentation of younger generations and well-educated participants in our VAAST sample. Although we have no reason to believe that the AAT under investigation works differently for different demographic characteristics, we recommend replicating this study in a sample with other age groups and educational levels. Hence, caution is required when generalizing the findings to general community samples. Third, due to the impact of the pandemic and lockdown, the VAAST was conducted in a mixed setting that combined a face-to-face setting and an online visual program. A major limitation of this mixed setting is that behavioral tendencies could not access the in-situation avoidance patterns due to the current VAAST setup, as some of the experiment errors need to be removed. The effects in this study would likely have been more substantial in a face-to-face lab setting, and the findings may differ for on-site experiments versus visual experiments. In addition, the experimental setting is subject to some uncertainties, as some inaccuracies can occur. Thus, further research is required to evaluate the AAT or VASST for studying the underlying mechanisms of fear of death in different samples and settings.

Given the promising results reported in the present study, exploring further extensions and applications of death-fear-induced avoidance tendencies influenced by an individual's LH seems worthwhile. First, it is crucial to evaluate the specificity of the observed effects by applying the AAT or other experimental designs for the indirect measurement of fear-induced avoidance tendencies. These behavioral tendencies cannot be assessed directly but are supposed to affect the processing of potentially threatening information, such as mortality threats or cues. Second, given the small effect of perceived current environmental unpredictability, it would be interesting to investigate whether different environmental statuses provide a surplus positive or negative effect to increase or reduce the fear of death for individuals adopting different LH strategies. Third, the current study adds to the large body of research supporting the association between LH and environmental threats (e.g., Chisholm et al., 1993; Lu et al., 2021a; Lu et al., 2021b; Griskevicius et al., 2011a). Differences in avoidance-approach responses between highly fearful and non-fearful individuals indicate that death-related concepts are evaluated as more fatally threatening than other negatively valenced content, for which the body immediately responds to this threat stimulus by preparing an avoidance reaction differing according to LH strategy. Overall, our preliminary findings provide the first hint that the AAT might be a valuable instrument for evaluating adaptive responses to mortality threats, and those slow LH individuals are more sensitive and fearful to these stimuli than fast LH individuals. Future research could corroborate and causally extend the link between LH manifestations and death fear-induced avoidance using other experimental and longitudinal designs with larger sample sizes.

Chapter Three
Changes in death fear during COVID-19 in Hubei, China: The effects of life-history and current external environment

3.1 Introduction

Since early 2020, Coronavirus disease (COVID-19) has rapidly spread across multiple continents and populations, overwhelming the public health systems and affecting nearly every aspect of human life. At some point during the ongoing pandemic, in which mortality has been made salient nearly constantly, every person will encounter threats to their survival in some manner, with some individuals witnessing others facing death and the dying process. From an evolutionary perspective, a fundamental predicament faced by all living organisms is the successful allocation of time, energy, and resources among the various tasks associated with survival (Griskevicius, 2011a). According to recent life history (LH) theory research, humans tend to adopt various LH strategies depending on variations in ecological factors such as environmental harshness (e.g., age-specific mortality and morbidity rate; Ellis et al., 2009), environmental unpredictability (e.g., harshness constancy from one period to another; Stearns, 1992). LH trade-offs on the fast and slow continuum are contingent on how individuals acquire energy and optimize resource expenditure under environmental risk and mortality threats. An abundant body of research has investigated the link between mortality threats and LH strategy and explored how LH strategy and its orientations are expressed when triggered by mortality salience or awareness of one’s mortality (Burger et al., 2012). Despite the growing number of studies focusing on the interaction between LH and its manifestations to jointly affect psychological responses as individuals confront extrinsic mortality risks (Ellis et al., 2009; Mittal & Griskevicius, 2014), there is a lack of research encompassing a change in environmental circumstances in relation fear-based responses and

LH strategy. The COVID-19 pandemic offers unprecedented insights into the dynamics of our everyday environments that can create viable paths for individuals' mortality threat perception. Previous death-related studies have focused on highly personal and reflexive investigations (e.g., Bowtell et al., 2013; Woodthorpe, 2007), end-of-life care (e.g., Barnett, 2001), phenomenological suicide research (e.g., Boden et al. 2016), theoretical underpinnings (e.g., Kübler-Ross,1969; Walter, 1994), and the experimental application of mortality salience primes (Griskevicius et al., 2011b; Mittal & Griskevicius, 2014). This research will address the research gap in a micro-focus on individual differences in processing mortality cues by offering a new evolutionary perspective on LH. Expanding on earlier research and addressing these research gaps, this study centers on how individuals' LH strategy and current environments affect fear of death and delineates the evolutionary logic underlying these dynamics.

3.1.1 LH Theory on Individuals' Variations in Response to Mortality Threat

The starting point of LH theory is the assumption that time and resources are inherently limited, so organisms have to decide how to invest in optimizing their fitness within different environmental constraints (Kaplan & Gangestad, 2005). LH theory seeks to explain how natural selection and other evolutionary forces shape organisms to optimize their survival and reproduction in facing ecological challenges posed by their environments (Stearns, 1992). This theory suggests that an individual adaptively adjusts to environmental stressors in early environments (e.g., Belsky et al., 1991; Mittal et al., 2015; Nettle, 2010). Notably, individuals' early childhood stressors could interact with current environmental cues that calibrate LH strategy (Kaplan & Gangestad, 2005; Griskevicius et al., 2012). A potentially fatal disease outbreak is a potent environmental signal that establishes selection pressures for most living organisms, including humans, that use these environmental signals adaptively to choose developmental paths on a continuum—from slower LH strategies that focus on longer-term goals to faster LH strategies that focus on more immediate payoffs (Chisholm et al., 1993; Griskevicius et al., 2012). Under extensions of the LH theory framework, a broader suite of motivational and attitudinal LH traits could elucidate individual differences in managing fear of death during highly unpredictable times, such as the COVID-19 pandemic. As uncertainty lingered during the pandemic and lockdown, cognitive and behavioral manifestations of fast–slow LH strategy were associated with the perception of risky and unpredictable current environments that may also have influenced emotional reactions such as fear to various extents.

In a generally unpredictable environment with a substantial mortality threat, an individual with slow LH, compared with individuals with fast LH, may experience a more intense fear of death because of the perception of an uncertain future. Particularly, during relatively peaceful times, such as periods free of natural disasters or potentially fatal viruses, slow-LH individuals may express a greater fear of death because of the possible interruption of their long-term plans. Compared with fast-LH individuals, slow-LH individuals require greater ecological and social stability to formulate optimal adaptive strategies (Gladden et al., 2009). As future-oriented and long-term planners, slow-LH individuals might express more worries regarding the future when their current environment is considered dangerous and unpredictable. Slow-LH individuals' cognitive and behavioral manifestations involve inclinations to preserve life; conserve energy; maintain affiliative, cooperative, and altruistic relationships with important others (Chang et al., 2019); exercise caution; gain control; execute long-term plans; and avoid risk (Del Giudice & Belsky, 2010). Under the social and emotional toll caused by unpredictable environments, individuals require substantially more effort to remain safe. This may generate heightened anxiety regarding unaccomplished long-term goals and plans, coupled with uncertainty about the future. On the other hand, fast-LH individuals may experience less worry and anxiety when facing unpredictable general environments than COVID-related environmental difficulties. A faster LH strategy is more adaptive when the future is uncertain or when mortality and morbidity rates are high (Bereczkei & Csanaky, 2001) and is more beneficial in risky, resource-limited, and unpredictable environments (Miller & Rucas, 2012). Moreover, fast LH manifestations are intrinsically favored in dangerous, changeable environments because outcomes are considerably more uncertain (Mittal et al., 2015). The cognitive and behavioral manifestations of fast-LH individuals include less risk aversion, a focus on the present, an inclination toward immediate gains, and manifestations of impulsivity (Chen & Chang, 2016), boldness, or risk-taking orientations (Copping et al., 2013). These contingent expressions of fast LH strategy might be adaptive in discounting potential future losses and mitigating current stresses and anxiety.

Nonetheless, slow LH manifestations may become a buffering factor to mitigate death fear during the lockdown. The mandatory mobility restrictions required by lockdown policies include social distancing and self-quarantine, which have led people to avoid public gatherings, forcing some individuals to rely on their household or family members for their sense of overall social connection (Lu et al., 2021b; Okabe-Miyamoto et al., 2021). Individuals who adopt slower LH strategies may previously have more stable relationships, whether with families, romantic partners, or friends, than those who adopt faster LH strategies (Del Giudice & Belsky, 2010). As they face the threat of death during a pandemic and the accompanying lockdown, slow-LH individuals may exhibit relatively less fear than the level they may experience during a normal period because of the social support they receive from family, friends, and close social relationships. Thus, either face-to-face or remote support may help them endure relentlessly challenging situations. Additionally, due to the inclination toward future-oriented perspectives, slow individuals may show less antagonistic and resistant to, various disease control and public health measures (Chang et al., 2021). Unlike slow individuals who are inclined to affiliative, cooperative, and altruistic sociality that is mindful of future cooperation and long-term reciprocation, fast individuals who are characterized by antagonistic and utilitarian social interactional style, aimed at serving immediate and self-focused needs (Chang et al., 2021). Thus, for many fast LH strategists, the COVID-19 pandemic and mandatory lockdown may create a void in personal contact and self-isolation for some people who live alone (Banerjee & Rai, 2020) and for those who may lack close social connections. Fast strategists are therefore expected to demonstrate increasing pandemic-increased fear compared to the normal period. Accordingly, the adverse influence of an individual's current environment regulates the individual's adaptive psychological responses, such as fear regarding unexpected mortality threats. As increasing deaths due to COVID-19, which is highly contagious, an adaptive response to fear is fundamental in preparation for the survival of potential threat events (Ornell et al., 2020) for both LH groups during the lockdown.

3.1.2 Moderating Role of the Current Environment

LH theory has identified extrinsic mortality–morbidity (i.e., all unpreventable sources of mortality), an intrinsic component of mortality risk (i.e., mortality-causing threats that an organism has some control in overcoming), and unpredictability (i.e., the extent to which individuals cannot predict future events) as the key dimensions that calibrate LH manifestations (Ellis et al., 2009; Stearns, 1992). Most pathogen stress and infectious diseases (e.g., the COVID-19 pandemic) represent intrinsic risks because they do not cause species-wide adult mortalities; instead, these risks are differentially tolerated or resisted by individuals that lead to individual differences in disease susceptibility or defensibility (Lu et al., 2021a; Schmid-Hempel, 2003). Because of the perception of environmental unpredictability during the COVID-19 pandemic, individuals might continually monitor their environments' specific features or mortality cues (e.g., death counts, regional mortality rates, and infection rate) that could sensitize their LH strategy. Rather than being anchored for life, the LH strategy shows environmental contingency in response to particular types of mortality cues during adulthood (Mittal et al., 2015). The pandemic exerts a strong adverse impact on individuals' lives; high transmission and mortality rates, compounded by a lack of effective prevention and treatment measures, reinforce perceptions of the threat of death and environmental unpredictability. The strictest disease control measures were initially applied in Wuhan and subsequently in other Hubei municipalities, with a complete lockdown of the entire population beginning in late January 2020. Hubei's lockdowns created a strong sense of mortality salience (with an extremely high threat of death levels surrounding nearby communities) that could exert a stronger influence on the relationship between LH and the fear of death. Thus, previous LH manifestations would become less decisively calibrated. Furthermore, the COVID-19 pandemic may have encouraged individuals to behave in a more guarded manner because of behavioral and motivational controls ranging from social distancing and self-quarantine to compulsory lockdowns (Melnick & Ioannidis, 2020). Slow-LH individuals may acclimate to such behavioral controls because these social prescriptions and those of other organized disease control policies tend to favor behaviors that better characterize the slower side of the LH strategy (Sherman et al., 2013). Thus, slow-LH individuals may exhibit less anxiety concerning mobility controls compared to fast-LH individuals, and the intensity of fear of death experienced during lockdown may be influenced by both the current environmental status and LH.

The perception of environmental data from mortality rate sources and the processing of this mortality salience may interact with individuals' LH strategy and influence their fear intensity as an adaptive psychological response to current environmental threats. Research examining the interaction between mortality salience concerning the current external environment and emotional and cognitive responses associated with LH has primarily used priming to activate environmental cues. Mortality salience has been established to affect attitude and decision-making through various means. For example, Griskevicius et al. (2011b) demonstrated that an individual establishes a particular LH strategy during early childhood, but this strategy may manifest only when triggered by an environmental challenge—in this case, a mortality salience prime. Mittal & Griskevicius (2014) indicated that individual distinctions associated with early unpredictable or uncertain environments are often contingent on environmental contexts later in life. For example, college students with lower socioeconomic status (SES) tend to take more risks and behave more impulsively after mortality priming. However, studies have employed only artificial subliminal presentations of death-related cues that led to augmented death-thought accessibility. Therefore, studies applying natural death-related cues should be conducted. Similar to experimental studies that have investigated attitude and decision-making using a mortality prime to create awareness of one's mortality (e.g., Pyszczynski et al., 2004; Rosenblatt et al., 1989), the COVID-19 pandemic may activate a more comprehensive network of death-related concepts as the global spread of the virus progresses. Natural environments were employed herein to avoid the artificial effect of mortality salience priming. After more than one year of pandemic navigation, residents in Hubei have been released from lockdowns and travel restrictions. After the compulsory lockdown, the effective implementation of comprehensive control measures and infection-treatment practices has continuously led the infection and mortality rates in Hubei to decline (Zhang et al., 2020). We plan to construct a second-wave assessment tool to measure Hubei residents' fear of death in April 2021, when no new cases and deaths have been confirmed. The present study answered the next-step question of the joint effect of LH and the external environment (during versus after lockdown) in influencing fear of death and dying.

3.1.3 Present Study

Considering this pandemic background, the present study aimed at testing the principal effects of extreme current environmental unpredictability during and after the COVID-19 lockdown and LH strategy, respectively, as well as the interaction between these two factors concerning the fear of death. More in detail, we postulated that LH in predicting the fear of death would differ for environmental status during versus after lockdown. We tested the following hypotheses:

1. The correlation between slow LH and death fear would be positive. We predicted that individuals adopting slower LH strategies would experience a heightened fear of death compared with individuals adopting faster LH strategies in a relatively peaceful environment (after lockdown).
2. There would be a significant negative moderation effect of the current environment on the relationship between individuals' LH strategy and fear of death. We predicted a significant disordinal interaction between LH and the current environment.
3. Under extremely high mortality threats during the pandemic and lockdown, the correlation between slow LH and death fear would be attenuated by the moderation effect of the current environment.

3.2 Method

3.2.1 Sample Selection and Data Collection

We administered two web surveys from 2020 to 2021 in accordance with the indication that data collected from the Internet can be reliable and valid (Gosling et al., 2004). The snowball sampling method (Fricker, 2008) was used to recruit participants from the general population in Hubei province through personal invitations or materials advertised via social media platforms. Because of the COVID-19 pandemic, participants were recruited randomly online from Hubei Province during the lockdown from late January to early April

2020. The surveys, which were in Chinese, were collected in two waves 12 months apart. All participants provided informed consent, completed the surveys online, and were assured that their responses would remain confidential and be used solely for research purposes. Individuals who refused to provide consent or were unable to complete the surveys were excluded. The first survey was completed during the COVID-19 lockdown (Time 1; March 2020), and the second survey was completed after the COVID-19 lockdown (Time 2; April 2021). Of the 267 participants from Time 1, 202 completed both surveys and satisfied our inclusion criterion of current Hubei residency. In total, 65 participants were excluded from Time 2. Our study protocol was approved by the institutional review board of the authors' affiliated university.

3.2.2 Demographic Characteristics

Participants were asked to provide their demographic data with self-constructed items of gender, age, residency, marital status, employment status, education level, and household income (Table 1). The participants were aged 14–54 years (*M* = 30.58, standard deviation [*SD*] = 7.53), and 89 (44.06%) were women. In total, 94 of the 202 participants (46.53%) were Wuhan residents, and 108 (53.47%) were residents of other Hubei municipalities. A total of 156 (77.23%) of the participants were currently employed or self-employed, 136 (67.33%) were married, and most (*N* = 151) had a bachelor's degree or higher.

3.2.3 Measures

Fear of Death

Fear of death experienced during the lockdown was measured using the Multidimensional Orientation Toward Dying and Death Inventory (MODDI-F), which has a five-factor feature dimension: fear of one's own death (e.g., 'I am frightened by the idea that all my thoughts and feelings will stop when I am dead'); fear of corpses (e.g., 'The thought of the coldness of a corpse terrifies me'); fear of one's own dying process (e.g., 'The thought that my dying could be long and painful is unbearable to me'); fear of another person's death (e.g., 'I am afraid of losing loved ones through death'), and fear of another person's dying process (e.g., 'I am afraid of having to support another person someday when he or she is dying'). Items are rated on a 7-point Likert scale (1 = very strongly disagree; 7 = very strongly agree), with higher scores indicating greater fear of death. The alpha coefficient of the results ranged from .82 to .92, meeting the standard for internal consistency reliability.

Mini-K Scheme

The participants completed a 20-item scale measuring LH strategy's behavioral and cognitive aspects on a single continuum in the direction of slow LH (Figueredo et al., 2006). The items were rated on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Higher values indicate the presence of a greater inclination of slow LH traits and vice versa. The estimated internal consistency reliability of the results was .77, meeting the standard for internal consistency reliability.

Time 1

Between March 3, 2020 and the end of March 2020, 267 participants completed the MODDI-F, Mini-K Scheme and demographic queries.

Time 2

We invited participants who had participated in the Time 1 survey to complete a second survey between April 2 and April 18, 2021. The Time 2 survey contained the same MODDI-F and Mini-K scheme questions. The data of 65 of the 267 participants were excluded from further analysis either because they failed to complete the Time 2 survey or because they had moved from Hubei.

Current Environment (During vs. After Lockdown)

On both the Time 1 and Time 2 surveys, participants were asked whether they were currently in compulsory lockdown or self-quarantine in Hubei. For consistency with lockdown status, we included only participants who completed the survey on or before the date the compulsory lockdown was lifted at Time 1 (April 26, 2020). While at Time 2, all participants in Hubei were free to travel. The item was coded as a binary variable (1 = during lockdown; 0 = after lockdown).

3.2.4 Data Analytic Strategy

All analyses were performed with the R statistical software system in version 3.5.3 (R Core Team, 2016), using the library "lme4" (Bates et al., 2011). Preliminarily, a multivariate multiple regression analysis was performed to exclude the potential confounding effects of the following variables (as covariates): age, gender, marital status, and education level. Thus, external variables were simultaneously regressed on all the aforementioned demographic variables. Slow-versus-fast LH differences in death fear were tested using t-tests. Answering an ecologically valid paradigm often requires clustering data with multiple predictors for a response variable of interest because observations uniquely belong to particular groups that might arise from repeated measurements of the same individuals in a time series (Zuur et al., 2009). A linear mixed effects model is appropriate for representing and analyzing clustered data. In our analysis, individual observations are grouped by random factors, constituting the grouping level. In the analysis of variance, death fear was treated as the outcome variable, with fixed effects of the current environment, LH, and their two-way interaction. In the first instance, we fit a maximal random effects structure, which includes random slopes for each participant's repetitive measurement at different times. The evaluation of significance in mixed-effects models is to use the z distribution to obtain p-values from the Wald t-values (Luke, 2017). The statistical level of .05 was set as significant.

3.3 Results

3.3.1 Preliminary Analysis

The descriptive statistics of the demographic characteristics of the sample are summarized in Table 3.1. For a preliminary analysis, the response scores for the Mini-K Scheme, were categorized into two groups using the median-split: 0 = “fast LH group,” 1 = “slow LH group.” During lockdown, fear of death scores of the 98 participants who reported fast LH (M = 4.15, SD = .69) and the 104 participants who reported slow LH (M = 4.27, SD = .79) did not differ significantly, $t(192) = -1.20$, $p = .23$ (Table 3.2). After lockdown, fear of death scores of the 105 participants who reported slow LH (M = 4.95, SD = .92) were significantly higher than those of the 97 participants who reported fast LH (M = 4.20, SD = 1.34), $t(184) = -4.63$, $p < .001$; Table 3.2). The preliminary multivariate multiple regression analysis showed no statistically significant effects of external variables on demographic variables except gender. More in detail, controlling for other external variables, no statistically significant effect of (1) age ($\beta < .01$, SE = .01, $p = .87$); (2) marital status (β = -.03, SE = .11, $p = .82$); (3) education level (β = -.02, SE = .06, $p = .72$). A small marginal effect was found on gender (β = .17, SE = .10, $p = .09$).

Table 3.1

Demographic characteristics of the participants (n = 202).

Characteristics	*Mean (SD) or n (%)*
Age in years, mean (SD)	30.58 (7.53)
Gender *female*, n (%)	89 (44.06%)
Marital status *married*, n (%)	136 (67.33%)
Education level (college degree or above), n (%)	151 (74.75%)
Occupational status, n (%)	
– employed/self-employed	156 (77.23%)
– unemployed	18 (8.91%)
– retired	28 (13.87%)
Household monthly income, n (%)	
– below 2,000 RMB or 2,000 to 4,000 RMB	33 (16.33%)
– 4,000 to 8,000 RMB	106 (52.48%)
– 8,000 to 12,000 RMB or above 12,000 RMB	63 (31.19%)
Current location, n (%)	44 (20.8%)
– Wuhan	94 (46.53%)
– Other locations in Hubei	108 (53.47%)

Table 3.2

Comparison of fear of death by life history strategy and time.

	Time Period							
	During Lockdown				After Lockdown			
LH Strategy	n	*M*	*SD*	*t*	n	*M*	*SD*	*t*
Fast Group	98	4.15	.69	-1.20	97	4.20	1.34	-4.63^{***}
Slow Group	104	4.27	.79		105	4.95	.92	

Note: *P*-value by the *t* test.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

3.3.2 Effects of LH and Current Environment on Death Fear

Further model fitting was done using a linear mixed effects regression model, which incorporates both fixed and random effects (Zuur et al., 2009), allowing for the nature of the data (i.e., repetitive measurement in a time series). Fixed effects represent population-level (i.e., average) effects that should persist across different times (Brown, 2021). LH, current environment status, and their interaction were included as fixed effect predictors. Random effects are clusters of dependent data points in which the component observations come from the same participant at different time points. Each participant's responses at time 1 and time 2 (using the unique participant's ID) were included as a random effect to allow for variance between each measurement. The results of the linear mixed effects model are displayed in Table 3.3. The intraclass correlation coefficient (ICC = .07) for each participant indicated that the repetitive measurement at different times accounted for 7% of the explained variance. The fixed effects showed that slow LH ($\hat{\beta}$ = 1.86, SE = .45, t = 4.15, p < .001), current environment ($\hat{\beta}$ = .86, SE = .04, t = 20.34, p < .001), and the two-way interaction between slow LH and current environment ($\hat{\beta}$ = -.47, SE = .09, t = -5.11, p < .001) each had a significant effect on fear of death score difference. Each of the simple slope tests revealed a significant positive association between slow LH and death fear, but slow LH was more strongly related to death fear after lockdown (β = .86, SE = .04, t = 20.34, p < .001) than during lockdown (β = .38, SE = .08, t = 4.64, p < .001). Notably, there was a significant disordinal interaction between the current environment and LH. As illustrated in Figure 3.1, current environment status moderated the association between slow LH and the fear of death, suggesting that slow LH strategy was predictive of a more intense fear of death at lower levels of mortality threat in a given environment than at higher levels of this threat.

Table 3.3

Linear mixed effects model.

Predictors	Estimates [a]	*SE*	*95% CI*	*t*	*df*	*p*
(Intercept)	.48	.21	[.07 – .88]	2.30	201	.022
Current Environment	.86	.04	[.77 – .94]	20.34	199	<.001
LH	1.86	.45	[.98 – 2.75]	4.15	199	<.001
Environment * LH	-.47	.09	[-.66 – -.29]	-5.11	199	<.001
Random Effects						
σ^2 = .41						
ICC = .07						
N_{ID} = 202 [b]						

Notes: [a] coefficient estimate beta (= $\beta/SE(\beta)$), associated with the Wald's *z*-score.

[b] Observations = 404

Marginal R^2 = .54.

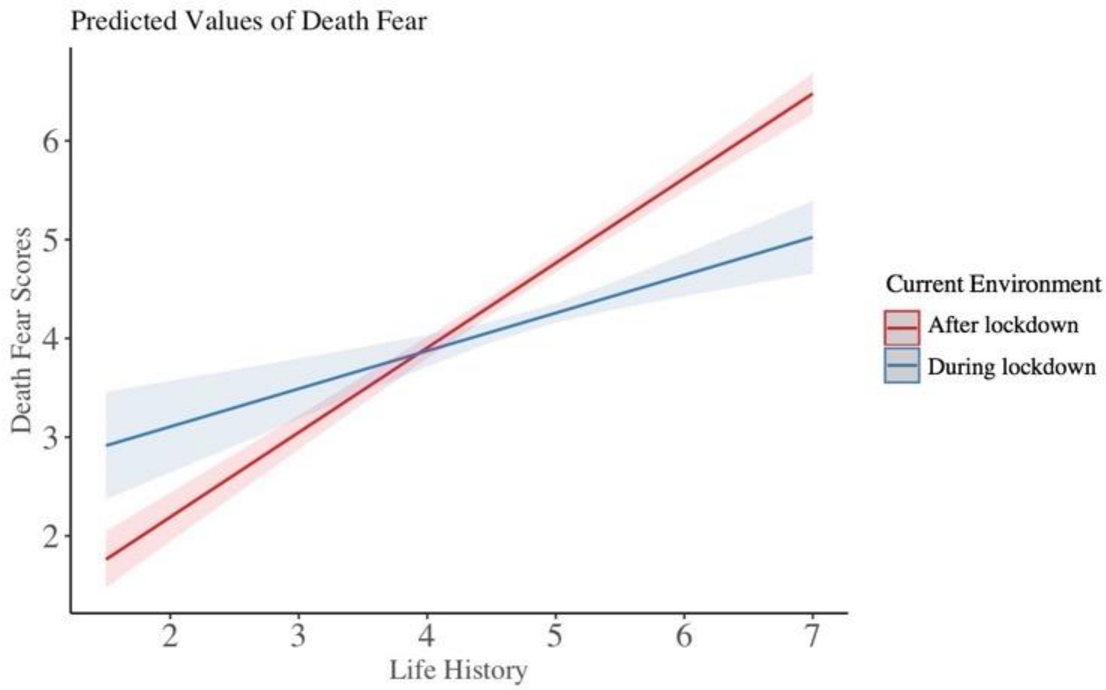

Figure 3.1 Simple slopes and 95% confidence bands from death fear regression on LH during lockdown (flatter; blue) and after lockdown (steeper; red) in linear mixed effects model (Higher LH values indicate the presence of a greater inclination of slow LH).

3.4 Discussion

The results of this study indicate that LH strategy, the current environment, and the two-way interaction between the current environment and LH strategy are individually related to, and predictive of, the fear of death. Our findings demonstrate that two factors interact in opposing directions influencing the fear of death. In particular, current environmental safety and unpredictability play a moderating role in the relationship between LH and death fear. In other words, slow LH strategy was associated with more intense death fear at lower than higher levels of mortality threats in individuals' current environment. These conditional predictions suggest that when the mortality threat is extremely high and when the future is highly unpredictable, LH manifestations could become less decisively calibrated. To reflect real-life psychological manifestations of LH that might not be encountered in a laboratory setting, we adopted a natural everyday setting of mortality salience instead of employing artificial mortality priming. In this study, people may shift their LH strategy slightly and/or become less dependent on their previous LH to better adapt to the unprecedented environment. These findings follow with past research that LH evolves in response to the environment (i.e., extrinsic factors; Nettle et al., 2014), and these environmental variations are assumed to affect LH traits through 'phenotypic plasticity' as individuals can respond to environmental cues to shift their LH strategy adaptively (Sear, 2020).

Investigating mortality threat psychology from an evolutionary perspective can lead to novel hypotheses and innovative approaches to support the integration of evidence across various analytical levels that are not integrated from existing theoretical perspectives. Death is the fundamental definition of conscious life; it is the experience, and emotional responses that guide, influence, and even determine that which forms our lives and how we adapt to a changing environment (Yalom, 1980). The frightening aspect of death is tethered to a general sense of danger (Wilson, 1903), and the focus of fear is palpably related to survival threats (Marks, 1987). Theories on anxiety and fear of death have provided a macro focus on approaches to 'managing' death (e.g., pedagogically in death education and financially in research and public health; Fortner & Neimeyer, 1999) and on conceptual investigations of the meaning of death and the afterlife (Thorson & Powell, 1994). The LH perspective focuses on how LH strategy affects fear of death and outlines the evolutionary logic underlying these dynamics. Considering specific ecological factors (e.g., predators, nutrition, natural disasters, and disease) and resource constraints and scarcity, LH strategy evolution by natural selection depends on a genetic variation on which selection can act to produce adaptations in response to the changing environment (Kaplan & Gangestad, 2005). When examining mortality threats from an evolutionary perspective, organisms better suited or adapted to their environment have a higher likelihood of survival (Kaplan & Gangestad, 2005). Variations in individuals' allocation decisions have generalized patterns on the fast-slow LH continuum. Applying the LH framework provides a means for studying evolutionary responses to mortality threats and unpredictable environments, particularly during unusual times such as pandemics. In this study, individuals who adopt slow LH strategies were generally more likely than those who adopt fast LH strategies to experience heightened fear of death in a less extreme environment (after lockdown with lower infection and death rates). This finding is consistent with reports that slow-LH individuals are more future-oriented (Chen & Kruger, 2017); thus, their perceptions of an uncertain future may substantially impact their current psychological status.

Mortality awareness and unpredictability with the unprecedented threat of death during an event like the COVID-19 pandemic lockdown have rarely been studied in the LH literature. The external environment operationalized herein was a larger ecology-wide variable affected by the pandemic in its influence on LH strategy and associated psychological responses (e.g., fear and anxiety). The research setting was realistic. The perception of environmental data from environmental sources and the processing of this mortality salience is essential in influencing psychological responses, which are also shaped by LH manifestations.

The overall impact of predictable variation on LH strategy is the evolution of additional life stages and potentially complex life cycles or events (Shefferson, 2010). Mounting evidence suggests that variation in the environment is associated with variation in LH traits and trade-offs (e.g., Walker et al., 2006), and such LH-related variation is linked to mortality risk and stressful environments (e.g., Frankenhuis et al., 2016; Nettle, 2015). Since many of the adaptations to the environment that allow organisms to deal with or escape these kinds of variability have created the diversity of LH (Shefferson, 2010). Despite some evidence of the predicted clustering of LH traits, the fixed fast-slow continuum did not receive overwhelming support, not least because there was within-sample variation (see Brown & Sear, 2020). Thus, it would be possible for LH strategy to be flexible under the influence of the current extreme environment. In this study, both fast and slow individuals reported similar scores of death fear during the lockdown. Although uncontrollable environments generally favor the psychological manifestations of fast LH strategy (Mittal et al., 2015), during the 2020 lockdown, fast-LH individuals may still have experienced distress because the lack of social mobility for an extended period may have strained their pursuit of immediate gains and because the threat of death is sufficiently considerable to override their hedonistic inclinations. The environmental cues reflect high mortality rates would neither prioritize fast LH (immediate gains) nor slow LH (future goals) because these immediate threats may outcompete the pre-existing LH manifestations. Future studies could further investigate the possible fluctuation of LH strategy in different ecological-wide paradigms with a longitudinal design.

Stress and panic swept through Hubei's communities in waves during government-mandated lockdown and self-isolation. Individuals may develop adaptive methods to cope with their fear of death, such as establishing meaningful relationships and social connections (Yalom, 2008) and seeking emotional support from others. Studies have demonstrated that social connection, a sense of belonging, and closeness with others, are fundamental to human development and well-being (e.g., Baumeister & Leary, 1995; Sun et al., 2019). This social connection was especially vital during the 2020 lockdown, when public gatherings were prohibited (later strictly regulated). Individuals who adopt a slower LH strategy may previously have had more stable relationships, whether familial, romantic, or social (Del Giudice & Belsky, 2010). Slow-LH individuals may have formulated more adaptive strategies and acquired more familial and social support (Gladden et al., 2009). During the compulsory lockdown, slow-LH individuals may have benefitted from the stable relationships they had created. Thus, during lockdown and self-quarantine, variations in the perceived environmental cues of mortality rates have driven and continue to drive individual distinctions in the predominance of cooperative (slow LH) versus unstable or distant (fast LH) social relationships (Figueredo et al., 2018). Our findings show a significant reduction in death fear scores during lockdown for slow individuals. These findings suggest that social connections could contribute positively to individuals' overall sense of connectedness, encouraging some of them to shift their LH to a slower direction and/or rely more on their previous familial and social support, thereby alleviating feelings of a loss of control and a fear of the unknown future. These individual variations in LH manifestations appear to strongly affect coping with fear during considerably worrisome and uncertain times. Future studies may expand on these findings to explore effects in LH variation that influence the intensity of fear of death in various circumstances.

Our findings should be interpreted cautiously because of the following limitations. First, given the relatively small number of participants, examining whether there are more detailed differences based on repetitive measurement at different time points is not feasible. Furthermore, time series data are frequently non-stationary, and further longitudinal studies with more time points are warranted to provide a more comprehensive understanding of the cumulative and long-term effects of individuals' fear of death on LH strategy as an adaptive response to a current environment. Additionally, larger sample sizes are required to examine LH variations better and delineate their interactions with current environmental factors such as cross-provincial or cross-national residential locations. For example, large-scale samples conducted across various regions may uncover distinctions in perceived death threats between individuals living in Hubei (where the infection rate was particularly high in the first quarter of 2020) and outside of Hubei. Second, the self-reported nature of the survey could have led to bias regarding variations in LH strategy and the fear of death. Consequently, a more in-depth investigation of participants' psychological reactions regarding fear or anxiety when their current environment is highly unpredictable and challenging, perhaps with experience sampling, qualitative methods, or daily diary application, is warranted. Third, the experience of confinement due to the COVID-19 pandemic has reinforced existing inequalities among some groups (e.g., older people, the homeless, and people with low SES) who may not be able to access electronic devices and digital technologies. The data collection has relied on a web-based survey; therefore, these marginalized groups may be excluded from this study. Finally, we used the multidimensional orientation toward dying and death as a dependent measure to examine cumulative attitudes toward mortality. Future studies may consider determining the effects of various expositions of death fear and examining more explicit mortality attitudes. This study is the first to compare associations between LH strategy and fear of death and the current environment's moderating role in this regard. Future studies should consider conducting more systematic investigations into the specific emotional responses and behaviors involved in this process relating to individuals' LH strategy and environments.

Our study is among the first to consider a natural environment and its interaction with individuals' LH strategy on the subject of fear of death under threats to survival. The application of the evolutionary framework of LH theory has immense potential to explain why and how an individual's emotional process responds to a specific environment. Such LH strategy expression may involve long-term versus short-term preference (Del Giudice & Belsky, 2010), risk avoidance versus boldness (Copping et al., 2013), and stable versus unstable social connections (Figueredo et al., 2018), and numerous psychological and behavioral aspects of LH trade-offs. LH theory emphasizes environmental contexts and individual distinctions, focusing on the micro aspects of psychological responses to changing environmental conditions. Our results reveal that an individual's current environment contributed critically to LH strategy and its psychological manifestation. When individuals encounter certain large-scale environmental challenges (e.g., pandemics, natural disasters, or famine), individual-level LH–related variables such as personality, family function, and social ties may become integral parts of the surrounding environment's perceptive and adaptive reactions. Under social distancing interventions that commenced in the spring of 2020, millions of individuals worldwide could no longer go to work or school in person or even leave their homes. These extraordinary environmental conditions led individuals to attach great importance to often-absent social closeness, belonging, and connection (Okabe-Miyamoto et al., 2021), shifting the slower end of LH. Our data can serve as a reference for practitioners across various disciplines to offer services to individuals who must enter social isolation during unusual events such as the pandemic. Policymakers should consider developing guidelines for physical distancing that mitigate fear and anxiety and regain a sense of closeness and connection. For example, local governments could provide online counseling. Systematic studies of individuals' distinctions in psychological responses when facing mortality threats are necessary. These investigations should explore underlying factors, such as family structure and socioeconomic status. To the best of our knowledge, this study is one of the first to examine how individuals' current environments and LH interact in calibrating individuals' adaptive psychological manifestations of the fear of death during the COVID-19 pandemic.

Chapter Four
Does life history, death fear and current environment influence end-of-life judgment? A vignette-based experiment

4.1 Introduction

The experience of the current pandemic, characterized by persistent mortality threats accompanied by prolonged death fear and other strong emotional reactions, has become part of the everyday concern to most people. One may experience pervasive cognitive preoccupation with environmental threats and intense fear and anxiety. Organisms better adapted to their environment have a greater chance of surviving and producing offspring (Swanepoel et al., 2016). Research has consistently revealed that environmental sensitivity helps people to develop in the ways that will be most adaptive, given the ecological circumstances in which they engage. Evolutionary life-history (LH) theory analyzes the costs and benefits of possible LH strategies on which selection can produce adaptations in response to the environment (Kaplan & Gangestad, 2005). Using an LH framework provides a means to study human evolutionary responses to a rapidly changing world. Recent LH research has indicated that if the variation in LH strategies is stably recurring, natural selection might favor the developmental path that uses cues to the environmental state to calibrate levels of vigilance and emotional sensitivity responsivity to process the mortality information (Boyce & Ellis, 2005). From an evolutionary perspective, ecological factors predicted by LH theory influence psychology and decision-making inclinations, for example, whether individuals are risk-taking or risk-aversive (Griskevicius et al., 2011b). However, few studies have explored the relationship between LH manifestations and cognitive decision-making and how emotional sensitivity toward death-related subjects could also influence the subjective justification of end-of-life decisions. Applying the LH framework, we propose that LH variations in emotional responses toward potential threats and their personality and behavioral manifestations are related to the cognitive judgment of life-ending behaviors, and this association is mediated by death fear.

4.1.1 LH on Individuals' Variations in Cognitive Process of Mortality Information

Accepting death-related behaviors or one's death, mainly referring to end-of-life decision-making, may exhibit individual differences that depend on environmental stress responsivity and further influence cognitive performance (Mittal et al., 2015). According to LH theory, our brains and bodies have been shaped by natural selection to respond adaptively to environmental cues (e.g., Belsky et al., 1991; Chisholm, 1993). All adaptive solutions require allocating time and energy from shared and limited ecological resources, and such trade-offs are called "LH strategies" that explain the behavioral and psychological differences between individuals (Promislow & Harvey, 1990). Researchers have found that humans, like other species, follow the developmental patterns that arise from different trade-offs and fall on a slow-fast continuum (e.g., Belsky et al., 2012; Nettle, 2010). Because the costs and benefits of different LH trade-offs differ as a function of individual characteristics and local ecological circumstances, optimal LH strategies vary across individuals within and between populations (Ellis et al., 2009). Hence, previous research has indicated that variations in LH strategies play a pivotal role in shaping individuals' cognitive processes (e.g., Figueredo et al., 2012; Wang et al., 2022). According to Woodley (2011), the different cognitive efforts are linked to LH, allowing individuals to better adapt to various ecologies.

Data anchored in several statistical approaches and laboratories have detected associations among measures of LH strategy and the possibility that LH trade-offs might maintain individual differences in cognitive styles favored by different environments (e.g., Hill et al., 1997; Wang et al., 2022; Woodley, 2011). The empirical research on LH theory has suggested that individuals who adopt fast LH strategies generally plan little for the future

(Gladden et al., 2009), lack of foresight (Figueredo et al., 2007), and engage in risk-taking and future-discounting-related behaviors (Figueredo et al., 2005; Jonason et al., 2012); whereas vice versa for individuals who adopted slow LH strategies. Specifically, slow LH is related to a superior capacity for rule governance that includes the abilities to plan, inhibit or delay responding & rewarding, initiate a behavior, and shift between activities flexibly (Figueredo & Jacobs, 2011), whereas vice versa for fast LH. Regarding cognitive strategy in decision-making, slow strategists prefer deliberate cognitive styles, while fast strategists are likely to adopt effortless, intuitive cognitive styles (Wang et al., 2022). Accordingly, intuitive cognitive styles allow individuals to deal with a more comprehensive range of micro-niches in an unstable environment (Woodley, 2011). By contrast, deliberate cognitive styles allow individuals to adapt better to stable ecological niches (Woodley, 2011). In this case, individuals adopting different LH strategies may differ in determining the justification or 'justifiable' and acceptability or 'acceptable' of end-of-life behaviors because of the individual's cognitive process differences. This hypothesis is supported by research showing that the lower the level of executive function, the more directly the individual responds to immediate extant adaptive problems, environmental conditions, and behavioral outcomes, which is associated with the characteristic of the impulsive, short-time-orientated fast LH strategies (e.g., Figueredo & Jacobs, 2011; Figueredo et al., 2012). On the other hand, the higher the level of executive function, the more the individual responds to long-term adaptive problems, environmental conditions, and behavioral outcomes, which is associated with the characteristic of the planful, long-time-orientated slow LH strategist (e.g., Figueredo & Jacobs, 2011; Figueredo et al., 2012).

4.1.2 Mediating Role of Death Fear

End-of-life decision-making moves beyond the concerns of cognitive styles with influences of emotions (e.g., fear, grief, and anxiety), which are associated with perceived mortality threats. Previous research assumed that emotions are one of the dominant drivers of most meaningful decisions in life (Frijda, 1986; Lazarus, 1991), through which emotions carry specific “action tendencies” that signal adaptive responses to the environment (e.g., Frijda, 1988; Lerner et al., 2015). Accordingly, the inevitability and unpredictability of death cause people to feel horror, and this fear of death is a fundamental source of psychological and behavioral responses in many circumstances (Yalom, 1980). Throughout evolutionary history, humans have contemplated the meaning of mortality and developed elaborate defense mechanisms against the terror of death (Wong & Tomer, 2011). Death remains one of the biggest and most significant challenges to survival. Notably, local mortality rates should have been a critical ecological cue in evolutionary history (Chisholm et al., 1993). In turn, local mortality rates allow individuals to use these perceived cues to adaptively select a developmental path on a continuum from slower strategies on longer-term goals to faster strategies on more immediate payoffs. In a generally unpredictable environment with a substantial mortality threat, an individual who adopts slow LH, compared with individuals who adopt fast LH, may experience a more intense fear of death because of the perception of an uncertain future (Guo & Lu, 2022). In addition, slow LH strategists may exhibit more death fear and anxiety when processing the mortality information because they have been exposed to relatively stable and predictable environments in their lives. On the other hand, fast LH strategists may exhibit less fear and anxiety when processing the mortality information because they have been exposed to relatively harsh and unpredictable environments more frequently. Hence, fast LH strategists may pay less emotional and cognitive attention to mortality information than slow LH strategists.

4.1.3 Moderating Role of Current Environment

Exposure to various environments could influence the relationship between LH strategy and the cognitive and emotional processes toward mortality. Rather than being anchored for life, the LH strategy shows environmental contingency in response to particular mortality cues during adulthood (Nettle et al., 2014). The perception and cognitive processing of ecological data from mortality rate sources may interact with individuals' LH strategy, which further influences their fear intensity as an adaptive psychological response to current environmental threats (Guo & Lu, 2022). Furthermore, mortality cues in the local environment have been established to affect attitude and decision-making. For example, Griskevicius et al. (2011a) found that an individual has a particular LH strategy set during early development that might be dormant in benign environments but may be especially likely to emerge in an environmental challenge (i.e., a mortality hazard). Previous research has examined how cues to mortality influence risky decision-making, suggesting that slow strategists should be associated with less risk and fast strategists should be associated with a preference for more risk (e.g., Hill et al., 1997; Griskevicius et al., 2011b). We, therefore, propose that LH strategies are linked to the decision-making process, and an individual's current mortality threats also influence this relationship. This study applied the experimentally manipulated mortality salience from previous studies to investigate emotion, attitude, and decision-making, using a mortality prime to create awareness of mortality (e.g., Pyszczynski et al., 1999; Rosenblatt et al., 1989).

4.1.4 Present Study

The current end-of-life literature is massive; many of these studies are developed from a decision theory standpoint (Knaus et al., 1995), clinical practices (Fins et al., 1999), and multiple measures of physiological functions (Baggs et al., 2007). Many of these efforts continue to be aimed at obtaining traditional in-the-moment medical decisions. Nonetheless, end-of-life decision-making should consider the nature of judgment and decision-making in adaptation to the current environment and predict future circumstances. Individuals may have difficulty predicting what they want in future circumstances because current predictions do not reflect and/or interact with one's current emotional and ecological contexts (Sudore & Fried, 2010). Hence, end-of-life decision-making can interactively involve more cognition, emotion, or both. We propose that faster versus slower LH strategies may exhibit some variations in environment adaptations, which in turn affect the decision-making process and judgment of life-ending behaviors by relying more on deliberate thinking versus intuitive thinking. Previous LH research has examined that slow LH (K-factor) is correlated negatively with psychoticism (Lafreniere, 2011) and neuroticism (Figueredo et al., 2007), emphasizing the variations in terms of emotional regulation for individuals adopting different LH strategies. Considering these LH variations and the role of emotional stability and regulation, this perspective can contribute to a deeper understanding of the influence of emotion (e.g., death fear) on end-of-life decision-making.

The present study partially replicated and extended previous research concerning factors affecting the reactions to end-of-life decision-making and judgment. We examined the associations among LH strategies, death fear, current environmental threat, and the agreement of committing life-ending behaviors (e.g., suicide, euthanasia, and abortion) by an experimentally controlled, randomized vignette study. Additionally, we assessed two possible current environmental factors (high mortality threat versus low mortality threat) that could affect how the previously adopted LH strategy frames death fear and end-of-life decision-making conflicts. We tested the following hypotheses: (a) Individuals adopting slower LH strategies would experience a heightened fear of death compared with individuals adopting faster LH strategies; (b) Slow LH would be associated with lower agreement and subjective justification scores of life-ending behaviors, and variations in death fear mediate this effect; (c) Current mortality threat may act as distinct variables in the structural model, moderating the effect of LH on death fear, death fear on the agreement and subjective justification of life-ending behaviors, and LH on the subjective justification of life-ending behaviors, respectively.

4.2 Method

4.2.1 Participants and Demography

Four hundred and thirteen college students and staff members from the University of Guangxi and Nanning Normal University in Guangxi participated in the study. Recruitment took place in several campus locations, and advertisements were placed on publicly accessible social media web pages. The study was conducted online and programmed in Qualtrics. Participants recruited on campus were asked for their WeChat accounts or email addresses and received a link to the survey. Participants were recruited via online advertisements or on-site so they could directly access the study via a web link. The Institutional Review Board approved the research protocol of the authors' affiliated university, and informed consent was obtained for participation in the research. The participants received monetary compensation for spending time completing all tasks.

A total of 207 participated in the priming study, and 206 participated in the control study. The total sample (N = 413) comprised 231 male participants (55.9%) and 182 females (44.1%). The average age is 20.3 years old (SD = 1.75). Most participants (84.3%) were single/unmarried, and over 80.7% had a college education and above. Overall, 309 current undergraduate students, 42 current graduate students, 34 current college employees, and 28 participants recruited via online advertisements with other occupations were included in the analyses.

4.2.2 Procedure

An experimentally controlled, randomized vignette survey was randomly distributed to each participant from January 2021 to April 2021. Participants read information about general study aims and procedures (e.g., data handling, anonymity, voluntariness) and provided informed consent. Participants first filled out a pre-prime survey about demographic questions, LH strategies, and perceived current environmental threats. After the pre-prime survey, the participants were divided randomly into two groups. One group received the mortality priming condition, and the other group received the control condition with the same format. Participants then performed a lexical decision task aimed at subliminally prime mortality-related versus mortality-unrelated words, and they were told to memorize the words as much as possible for a memory test. In addition, each participant received a mortality threat-related (priming condition derived from the mortality salience study; Greenberg et al., 1994) and a law-related newspaper article to read and evaluate. Both treatment and control groups consisted of participants responding to an open-ended question: "Please briefly describe in words the emotions and thoughts this article arouses in you." After the prime, each participant read seven vignettes describing suicidal situations, seven vignettes describing euthanasia situations, and seven abortion situations. After reading the vignettes, participants filled out questions about their agreement and justification scores of end-of-life decisions described in the vignette (see Measures). Participants finally responded to a death fear scale and a current environmental adversity scale. Once respondents turned in the complete questionnaires, they were given a debriefing form and thanked.

4.2.3 Measures

Slow LH Traits

Slow LH traits were assessed before the mortality prime, using a 20-item Mini-K Scheme measuring LH strategy’s behavioral and cognitive aspects on a single continuum in the direction of slow LH (Figueredo et al., 2006). The items were rated on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Higher values indicate the presence of a greater inclination of slow LH traits and vice versa. The estimated internal consistency reliability of the results was .77, meeting the standard for internal consistency reliability.

Death Fear

The death fear was measured using the Multidimensional Orientation Toward Dying and Death Inventory (MODDI-F), which has a five-factor feature dimension: fear of one's own death (e.g., 'I am frightened by the idea that all my thoughts and feelings will stop when I am dead'); fear of corpses (e.g., 'The thought of the coldness of a corpse terrifies me'); fear of one's own dying process (e.g., 'The thought that my dying could be long and painful is unbearable to me'); fear of another person's death (e.g., 'I am afraid of losing loved ones through death'), and fear of another person's dying process (e.g., 'I am afraid of having to support another person someday when he or she is dying'). Items are rated on a 7-point Likert scale (1 = very strongly disagree; 7 = very strongly agree), with higher scores indicating greater fear of death. The alpha coefficient of the results ranged from .82 to .92, meeting the standard for internal consistency reliability.

Vignettes

Respondents' judgment of life-ending behaviors was evaluated through the use of vignettes. The basic form of the vignettes used in this study was derived from the end-of-life case study vignettes (Maris et al., 1992), Suicide Attitude Vignette Experience (SAVE; Stillion et al., 1984), euthanasia vignettes (Kouwenhoven et al., 2013), and abortion vignettes (Marini et al., 2006). Though there exist different and opposing views about abortion across cultures, a research project on Chinese views and experiences of abortion argued that in the present, many Chinese believe that deliberately terminating the pregnancy is to end a human life, starting far earlier than at birth (Nie, 2002). Hence, in contemporary Chinese culture with a moral foundation of a 'conservative' Confucian position, abortion is unfortunate and morally wrong and marks the end of a potential human life (Ivanhoe, 2010). The vignettes were modified to make explicit that the decision was related to the participant and other individuals in hypothetical situations (see Table 4.1). This was accomplished by using a fictional person who would face end-of-life decisions and asking the participant to imagine themselves either as that person or with a third person's eye. The vignettes targeted three life-ending behaviors (e.g., suicide, voluntary euthanasia, and abortion), with nine different scenarios for 'the self' and twelve different scenarios for 'the other,' respectively. We used a 6-point scale measuring respondents' agreement with committing life-ending behaviors and a 6-point scale assessing the justification scores of these life-ending decisions. Higher numbers indicated more agreement on conducting life-ending acts, and higher subjective justification scores indicated how much more the participant found the above end-of-life behaviors' justifiable.' The calculated consistency reliability was .96, highly satisfying the standard of internal consistency reliability.

Priming Conditions (Perceived Mortality Threat)

Participants were randomly assigned to a mortality salience or a control condition (see Procedure section). The item was coded as a binary variable (1 = subtle death salience treatment; 0 = control condition).

Table 4.1

Vignette examples (chapter 4).

Vignettes	Descriptions
Suicide	You are divorced and living alone. Recently you have been admitted to the hospital in a nearly comatose condition because of an overdose of approximately thirty tablets of Valium, combined with alcoholic intoxication. As a heavy drinker, you have been unemployed from your janitorial job for the past three months. You felt increasingly depressed after you lost your job. For the past few weeks, you had insomnia, anorexia, and weight loss. The use of alcohol has increased considerably in the past month. You don't have any close relationships. You plan to end your life with substances.
Voluntary Euthanasia	You were cycling down a hill when you collided with an oncoming car around a blind curve, catapulting you onto the mountain path. Your helmet cracked, and you fell directly on your head. You broke your neck at the top of the spine. After the accident, you suffered a grievous injury leading to a terminal or vegetative state. You decide to exit treatment plans because you believe that all treatments would serve only to postpone or prolong the dying process unnaturally.
Abortion	You are a pregnant woman (or your wife is pregnant) with diabetes. You (She) had suffered from a series of body symptoms during your (her) pregnancy. You (She) developed megaloblastic anemia at 32 weeks of pregnancy. The baby developed hypoglycemia and had a loud heart murmur. A large heart was detected on chest X-ray, and echocardiography showed the presence of a truncus arteriosus. You plan to schedule an abortion surgery.

4.3 Results

4.3.1 Manipulation Check

Three items were used before the analyses to check whether manipulation was successful. Pairwise comparison between the subtle death-salient and control condition revealed that subtle death subjects and concepts exhibited more extensive relative perception of the current mortality threats, $t(411) = -2.28$, $p = .02$, hence replicating the previously obtained effect of mortality salience (Greenberg et al., 1994). The prime allows us to test our hypothesis with a comparison, in which each variable was compared with the perceived mortality threat and control conditions.

4.3.2 SEM Analysis

Structural equation modeling (SEM) was used to follow up on the main effects of LH strategy on the subjective justification of life-ending behaviors mediated by death fear. To assess the moderated mediation SEM model, we examined the relationships and significance tests among three variables (Table A.1; Appendix). Specifically, we investigated whether there were significant interactions between the priming conditions (mortality salience versus control) and each of the three latent constructs (e.g., slow LH traits, death fear, subjective justification of life-ending behaviors). The Likelihood-Ratio test (LRT) indicated a better goodness-of-fit for a moderated mediation SEM model compared with a mediated SEM ($\chi^2(1) = 614.61$, $p < .001$). Relationships among the constructs are depicted in Figure 4.1. Slow LH traits were significantly associated with a higher level of death fear ($\beta = .54$, $p < .001$), which in turn, predicted a lower justification score of end-of-life behaviors ($\beta = -.21$, $p < .05$). The direct path between slow LH traits and justification scores of end-of-life behaviors was statistically significant in the present model ($\beta = -.41$, $p < .001$), indicating the partial mediation effects of death fear. Based on the bootstrapping results, the mediated effect (ab) is partially significant ($Z = -1.74$, $p = .06$), direct effect (c) is statistically significant ($Z = -12.22$, $p < .001$), with 10.0 [1.4, 20.6] % mediated. Despite the significant Chi-Square value ($\chi 2$ (43, $n = 413$) = 211.70, $p < .001$), the $\chi 2$-to-degree of freedom ratio ($\chi 2/df = 4.92$) was adequate based on Wheaton et al.'s (1977) relative/normed chi-square ($\chi 2/df$). The criterion for accepting the $\chi 2$-to-degree of freedom ratio ranges from less than 2 (Ullman, 2006) to less than 5 (Schumacker & Lomax, 2004). Other goodness-of-fit indices demonstrated satisfying results (*CFI* = 0.998, *TLI* = .971, *RMSEA* = .096, *SRMR* = .002). The moderated mediation SEM further revealed that only the interaction between slow LH traits and perceived mortality threat on death fear was significant (β = -.31, p < .001), suggesting that individual's difference in death fear at the higher level of mortality threat was much less so than at the lower level of mortality threat.

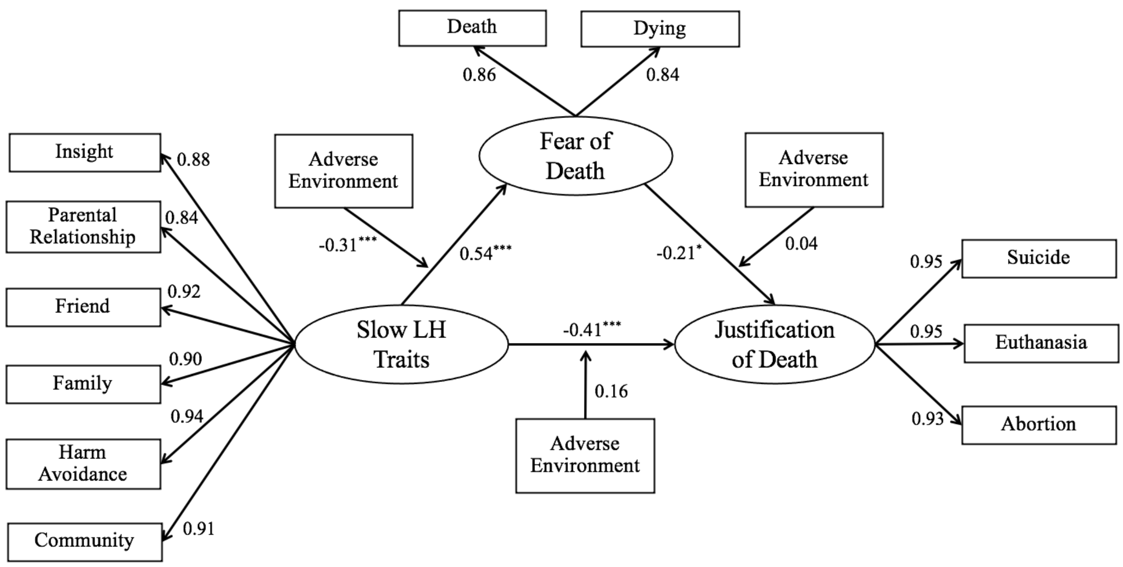

Figure 4.1 Structural relationships among slow LH traits, death fear and justification of life-ending behaviors. $^{*}p$ < .05, $^{**}p$ < .01, $^{***}p$ < .001. (χ^2/df = 211.70/43 = 4.92, *CFI* = .998, *TLI* = .971, *RMSEA* = .096, *SRMR* = .002).

Note: *CFI*, comparative fit index; *TLI*, Tucker–Lewis index; *RMSEA*, root mean square error of approximation; *SRMR*, standardized root mean square residual.

4.4 Discussion

The present study experimentally investigated the processes of mediation and moderation linking LH strategy, death fear, and current mortality threat to the agreement and subjective justification of life-ending behaviors. We explored the mediating role of death fear and the moderation roles of current mortality threat in the structural model, respectively (see Figure 4.1 for details). We find that slow LH is predictive of a higher level of death fear, which in turn predicts a lower justification and acceptability of life-ending behaviors. The SEM results suggest that death fear partially mediates the relationship between slow LH and the subjective justification of life-ending behaviors. Furthermore, the strength of the association between slow LH and death fear depends on perceived current mortality threats. That is, the level of death fear is influenced by the interaction between slow LH and the current mortality threat. These results have several theoretical and practical implications, which we consider in turn.

Our findings suggest that death fear is a significant mediating variable linking slow LH to the justification of end-of-life decisions. In line with the previous research, this study partially replicated and extended past research on the effect of death reminders could cause deep fear and anxiety that arise from the thoughts of death (Vaughn et al., 2010), which in turn caused a notable change in attitudes and behaviors (Greenberg et al., 1994). From an evolutionary point of view, natural selection combines psychosocial traits into meaningful functional composites that include situation-specific signatures (Figueredo et al., 2005; Mischel & Shoda, 1995). Thus, the LH calibration on the fast and slow continuum depends on how individuals gain energy and optimize resource expenditures influenced by environmental risk and mortality threats. Accepting death-related behaviors or one's death, particularly referring to end-of-life decision-making, may exhibit individual differences contingent on environmental stress responsivity. Previous studies have discovered the link between mortality and LH strategy (Chisholm et al., 1993; Greenberg et al., 1992); however, the evidence of psychological mechanisms, such as the intensity of death fear influenced by LH strategy, which in turn affects death attitudes, is relatively scarce. The structural model proved that the relation between slow LH and justification of life-ending behaviors was partially mediated by death fear. The end stages of life are beset with fear, and the thought of death can be a source of overwhelming emotions (Becker, 1973). The fear of death is one of the emotional forms in which we express the instinct for life, and the frightening aspect of death is bound up with a sense of danger to survive in the changing environments. Hence, the death reminders that increase death thought to posit the sophisticated cognitive abilities to facilitate our ability to survive and reproduce (Becker, 1971).

As expected, the observed results provide preliminary evidence for an association between LH manifestations and the subjective justification of life-ending behaviors. This is consistent with previous studies that the fast end of LH strategy predicts the expression of impulsivity (Copping et al., 2013), risk-taking behaviors (Figueredo et al., 2005), and a preference for short-term gains (Carver, 2005), compared to the slow end of LH strategy. Data from recent studies have detected the relations among measures of LH strategy, specific cognitive functions (Bergeron & Valliant, 2001), and constellations of high-risk behavior (Figueredo et al., 2005). Individuals who adopted faster LH strategies may be more impulsive and short-term oriented in decision-making and judgment for the acceptability of ending life. In comparison, individuals who adopted slower LH strategies may be less impulsive and long-term oriented in decision-making and judgment for the acceptability of ending a life. These characteristics of LH traits may further exhibit individual differences in cognitive judgment of death and dying. These findings merit consideration of other influential factors or mediators (e.g., personality manifestations of LH, impulsivity, inhibiting or delay responding & rewarding; Figueredo & Jacobs, 2011) in future studies on the role of LH variations in the acceptability of end-of-life decisions.

The findings reveal that the trade-offs in cognitive resource expenditures (i.e., intuitive thinking versus deliberate thinking) is likely linked to LH manifestations (Richardson & Hardesty, 2012). We find a negative association between slow LH strategies and subjective acceptability/justification of end-of-life decisions. Studies have documented that slow LH traits are associated with the ability to delay gratification due to exposure to an unstable and unpredictable environment (Brumbach et al., 2009). One plausible reason for this finding, consistent with previous research (Wang et al., 2022), is that effortful, controlled cognitive processes and cognitive styles are conducive to future development and success, which is prioritized by slow LH strategists (Figueredo et al., 2012). Slow LH strategists may be more cautious and thoughtful about future outcomes; therefore, they may judge suicidal decisions, voluntary euthanasia, and abortion as less acceptable and justifiable because these end-of-life decisions disrupt future-oriented goals or plans. On the other hand, faster LH strategists generally focus more on short-term gains and tend to have inclinations toward risk-taking, sensation-seeking, and impulsive expressions (Copping et al., 2013). These characteristics are correlated with an intuitive cognitive style characterized by impulsivity and time-intensive reflection with more present-focused (Wang et al., 2022). Fast LH strategists may rely more on intuitive decisions when judging end-of-life behaviors by avoiding the cost of overthinking and hesitation. Researchers also have found that fast LH strategies generally plan little for the future (e.g., Gladden et al., 2009), engage in risk-taking behaviors (e.g., Figueredo et al., 2005), and sensation-seeking (Zuckerman, 1971). Hence, for fast LH strategists, end-of-life behaviors may be judged relatively more acceptable with the ‘gut instinct’ in threatening situations by avoiding physical and mental suffering.

Consistent with previous research (Guo & Lu, 2022), slow LH is predictive of more intense death fear. In this study, the current mortality threat moderated the relationship between LH and death fear. The previous findings suggest that individuals may adjust LH strategies to remain flexible and sensitive to environmental signals (Chisholm et al., 1993), and LH manifestations could become less decisively calibrated when the mortality threat is exceptionally high (Guo & Lu, 2022). Specifically, individual variations in emotional sensitivity would be reduced when mortality cues were present. These results are consistent with previous findings that unpredictable environments with a relatively higher mortality-morbidity rate tend to shift organisms toward "faster" LH strategies to reduce long-term investment (e.g., Chisholm, 1993; Ellis et al., 2009). Therefore, a more plausible interpretation of our findings is that individuals who experience high mortality threats would have learned or unconsciously shifted LH strategy to save energy for more urgent tasks, confirming their anticipation of an unpredictable future. In this way, the individual variations in death fear influenced by LH may become less dependent. These findings highlight the need for future research to examine potential mechanisms in the relationship among LH variations, environmental factors, and emotional and cognitive responses to death.

Establishing attitudes or judgments to end-of-life decision-making will likely provide an excellent impetus for psychology research and care plan development for people experiencing strong emotions such as intense death fear or anxiety and severe grief reactions. First, the perceptions of the acceptability and meaning of end-of-life behavior are associated with different risks for such behavior, which could be incorporated into prevention activities (Dahlen & Canetto, 2002). For example, the educational program would reduce the adverse effects of public and self-stigma of unnecessary suicidal attempts, allowing help-seeking behaviors. Educational programs may also do well at addressing the cultural and situational acceptability of euthanasia in response to a severe physical illness and abortion, allowing less impulsive end-of-life decision-making. Second, this study indicates that fast LH strategists exhibited more subjective acceptance of end-of-life behaviors; therefore, these findings could translate to ideas for prevention. Unlike fast LH strategists, slow LH strategists may previously have more stable relationships – e.g., kin, romantic, and social exchange partners (Del Giudice & Belsky, 2010). Healthy family functioning and family social support are vital to protecting individuals from various forms of suicidal attempts and irrational end-of-life decisions. Intervention programs targeting people without much social support and connection should consider incorporating other forms of community support into these programs.

The present research has several limitations. First, we used a sample that contained the most higher educated individuals than the average population. It remains to be investigated whether our conclusions would hold in more representative samples (e.g., samples with different age groups and samples of other regions). Second, the retrospective self-report questionnaires and vignettes could have led to bias regarding variations in LH strategy, current mortality threats, death fear, and agreement/justification scores of end-of-life decisions. Future research may adopt a longitudinal approach to more accurately discern participants' psychological reactions regarding fear or anxiety, past experiences, and current environmental threats. Third, vignettes may not be able to generalize to real-world situations. Future studies should consider conducting more systematic investigations into the specific emotional and cognitive responses to end-of-life decision-making.

The present study contributes to a deeper understanding of the underlying mechanisms of death fear and current mortality threat in the relationship between LH strategy and the agreement and subjective justification of end-of-life behaviors. The mediation role of death fear indicated that end-of-life decisions could interact with cognition and emotion. Furthermore, the perceived current environment (e.g., mortality threat) moderates the relationship between LH strategy and death fear, suggesting that adaptive LH strategies require the integration of multiple LH traits and often show coordinated plasticity to environmental conditions (Roff, 2002). The empirical research on LH theory has suggested that humans can discretionally adjust their LH strategies in response to various ecological conditions during development (e.g., Belsky et al., 1991; Ellis et al., 2009). This study provides insights into the possible relationship between LH strategy and emotional and cognitive aspects of end-of-life decision-making for future research to explore further.

Chapter Five
An analysis of life history, adverse environment and subjective justification of life-ending behaviors

5.1 Introduction

Heightened awareness of death and dying can be associated with the increasing population density, limited resources, and unpredictable ecological and social environment. Evolution by natural selection gave organisms the ability to adapt their behaviors flexibly to different environments (Lettinga et al., 2020). Given certain ecological factors (e.g., predators, natural disasters, disease) and resource constraints and scarcity, a fundamental problem faced by all living organisms is the allocation of limited time, energy, and resources successfully among the various tasks associated with survival (Griskevicius, 2011b). Life History (LH) theory deals with the trade-offs in allocating time and resources over an organism's life span to different functions with the impact of the local environment on the optimal allocation balance (MacArthur & Wilson, 1967). These trade-offs operate on the notion that the differences in the amount of bioenergetic and material resources allocated for somatic effort (i.e., resources devoted to continued survival) and reproductive effort (i.e., devoted to mating and parenting) exhibit individual differences (Jonason et al., 2016). Thus, LH theory focuses on the allocation of "decisions" made by an individual because it assumes that the selection would shape an individual's specific psychological and physiological mechanisms (Stearns, 1992). The variation of allocation decisions for environmental adaptations has generalized patterns on the fast-slow LH continuum. In this study, we proposed that the cognitive responses and judgment toward life-threatening situations (i.e., death threats, mortality hazards, and end-of-life decisional dilemmas) may be influenced by numerous environmental and psychological factors shaped by LH strategy over time. The inherent decision-making processes underlying mortality-related and end-of-life situations may be ultimately associated with adaptive trade-offs as they refer to the variations in cognitive styles, rationality, personality traits, and environmental adaptations. This research will address the research gap in a micro-focus on individual differences in the cognitive process of mortality by offering a new evolutionary perspective on LH. From an evolutionary perspective, we propose that LH predictors are more or less likely to influence attitudes and decision-making in a given environment.

5.1.1 Fast versus Slow LH

The LH theory analyzes the trade-offs of possible LH strategies resulting from natural selection without the genetic and developmental constraints within particular ecological environments (Kaplan & Gangestad, 2005). In humans, the critical ecological cues for calibrating LH include safety constraints, extrinsic risk, and mortality hazards (Chang et al., 2019). According to LH theory, natural selection favors individuals who can allocate limited resources over the life span and across different ecological conditions (Belsky et al., 2012). The individual differences in LH strategy constitute a comprehensive pattern of development that may affect many aspects of psychological and behavioral traits. An overall trend exists in the directionality of the trade-offs made at the level of specific LH traits (Ellis et al., 2009). According to Promislow & Harvey (1990), the variation in LH strategies lies on a continuum that can be described as fast versus slow that arises from different trade-offs in resource allocation and expenditure. In response to local socio-ecological conditions, trade-offs between growth/maintenance and reproduction would enhance inclusive fitness during the species' evolutionary history (Ellis et al., 2009). A growing body of experimental work demonstrated that higher local mortality appears to affect how individuals deal with the LH trade-offs (e.g., Belsky et al., 2012; Chisholm et al., 1993; Nettle, 2010), and these LH trade-offs on the fast and slow continuum is contingent on how individuals gain energy and optimize resource expenditures under environment risk and mortality threats. In general, slow

LH is associated with later reproduction age, having fewer offspring with more investment in each child, and increased somatic efforts, whereas faster LH is associated with earlier reproduction age, having more offspring with less investment in each child, and diminished investment in somatic maintenance (Belsky et al., 2012; Ellis et al., 2019). Fast LH strategists who produce many offspring are more likely to hedge against juvenile mortality and achieve higher fitness than slow LH strategists who exhibit high parental investment, which is ineffective in preventing juvenile mortality (Lu et al., 2021a). By contrast, slow LH strategists prevail in safe and predictable environments (Griskevicius, 2011a). They invest time and energy in their own physical and mental development (acquiring knowledge and skills) and the development of their offspring. Whether an individual adopts a slower or faster LH strategy is also influenced by events in one's current adult environment and events that are salient in one's childhood environment (Griskevicius, 2011a).

Likewise, the fast-slow LH trade-offs are also related to some clusters of psychological traits that facilitate certain adaptive behaviors (Simpson et al., 2012). LH theory predicts that personality traits should cluster non-random to adaptatively solve survival, reproduction, and developmental tasks (Rushton, 1985). Accordingly, previous research has found that faster LH strategies are adopted in ecologies that are perilous, threatening, and resource-limited (Simpson et al., 2012). Because individuals may have shorter life spans under these ecologies, they are more prone to invest in immediate payoffs than long-term outcomes. Furthermore, fast LH strategies tend to be related to risk-taking and opportunism, being more aggressive and chasing short-term benefits (Figueredo et al., 2018). On the other hand, slower LH strategies are adopted in ecologies that are more stable, less threatening, and resource plentiful. Hence, slow LH strategies are associated with a general psychological disposition for long-term planning (Gladden et al., 2009), less aggression, and more risk aversive (Figueredo et al., 2018). In line with this idea, correlational research in humans has shown that the variations in LH are associated with psychological traits and behavioral constellations that are contextually appropriate (Pepper & Nettle, 2017).

5.1.2 LH Variations in Cognitive Judgment and Decision-making

Previous studies propose that cognitive processes constitute a crucial part of human LH strategies in a continuum of short-term (fast LH) versus long-term (slow LH) (Figueredo et al., 2012; Wang et al., 2022). The thinking style varied by LH carries implications of a broad range of psychological and cognitive responses, including the adjustment to the environment (Epstein et al., 1992), various types of cognitive efforts (Woodley et al., 2011), and cognitive strategy preference in decision-making (Maran et al., 2020). Recent work on LH suggested that slow LH manifestations are associated with cognitive differentiation efforts, while fast LH manifestations are associated with cognitive integration efforts (Woodley et al., 2011). According to the cognitive differentiation-integration effort (CD-IE) hypothesis, environmental factors regulating LH variations exhibit the trade-off between a specialized form of somatic effort (cognitive differentiation effort) that invests energy and resources into the development of different abilities and a specialized form of mating effort (cognitive integration effort) that invests energy and resources into strengthening the positive manifold (Woodley et al., 2011). This trade-off is related to a variety of cognitive phenotypes, including variance in intelligence (Carroll, 1993), cognitive specialism versus generalization (Woodley et al., 2011), and the capacity to allocate time as a resource to acquire skills and knowledge (slow LH) versus acquiring a broad set of competencies (fast LH; see Del Giudice et al., 2011). These findings highlight that variations in cognitive styles shaped by LH trade-offs would allow individuals to deal with more comprehensive ranges of micro-niches under certain environments.

In addition, accepting death-related behaviors or death, mainly referring to end-of-life decision-making, may also exhibit individual differences that depend on environmental stress responsivity and cognitive performance. The psychological traits associated with LH trade-offs, such as the constellations of high-risk versus low-risk behaviors (Figueredo et al., 2005), pursuit versus delay of current rewards (Figueredo & Jacobs, 2011), and the capacity for rule governance and intelligence (Maran et al., 2020) tend to influence the cognitive judgment and decision-making process. Compared with fast LH strategists, slow LH strategists tend to develop an enhanced executive functioning and, more specifically, a superior capacity for rule governance that includes abilities to plan, inhibit and delay responding (Figueredo & Jacobs, 2011). Particularly, there is a solid relationship between general self-control and an individual's level of executive function. Hence, the lower the level of executive function, the more directly the individual responds to immediate extant adaptive problems characterized by impulsive, short-time-orientated fast LH manifestations (Figueredo et al., 2012). On the contrary, the higher the level of executive function, the more the individual responds to long-term adaptive problems characterized by planful, long-time-orientated slow LH manifestations (Figueredo et al., 2012). Therefore, faster versus slower LH strategists may exhibit variations in environment adaptations, influencing the cognitive styles, judgment, and decision-making process.

These hypotheses are supported by research showing that deliberate cognitive efforts, such as deliberate thinking and thorough cognitive efforts for the outcomes, are crucial for gaining knowledge that benefits individuals in the future (Sih & Del Giudice, 2012; Wang et al., 2022). Deliberate thinking through perspective-taking may be positively associated with future-oriented behaviors, long-term planning, and self-regulation, manifested by slower LH (Wang et al., 2022). On the other hand, intuitive thinking is associated with prioritizing immediate returns but at the cost of long-term gains, which are characterized by faster LH (Wang et al., 2022). In addition, according to Sih & Del Giudice (2012), the risk-reward mentioned above trade-offs could link between fast-slow LH manifestations and cognitive decision-making styles. For example, fast LH individuals exhibiting a higher level of impulsivity tend to prefer immediate rewards over delayed rewards, which in turn influence the cognitive styles (e.g., speed over accuracy, less persistence in evaluating options, and more heuristic responses, and vice versa for slow LH individuals (see Chittka et al., 2009; Trimmer et al., 2008). However, more research has yet to explore whether individuals adopting different LH strategies may differ in the decision-making process regarding end-of-life judgments and decisions.

5.1.3 The Impact of Current Adverse Environment

Recent research has broadened its focus to investigate whether individuals' ecology impacts LH traits. Because the costs and benefits of different LH trade-offs diversify as a function of individual characteristics and local ecological circumstances, optimal LH strategies vary across individuals within and between populations (Ellis et al., 2009). A stressful environment can be harsh and/or unpredictable, and each environment dimension may affect future behavioral patterns (Simpson et al., 2012). Specifically, local mortality rates should have been a critical ecological cue in evolutionary history (Chisholm et al., 1993). Various events in life, such as terminal illness or the death of a loved one, would push individuals front of the reality of mortality. Rather than being anchored for life, the LH strategy shows environmental contingency in response to particular mortality cues during adulthood (Nettle et al., 2014). For example, exposure to harsher ecologies may tend to inhibit the pursuit of deferred rewards and future benefits (Griskevicius et al., 2011b). Other important environmental signals include harshness characterized by a high mortality rate and unpredictability that reflects stochasticity in harshness over time (Ellis et al., 2009). These environmental cues reflect that high mortality rates tend to cause individuals to behave in ways that prioritize immediate gains while avoiding any substantial long-term investment (Brumbach et al., 2009). Considering the fitness benefits of risk-taking, including the role of outcome variability, this evolutionary perspective can contribute to a deeper understanding of the myriad forces influencing judgment about future eventualities and the decision-making process. These dispositions may also influence risk-taking propensities that may affect cognitive judgment and decision-making in people's lives. Hence, the perception of ecological data from mortality rate sources and the processing of this mortality salience may interact with individuals' LH strategy that, further influences their cognitive responses to current environmental threats.

5.1.4 Present Study

This paper examined the relationship among LH strategy, the current adverse environment, and the subjective justification of life-ending behaviors. We further tested the hypothesis that the relationship between LH and the subjective justification of end-of-life behaviors would be moderated by the current adverse environment (i.e., harshness and unpredictability). Our specific hypotheses were that: (a) Slow LH strategies and traits would be associated with the lower justification scores for end-of-life behaviors; (b) The current adverse environment would moderate the relationship mentioned above; (c) We predicted a significant ordinal interaction between LH and current adverse environment. These hypotheses were tested by analyzing two datasets: a cross-sectional survey (Study 1) and the World Values Survey (WVS; Study 2). Using two independent datasets allowed us to replicate our results externally and to test the robustness of the association between LH strategy and the subjective justification of life-ending behaviors. In addition, we further simulated a replication using a large cross-nation dataset (WVS) that provides representative samples of respondents.

5.2 Study 1

5.2.1 Method

5.2.1.1 Sampling and Recruitment Process

Two hundred and four subjects from the University of Guangxi and Nanning Normal University (Nanning, China) participated in the study. Recruitment took place in several locations, and advertisements were placed on publicly accessible social media web pages from May 2021 to August 2021. The study was conducted online and programmed in Qualtrics. Participants recruited on campus were asked for their WeChat accounts or email addresses and sent a link to the survey. Participants recruited via online advertisements could directly access the study via a web link. The participants received monetary compensation for spending time completing all tasks. The total sample comprised 113 male participants (55.39%) and 91 females (44.61%). The average age was 20.1 years old (*SD* = 1.83). Most participants (*N* = 171; 83.82%) were single/unmarried, and over (*N* = 168; 82.35%) received a college education and above. Most participants were current undergraduate or graduate students (*N* = 163; 79.90%), and others were employed with full-time jobs (*N* = 39; 19.12%).

5.2.1.2 Procedure

A vignette survey was randomly distributed to each participant. Participants read information about general study goals and procedures (e.g., data handling, anonymity, voluntariness) and provided informed consent. Participants first filled in questions about LH strategy in the mini-k scheme. After the first part of the survey, each participant read seven vignettes describing suicidal situations, seven vignettes describing euthanasia situations, and seven vignettes describing abortion situations. After reading vignettes, participants filled in questions about their justification scores of a hypothetical person's end-of-life decisions described in the vignette (see Variables). Participants then responded to a current environmental adversity scale and demographic questions. Once respondents turned in the complete questionnaires, they were given a debriefing form and thanked. All participants were treated following the ethical guidelines for human subjects of the author's affiliated institution.

5.2.1.3 Variables

Slow LH Traits

Slow LH traits were assessed before the mortality prime, using a 20-item scale measuring LH strategy’s behavioral and cognitive aspects on a single continuum in the direction of slow LH (Figueredo et al., 2005). The items were rated on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Higher values indicate the presence of a greater inclination of slow LH traits and vice versa. The estimated internal consistency reliability was .77, meeting the standard for internal consistency reliability.

Current Adverse Environment

The current adverse environment was measured in two dimensions: environmental unpredictability (fluctuations in environmental conditions related to social environment instability; Sung et al., 2016) and environmental harshness (limited economic resources and income harshness; Ellis et al., 2009). Four global items about perceived environmental unpredictability were obtained by Luo et al. (2020). Participants were asked: ‘To what extent do you believe the environment is getting more dangerous?’, ‘To what extent do you believe the environment is getting more unsafe?’, ‘To what extent do you believe the environment is getting more unpredictable?’ and ‘To what extent do you believe the environment is getting more uncertain?’. All four items were responded to on a seven-point scale from 1 = “very strongly disagree” to 7 = “very strongly agree,” with higher scores indicating higher perceived levels of environmental unpredictability. An alpha coefficient was reported as .94, suggesting these results meet the standard for internal consistency reliability. The current environmental harshness was modeled using the respondent’s income level and economic resources in seven items (scale 1-7: the higher the score, the lower the income level, or the harsher the economic resources). An alpha consistency reliability was calculated as .91, meeting the standard for internal consistency reliability.

Vignettes

Respondents' agreement and subjective justification of life-ending behaviors were evaluated using vignettes. The basic form of the vignettes used in this study was derived from the end-of-life case study vignettes (Maris et al., 1992), suicide attitude vignette experience (SAVE; Stillion et al., 1984), euthanasia case study vignettes (Kouwenhoven et al., 2013), and abortion case study vignettes (Marini et al., 2006). Though there exist different and opposing views about abortion across cultures, a research project on Chinese views and experiences of abortion argued that in the present, many Chinese believe that deliberately terminating pregnancy is to end a human life, starting far earlier than at birth (Nie, 2002). Hence, in contemporary Chinese culture with a moral foundation of a 'conservative' Confucian position, abortion is unfortunate and morally wrong and marks the end of a potential human life (Ivanhoe, 2010). The vignettes were modified to clarify that the decision was related to the participant or other individuals in hypothetical situations (see Table 5.1). This was accomplished by using a fictional person who would face end-of-life decisions and asking the participant to imagine themselves as that person, and with a third person's eye. The vignettes targeted three life-ending behaviors (e.g., suicide, voluntary euthanasia, and abortion), with nine different scenarios for 'the self' and twelve different scenarios for 'the other,' respectively. We used a 6-point scale measuring respondents' agreement with committing life-ending behaviors and a 6-point scale assessing the justification scores of these life-ending decisions. Higher numbers indicated more agreement on conducting life-ending acts, and higher subjective justification scores indicated how much more the participant found the above end-of-life behaviors' justifiable.' The calculated consistency reliability was .96, highly satisfying the standard of internal consistency reliability.

Table 5.1

Vignette examples (chapter 5).

Vignettes	Descriptions
Suicide	Your partner has abused you, and you can’t cope with your schizophrenic symptoms anymore. You wanted to be in the hospital after committing several suicidal attempts. Your spouse said that you had been threatening to shoot family members once. Recently you have been arrested for disorderly conduct (threatened police with a butcher knife). You decide to kill yourself.
Voluntary Euthanasia	You are an architect who has recently been diagnosed with colon cancer. You have been hospitalized, treating pneumonia that developed after your last doses of chemotherapy. Your doctor told you about the seriousness of your illness and that you may have little time to live. You decide to end your treatment.
Abortion	You were a pregnant woman (or your wife was pregnant). You (your wife) previously had two spontaneous abortions at 12 and 18 weeks and were admitted to the hospital with premature labor at 24 weeks. You (your wife) delivered an underweight infant upon admission. The infant was treated in a neonatal intensive care unit, and the doctor told you that chest X-ray had shown dense lung fields with severe hyaline membrane disease. The treatment is expensive, and the survival rate may be low, you decide to end your baby’s treatment.

5.2.1.4 Statistical Analysis

We used the individual variables and item parcels as indicators in Structural Equation Modeling (SEM) analysis to examine the structural relationships among the latent constructs and individual indicators. The structural model consisted of theoretically based relationships among the exogenous – variables that were not caused by another variable in the model (e.g., current environmental status, slow LH traits) and endogenous – variables that were caused by one or more variables in the model (e.g., the interaction between current environmental status and slow LH traits, the justification of life-ending behaviors) (Motl et al., 2002). For the latent constructs, we used stand-alone measures and constructs as indicators. If a particular item was identified as a poor measure of the latent construct, they were removed from subsequent model development. For testing the moderation effect, we applied the product-indicator approach (Kenny & Judd, 1984), in which the latent interaction term is extracted from the products of the factors' indicators. The structural model included direct paths from the current environmental status toward the justification of life-ending behaviors and slow LH traits toward the justification of life-ending behaviors. It also included indirect paths from the interaction between the current environmental status and slow LH traits toward the justification of life-ending behaviors. We used probing interaction for a simple slope for the residual-centered latent two-way interaction (Preacher et al., 2006).

A correlation matrix was created to examine the relationships between various forms of slow LH, the current adverse environment, and the justification of life-ending behaviors. Multiple indices were used to assess the model fit while testing both the measurement and structural models, including chi-square to degrees of freedom ratio or $\chi 2/df$, the comparative fit index (*CFI*; Bentler, 1990), Tucker–Lewis index (*TLI*; Tucker & Lewis, 1973), root mean square error of approximation (*RMSEA*; Steiger, 1990) and standardized root mean square residual (*SRMR*; Jöreskog & Sörbom, 1993). All statistical analyses were carried out in R

3.5.1 (https://www.r-project.org/). The SEM model was fitted using the R package *lavaan* (Rosseel, 2012). The statistical significance level was set at .05.

5.2.2 Results

Descriptive statistics and the correlation matrix for the variables included in the SEM can be found in Table A.2 (see Appendix). Figure 5.1 depicts the SEM results. The results showed that LH traits in a slower direction had a direct negative and significant impact on the subjective justification scores of life-ending behaviors (β = -.75, p < .001), indicating that individuals who adopt slower LH strategies agreed less on end-of-life decisions and found end-of-life behaviors less justifiable. Furthermore, a negative and significant moderation of the current adverse environment was observed with β = -.42, p < .05. Probing of the interaction showed that across values of the current environmental harshness and unpredictability, the simple slope of LH traits was negative, and this relationship was stronger as the adverse environment score increased (in a perceived more unpredictable and harsh environment), Table 5.2. The SEM model had acceptable fit indices, with [$\chi 2$ (37, n = 204) =1.22, p = .17], *CFI* = .995, *TLI* = .992, *RMSEA* = .039, *SRMR* = .028.

Table 5.2

Simple slopes for slow LH predicting the justification of life-ending behaviors in Study 1.

Adverse Environment	Estimate	*z*	*SE*	*p-value*
Mean -1 × *SD*	-0.32	-4.537	0.168	0.018
0	-0.75	-2.364	0.512	< 0.001
Mean + 1× *SD*	-1.21	-2.845	0.941	0.004

Notes: *SD* = standard deviation; Higher current adverse environment values indicate stronger perceived environmental unpredictability and harshness.

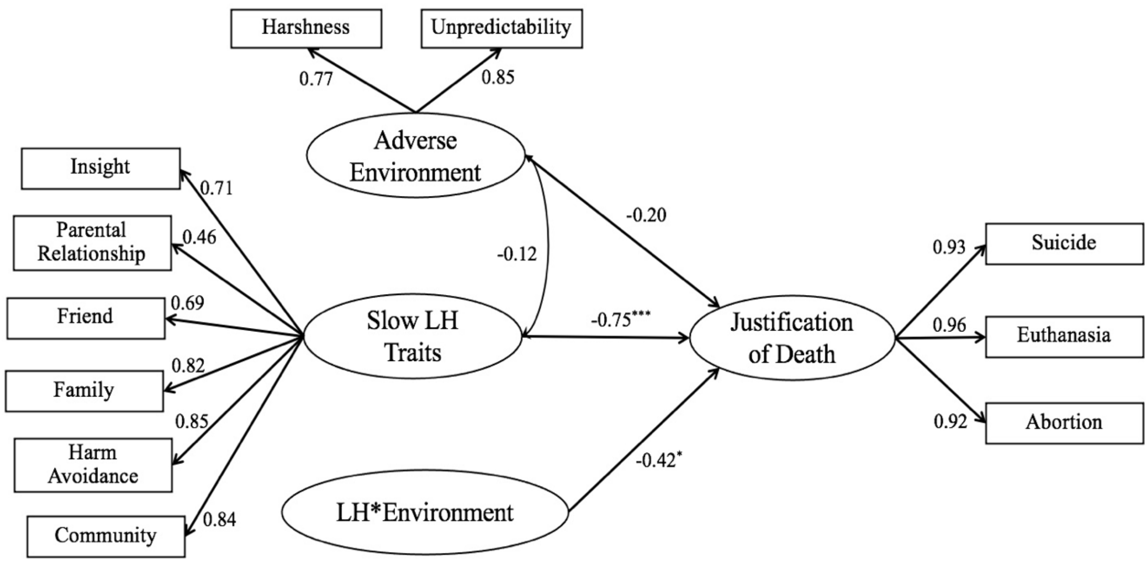

Figure 5.1 Structural relationships among slow LH traits, current adverse environment and justification of life-ending behaviors in study 1. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. (χ^2/df = 45.15/37 = 1.22, *CFI* = .995, *TLI* = .992, *RMSEA* = .039, *SRMR* = .028).

Note: *CFI*, comparative fit index; *RMSEA*, root mean square error of approximation; *SRMR*, standardized root mean square residual; *TLI*, Tucker–Lewis index.

5.2.3 Discussion

We predicted that people who adopted a slower LH strategy considered life-ending behaviors less justifiable, and this effect is moderated by the current adverse environment. Data from the vignette survey confirm this hypothesis and show that the current environmental harshness and unpredictability moderate the association between LH and the justification of life-ending behaviors. This result is compatible with the following interpretations. First, future-oriented slow LH individuals are guided by a longer-term calibration that affects a constellation of cognitive judgments and behaviors, including being less likely to accept and justify life-ending behaviors and less impulsive to conduct these behaviors. Although testing the impact of long-term calibrations of LH requires a properly causal and longitudinal design, the first step is to look at the association between LH variations and the subjective justification of life-ending decisions. Second, it should often be adaptive for individuals to adjust their LH based on cues about the state of the environment and/or their condition. Indeed, humans can discretionally adjust their LH strategies in response to various ecological conditions (Brumbach et al., 2009). A stressful environment can be harsh and/or unpredictable, and each environment dimension may affect the association between LH and cognitive judgment and decision-making.

5.3 Study 2

5.3.1 Method

5.3.1.1 Data Description and Sample

The sample from the World Value Survey (WVS) wave 6 included 60 country-level data. After removing missing values, 38,452 individuals' responses were on record. The demographic characteristics of the respondents were gathered in WVS items. These items included gender (V240), age (V242), educational level (V248), and ethnicity (V254). The sample obtained in WVS contained 18,457 males and 19,995 females. The average ages of the respondents were 41.96 (standard deviation (*SD*) = 16.58). Over 25% (*N* = 9,913) participants completed primary school, over 42% (*N* = 16,684) participants completed high school, and over 30% (*N* = 11,855) completed college or above. For ethnic groups, 15,474 participants identified themselves as "Caucasian white," 6,017 participants identified themselves as "Black," 1,083 participants identified themselves as "South Asian Indian, Pakistani, etc.," 14,908 participants identified themselves as "East Asian Chinese, Japanese, etc.," 711 participants identified themselves as "Arabic, Central Asian," and 259 participants identified themselves as "others."

5.3.1.2 Measure

Variables were constructed to reflect the main component of LH theory, environmental conditions, and the subjective justification of life-ending behaviors. First, LH traits were measured based on the mini-K scheme's components, such as the Arizona Life History Battery (ALHB) short-form that assesses various behavioral and cognitive indicators of LH strategies (Figueredo et al., 2007). Second, current environmental conditions were measured by two primary dimensions: harshness indicated by extrinsic mortality cues, and unpredictability indicated by unreliable and unpredictable future social conditions. Third, the justification of end-of-life decision-making was measured via three WVS items related to suicide, euthanasia, and abortion.

LH Traits

We sourced the WVS items that were conceptually similar to the mini-K scheme that measured the behavioral and cognitive aspects of LH strategies on a single continuum in the direction of slow LH (Figueredo et al., 2007). These domains were (a) *family social contact and support:* "V49: One of my main goals in life has been to make my parents proud." (1 = strongly agree; 4 = strongly disagree; reversed coded); "V79: Tradition is important to this person; to follow the customs handed down by one's religion or family." (1 = very much like me; 6 = not at all like me); "V250: Do you live with your parents?" (1 = yes; 2 = no; reversed coded); (b) *altruism*: "V74: It is important to this person to do something for the good of society." (1 = very much like me; 6 = not at all like me); "V74B: It is important for this people to help the people nearby; to care for their well-being." (1 = very much like me; 6 = not at all like me); "V160B: I see myself as someone who is generally trusting." (1 = disagree strongly; 5 = agree strongly; reversed coded); (c) *insight, planning and control*: "V8: How important is work in your life." (1 = very important; 4 = not at all important); "V75: Being very successful is important to this person; to have people recognize one's achievements." (1 = very much like me; 6 = not at all like me); "V160C: I see myself as someone who tends to be lazy." (1 = disagree strongly; 5 = agree strongly); (d) *religiosity*: "V9: How importance of religion in your life?" (1 = very important; 4 = not at all important); V79: "Tradition is important to this person; to follow the customs handed down by one's religion or family." (1 = very much like me; 6 = not at all like me); V145: "Apart from weddings and funerals, about how often do you attend religious services these days?" (1 = more than once a week; 7 = never, practically never); V153: "Whenever science and religion conflict, religion is always right." (1 = strongly agree; 4 = strongly disagree); V154: "The only acceptable religion is my religion.” (1 = strongly agree; 4 = strongly disagree). A higher value indicated the presence of a greater inclination for slow LH traits. The calculated Cronbach’s α was .67.

Adverse Environment

We searched for the items in WVS that were conceptually related to current environmental harshness and unpredictability that constitutes the rates at which extrinsic factors cause disability and death at each age in a population (Ellis et al., 2009); and fluctuations in environmental conditions that were related to social, environmental instability (Sung et al., 2016). A general question measured perceptions of the current environment: “In the last 12 months, how often have you or your family been:” The four responding items were starvation (V188: “Gone without enough food to eat.”), no cash (V191: “Gone without a cash income.”), unsafe home environment (V189: “Felt unsafe from crime in your home.”), and no medication (V190: “Gone without medicine or medical treatment that you needed.”). The items were rated on a 4-point scale ranging from 1 (very much) to 4 (not at all). A higher value indicated a more stable current environment. The calculated Cronbach’s α was .8.

Justification of End-of-life Behaviors

We measured attitudes toward ending a life by looking at the three WVS variables capturing beliefs on the ‘justifiable’ of the social actions, including suicide, euthanasia, and abortion. Three questions accessed whether the actions of suicide, euthanasia, and abortion can be justifiable and can take values from 1 (never justifiable) to 10 (justifiable), respectively: “Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between.” A higher value indicated higher subjective justification scores for life-ending behaviors. The calculated Cronbach’s α was .78.

5.3.1.3 Statistical Analyses

The analyses were based on secondary data from a previously published WVS dataset. First, we conducted the confirmatory factor analysis (CFA) to verify the factor structure of a set of observed variables obtained from WVS. Accordingly, we applied the measurement invariance to test whether the psychometric properties of a scale were equal (i.e., invariant or equivalent) across all country-level groups (see Asparouhov & Muthén, 2014; Alignment Method). Second, a correlation matrix was created to examine the relationships between various forms of justification for the life-ending decision, slow LH traits, and current environmental adversity. Third, structural equation modeling (SEM) was applied to test the structural relationships among environmental conditions (harshness & unpredictability), slow LH traits (in the mini-K scheme), and attitudes toward ending life (suicide, euthanasia, and abortion). As a flexible multivariate analysis method that includes factor and path analysis, SEM is suited to evaluate the relative importance of the pathways (Mulaik, 2009). The SEM was applied to specify the structure between observed indicators and latent constructs. For the latent constructs, we used stand-alone measures and constructs as indicators. The data for SEM were analyzed using R software version 3.5.1 and the *lavaan* package (Rosseel, 2012). The EM algorithm was selected for handling the missing data and nonresponses because it is an efficient iterative procedure to compute the maximum likelihood (ML) estimate in the presence of missing values (McLachlan & Krishnan, 2008).

5.3.1.4 Model Fit

Since the sample size was relatively large (n = 38,452) and some items were skewed, the root mean square error of approximation (*RMSEA*, see Browne & Cudeck, 1992), the comparative fit index (*CFI*, see Bentler, 1990), and the Tucker-Lewis Index (*TLI*, see Tucker & Lewis, 1973) indices were mainly used to examine the overall model fit. Following the recommendations of Hu & Bentler (1999), chi-square statistic and chi-square degrees of freedom ratio (*χ2/df*) may be susceptible to overestimating model misfit when sample size increases. According to Bollen (1989), factor loadings, path coefficients, factor correlations, standard errors, *t* values, and squared multiple correlations were also inspected for appropriate signs or magnitude (Motl et al., 2002).

5.3.2 Results

5.3.2.1 Summary of CFA Findings

A summary of the measurement model findings based on the CFAs of the WVS data file is offered in Table 5.3. The determination of model fit was based on comparing the fit indices (e.g., the *CFI*, *RMSEA*, and *SRMR* indices). However, because the chi-square statistic is known to be particularly sensitive to sample size, and given the large sample size of our study, our model may fit on large samples to be systematically rejected (Schermelleh-Engel et al., 2003). A model is determined to exhibit a "good," "marginal," or "poor" fit based on the comparisons. Both "current environmental status" and "slow LH traits" extracted from WVS were categorized as a "good" fit (Kline, 1998).

Table 5.3

CFA results summary for the WVS subscales in study 2.

Subscale	*Cronbach's α*	χ^2	*df*	*CFI*	*RMSEA*	*SRMR*
Current Environmental Status	0.8	1403.753^{***}	2	0.988	0.09	0.02
Slow LH traits	0.64	940.646^{***}	2	0.954	0.11	0.04

Notes: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

CFI = comparative fit index, *RMSEA* = root mean-square error of approximation, *SRMR* = standardized root mean square.

The multiple-group CFA (MGCFA) was used to test the equality of measurement properties (i.e., factor structure, loadings, intercepts) across groups in increasingly strict stages, starting from the bottom of the hierarchy and subsequently compared to the level precisely above it (i.e., configural versus metric and metric versus scalar; see Asparouhov & Muthén, 2014). The invariance of a model across subgroups can be tested with nested model comparisons, and invariance indicates that the two groups are drawn from equivalent populations with the equality of measurement properties (Vandenberg & Lance, 2000). The chi-square model fit test between the configural and metric model indicated that weak invariance was supported in this dataset ($\Delta\chi^2 = 98.4$, $df = 72$, $p = .22$). While the chi-square model fit test between the configural and metric model remained significant ($\Delta\chi^2 = 372.1$, $df = 144$, $p < .001$), indicating that strong invariance was not supported. Hence, metric (weak) invariance is met with equal factor loadings across groups.

5.3.2.2 Correlation Matrix and Descriptive Statistics

Table A.3 (see Appendix) presents the means, *SD*s, and correlations of the variables used in the SEM. The correlations were small to moderate in part because they were based on a large sample of cross-country survey data. The majority of the current environmental conditions and slow LH traits variables were negatively correlated. Slow LH traits except "altruism" were positively associated with all three forms of justification of life-ending behaviors. A marginal to the small significant association was found between current environmental conditions and the justification of end-of-life behaviors.

5.3.2.3 Measurement Model

The hypothesized structural models were developed to examine the structural relationships among the current environmental conditions, slow LH traits, and the justification of life-ending behaviors. Relationships among the latent constructs and indicators are depicted in Figure 5.2. The SEM results showed that the current adverse environment had a direct negative and significant impact on the subjective justification of life-ending behaviors (β = -.15, $p < .001$), indicating that individuals in unpredictable and harsh environments showed less subjective justification of life-ending behaviors. Also, LH traits in a slower direction had a direct negative and significant impact on the subjective justification (β = -.24, $p < .001$), indicating that individuals who adopt slower LH strategies believed life-ending behaviors less justifiable. Furthermore, a negative and significant moderation of the current environmental adversity on the relationship between LH traits and the subjective justification of life-ending behaviors was observed with β = -.32, $p < .001$. Probing of the interaction showed that across values of the current environmental harshness and unpredictability, the simple slope of sources of LH traits was negative, and this relationship was stronger as the adverse environment value increased (in a more unpredictable and harsh environment); table 5.4. Despite the significant Chi-Square value ($\chi 2$ (37, n = 38,452) = 178.54, $p < .001$), the $\chi 2$-to-degree of freedom ratio ($\chi 2/df$ = 4.81) was adequate based on Wheaton et al.'s (1977) relative/normed chi-square ($\chi 2/df$). The criterion for accepting the $\chi 2$-to-degree of freedom ratio ranges from less than 2 (Ullman, 2006) to less than 5 (Schumacker & Lomax, 2004). Other goodness-of-fit indices demonstrated satisfying results (*CFI* = .998, *TLI* = .999, *RMSEA* = .010, *SRMR* = .006).

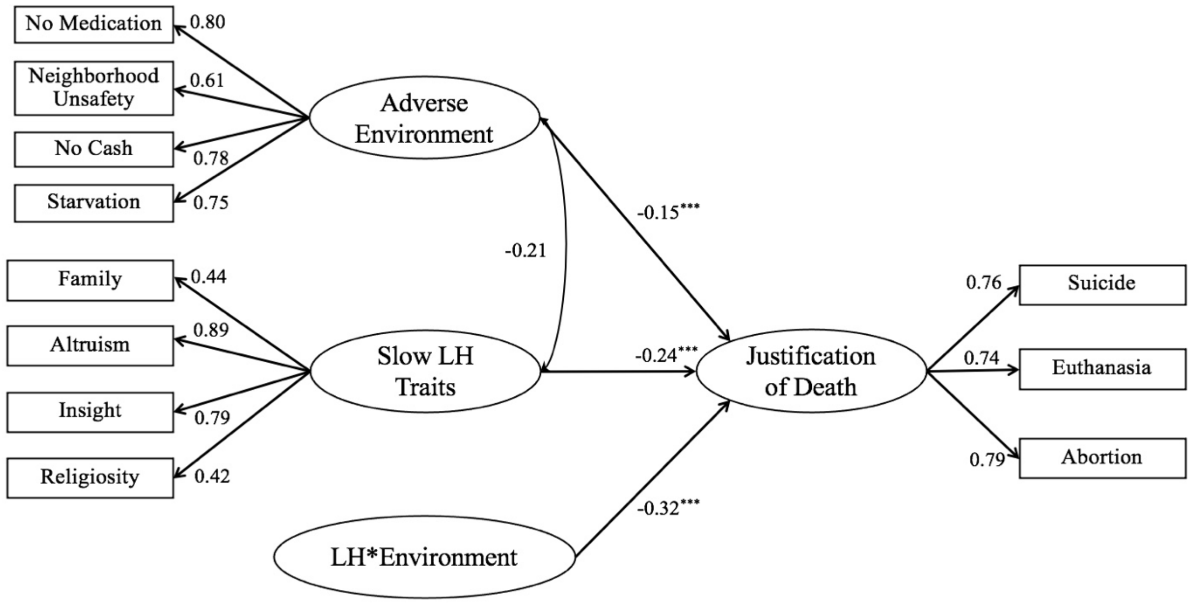

Figure 5.2 Structural relationships among slow LH traits, current adverse environment and justification of life-ending behaviors in study 2. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. (χ^2/df = 178.54/37 = 4.81, *CFI* = .998, *TLI* = .999, *RMSEA* = .010, *SRMR* = .006).

Note: *CFI*, comparative fit index; *RMSEA*, root mean square error of approximation; *SRMR*, standardized root mean square residual; *TLI*, Tucker–Lewis index.

Table 5.4

Simple slopes for slow LH predicting the justification of life-ending behaviors in Study 2.

Adverse Environment	Estimate	*z*	*SE*	*p-value*
Mean -1 × *SD*	-0.11	-14.699	0.124	< 0.001
0	-0.24	-26.708	0.124	< 0.001
Mean + 1× *SD*	-0.35	-35.647	0.134	< 0.001

Notes: *SD* = standard deviation; Higher current adverse environment values indicate stronger perceived environmental unpredictability and harshness.

5.3.3 Discussion

Data from the WVS confirm the hypothesis proposed in study 1. The results are replicated in a larger data set that is a rich resource for making cross-national comparisons. After taking account of individual demographic variables across a wide range of countries, an association has been found between LH variations and the subjective justification of life-ending decisions, and the current environment moderates this effect. As postulated by previous research, individuals who develop their slow LH niches tend to be more future-oriented and focus more on collective decisions later in life. Chisholm (1993) suggested that LH strategy development was guided by an individual's time preference, including "intertemporal choice between alternatives with varying costs or benefits over time, patience, impulsiveness, self-control, and the ability to defer gratification." Hence, individuals' cognitive judgment toward life-ending decisions may result from long-term versus short-term oriented LH calibration processes. Specifically, this study confirms that the adopted LH strategies (either fast or slow) developed in childhood might be more or less prominent depending on the current environment. A current environment that is inconsistent with one's childhood environment in terms of the degree of harshness and unpredictability may hinder the manifestation of one's LH strategy. Therefore, not only single LH traits but also correlations between LH traits can be plastic, and different environments can change the slope and/or sign of the LH trait correlation (Stearns 1992).

5.4 Conclusion and Discussion

The present study replicated existing research linking current adverse environments with variations in individuals' LH strategy, LH with the perceptions of environmental threats, and further proposed and analyzed a moderation-SEM of how the interaction between LH and the current adverse environment impacted the subjective justification of life-ending behaviors. Our study extends the domain of cognitive manifestations of LH. The present study contributes to this literature by showing that people who adopted a slower LH strategy exhibit less agreement on end-of-life decisions and less justification/'felt less justifiable' toward end-of-life behaviors, and the current adverse environment moderates this effect. Specifically, the moderating role of current environmental adversity concerning slow LH traits and the subjective justification of life-ending behaviors was found to be negative and significant. Data from study 1 and study 2 confirm this hypothesis and show that individuals' cognitive judgment about end-of-life behaviors is influenced by the interaction between an individual's LH and the current environmental status. This finding is compatible with the assumption that the cognitive processing of mortality information results from a flexible psychological and behavioral adjustment that shapes the LH, and this effect is influenced by the interaction between LH and the current environment. The results further suggest that humans routinely adjust their LH in response to short-term environmental changes (e.g., Ellis et al., 2009; Griskevicius et al., 2011a).

The rationale for this study is that individuals' justification of life-ending behaviors possibly results from LH calibration processes and the interaction between current environmental adversity and LH traits. Previous research has already gathered some evidence for the framework that guides the development of interventions to focus on LH traits in the domains of investment in a different life component (forgoing versus delaying; Figueredo et al., 2011), and behaviors and psychological dispositions that facilitate certain adaptive behaviors in response to various ecological conditions (Simpson et al., 2012). The findings are consistent with previous studies that build the link between environmental threats and LH strategy (see Chisholm et al., 1993; Greenberg et al., 1992; Rosenblatt et al., 1989). More specifically, this study suggests that the moderation effect of current environmental adversity on LH strategies might reflect the flexible adjustment of behavior in response to short-term variations in local contingencies (Griskevicius, 2011a; Pepper & Nettle, 2017). This analysis demonstrates that the environmental harshness and unpredictability influenced LH traits in the same direction directly through interaction effects on the attitudes toward ending a life or by shaping LH strategies that regulate an individual's cognitive judgment on end-of-life issues. This interaction suggests that the current adverse environment further pushes individuals to stick to their previously calibrated LH, which reinforces the cognitive decision-making styles. Further research is therefore needed to fully explore the role of other underlying mechanisms, as it may explain the direct and indirect impact of LH trade-offs on the subjective justification of end-of-life behaviors.

We found a negative association between slow LH strategies and the subjective justification of end-of-life decisions and life-ending behaviors. This is consistent with previous research that slow LH is associated with a deliberate thinking style (Wang et al., 2022), less aggression and pursuit of long-term outcomes (Nettle, 2010), and more cognitive and behavioral control (Gladden et al., 2009). One plausible reason for this finding is that deliberate cognitive style and thorough cognitive efforts are conducive to future outcomes, including long-term thriving and survival, which are prioritized by slow LH orientation. In other words, making irrational or impulsive life-and-death decisions are not favorable for those long-term oriented slow LH individuals. On the other hand, fast LH individuals tend to be less future-oriented, more pessimistic about their future, and more impulsive (Figueredo et al., 2012), characterized by the intuitive cognitive style. Thus, the intuitive cognitive style and heuristic cognitive efforts may avoid time-intensive reflection without considering the future outcome in threatening situations (Wang et al., 2022), even with the cost of intuitive and relatively inaccurate decisions. Although humans have a survival instinct, there is variability across individual LH trade-offs reflected by cognitive styles and behavioral and psychological manifestations, influencing the ‘justifiable’ of certain end-of-life decisions. Using a large and representative international sample in study 2, we also found correlations between LH manifestations and mortality-related judgment. Specifically, when mortality threats and end-of-life dilemmas are present, fast LH individuals may become more risk-seeking and future-discounting than slow LH individuals. Therefore, they may rely more on their intuition and ‘gut instinct’ when making end-of-life decisions.

We extend this body of work on cognitive judgment by looking at end-of-life decisions, which is, by definition, referred to as a process in which a choice is made after reflection on the consequences of that choice (Kahneman, 2003). It also reflects the long-term (slow) versus short-term (fast) LH strategies. In the short term, it is always more advantageous to obtain immediate outcomes by being selfish and exploitative, but in the long term, it is more advantageous to invest in longer-term direct and indirect benefits (Lettinga et al., 2020). Recent work highlights that the variations in LH may play an essential role in shaping the cognitive decision-making process by considering the adaptive trade-offs (e.g., forgoing versus delaying and short-term versus long-term orientation) between functions and costs of intuitive and deliberate cognitive styles (e.g., Maran et al., 2020; Wang et al., 2022; Woodley et al., 2011). Overall, our results are compatible with a wide range of evolutionary mechanisms and could provide practical implications for the educational program – e.g., mitigating fear and anxiety, coping with mortality-related issues, and suicide prevention. For example, a stable early environment is crucial for shaping the adulthood LH and, most importantly, is conducive to a later proclivity for rational thinking styles when deciding in emergency conditions. Family counseling and social services could provide protective barriers to early adversity and help to build a healthy family functioning and social environment. Our findings further suggest that situational adaptation carries benefits that arise with some degree of environmental adversity and uncertainty. The results are consistent with previous studies (Wang et al., 2022); when exposed to life-threatening situations (e.g., injury, disease, trauma), a cognitive style that excels in these situations might help individuals endure adversity that may cause physical and mental suffering. This implication provides insights into future intervention programs by considering the importance of environmental adaptations.

There are several limitations of this research. First, the cross-sectional design of study 1 might limit the testing of moderating effects, which may restrict a detailed exploration of possible factors in specific situational contexts. Longitudinal studies should be utilized in future efforts to examine the roles of other potential mediating and moderating factors such as family structure, SES, and neighborhood environment. Second, the end-of-life scenarios used in study 1 had limitations. The participants judged hypothetical situations; therefore, the results could be biased. It would be impossible to include all the important variables and their nuances in the scenarios; for instance, the hypothetical medical treatments, social environment, and cultural factors. Third, self-reporting questions may underestimate the causal relationships among LH, current adverse environment, and subjective justification scores on end-of-life decisions. Longitudinal data involving exogenous shocks to the individual’s environment (e.g., sudden income decline, pandemic, famine, war, etc.) should be included in future studies. Finally, in study 2, we selected the WVS items that were conceptually similar to previous scales and priori-defined criteria. Multiple informants and survey items should be included in future studies to improve the validity of the research.

Future empirical research could explore broader physical and mental health consequences of end-of-life decisions to inform the development of effective interventions.

Despite these limitations, the current research has found that the slow LH strategy is associated with less subjective justification and acceptability of end-of-life behaviors through two studies. In contrast, the fast LH strategy is associated with more subjective justification and acceptability of end-of-life behaviors. Particularly, the current research provides empirical evidence on a moderating role of the current adverse environment. Exposure to current environmental adversity enhances the association between LH and subjective justification of life-ending behaviors. Further investigation of demographic and psychosocial correlates of the end-of-life decisional conflict is required. Such knowledge would improve the interventions based on environmental factors, and it would be essential to be aware of these differences in attitudes and LH's adaptive functions to reduce end-of-life decisional conflicts.

Chapter Six: Conclusion

The major thrust of this thesis has been to examine the effects of Life-History (LH) theory along a continuum of slow to fast trade-offs on the emotional and cognitive process of mortality information. Applying the LH framework could guide the development of interventions to focus on malleable LH traits and psychological processes in ways to respond adaptively to both "positive" and "negative" environmental contexts (Ellis et al., 2009). Organisms better fitted to their environment or better 'adapted' to their environment have a higher chance of surviving and producing offspring (Kaplan & Gangestad, 2005). Although the developmental pathways activated in hostile environments may have some adverse effects on longer-term physical and psychological outcomes (Swanepoel, 2016), when looking through an evolutionary lens, the findings reported in this thesis explore further extensions and applications of why these pathways exist and how they can be adaptive in a particular ecological context. More particularly, investigating the psychological mechanism of mortality from an evolutionary perspective can lead to novel hypotheses or ways of integrating evidence across different levels of analysis through these four papers.

LH theory provides a life span, time-integrated framework across the component of phenotypes under the assumption that a single genotype could produce different phenotypes across different environments (Pigliucci, 2001). The LH framework considers psychological and behavioral mechanisms to function "adaptively" when they perform their evolved function to interact with the changing environments favored by natural selection. Over evolutionary history, natural selection favors the phenotypes that successfully allocate resources and adjust to environmental fluctuations (West-Eberhard, 2003). The design of LH theory is a solution to an ecological challenge posed by the environment and subject to intrinsic constraints on the organism (Stearn, 1992). Under the assumption that LH trade-offs are an important type of constraint (Roff, 2002), the trade-off for improving fitness may consist of a certain LH trait pairing with a reduction in fitness from another LH trait (Fabian & Flatt, 2012). Hence, LH trade-offs deal with the differences in the amount of bioenergetic and material resource allocation among growth, storage, maintenance, survival, and reproduction (Reznick, 2010). Although researchers originally used LH theory to account for species-level differences, this theory has proved helpful in understanding within-species differences (e.g., Houle, 1992; Stearn, 1989; Schaffer, 1983). To study human behaviors, the LH framework is employed by a suite of biological and psychological systems organized over individuals' life circles (Belsky et al., 1991; Ellis et al., 2009; Kaplan & Gangestad, 2005). At the biological and physiological level, trade-offs are caused by the competitive allocation of limited resources to one LH trait versus another trait within a single individual (Fabian & Flatt, 2012). In addition to the importance of LH theory as an evolutionary biological model, recent research has found application in evolutionary approaches to human psychology (e.g., Buss, 2009; Figueredo et al., 2005; Kaplan & Gangestad, 2005). The allocation "decisions" made by an individual would shape an individual's specific psychological and physiological mechanisms. This extension of LH theory to psychology has explored the multivariate correlational techniques to detect specific functional, cognitive, affective, and behavioral composites of LH indicators (e.g., Figueredo et al., 2005; Quinlan, 2007). Applying the LH framework to study psychology, a broad suite of traits related to the fast–slow continuum include not only classical LH traits, such as the timing of maturation or reproduction, but also psychological variables, such as the preference to risk, ability to delay gratification, prosociality, optimism, hedonism and others (Nettle & Frankenhuis, 2020). The LH framework expands previous theorization on evolutionary psychology and especially focuses on individual differences attributed to phenotypic plasticity, with the acknowledgment of genotypic variation (Kuzawa, 2012). This move allows the shift in focus, within LHT in psychology, to LH strategic responses to individual environmental variables (Nettle & Frankenhuis, 2020).

At the core of the LH framework is the biological fact that all organisms face important trade-offs in the way to budget their limited resources at any given point in the life course before the inevitability and unpredictability of death (e.g., Bereczkei & Csanaky, 2001; Greenberg et al., 2003; Griskevicius, 2011a; Quinlan, 2010; Rosenblatt et al., 1989). Adaptive LH strategy would develop in response to the costs and benefits of allocating recourses and energy to growth, maintenance, and reproduction within an ecological context (Caudell & Quinlan, 2012). The individual differences in LH strategies and manifestations constitute overarching patterns of development and behavior that affect many aspects of life (Brumbach et al., 2009). All the adaptive compromised solutions require the allocation of time and energy from limited shared ecological resources. LH theory focuses on the allocation of "decisions" made by an organism (individual) because it assumes that the selection would shape an individual's specific psychological mechanisms (Belsky et al., 2012).

Throughout this work, I have argued that the LH manifestations are contingent on the variations in emotional and cognitive processing of environmental information (e.g., mortality threats and environmental adversity). This association is influenced by the current environmental status that further calibrates an individual's LH. Given certain ecological factors (e.g., predators, resource supplies, natural disaster, disease) and safety hazards, with the extensions of the LH theory framework, a broader suite of LH traits constitute intra-individual calibrations across emotion, behavioral tendencies, and cognitive judgment in various environments could explain the individual differences regarding psychology in managing the fear of death and subjective judgment about end-of-life decisions. Research regarding death and dying should not be overlooked because the experience and psychology of death could guide, influence, and determine how to adapt to the changing environment (Yalom, 1980). The results highlight that the role of psychological mechanisms (e.g., emotion and cognition) influenced by LH strategy is linked to an individual's response to the ecological consequences and environmental adaptations. Moreover, the thesis offers theoretical insights into the perception of environmental information (sources of mortality) and how processing this information may be characterized and shaped by an individual's LH and the interaction effect of LH and the current environment. Following the previous findings that events also influence LH strategies in one's current adult environment (e.g., Cabeza de Baca & Ellis, 2017; Charnov, 1993; Griskevicius et al., 2011a; Kuzawa & Bragg, 2012; Shefferson, 2010), the moderation effect of the current environmental status reflects the flexible adjustment in response to short-term variations in local environmental contingencies. It is ultimately associated with the LH trade-offs as they refer to the variations in emotional sensitivity, cognitive styles, cognitive judgment, personality traits, and environmental adaptations.

Previous empirical research has shown the predicted relationship between extrinsic mortality and human LH patterns (e.g., Low et al., 2008; Quinlan, 2007). Extrinsic mortality is statistically defined as the variance in the probability of death that causes mortality and morbidity beyond an individual’s survival efforts (Quinlan, 2010). The LH trade-offs are related to the ecological patterns of extrinsic mortality cues that set up selection pressures for an individual to use these cues adaptively to adopt LH strategy on a continuum from slower strategies that focus on longer-term goals to faster strategies that focus on more immediate payoffs (e.g., Chisholm et al., 1993; Del Giudice et al., 2011; Gladden et al., 2009; Lu & Chang, 2019). Humans follow these critical developmental trade-offs during which LH remains flexible and sensitive to environmental signals (Hill et al., 2008). According to LH theory, natural selection favors individuals who can optimally allocate limited resources over a life span and across different ecological conditions (Belsky et al., 2012). The empirical research on LH theory has suggested that humans can discretionally adjust their LH strategies in response to various ecological conditions, including extrinsic mortality and environmental risks (e.g., Brumbach et al., 2009; Belsky et al., 1991; Chisholm, 1993; Ellis et al., 2009).

To adapt to environmental change and maximize fitness, individuals develop LH strategies in pursuit of optimal adaption to our current environment; however, the empirical investigation regarding the flexibility and adaptive functionality of this phenotype plasticity is limited (Nettle et al., 2020). The explanation of variation in LH will not be complete because recent empirical evidence is needed to fully understand the mechanisms that cause the LH trade-offs (Stearns, 2000). Despite advances in having predictive adaptive responses in the form of developed LH history strategies, particularly the fast-slow paradigm, the empirical research based on the fast-slow paradigm are mostly self-referential (Nettle & Frankenhuis, 2019). For example, the inherent risk of maladaptation may exist if the perceptions or the forecasts about an environment are sometimes incorrect (Kavanagh & Kahl, 2018); however, previous research relies mainly on self-referential predictions without critically examining the assumption of adaptive responses (Zietsch & Sidari, 2019). Specifically, though recent research with a large amount of indirect evidence investigating the roles of executive functioning and cognitive styles between LH manifestations and personality traits (Figueredo et al., 2012; Gladden et al., 2009), critics argue that there is a lack of direct evidence supporting the underlying mechanism of the development of socially undesirable and abnormal personality traits (e.g., psychopathy, narcissistic, borderline, histrionic, antisocial; Kavanagh & Kahl, 2018). Future research should apply the longitudinal design to track individuals over a long period of time in terms of their early rearing environments and their current environments.

LH analysis is based mainly on the individuals' average LH traits. The variance of environmental conditions and social contexts may not be included within and between individuals (Brommer, 2000). Accordingly, the models used in LH analysis do not fully consider the possible mediators of resource allocation and other possible environment constraints (National Research Council (US) Panel for the Workshop on the Biodemography of Fertility and Family Behavior et al., 2013). According to the critiques raised by Nettle & Frankenhuis (2020), the predictions over the course of development are varying and intercorrelated in the broader suits of LH traits (e.g., behavioral, motivational, and attitudinal traits) and psychological manifestations (e.g., personalities). Future research should be embedded in more sophisticated measures of LH-related traits. Despite the limitation that research based on the fast-slow LH paradigm may be disconnected from mathematical work on LH evolution (Nettle & Frankenhuis, 2019), the fast-slow continuum can make adaptive sense of the covariation among behavioral and personality traits, their relations with physiological processes, and their past developmental stages (e.g., early stress, see Belsky et al., 1991; Del Giudice, 2019; Ellis et al., 2009; Figueredo et al., 2006). Future investigation should build in-depth mathematical models with refinement in response to previous empirical findings.

Responses to Arizona Life-History Battery (ALHB; Figueredo et al., 2007) and the mini-K scheme (Figueredo et al., 2005) are subjected to the self-report basis on the observable manifestations of the LH strategy (Gruijters & Fleuren, 2018). Throughout this thesis, the psychological constructs that could not be directly measured or observed (e.g., LH strategies and traits) are normally quantified as latent constructs or variables. Figueredo et al. (2005) proposed that various indicators of LH strategy converged on a single multivariate construct, the latent K-factor. However, the standard errors of estimates produced by latent variables can be higher than those produced by observed variables, and the increased accuracy in latent approaches may be accompanied by a decrease in precision (Ledgerwood & Shrout, 2011). Though the current common measurement of LH strategy, the latent K-factor (e.g., ALHB and mini-K), is employed in many published studies, concerns are raised for the K-factor as the clusters of certain psychosocial traits into meaningful functional composites of LH strategy (Gruijters & Fleuren, 2018).). Hence, the methodological of limitation of the latent K-factor is that it relies exclusively on self-report, as it tends to be biased and less precise. In addition, Gruijters & Fleuren (2018) argued that the latent K factor can only provide a meaningful summary of an individual's characteristics corresponding to LH traits but cannot define functional descriptions at the proximate level. Copping et al. (2017) further suggested that the constructing K-factor and the scales included in measures (e.g., the mini-K scheme) required more consideration to predict LH trajectory. Therefore, more research will be needed to support theoretical prediction and, more importantly, the precise and direct measurement of LH strategy.

The evidence from this thesis extends prior research on the scope of the evolutionary perspective and LH framework, with a new micro-focus on how an individual's LH and the current environment affect death with its emotional responses in terms of fear, fear-induced avoidance, emotional sensitivity, and its cognitive responses in terms of attitudes, judgment, and decision-making. Figure 6.1 displays the effect sizes calculated from each study. The results from the first study reveal that LH variation is uniquely associated with implicit avoidance of death fear, and the current environment moderates this relationship. The second study explores natural settings to activate a more extensive ecological network of perceived current environmental threats. The results from the second study further reveal that LH is associated with fear of death, and the current mortality threat moderates this association. Based on the assumption that LH strategy may come to be expressed when triggered by an environmental challenge (Ellis et al., 2009), the intra-individual LH calibrations across ecological factors could further influence physiology (behavioral tendencies), psychology (emotion), cognition and decision-making over a person's lifespan (Shefferson, 2010). The results from the third study reflect that the fear of death partially mediates the relationship between LH and the justification of life-ending behaviors and, further, the strength of the association between LH and death fear depends on perceived current mortality threats (through mortality salience priming; see Griskevicius et al., 2011b). End-of-life decision-making and acceptability judgment can involve more cognition, emotion, or interactively. The fourth study replicates the previous studies that a variant of LH plays a crucial role in influencing the subjective justification of end-of-life behaviors and further proposes that the association mentioned above is moderated by the current adverse environment (i.e., harshness and unpredictability). The findings from two datasets in the fourth study confirm that LH traits are linked to the justification/acceptability of end-of-life behaviors and further suggest that the interaction between LH and the current adverse environment influences individuals' cognitive judgment about end-of-life behaviors.

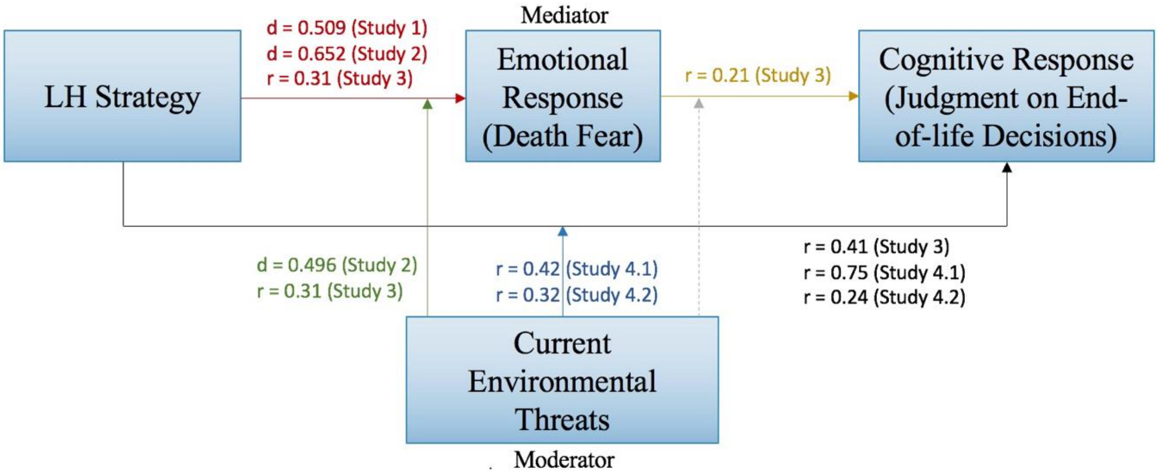

Figure 6.1 Summary of Effect sizes in Cohen's *d* or Correlation Coefficient *r* (The colors of the effect sizes are matched with the colors of the paths).

This thesis not only contributes to the theoretical underpinning to explain the principal effect of LH on emotional and cognitive responses toward mortality moderated by the current environment but also provides an impetus for psychology research and care plan development for people experiencing strong emotions such as intense death fear or anxiety and severe grief reactions. Putting these results in a broader perspective, it is essential to consider the possible implications of current findings for understanding death fear as an adaptive response to environmental threats. When individuals encounter large-scale environmental challenges (e.g., pandemics, natural disasters, war, and famine), individual-level LH-related variables such as personality, family function, and social ties may become integral parts of the surrounding environment's perceptive and adaptive reactions. Our data can serve as a reference for practitioners across various disciplines to offer services to individuals who must enter social isolation during unusual events such as the pandemic, lockdown, and mobility control. Policymakers could consider developing guidelines for physical distancing that mitigate fear and anxiety and regain a sense of closeness and connection. For example, local governments could provide help hotlines and online counseling services. Furthermore, the perception of the acceptability and justification of end-of-life decisions is associated with different risk preferences for end-of-life decisions and life-ending behaviors shaped by LH manifestations, which could be incorporated into prevention activities. Educational programs may also address the situational acceptability of euthanasia in response to a severe physical illness and abortion, allowing less impulsive end-of-life decisions. In addition, healthy family functioning and family social support are vital to protecting individuals from various forms of suicidal attempts and irrational end-of-life decisions. Intervention programs targeting people without much social support and connection should consider incorporating other forms of community support. Finally, our findings further suggest that a situational-adaption perspective carries benefits that arise with some degree of environmental adversity and uncertainty. When exposed to life-threatening situations (e.g., injury, disease, trauma), a cognitive style that excels in these situations might help individuals endure adversity that may cause physical and mental suffering. This implication provides insights into future intervention programs by considering the importance of environmental adaptations and fear & anxiety management.

Several aspects of this thesis to be implemented in the future include further improvements in extending a link between LH manifestations and death fear-induced avoidance by other experimental and longitudinal designs, clarifying therapeutic issues concerning thanatophobia or coping with death fear and anxiety. First, future research may adopt a longitudinal approach to more accurately discern participants' psychological reactions regarding fear or anxiety, past experiences, and current environmental threats. Future empirical research may also explore the underlying mechanisms of family structure and function, socioeconomic status, neighborhood environment, educational background, subjective well-being, and the influence of aging and religious beliefs on emotional sensitivity and cognitive judgment of death-related issues. Second, larger sample sizes are required to examine LH variations more precisely and delineate their interactions with current environmental factors such as cross-provincial or cross-national residential locations. Hence, multiple informants with various demographics should be included in future studies to improve the validity of the research. Third, to comprehend the impacts of the findings brought out in this thesis, more studies could help to find out a more in-depth investigation of participants' psychological reactions regarding mortality when their current environment is highly unpredictable, harsh, and challenging, with experience sampling, qualitative methods, or daily diary application. Longitudinal data involving exogenous shocks to the individual's environment (e.g., income decline, pandemic, famine, war, etc.) should be included in future studies.

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Appendix: Additional Tables

Table A.1

Correlations among LH, death fear, and justification of life-ending behaviors.

	1	2	3	4	5	6	7	8	9	10	11
1. Insight	-										
2. Parent Relation	0.79***	-									
3. Friend	0.83***	0.80***	-								
4. Family	0.82***	0.76***	0.84***	-							
5. Harm Avoidance	0.85***	0.79***	0.87***	0.89***	-						
6. Community	0.83***	0.77***	0.87***	0.82***	0.91***	-					
7. Fear Death	0.80***	0.77***	0.83***	0.82***	0.84***	0.81***	-				
8. Fear Dying	0.62***	0.55***	0.63***	0.62***	0.63***	0.63***	0.64***	-			
9. Suicide	-0.80***	-0.77***	-0.79***	-0.80***	-0.83***	-0.78***	-0.77***	-0.80***	-		
10. Euthanasia	-0.79***	-0.78***	-0.78***	-0.79***	-0.77***	-0.79***	-0.57***	-0.61***	0.81***	-	
11. Abortion	-0.77***	-0.75***	-0.75***	-0.79***	-0.79***	-0.78***	-0.81***	-0.63***	0.71***	0.83***	-
Mean	3.92	3.81	3.75	3.83	3.79	3.81	3.42	3.20	1.87	2.16	2.11
SD	0.94	0.99	0.92	0.98	0.95	0.93	0.58	0.33	0.99	1.07	1.11

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table A.2

Correlations among LH, death Fear, and justification of life-ending behaviors in study 1 (Chapter 5).

	1	2	3	4	5	6	7	8	9	10	11
1. Insight	-										
2. Parent Relation	0.72***	-									
3. Friend	0.78***	0.75***	-								
4. Family	0.75***	0.69***	0.78***	-							
5. Harm Avoidance	0.80***	0.71***	0.83***	0.86***	-						
6. Community	0.79***	0.69***	0.84***	0.77***	0.88***	-					
7. Harshness	0.77***	0.71***	0.77***	0.77***	0.75***	0.72***	-				
8. Unpredictability	0.79***	0.73***	0.79***	0.76***	0.78***	0.79***	0.66***	-			
9. Suicide	-0.68***	-0.67***	-0.66***	-0.73***	-0.66***	-0.69***	-0.75***	-0.70***	-		
10. Euthanasia	-0.70***	-0.69***	-0.67***	-0.67***	-0.69***	-0.69***	-0.78***	-0.71***	0.91***	-	
11. Abortion	-0.66***	-0.65***	-0.63***	-0.69***	-0.64***	-0.62***	-0.78***	-0.68***	0.85***	0.89***	-
Mean	4.04	3.93	3.86	3.95	3.79	3.89	3.99	4.28	2.03	1.88	1.89
SD	0.82	0.87	0.83	0.84	0.95	0.83	0.68	1.11	0.93	1.05	0.97

Note: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table A.3

Correlations among LH, death Fear, and justification of life-ending behaviors in study 2 (Chapter 5).

	1	2	3	4	5	6	7	8	9	10	11
1. Starvation	–										
2. No medicine	0.59***	–									
3. No cash	0.58***	0.60***	–								
4. Unsafe home environment	0.45***	0.47***	0.36***	–							
5. Family	-0.13***	-0.09***	-0.14**	-0.16***	–						
6. Altruism	-0.06***	-0.03*	0.03*	-0.04**	0.05***	–					
7. Insight	-0.16***	-0.15***	-0.09***	-0.10***	0.14***	0.83***	–				
8. Religiosity	-0.10***	-0.13***	-0.14***	-0.11***	0.50***	-0.04**	0.07***	–			
9. Justify Abortion	-0.07***	0.08***	0.07***	-0.05***	-0.24***	0.06***	-0.02†	-0.37***	–		
10. Justify Suicide	0.02†	-0.02†	0.01	-0.05***	-0.17***	-0.10***	-0.12***	-0.20***	0.51***	–	
11. Justify Euthanasia	0.02†	0.03**	0.02†	0.04**	-0.20***	0.07***	-0.03*	-0.34***	0.57***	0.53***	–
Mean	3.45	3.35	3.09	3.41	3.14	6.96	4.03	2.61	3.23	2.27	3.34
SD	0.86	0.92	1.03	0.89	0.71	2.28	1.26	1.08	2.76	2.24	2.97

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, † $p < 0.10$.