The Role of Awe in Risk-Taking and the Exploration of the Unknown

Matthew Thomas Richesin
mriches@vols.utk.edu

Follow this and additional works at: https://trace.tennessee.edu/utk_graddiss

Part of the Biological Psychology Commons, and the Experimental Analysis of Behavior Commons

Recommended Citation
https://trace.tennessee.edu/utk_graddiss/10158

This Dissertation is brought to you for free and open access by the Graduate School at TRACE: Tennessee Research and Creative Exchange. It has been accepted for inclusion in Doctoral Dissertations by an authorized administrator of TRACE: Tennessee Research and Creative Exchange. For more information, please contact trace@utk.edu.
To the Graduate Council:

I am submitting herewith a dissertation written by Matthew Thomas Richesin entitled “The Role of Awe in Risk-Taking and the Exploration of the Unknown.” I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Experimental Psychology.

Debora R. Baldwin, Major Professor

We have read this dissertation and recommend its acceptance:

Todd M. Freeberg, Bob DuBois, Jon F. Garthoff

Accepted for the Council:

Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)
The Role of Awe in Risk-Taking and the Exploration of the Unknown

A Dissertation Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Matthew Thomas Richesin

May 2024
ACKNOWLEDGEMENTS

It is likely that only my committee will read this dissertation so I will start by thanking Todd Freeberg, Bob DuBois, and Jon Garthoff for being willing to sit on my dissertation committee and helping guide me through this process. Your guidance and teaching in the classroom has also shaped my thinking about various topics. There are many ideas I would have never been introduced to without your expertise, thank you for sharing them with me. To Dr. Baldwin, it's hard to convey how much I have changed as a person since I wandered into your office however many years ago it’s been now. None of that would have happened if you had not given me a chance to work in your lab. Your guidance both professionally and about life in general has been invaluable. I complain sometimes but I wouldn’t change my time here for anything, so thank you. To Amber, Nolan, and Austin, thank you for putting up with me working all the time for no money. To my father, Bruce Richesin, thank you for always supporting me no matter what route I choose. To Sandy Sherlin, my stepmother, thank you for treating me as if I were your own. I also want to thank Lahai Wicks for always being willing to listen to my weird ideas and even taking them seriously. Finally, I want to thank my research assistants Ashley Bell and Sarah Reaves who helped with lab work and video scoring for the following dissertation. I could not have completed it without their help.
ABSTRACT

Much has been learned about awe through scientific inquiry in the last twenty years, however, few researchers have looked to understand the adaptive function. Recent work has suggested that the function of awe is cognitive in nature. This view argues that the function awe plays is linked to how individuals respond to uncertainty. This approach proposes that awe should be linked to various epistemic dispositions such as curiosity, impulsivity, intolerance to uncertainty, and existential thinking. It further suggests that awe will have a distinct effect on risk-taking behaviors compared to fear and curiosity. The current project consists of three studies designed to test these predictions. The first study works to explore the relationship between awe and epistemic dispositions. 398 participants recruited from introductory psychology classes participated in the study. Each participant was given a battery of surveys to measure dispositional positive emotions and epistemic dispositions. Results show that awe is indeed related to epistemic dispositions in general. Further, mediation models show that this relationship is complex and may involve competing pathways. The second study (N=156) suggests that awe does not affect probabilistic risk-taking compared to fear and curiosity groups. Regression models show that dispositional awe may have a small predictive effect on risk-taking. Results of the third study (N=152) showed that awe does have a distinct effect on some risk-taking measures when exploring an uncertain object. Finally, in terms of physiology, all groups were similar with some evidence that fear facilitated increases in respiration rate and sAA which indicates greater sympathetic activation compared to awe and curiosity. In conclusion, the findings suggest that awe is indeed associated with epistemic dispositions and facilitates the exploration of uncertainty.
# TABLE OF CONTENTS

CHAPTER I: INTRODUCTION AND REVIEW OF THE LITERATURE ......................................... 1  
Introduction .................................................................................................................. 2  
What is Awe? ................................................................................................................ 5  
The Adaptive Function of Awe .................................................................................. 9  
Need for Safe Shelter ................................................................................................. 11  
Response to Natural Wonders ................................................................................... 12  
Curiosity Governor ..................................................................................................... 14  
Awe and Cognition ...................................................................................................... 15  
Uncertainty .................................................................................................................. 15  
Violation of Expectations ......................................................................................... 17  
Awe in Learning and Thinking ................................................................................... 18  
Summary ..................................................................................................................... 28  

CHAPTER II: STUDY 1 ................................................................................................. 30  
Introduction ................................................................................................................ 31  
Methods ....................................................................................................................... 33  
Participants .................................................................................................................. 33  
Measures ....................................................................................................................... 33  
Procedure ..................................................................................................................... 37  
Results ........................................................................................................................... 37  
Correlations Between Awe and Epistemic Dispositions ...................................... 37  
Awe as a Distinct Predictor of Epistemic Dispositions .............................................. 40  
Awe, Curiosity, and Impulsivity .................................................................................. 41  
Awe and Intolerance of Uncertainty .......................................................................... 44  
Discussion ..................................................................................................................... 48  

CHAPTER III: STUDY 2 ............................................................................................... 54  
Introduction ................................................................................................................ 55  
Methods ....................................................................................................................... 56  
Participants .................................................................................................................. 56  
Materials Used ............................................................................................................ 57  
Procedure ..................................................................................................................... 62  
Results ........................................................................................................................... 64  
Manipulation Check ................................................................................................. 64  
Between Group Differences ...................................................................................... 64  
Discussion ..................................................................................................................... 70  

CHAPTER IV: STUDY 3 ............................................................................................... 73  
Introduction ................................................................................................................ 74  
Methods ....................................................................................................................... 75
Participants......................................................................................................................... 75
Materials Used .................................................................................................................... 76
Procedure .............................................................................................................................. 79
Results................................................................................................................................ 80
Manipulation Check.............................................................................................................. 80
Dichotomous Variables ........................................................................................................ 81
Time Variables ..................................................................................................................... 84
Physiological Variables ........................................................................................................ 88
Discussion.............................................................................................................................. 90

CHAPTER V: DISCUSSION ................................................................................................. 93

Goal 1: To determine if dispositional measures of awe are associated with various other epistemic dispositional measures............................................................. 94
Goal 2: To determine if awe leads to a more systematic approach to the uncertainty involved in a risk-taking task......................................................................................... 96
Goal 3: To determine if awe leads to greater exploratory behaviors of an uncertain object.............................................................................................................................. 98
Goal 4: To document group differences in physiological effects of awe as manifested in ANS activity................................................................................................................. 102

REFERENCES ...................................................................................................................... 107
APPENDIX .......................................................................................................................... 122
VITA .................................................................................................................................... 158
LIST OF TABLES

Table 1. Means, standard deviations, and correlations between dispositional awe and target variables. .......................................................... 39

Table 2. Results of linear regression models with dispositional awe as predictor while controlling for other positive emotions from the dispositional positive emotion scale. .......................................................... 42

Table 3. Full parameters of each path in the parallel mediation model examining the mediating role of curiosity in the relationship between dispositional awe and impulsivity. (N = 398) .......................................................... 45

Table 4. Full parameters of each path in the parallel mediation model examining the mediating role of love, contentment, and pride in the relationship between dispositional awe and intolerance to uncertainty factor 1. (N = 398) ................. 46

Table 5. Full parameters of each path in the parallel mediation model examining the mediating role of curiosity and intolerance of uncertainty in the relationship between dispositional awe and existential thinking. (N = 398) .................................. 47

Table 6. Means and Standard Deviations for Study 2 .......................................................... 67

Table 7. Percentages of Behavior Engagement .......................................................... 82

Table 8. Means and Standard Deviations for Study 3 .......................................................... 83

Table 9. Delta Means and Standard Deviations for Physiological Variables ................. 89

Table 10. Hypothesis vs Results .......................................................... 128
LIST OF FIGURES

Figure 1. Study Two, Manipulation Check................................................................. 66
Figure 2. Average Number of Cards Per Trial............................................................. 68
Figure 3. Black Box....................................................................................................... 77
Figure 4. Mean Hand Time by Group.......................................................................... 85
Figure 5. Mean Box Search Time by Group................................................................. 86
Figure 6. Total Exploration by Group........................................................................... 87
Figure 7. The parallel mediating effect of curiosity subscales in the relationship between dispositional awe and Impulsivity......................................................... 123
Figure 8. The multiple mediating effect of love, contentment, and pride in the relationship between dispositional awe and factor 1 of the intolerance to uncertainty scale.................................................................................................................. 123
Figure 9. The parallel mediating effect of curiosity and intolerance of uncertainty in the relationship between dispositional awe and existential thinking. .......... 125
Figure 10. Dispositional Awe > Average Card............................................................. 126
Figure 11. Dispositional Awe > Total Score................................................................. 127
CHAPTER I:

INTRODUCTION AND REVIEW OF THE LITERATURE
Introduction

Since the publication of Keltner and Haidt’s (2003) model, the science of awe has blossomed and continues to gain steam. While the scientific understanding of awe has grown, the variety of results has done little to bring clarity to the enigmatic aura surrounding it. Theorists have conceived of awe as a social emotion due to its many prosocial effects. While this list continues to lengthen some examples are reductions in aggression (Yang et al., 2016) and increases in humility, gratitude, and a range of helping behaviors (Joye & Bolderdijk, 2015; Kahn & Cargile, 2021; Piff et al., 2015; Prade & Saroglou, 2016). Awe is also classed most often as a positive emotion, capable of improving both overall well-being and life satisfaction (Anderson et al., 2018; Rudd et al., 2012). It has also been shown to reduce levels of stress (Bai et al., 2021; Rankin et al., 2020).

Along with these positive effects often come other, somewhat equivocal effects, usually treated as mediators or moderators of the positive effects listed above. Perhaps the most common of these is self-diminishment or the “small self” as it is often called (Bai et al., 2017; Piff et al., 2015; Shiota et al., 2007). The main idea here is that the awe experience makes oneself seem small and insignificant in comparison. This has led some to propose that awe is an altered state of consciousness known as self-transcendence (Yaden et al., 2017). Awe is also consistently associated with an increased “sense of connectedness” (Shiota et al., 2007). This connectedness can be towards one’s culture, towards mankind, or toward the world at large. What seems important is a sense of unity with something larger than the self. Awe has also been shown to alter the experience of
time, leading those who experience awe to see time as more plentiful than those primed with other emotions (Rudd et al., 2012). Finally, Valdesto and Graham (2014) show that awe might increase the likelihood of seeing the world as designed by an agent.

While recent work has focused on these positive aspects of awe, historically, awe has been discussed with a more mixed air. McDougal (1910) sees awe as admiration mixed with fear. The awe-evoking stimulus is powerful and mysterious, enough to make one seem insignificant and submissive while simultaneously desiring to approach. Thus, awe leaves us teetering on the threshold of wonder and fear. A state where we neither want to approach haphazardly nor run too far. Burke (1757/1759) saw this contradictory nature of awe in his study of the sublime. Burke’s conception of this emotional state is positive, but it is a pleasure that exists in the shadow of pain. Specifically, Burke says that the awe-evoking stimulus brings the idea of pain, and simultaneous relief from that idea as the pain is only instantiated in an imaginary way. Burke’s thought on the subject implies that this potentially contradictory nature of awe is a result of cognitive processes.

While we know much about associations with and effects stemming from the awe experience, it is not clear what adaptive functions might explain this motley bunch of effects. The first attempt to provide an adaptive function of awe comes from Keltner and Haidt’s (2003) original article. They consider awe to be a primordial emotion or one that is biologically hardwired via evolutionary processes. The function of awe for Keltner and Haidt is social submission to powerful, or awe-inspiring, others. Chirico and Yaden (2018) propose that awe makes salient the kind of landscapes that might provide both safe shelter and a vantage point where incoming threats can be identified. Konečni (2005) provides three potential functions of aesthetic awe which will be discussed at length in
the following section. Most recently, Richesin and Baldwin (2023) have proposed that the function of awe is cognitive in nature. They contend that awe leads to a more systematic expression of curiosity that enables a relatively safe exploration of the unknown.

The following dissertation addresses Richesin and Baldwin’s theoretical conception of awe as a fundamentally epistemic emotion via correlational and experimental methodologies. The first study examines dispositional measures of awe in conjunction with other dispositional measures thought to be associated with awe such as curiosity and impulsivity. This study examines whether awe relates to these constructs in ways that would be expected if it is functionally situated between fear and curiosity. For example, awe should be related to curiosity but should not carry impulsive behavior. Studies two and three incorporate an experimental design in which participants were primed with awe, fear, or curiosity and then subjected to a risk-taking or physical exploration task. In both studies, self-report, as well as physiological measures associated with autonomic nervous system (ANS) activity were recorded. The goals of these three studies are as follows:

1) To determine if dispositional measures of awe are associated with various other epistemic dispositional measures as predicted by the theory.

2) To determine if awe leads to a more systematic approach to the uncertainty involved in a risk-taking task.

3) To determine if awe leads to exploratory behaviors of an uncertain object that line up with the theoretical proposition of awe being functionally situated between fear and curiosity in the context of approach and exploration.
4) To document group differences in physiological effects of awe as manifested in ANS activity. Before moving to the studies, however, we must review the necessary literature.

**What is Awe?**

Keltner and Haidt (2003) were the first in the psychological literature to seriously take up the task of building a conceptual framework for awe. In their seminal article, they review literature in sociology, philosophy, religion, and psychology to identify the important components of the awe experience. Since its publication, the study of awe has grown and flourished. Nearly every subsequent investigation into awe as an emotion has cited Keltner and Haidt’s framework. They name two features that they believe “form the heart” of the awe experience: vastness and the need for accommodation.

They define vastness as an experience of something that is larger than the self, or the self’s ordinary level of experience or frame of reference. The second part of the definition is important because it can explain a wide range of awe experiences and work to explain individual differences in awe experience. This makes it clear that the awe experience is subjective, the mountaineer may have a different awe experience at the summit than a first-time hiker. What is mundane to one may be awe-inspiring to another.

The most obvious form of vastness is physical size. When thinking about awe we often default to dramatic or panoramic landscapes. However, Keltner and Haidt (2003) also highlight social size as an important elicitor of awe. Fame, authority, prestige, or anything that indicates power in social settings may elicit awe. There are also experiences symbolic of vastness such as the ground shaking, or noises that can be heard at great distances. In social settings, this may be the lavish lifestyles of the rich and famous or the
level of following/support they have from fans/constituents. This social symbolism has become more visible (and inflatable) in the social media age.

There is also the idea of conceptual vastness. This kind of vastness can be found when we meditate on eternity, infinity, or ontological questions. Theories that work to explain a large swath of reality, particularly across time, capture this idea well. One of the most often cited examples of this kind of theory is Darwin’s theory of natural selection. I think this quote by Daniel Dennett (1995) is an illustrative example, “In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning, and purpose with the realm of space and time, cause and effect, mechanism and physical law. But it is not just a wonderful scientific idea. It is a dangerous idea.” This quote provides a clear idea of the feeling of vastness that ideas can evoke.

The danger he speaks about at the end is the threat that the idea of evolution has on many of our preconceived notions about the world and things we value. He compares the theory to a “universal acid” because it is capable of eating away at nearly every traditional concept. This is important because it highlights that not only is this theory vast, but it violates traditional beliefs about values and meanings that people hold dear. It leaves many with difficulty fitting it into their view of the world. This leads to the second feature at the heart of awe, the need for accommodation.

Borrowing from Piaget & Inhelder (1966), accommodation refers to the adjustment of mental structures to assimilate a new experience that challenges one’s mental model of the world. Specifically, experiences that cannot be assimilated through the use of existing mental structures. Keltner and Haidt (2003) stress the “need for accommodation” not that the experience is successfully accommodated. In other words,
an awe experience cannot be accommodated by existing mental structures. Success or failure in accommodation might explain the range of feelings associated with awe. If one succeeds in accommodating the experience, they may feel enlightened. Refining mental structures may provide a new lens through which to view the world. An inability to accommodate may lead to fear or confusion. It must be noted that both vastness and the need for accommodation are necessary for an awe experience under this framework. The authors note that accommodation without vastness is something more like surprise than awe. While vastness without accommodation is closer to deference or reverence.

They go on to propose five more themes that help explain the variation in awe experiences. The first is threat, this is the kind of awe that comes with feelings of fear or danger. This is exemplified by natural disasters or vicious leaders. The dreadful feeling evoked by entities in the Lovecraftian mythos is a good example of awe flavored with fear. The variation these elements are meant to explain is the opposing valences resulting from categorically similar events. For example, the differing emotions felt when seeing a hurricane vs a sunset or Stalin vs the Dali Lama.

The next theme is beauty. Many experiences of awe resulting from nature are a result of beautiful scenes. These beautiful scenes are arguably different than other scenes in nature that might be better described as dramatic, such as the hurricane or the intense terrain of the Rockies. This may also be present in social awe; a beautiful speech elicits a distinct set of emotions than a powerful or threatening speech.

Ability is the next theme able to flavor the awe experience. This refers to incredible skill, talent, or any exceptional ability be it physical or mental. Athletes, musicians, scientists, and philosophers might elicit this kind of awe. Ability often leads to
a need for accommodation. How can he be so skilled? How can she be so prolific? Keltner and Haidt (2003) point out that the need for accommodation without vastness in this circumstance leads to admiration but not awe. The ‘vastness’ of the ability or accomplishments takes the experience beyond mere admiration.

The fourth theme is virtue or strength of character. Here Keltner and Haidt (2003) cite Keltner’s (2000) own conception of “elevation”. Elevation is described as a response to moral beauty or human goodness. Keltner characterizes the feeling as a warm pleasant feeling in the chest and the desire to improve oneself. Keltner and Haidt (2003), however, go on to say that, while elevation is related to awe, it does not often elicit awe because feelings of vastness are not often involved. They argue that these experiences should be called elevation, not awe.

The final item on the list of themes is supernatural causality. This refers to the belief that experiences are caused by supernatural entities such as gods, angels, or ghosts. These experiences can be either beautiful and powerful (gods, angels) or terrifying (malevolent spirits). While I think that these examples are indicative of the awe experience. It seems like the awe experience would happen before any supernatural designation. The supernatural causality may be a response to the need for accommodation evoked by the awe experience. These kinds of experiences could have numerous explanations (sleep deprivation, various disorders, migraines, drugs). An experience simply being inexplicable may better get to the core of this theme.
The Adaptive Function of Awe

One of the most interesting questions when reflecting on the experience of awe is what purpose it served in evolutionary history for it to become a mainstay in our emotional repertoire. This answer seems clear for our threat-based emotions such as fear or disgust. For awe, however, it is not obvious how individuals or groups with the capacity for awe were more likely to survive and reproduce than those without. So far there have been three attempts to answer this question. In this section, I review those attempts and introduce my own.

Social Submission

After building their framework, Keltner and Haidt (2003) went on to discuss what they call “primordial awe”. A primordial emotion is “hard-wired” or “shaped by evolution” This is emotion at the level of its most basic evolutionary function. This contrasted with “elaborated emotion,” which consists of the cultural/social norms and values that are built around emotion. Keltner and Haidt claim that the primordial function of awe “centers upon the emotional reaction of a subordinate to a powerful leader. (306)” This idea is somewhat surprising as the most stereotypical awe experiences arise from natural scenery. In this view, the more stereotypical awe experiences in nature are just an evolutionary spandrel, a mere byproduct of the primordial function of social submission.

They begin by noting the adaptive function of submission to powerful others. It fortifies social hierarchies and subsequently reinforces the stability of the group. The feeling of awe would reduce disorder or uprisings within the group that would be detrimental to survival. This would make awe a trait selected at the group level. Awe is
conducive to a stable social hierarchy, which leads to less conflict within the group. Less group conflict leads to a stronger group that is more likely to survive and the members of the group will be more likely to pass on their genes. For this reason, they suggest that those with a higher socioeconomic status, therefore greater power, will experience less awe than lower-status individuals.

In the section on extensions to nature, they point out that the awe experience in natural contexts is often accompanied by a sense of a higher power. If the emotion of awe evolved as a social function it may make sense that we often have the feeling of some greater entity when the feeling is evoked by nature. When we experience awe beyond the social realm, there is no agent to be superior, so we perceive some higher power or principle to implicitly submit.

This theory is also able to address a difficult characteristic in Ekman’s list of basic emotions. The second item on Ekman’s list is “comparable expressions in other animals.” If awe evolved for social submission, then we should see the expression of submission to powerful others in lower animals. Many primate species, our closest evolutionary neighbors, show submissive behavior to powerful others in social hierarchies (de Waal, 1986). Primates are not the only other animals that show social hierarchies, this behavior is rife in both mammals and birds. This theory currently provides the clearest example of the complicated issue of awe expression in our evolutionary lineage. The idea that awe might require self-reflective consciousness (Prade, 2022), however, brings this view into question.
**Need for Safe Shelter**

Chirico and Yaden (2018) also approach the function of awe as an adaptation in naturalistic settings. They appeal to Appleton’s (1996) theory of “prospect and refuge.” This theory works to illustrate the ideal shelter. The two constituents of the ideal shelter are “safety” which states that there is protection from attack and “vantage” which states that it must be situated so that you may see approaching predators or enemies. Chirico and Yaden point out that the wide sweeping natural landscapes that often elicit awe would be considered good shelter by these guidelines. In this theory, awe was adapted as a salient emotional response to shelter that was safe and provided a good vantage point. Diverting attention to ideal shelter would provide a better chance of survival and reproduction.

Prior to their evolutionary theory, Chirico and Yaden (2018) also present the theory proposed by Keltner and Haidt (2003). They push back on a few issues with the view that awe’s evolutionary function is social submission. They argue that awe may not be needed to explain submission in the social hierarchies of animals as aggression and fear would suffice. I do agree that there is no clear reason to propose awe in the social hierarchies of animals with aggression being a common and easily observable reinforcer of animal hierarchies. This is not to say that animals cannot feel awe, but it doesn’t seem to be the most parsimonious explanation with current knowledge.

They also note that social awe usually only occurs towards individuals we don’t know. Leaders and celebrities who might evoke awe are not usually people known personally. Those who do know them personally probably don’t experience awe in their presence. We often hear stories of the irreverence toward powerful people by their
children. Chirico and Yaden point out that in small hunter-gatherer groups, it would be unlikely that any member would be unfamiliar with others in this way. From this lens, social awe could not occur until groups grew to a size where leaders would be strangers to the majority. I think novelty does play a role in social awe. I also think, however, that awe can be evoked by familiar others. In fact, a later study by Graziosi & Yaden (2019) found that interpersonal awe (awe from close others) has many of the requisite components of awe. It was, however, found to be distinctly different from the awe evoked by nature as there was no evidence of increased connectedness or altered time perception. Also recall the finding by Yang, Hu, Jing & Nguyen, (2018) that awe elicited by great leaders led to greater feelings of connectedness to nature. So, there may be something to the idea that interpersonal awe is distinct from social awe elicited by powerful (unfamiliar) others.

**Response to Natural Wonders**

Vladimir Konecni took a different route and proposed that the evolutionary function of awe was originally a response to the natural wonders we most often associate with the awe experience. He distinguishes an experience of awe from the sublime stimulus responsible for the experience. Konecni moves the sublime away from the mental and situates it in the external world. In his view objects are sublime and awe is the feeling that happens when we encounter the sublime.

Konecni proposes three reasons why awe as a reaction to a sublime stimulus in nature would be sexually selected. The first is “reverence” which he says may lead others to believe you have private access to the supernatural. The second is “apparent emotional
and intellectual sensitivity.” Suggesting that this trait will be beneficial for raising young.
The third is “elite-membership,” demonstrated by the possession of the economic and physical means that enable the encounter with the sublime stimulus (31)”. For Konecni the sublime stimulus is rare and only those with greater means will be able to access sublime stimulus. This is in stark contrast with Keltner and Haidt above that suggests higher power individuals may experience less awe.

I think the biggest issue with this view is the conception of awe necessarily coming from some external object. This means that awe must be the result of perception. Konecni recognizes this as well, he notes that hallucinations and trance states such as those induced by hallucinogenic drugs or some of Maslow’s peak experiences should be “conceptually excluded (32)” from future work on the subject. This doesn’t make sense. If a hallucinatory experience evokes the same feeling of awe as a perceived object, why should it be excluded? This may be a way to separate the hallucinatory experiences from his “aesthetic awe,” but if this is the case then there needs to be an explanation of why these awe experiences have a meaningful conceptual difference.

There are also issues with other common experiences of awe. Konecni’s article has what seems like a friendly view toward religious awe, a very common elicitor. The section on hallucination, however, does not acknowledge that some forms of religious awe could stem from instances of hallucination or delusion. How would we differentiate true aesthetic awe and hallucinatory awe in response to an experience with what seems to be supernatural? This conception also makes grand theories a curious case. What exactly is the external object that evokes awe in the case of a grand theory? You can feel awe towards the theorist of course, but I personally also feel awe directed towards the idea
itself. The concept or idea doesn’t seem to exist externally as an object, at least not in any way that wouldn’t warrant further explanation.

**Curiosity Governor**

Relying on insights gained from the research connecting awe with curiosity and learning, we have developed another potential solution to the problem of awe’s adaptive function. As mentioned in the introduction, literature on the sublime has long thought of it as a mixed emotion. John Dennis (1688) writes of his experiences of the sublime in the Alps, “In the very same place Nature was seen Severe and Wanton…. The sense of all this produc’d different motions in me, a delightful Horror, a terrible Joy, and at the same time, I was infinitely pleas’d. I trembled.” (Dennis, 1943, 380) Likewise, Edmund Burk (1757/1759) places these contradictory feelings as a centerpiece in his famous theory of the sublime. The early social psychologist William McDougal (1910) says that awe leaves us in a middle ground of wonder and fear, a submissive state where we neither want to approach too closely nor run too far.

Recall that awe also increases curiosity and information search as discussed in the section on ontogeny. Interestingly it does this in the face of an experience that leads to uncertainty, which is known to be aversive. Further, unfamiliar or uncertain stimuli may often be dangerous, it isn’t clear how increasing curiosity in this manner could be beneficial. We propose that awe strikes a middle ground between fear of the unknown and impulsive curiosity. It balances the idioms “scaredy cat” and “curiosity killed the cat.” It produces a thoughtful or reflective curiosity that allows for a relatively safe exploration of the unknown. The awed individual will learn more about the world than
the fearful individual while at the same time having a better chance of survival than one who is impulsively curious.

We think this would most likely be prominent at the level of group selection. A fearful individual should still survive longer than a cautiously curious one. An individual who experiences awe, however, might be more likely to pass on the benefits of information search to the group. If awe proliferates in a certain group, then that group should progress to have a better command of the world than groups without awe, leading awe-experiencing groups to outcompete others over time. Awe combines cognition and emotion in a way that makes uncertainty salient and approachable. In the next section, I will review the literature that led to this theoretical approach.

**Awe and Cognition**

**Uncertainty**

Piaget’s (1952) idea of cognitive disequilibrium is caused when there is an imbalance between an individual’s cognitive model of the world and what they are experiencing. This state is unpleasant, and the natural desire is to return to an equilibrium where experience and understanding are congruous. This often requires an individual to seek out new information in order to refine mental structures and resolve the disequilibrium. Looking back to Keltner and Haidt’s framework, this refining of mental structures is the Piagetian idea of accommodation. In the case of awe, some experience goes beyond one’s current worldview and cannot be assimilated with an individual’s current understanding or cognitive tools. This unexpected state pushes the brain out of the comfortable hemostasis it normally inhabits. Things like reasoning, curiosity, and
searching for novel information are allostatic tools to return to a comfortable epistemic equilibrium.

Other eminent figures in psychology had similar ideas about uncertainty. William James (1950) says that uncertainty leads to seeking new information to procure knowledge about the unfamiliar stimulus. Donald Hebb (1955) gets at something similar when he speaks on “risk and puzzle”. He says that risky and puzzling experiences can be positively arousing and lead to learning up to a certain point. These experiences lead to an enhanced motivation to learn new information. If the stimulus is too risky or too puzzling, however, it can lead to stunted learning through emotional disturbance or anxiety. This view is remarkably close to Sundararajan’s (2002) concerns about the Keltner and Haidt (2003) model.

All of these ideas point to a need to search for new information. A recent review by Grossnickle (2016) says that curiosity is most often described as a need for information and the motivation to seek it through exploration. Eliciting curiosity may prove to be the key mediating variable between awe and learning. It has been well-established that uncertainty fosters creativity both in the lab and observational settings (Lamnina, & Chase, 2019). Work on guided play in children shows that learning is enhanced when the child is allowed to explore freely but guided toward unknown information by a knowledgeable adult guide (Weisberg, Hirsh-Pasek, Golinkoff, Kittredge, & Klahr, 2016). This allows children to experience uncertainty and then freely explore the environment to find more information. Other studies show that increasing uncertainty increases curiosity in adults even when the results of satisfying curiosity are likely to be aversive (Hsee, & Ruan, 2016).
Violation of Expectations

Another common theme often associated with the awe literature is the violation of expectations. A violation of expectation is certainly present in many occurrences of awe and leads to feelings of uncertainty. I am not convinced, however, that it is a necessary condition for eliciting awe. A recent study shows that awe may be more closely related to an exceeding of expectations rather than a violation (Gocłowska, Elliot, van Elk, Bulska, Thorstenson, & Baas, 2021). Future research may need to take a more fine-grained approach by looking at subclasses of expectation violation rather than treating it as one category.

A violation of expectations tends to make experiences more salient and has been shown to increase memory in both adults and infants. Munnich, Ranney, & Song (2007) asked adult participants to answer “policy-relevant questions” such as the annual tuition to UC Berkley or the average daily garbage production of a US citizen. After answering the questionnaire, they were given the true values and asked to rate their surprise. They found that the most surprising values were best recalled at both eight days and twelve weeks.

Even infants who observe events that seem impossible are more likely to recall characteristics of the impossible event than a similar possible event. If an infant observes an object seemingly passing through another solid object, the infant is more likely to remember the characteristics of the object in the impossible situation (Stahl & Feigenson, 2015).

It has also been found that a violation of expectation may lead to more causal explanatory reasoning (Legare, Gelman, & Wellman, 2010; Shtulman & Yoo, 2015). In
other words, when expectations are violated, we are much more likely to use reasoning to explain that violation than if the outcome is expected. That may seem like an obvious finding in hindsight, but this tendency is extremely important in developing critical thinking skills, particularly for children. Schulz, Goodman, Tenenbaum, & Jenkins (2008) found that preschool-aged children will explain expectation-violating phenomena via unobserved causal variables, such as a hidden object.

Reflecting on what we know so far, most scientists have agreed that awe, uncertainty, and a violation of expectations are intricately connected and lead to a heightened motivation to search for more information due to the psychological discomfort caused by the pre-existing mental structure's inability to accommodate an experience. Recent physiological work has added some support for these ideas. Gruber, Gelman, & Ranganath (2014) found that brain areas associated with reward mediate learning in the context of expectation violation. The results suggest that violations of expectations foster curiosity and that enhanced learning via curiosity is associated with activity in known reward pathways.

**Awe in Learning and Thinking**

The research that connects awe and learning directly is less developed than the uncertainty, expectation violation, and curiosity research. There are only a few studies that examine learning outcomes. Most look at cognitive tendencies and behaviors that will, in theory, make people more likely to learn. However, the need for awe in teaching has been recognized. In a letter to the editor of *Education in Health* Jason Hilliard (2001) urges that awe and wonder need to be present in the classroom. He relates a time when he
was a medical student and realized he was so preoccupied with performance and facts that he was unable to see the significance of the birth of a child he was assisting in delivering. He goes on to argue that many students do not reach anywhere near their full potential because they are caught up in memorizing and performing but don’t recognize how awe-inspiring their topic can be. How can one become a true expert without some visceral emotional drive to know more? Recently, a literature has begun to emerge on the positive effects of awe in the context of science learning in both formal and informal settings. (Gail et al., 2023; Krogh-Jespersen et al., 2020; Price et al., 2021) What follows is the current empirical work showing how awe may drive us to enhance our knowledge and understanding.

An early series of studies by Shiota, Keltner & Mossman (2007) resulted in a few findings that connect awe and learning. In one experiment that focused on what kinds of experiences elicit awe, they found that awe was most elicited by information-rich experiences. This is in contrast with experiences of social engagement as well as those that led to personal gain. Another experiment looked at the relationship between dispositional awe and a need for cognitive closure. If the awe experience requires a failure of assimilation and a need for accommodation, then those who experience more awe should be more familiar with this uncertainty. Indeed, those who more often experienced dispositional awe were less likely to need cognitive closure. Suggesting that those who are more prone to experiencing awe in everyday life are more comfortable recognizing a cognitive deficit and then revising mental structures in response to the need to accommodate. Not only does awe lead to the revision of mental structures, but those
who more regularly have experiences of awe find a need for accommodation less aversive.

A recent study by Anderson and colleagues (2020) aimed to look at the relationship between dispositional awe and curiosity. They found that dispositional awe was positively associated with dispositional curiosity. In general, those who experience more awe in life are also more curious. These findings held when controlling for trait measures of openness to experience and six other positive emotions. This is evidence that awe has a unique effect on curiosity beyond that of other positive emotions. Pride was also found to be positively associated with dispositional curiosity.

To further validate these self-report findings, the researchers conducted another study that measured how curious the participant’s friends perceive them to be. Participants provided contact information for four friends. Their friends were then sent a perceived curiosity measure. The findings from the first study were replicated, it was found that dispositional awe was positively associated with others' perceived curiosity. Again, this finding was persistent when controlling for other dispositional positive emotions and openness to experience.

In the final study, Anderson and team (2020) wanted to see if there was any relationship between dispositional awe and academic outcomes. To measure academic outcomes indirectly, they looked at self-report work ethic, behavioral engagement, and academic self-efficacy. A structural equation model showed the best fit for a model that indirectly connects awe with the three academic measures via curiosity. Higher dispositional awe led to greater trait curiosity which was significantly positively associated with work ethic, behavioral engagement, and academic self-efficacy.
An impressive series of studies by Gottlieb, Keltner & Lombrozo (2018) examined how awe was related to scientific thinking. In the first study, they compared measures of dispositional awe to a “nature of science” scale. This scale was meant to test the understanding of basic scientific principles such as the understanding that, “scientific hypotheses and theories can be modified over time” and “the process of science is influenced by social and cultural factors”. They found that those higher in dispositional awe had a more accurate model of the nature of science.

The next study used the same methods to replicate the first with the addition of openness to experience and the need for cognitive closure. The findings from the first study were replicated with awe being positively related to scientific understanding. These findings remained significant when including openness to experience as a predictor, indicating that awe influences scientific understanding independent of openness to experience. Interestingly, including the need for cognitive closure as a predictor in the regression model led to awe’s relationship with scientific understanding to become non-significant. Further analysis, however, did not find a need for cognitive closure to be a significant mediator. Further research will be needed to understand this relationship.

The third study looked to replicate findings from the first two with a different measure of scientific understanding. The researcher also added a measure meant to look at “scientism,” the idea that science is the only route to knowledge. Once again, they found that dispositional awe predicted scientific understanding. Interestingly, there was no significant association between dispositional awe and the measure of scientism. While awe leads to a greater understanding of the foundational ideas of science, it does not lead to dogmatic faith in science. It appears that awe pushes individuals to search for
information and reason about a situation to alter their model of the world to fit that
situation. Regular exposure to this process seems to make individuals less polar in their
beliefs, even if it is a belief about something they have developed competence in.

The first three studies looked at the relationship between awe and the general
foundations of science. Next, the researchers wanted to see if there was any relation
between awe and specific ideas in science. In study four they look specifically at
creationism vs evolution. The three ideas were: young earth creationism, the idea that
God created people as they are relatively recently; theistic evolution, the idea that
evolution did occur over millions of years, but it was guided by God; nontheistic
evolution, The idea that evolution did occur over millions of years through only natural
mechanisms. They found that higher levels of dispositional awe were predictive of a
rejection of young earth creationism. It was not, however, predictive of endorsing either
theistic or non-theistic evolution.

As a follow-up, study five used a forced-choice method of measuring either
evolution or creation and then theistic or non-theistic evolution. They first asked if
participants believed either that humans evolved over time or if they have always existed
in their present form. After answering this they were asked if they believed either that
“humans evolved due to natural processes” or if it was guided by some supreme being.
They did not find evidence that dispositional awe predicted favoring an evolutionary
view, measured by the first set of questions. They did find, however, that dispositional
awe decreased the likelihood of ascribing to the theistic evolution in the second set of
questions.
The final study looked to examine the relationship between dispositional awe and “questionable teleological beliefs.” They measured this with true or false questions that ascribed ends to either biological or non-biological physical phenomena such as “bees exist to facilitate pollination in plants” or “Lightening releases electricity in order to travel.” Results show that dispositional awe predicts the likelihood that questionable nonbiological teleological beliefs will be rejected. They conclude that awe-prone individuals are more likely to have scientifically informed beliefs about the world.

Work in the field of awe has found that feelings of awe do lead to more systematic cognitive processing. Griskevicius, Shiota, and Neufeld (2010) examined the effects of six different positive emotions on the cognitive processing of persuasive information. First participants were given a narrative recall task where they recalled and wrote about either anticipatory enthusiasm, contentment, attachment love, amusement, awe, nurturant love, or a neutral control condition. Next, the participants were told that the university they attended was considering instituting a comprehensive examination for all seniors. They were randomly assigned to read what was considered a strong or weak argument for this policy. They then reported their feelings towards the policy to measure perceived persuasion.

As would be expected, the strong argument was significantly more persuasive than the weak argument in the control group. There was no difference in persuasive ratings between strong and weak for the emotions of anticipatory enthusiasm, amusement, attachment love, and contentment. For the participants in the awe and nurturant love groups, the weak argument was less persuasive than the strong argument. Not only was the weak argument less persuasive, but it was also rated significantly less
persuasive than control participants. This was taken as evidence that awe and nurturant love led to increased systematic processing while the other positive emotions led to more heuristic processing.

A follow-up study in the same article looked to conceptually replicate the above findings as well as looking at possible mechanisms that drive these results. In this study, emotions were elicited via reading a short story rather than narrative recall. The protocol for the persuasive component was similar. Participants were told that grade inflation was a problem at the university and given a short reading arguing that grade inflation needs to be addressed. This argument was intentionally weak, but it was noted that it was written by a distinguished Harvard professor. The results show that awe did reduce the perceived persuasiveness of the weak argument compared to control.

Only a few studies have looked at learning specifically. One such series of five studies looked at how awe effects openness to learning and preference for experiential creation (Rudd, Hildebrand, & Vohs, 2018). In the first study emotions of awe, happiness, or neutral control were induced through short videos. After this manipulation, participants were asked to fill out a dummy survey about Valentine’s Day. At the end of this survey, they were asked if they would prefer to receive either a recipe for Valentine’s Day chocolates to give as a gift or a discount coupon for premade chocolates. The recipe indicates a desire for experiential creation. Results show that those primed with awe were more likely to choose to receive a recipe than either the happiness or control conditions. There was no difference in preference between happiness and control.

In the second experiment, researchers wanted to replicate the findings from experiment one in a naturalistic setting and examine how openness to learning fits into
the equation. This experiment took place at an undisclosed hiking destination in Switzerland. The two groups were hikers either at the summit of the mountain (awe) or the parking lot prior to ascending (control). The participants answered some dummy questions and completed a survey on their level of perceived awe. The participants were led to believe that the study was over and told to choose from two rewards, either a premade bag of trail mix or the ability to make their own bag of trail mix with the same ingredients. On the same table as the trail mix, there were informational brochures about the region, which they could take if they desired. The trail mix was meant to represent a desire for experiential creation and choosing to take a brochure was meant to represent openness to learning. Hikers at the top of the mountain were much more likely to choose to make their own bag of trail mix. They were also more likely to take the informational brochure. Mediational analysis showed that openness to learning was a significant mediator of the desire for experiential creation.

Next Rudd, Hildebrand, & Vohs (2018) returned to the lab to attempt to conceptually replicate the findings from the naturalistic setting. Awe and happiness were induced via short videos. After this, participants were given some common dilemmas and asked how they would solve the problem. For example, if there was a broken sink would they like to try and figure out how to fix it themselves (experiential creation) or call a handyman to fix it for them. As expected, participants in the awe condition were more likely to choose the experiential creation route to fixing problems. Those in the awe condition were also more open to learning than those in the happiness group. Once again, openness to learning was found to be a mediating variable for the choice of experiential creation.
To ensure that the observed phenomenon was not due to arousal in general, study four compared awe against excitement. These emotions, as well as a neutral control, were elicited via different images on a print advertisement for a ski resort. After the manipulation participants were asked to choose what cake mix they would be most likely to buy between two different advertisements. The language differed between the two ads, one with language such as “make your own cake” and the other along the lines of “let us do the work for you”. Those in the awe group were more likely to buy the cake that was framed towards experiential creation than those in the excitement or control conditions. Awed participants were also more likely to be open to experience. A moderated mediation analysis showed that when the product was framed as high in experiential creation, the likelihood of purchase was mediated by openness to experience. Openness to experience was not a mediator, however, if the ad was framed with low experiential creation.

To further test if the relationship above is related to cognitive closure, participants were given a need for closure survey and then watched a slideshow to elicit either awe or happiness. Next, they were told that a company was interested in consumer preference for coaster material. After being taken to a table with a display of premade coasters and coaster materials they were given the choice to make their own coaster or to choose a coaster to keep from the premade coasters. Experiencers of awe scored higher on the openness to learning index and were more likely to make their own coaster than those in the happiness group. Further analysis indicated that the need for closure was indeed a moderator for openness to learning. Those with a high need for closure were more open to learning than those that were not. The path of awe > openness to learning >
experiential creation was significant when the need for closure was high but not when it was low.

To my knowledge, only one study has manipulated awe and looked at subsequent learning outcomes associated with that awe experience. van Limpt–Broers, Louwerse, & Postma (2020) have found evidence that feelings of awe elicited by immersive virtual reality are associated with greater learning outcomes in elementary school-aged children. In this study, participants were given lessons and conducted learning activities about space (astronauts, satellites, the solar system) before the simulation. After these activities participants were taken to a mock space shuttle and given headsets for the simulation. The simulation consisted of a 15-minute flight into orbit around the earth, narrated by a European astronaut. They found that feelings of awe were highly correlated with the overview effect. The overview effect was correlated with learning as well as presence, dispositional awe, and dispositional compassion. In summary, those who scored higher on constructs of the overview effect tended to experience higher levels of awe and have better learning outcomes.

Kim and colleagues (2023) found both dispositional and experimentally manipulated awe to be associated with higher measures of wisdom. In the first of three studies, those who had higher levels of dispositional awe and dispositional flow were more likely to display wise reasoning and show epistemic humility. The second study found that individuals who experience more awe during a recall task were more likely to display wise reasoning. The third study evoked either awe or flow and found that both awe and flow led to wise reasoning, acknowledgment of epistemic gaps and the desire to improve their understanding and their moral character in general.
Urban (2023) finds evidence that awe may promote curiosity and information-seeking. This work found that different awe-inspiring stimuli had different effects on curiosity. The finding most relevant to the topic at hand is that awe elicitors that evoked thought were those, “surrounding the origins of unknown or unexplained awe elicitors.” In other words, the elicitors that made participants wonder why or how a phenomenon occurred led to the greatest curiosity. Interestingly, this curiosity did not necessarily lead to an independent search for information, only a subset of participants followed up on the unknown aspects of the awe-eliciting stimuli.

Lv, Shi, Yu, & Zhang (2023) found that positive awe distinctly promotes natural risk-taking preferences and reduces the need for closure. The first study found that dispositional awe predicted risk taking preference above other positive emotions. Further experimental studies showed that evoking awe decreased need for closure and risk perceptions while increasing risk taking preferences. Need for closure significantly mediated the relationship between awe and risk-taking preferences. Negative awe was found to reduce risk taking preferences while having no significant effect on the need for closure and risk perceptions.

Summary

In this literature review, I summarized the findings from the awe literature that point toward a potential adaptive function of awe. I began by outlining the seminal paper in the field, which contains the current framework for the emotion awe. Next, I described various attempts to theorize about the adaptive function of awe. I then reviewed the literature that led me to my own theoretical approach to awe’s adaptive function. In what
follows, three studies will examine the concept of awe regarding other positive
dispositional measures, and the cognitive significance of awe from a risk taking and
exploratory behavior perspective.
CHAPTER II:

STUDY 1
Introduction

Richesin and Baldwin (2023) contend that awe is functionally situated between fear and curiosity. Further, they suggest that awe promotes a more systematic form or expression of curiosity and subsequent exploration. This allows for a relatively safe investigation of the unknown. This middle ground allows awe experiencers to reap the benefits of curiosity and exploration without suffering the consequences of impulsivity. Moreover, the distribution of dispositional awe scores may be reflective of adaptation at the group level. The following study will use the theoretical framework proposed by Richesin and Baldwin, (2023) to explore the relationship between awe and epistemic dispositions.

Anderson and colleagues (2020) have shown that dispositional awe is related to measures of dispositional curiosity. Curiosity has also been shown to be associated with impulsivity (Marvin, Tedeschi, & Shohamy, 2020). Therefore, a positive association between awe and various curiosity measures is expected. Additionally, awe will be a significant predictor when controlling for other positive emotions. To our knowledge, no evidence has demonstrated a relationship between awe and impulsivity. We theorized that those who experience more awe will be more prone to a systematic or planned exploration, thus being less impulsive. To examine this relationship, trait measures of awe, curiosity, and impulsivity were collected. It was hypothesized that dispositional awe should be negatively correlated with impulsivity. Further, impulsivity may be a mediating variable for the relationship between awe and curiosity.

One underlying theme of the epistemic approach put forth by Richesin and Baldwin is uncertainty. Another goal of this current study is to examine the relationship
between dispositional awe and tolerance to uncertainty. It is hypothesized that those who are higher in dispositional awe will be more tolerant of uncertainty. Curiosity is also expected to be involved. It has long been shown that uncertain or ambiguous stimuli are associated with increased curiosity (Loewenstein, 1994). The connection between trait curiosity and uncertainty tolerance, however, is less studied. Littman (2010) shows that curiosity type may play a role. Because we expect awe to be positively associated with curiosity and negatively associated with intolerance of uncertainty, we hypothesized that curiosity would be a mediating variable in the relationship between dispositional awe and curiosity.

Richesin and Baldwin speculate that individuals high in dispositional awe may also be predisposed to mental exploration, specifically those related to existential concerns such as meaning, being, or eternity. To assess this, we used two questionnaires. One will evaluate the frequency of existential thinking, the other will measure aversion and avoidance of existential thought. It is expected that those higher in dispositional awe will be more disposed to think about existential concerns while those low in dispositional awe will be more avoidant. It is also hypothesized that dispositional awe will be negatively associated with and predictive of existential anxiety. Finally, existential thinking has been shown to be positively associated with curiosity (Allan & Shearer, 2012). While we cannot find evidence that intolerance to uncertainty is related to existential thinking, we expect that those more tolerant of uncertainty will be more likely to engage in existential thinking. Thus, it is hypothesized that curiosity and intolerance to uncertainty would be mediating variables in the relationship between awe and existential thinking.
Methods

Participants

Initially, 425 students from introductory psychology classes participated in the study. Data from nine participants were deleted due to failed attention checks. Data from 18 participants were deleted due to missing data, leaving a total of 398 participants. The average age of participants was 19.95 (SD = 2.87). 67.8% (n = 270) of participants identified as female, 31.2% (n = 124) of participants identified as male, 3 participants identified as non-binary, and 1 participant answered “other”. In terms of ethnicity, 82.9% (n = 330) identified as “White, non-Hispanic”, 6.3% (n = 25) identified as “Black or African American”, 4.8% (n = 19) identified as “Hispanic, Latino, or Spanish origin”, 4.3% (n = 17) identified as Asian, .8% (n = 3) identified as middle eastern, .8% (n = 3) identified as Native Hawaiian or other Pacific Islander, and .3% (n = 1) identified as American Indian or Alaska Native. Participation in this study was voluntary and all participants provided consent prior to participation. Class credit was awarded for participation in this study.

Measures

Demographic survey:

Demographic characteristics such as age, ethnicity, and gender were assessed.

Dispositional awe and positive emotions:

The Dispositional Positive Emotions Scale (DPES) measures a general disposition toward experiencing the seven positive emotions of joy, contentment, pride, love,
compassion, amusement, and awe (Shiota et al., 2006). The DPES consists of 38-items and uses a 7-point Likert scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*. Sample items from the awe subscale include, “I seek out experiences that challenge my understanding of the world” and “I feel wonder almost every day.” Cronbach’s alpha ranged between .58 and .92 for the subscales. Scores range from 1 to 7 and higher scores indicate more occurrences of the respective emotion in everyday life.

*Dispositional Curiosity:*

The Five-Dimensional Curiosity Scale (5-DC) consists of 25-items and is used to measure trait curiosity across five subscales (Kashdan et al., 2018). The subscales consist of joyous exploration, deprivation sensitivity, stress tolerance, social curiosity, and thrill-seeking. Joyous exploration is a positive experience of finding the world intriguing. Deprivation sensitivity is the anxiety that comes with the understanding that one does not know and the effort that works to explore and uncover information. Stress tolerance is the dispositional tendency to be able to manage the anxiety that arises when faced with the novelty of new stimuli. Social curiosity refers to curiosity about other people. Thrill-seeking is the tendency for arousal to be appraised as intrinsically desirable. Each item is scored from 1 = *Does not describe me at all* to 7 = *Completely describes me*, on a 7-point Likert scale. Cronbach’s alphas across two studies range from .81 to .90. Scores range from 1 to 7 and higher scores indicate greater curiosity.

For a more compact measure of curiosity, we also employed The Curiosity and Exploration Inventory (CEI-II). Created by Kashdan and colleagues (2009) the CEI-II uses a 10-item Likert-type scale with five response options (1 = “Very little or none” to 5 = “A lot”) Cronbach’s Alpha ranges from 0.83 to 0.86 indicating good reliability. This
measure can be used as a unidimensional total score or can be separated into two
dimensions, stretching, and embracing. Stretching refers to the motivation to seek
experiences and information from stimuli that involve novelty and complexity.
Embracing refers to the willingness to embrace novelty and uncertainty in daily life.
Higher scores indicate greater curiosity.

Impulsivity:

Cyders and colleagues (2014) developed the short version of the Impulsive
Behavior Scale (S-UPPS-P) which was derived from the original 59-item UPPS-P
(Whiteside et al., 2005). This scale is used to evaluate the dispositional tendency toward
impulsive behavior across multiple dimensions. The short form of the UPPS-P consists of
20-items evaluating five subscales: sensation seeking, negative urgency, positive urgency,
lack of perseverance, and lack of premeditation. Sensation-seeking is the tendency to
seek out novel and thrilling experiences. Negative urgency is the tendency to act rashly in
response to negative mood or affective states. Positive urgency is the tendency to act
rashly in response to positive mood or affective states. Lack of perseverance refers to a
lack of self-discipline or the inability to focus on a task. Lack of premeditation refers to a
tendency to act without thinking. Each item is scored on a 4-point Likert scale from 1 =
completely agree to 4 = completely disagree. Higher scores on each item relate to higher
levels of impulsivity. Cronbach’s alpha values range from .75 to .89 across subscales.

Tolerance to uncertainty:

The Intolerance of Uncertainty Scale (IUS) is composed of 27-items assessing
negative beliefs about uncertainty and its perceived consequences (Buhr & Dugas, 2002;
Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). Higher scores on the IUS
indicate greater intolerance of uncertainty. Items are scored from 1 = *Not at all characteristic of me* to 5 = *Entirely characteristic of me*, on a 5-point Likert scale. The scale can be used as a unifactorial measure for a global intolerance to uncertainty score. Sexton and Dugas (2009) have identified a bifactorial use of the scale as well. Factor one: “Uncertainty has negative behavioral and self-referent implications.” This corresponds with beliefs such as uncertainty: increases vulnerability, reduces confidence, reduces ability to function, is paralyzing, or keeps one from sleeping. Factor two: “Uncertainty is unfair and spoils everything.” This is associated with beliefs such as, uncertainty makes me anxious, stressed, and upset. Higher scores correspond with less tolerance to uncertainty. The English version has shown excellent internal consistency (.94).

*Existential anxiety*

The Existential Concern Questionnaire (ECQ) is used to measure aversive attitudes toward existential concerns (van Bruggen et al., 2017). The ECQ consists of three dimensions of existential anxiety measured across a total of 22-items. The dimensions consist of *general existential anxiety, death anxiety, and avoidance* (of existential concerns). Items are rated on a 5-point Likert scale from 1 = *totally disagree* to 5 = *totally agree*. The authors suggest using a global total existential anxiety score, and this scale has been shown to have excellent internal consistency (.91). Higher scores indicate greater anxiety or avoidance of existential questions.

*Likelihood of Existential Thinking:*

The Scale for Existential Thinking (SET) is used to quantify one’s frequency of reflection on “deep” matters such as the nature of reality or meaning (Allan & Shearer, 2012). The SET is an 11-item questionnaire with responses that range from 1 =
never or rarely to 5 = all the time. Scores range from 11 to 55, and higher scores indicate higher levels of existential thinking. Cronbach’s alpha of .91 indicates excellent internal consistency.

**Procedure**

This study was approved by the university’s institutional review board. Participants were recruited online via a university participant pool. Prior to signing up, participants read a brief description of the study via a consent form. Once consent was obtained, participants were given a link to the survey on Qualtrics. Those who agreed to participate then completed the survey package. Finally, participants were given a debriefing sheet disclosing the study's aims, methods, and suggested readings. With the exclusion of extreme outliers, (i.e., leaving the computer) the online survey package took approximately 20 minutes to complete on average.

**Results**

**Correlations Between Awe and Epistemic Dispositions**

Correlation analysis was conducted using IBM SPSS Statistics version 29. For means, standard deviations, and hypothesis-relevant correlation coefficients with confidence intervals, see Table 1 located in this chapter. In terms of curiosity measures this hypothesis was confirmed. A Pearson correlation shows that dispositional awe was significantly positively associated with dimensions of positive emotions: *joyous exploration* \( r(396) = .453, p < .001 \), *deprivation sensitivity* \( r(396) = .243, p < .001 \), *stress tolerance* \( r(396) = .102, p < .042 \), *social curiosity* \( r(396) = .247, p < .001 \), and
thrill-seeking \((r_{396} = .271, p < .001)\). Results were similar to the curiosity CEI-II measure. Dispositional awe was significantly positively associated with the total score \((r_{396} = .435, p < .001)\), and both the stretching \((r_{396} = .417, p < .001)\) and embracing \((r_{396} = .372, p < .001)\) subscales. Thus, those participants who endorsed higher dispositional awe were more likely to be curious than their counterparts.

The hypothesis regarding intolerance to uncertainty was confirmed, dispositional awe was indeed negatively correlated to the unifactorial measure of intolerance to uncertainty \((r_{396} = -.157, p < .002)\). Suggesting that those higher in dispositional awe are more tolerant of uncertainty. The bifactorial scoring, however, paints a more nuanced picture. Dispositional awe was only significantly negatively correlated with factor one \((r_{396} = -.208, p < .001)\). There was no association with factor two \((r_{396} = -.074, p = .141)\). This implies that for those with higher dispositional awe, uncertainty has fewer negative behavioral and self-referent implications but no effect on feelings of stress, anxiety, or the appraisal that uncertainty is unfair and spoiling.

Our hypothesis on existential thinking was partially confirmed. The results show that dispositional awe was positively correlated to one’s tendency to engage with existential questions via the SET questionnaire \((r_{396} = .363, p < .001)\). Regarding existential anxiety, there was no association between dispositional awe and either general existential anxiety \((r_{396} = -.074, p = .142)\) or death anxiety \((r_{396} = -.024, p = .635)\). There was, however, a significant negative association with avoidance \((r_{396} = -.126, p = .012)\). This shows that those higher in dispositional awe are indeed more likely to engage with existential questions and less likely to avoid existential questions.
Table 1. Means, standard deviations, and correlations between dispositional awe and target variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dispositional Awe</td>
<td>5.02</td>
<td>0.87</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2. Scale for Existential Thinking</td>
<td>33.04</td>
<td>10.45</td>
<td>.363***</td>
<td>.274-.445</td>
</tr>
<tr>
<td>3. Joyous Exploration</td>
<td>5.01</td>
<td>1.01</td>
<td>.453***</td>
<td>.371-.527</td>
</tr>
<tr>
<td>4. Deprivation Sensitivity</td>
<td>4.61</td>
<td>1.31</td>
<td>.243***</td>
<td>.148-.333</td>
</tr>
<tr>
<td>5. Stress Tolerance</td>
<td>4.32</td>
<td>1.37</td>
<td>.102*</td>
<td>.004-.198</td>
</tr>
<tr>
<td>6. Social Curiosity</td>
<td>5.26</td>
<td>1.17</td>
<td>.247***</td>
<td>.153-.337</td>
</tr>
<tr>
<td>7. Thrill Seeking</td>
<td>4.09</td>
<td>1.35</td>
<td>.271***</td>
<td>.178-.360</td>
</tr>
<tr>
<td>CEI-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Total</td>
<td>31.81</td>
<td>7.12</td>
<td>.435***</td>
<td>.351-.511</td>
</tr>
<tr>
<td>9. Stretching</td>
<td>17.03</td>
<td>3.72</td>
<td>.417***</td>
<td>.322-.494</td>
</tr>
<tr>
<td>10. Embracing</td>
<td>14.77</td>
<td>4.16</td>
<td>.372***</td>
<td>.284-.453</td>
</tr>
<tr>
<td>S-UPPS-P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Negative Urgency</td>
<td>2.50</td>
<td>0.69</td>
<td>-.030</td>
<td>-.128-.069</td>
</tr>
<tr>
<td>12. Lack of Perseverance</td>
<td>1.78</td>
<td>0.55</td>
<td>-.188***</td>
<td>-.281-.091</td>
</tr>
<tr>
<td>13. Lack of Premeditation</td>
<td>1.84</td>
<td>0.58</td>
<td>-.165***</td>
<td>-.259-.068</td>
</tr>
<tr>
<td>14. Sensation Seeking</td>
<td>2.75</td>
<td>0.62</td>
<td>.160***</td>
<td>.063-.255</td>
</tr>
<tr>
<td>15. Positive Urgency</td>
<td>2.11</td>
<td>0.69</td>
<td>.026</td>
<td>-.073-.124</td>
</tr>
<tr>
<td>IUS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Total</td>
<td>70.26</td>
<td>18.65</td>
<td>-.157**</td>
<td>-.251-.059</td>
</tr>
<tr>
<td>17. Factor 1</td>
<td>35.91</td>
<td>10.87</td>
<td>-.208***</td>
<td>-.300-.112</td>
</tr>
<tr>
<td>18. Factor 2</td>
<td>34.34</td>
<td>8.86</td>
<td>-.074</td>
<td>-.171-.025</td>
</tr>
<tr>
<td>ECQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. General Existential Concern</td>
<td>35.43</td>
<td>11.08</td>
<td>-.074</td>
<td>-.171-.025</td>
</tr>
<tr>
<td>20. Death Anxiety</td>
<td>17.77</td>
<td>6.48</td>
<td>-.024</td>
<td>-.222-.075</td>
</tr>
<tr>
<td>21. Avoidance</td>
<td>10.36</td>
<td>3.45</td>
<td>-.126*</td>
<td>-.222-.028</td>
</tr>
</tbody>
</table>

Note: M and SD are used to refer to means and standard deviations respectively. I refers to correlations between the dispositional awe subscale and target variables. “5-DC” refers to the Five-Dimensional Curiosity Scale. Items under CEI-II refer to the Curiosity and Exploration Inventory. “S-UPPS-P” refers to the Impulsive Behavior Scale. “IUS” refers to the Intolerance of Uncertainty Scale. “ECQ” refers to the existential concern questionnaire. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). *** Correlation is significant at the 0.001 level (2-tailed).
Awe as a Distinct Predictor of Epistemic Dispositions

Informed by the above correlations, the next step was to determine if awe significantly predicts the variables identified above when controlling for the six other positive emotions joy, contentment, amusement, compassion, love, and pride in the DPES. Several multiple linear regression models with all seven positive emotions as predictors were computed. All target variables with insignificant correlations were not analyzed. Regression analyses were conducted using IBM SPSS Statistics version 29. For both standardized and unstandardized coefficients, standard error and 95% confidence intervals, see Table 2 located in this chapter. To keep in line with the hypothesis, beta and p values will only be reported for Dispositional awe as a predictor of the relevant target variables.

With the exception of stress tolerance ($R^2 = .090$, $F(7,390) = 5.510$, $\beta = 0.050$, $p = 0.388$), awe was a distinct predictor of target curiosity variables. The analyses revealed that joyous exploration ($R^2 = .265$, $F(7,390) = 20.122$, $\beta = 0.386$, $p < .001$), deprivation sensitivity ($R^2 = .130$, $F(7,390) = 8.310$, $\beta = 0.218$, $p < .001$), social curiosity ($R^2 = .234$, $F(7,390) = 17.107$, $\beta = 0.172$, $p = 0.001$), thrill seeking ($R^2 = .149$, $F(7,390) = 9.767$, $\beta = 0.155$, $p = 0.006$), CEI total ($R^2 = .250$, $F(7,390) = 18.606$, $\beta = 0.327$, $p < .001$), stretching ($R^2 = .247$, $F(7,390) = 16.822$, $\beta = 0.370$, $p < .001$), and embracing ($R^2 = .216$, $F(7,390) = 15.391$, $\beta = 0.230$, $p < .001$) were predictors of awe.

Of the subscales measuring impulsivity (S-UPPS-P), only lack of premeditation was significantly predicted by awe when controlling for other positive emotions ($R^2 = .095$, $F(7,390) = 5.875$, $\beta = -0.126$, $p = 0.031$). Neither lack of perseverance ($R^2 = .132$, $F(7,390) = 8.485$, $\beta = -0.064$, $p = 0.259$) nor sensation seeking ($R^2 = .087$, $F(7,390) = ...
5.320, β = 0.102, p = 0.080) were significantly predicted by awe when controlling for other positive emotions. Of all impulsive measures, awe is most strongly associated with decreased lack of premeditation. Or, presumably, an increase in premeditation.

In terms of intolerance to uncertainty, awe was not a significant predictor of Factor 1 when controlling for other positive emotions (R\(^2\) = .246, F(7,390) = 18.166, β = -0.056, p = 0.29). Awe is related to greater tolerance to uncertainty, however, not distinctly so. Love, pride and contentment were all significant predictors of factor 1 (in this model.

Regarding existential thinking and existential anxiety, the results show that awe was a distinct predictor of the likelihood of existential thinking (R\(^2\) = .161, F(7,390) = 10.713, β = 0.391, p < .001). Awe was not a distinct predictor of the avoidance subscale (R\(^2\) = .067, F(7,390) = 4.020, β = -0.108, p = .068) of the existential concern questionnaire. These results show that dispositional awe is a positive predictor of existential thinking. Awe does not, however, predict the anxiety provoked by existential wonderings.

**Awe, Curiosity, and Impulsivity**

Next, we wanted to better understand the relationship between awe, curiosity, and impulsivity. It was hypothesized that impulsivity would be a mediating variable in the relationship between awe and curiosity. The analysis above, however, has adjusted our approach. The regression model shows that awe is a distinct predictor of impulsivity via a lack of premeditation. Those with higher dispositional awe are more likely to engage in premeditation.
Table 2. Results of linear regression models with dispositional awe as predictor while controlling for other positive emotions from the dispositional positive emotion scale.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale for Existential Thinking</strong></td>
<td>4.692</td>
<td>.671</td>
<td>.391***</td>
<td>6.988</td>
<td>3.37</td>
<td>6.01</td>
</tr>
<tr>
<td><strong>5-DC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joyous Exploration</td>
<td>.446</td>
<td>.061</td>
<td>.386***</td>
<td>7.361</td>
<td>.327</td>
<td>.565</td>
</tr>
<tr>
<td>Deprivation Sensitivity</td>
<td>.327</td>
<td>.085</td>
<td>.218***</td>
<td>3.821</td>
<td>.159</td>
<td>.495</td>
</tr>
<tr>
<td>Stress Tolerance</td>
<td>.079</td>
<td>.092</td>
<td>.050</td>
<td>0.863</td>
<td>-.101</td>
<td>.260</td>
</tr>
<tr>
<td>Social Curiosity</td>
<td>.231</td>
<td>.072</td>
<td>.172***</td>
<td>3.221</td>
<td>.090</td>
<td>.372</td>
</tr>
<tr>
<td>Thrill Seeking</td>
<td>.240</td>
<td>.087</td>
<td>.155**</td>
<td>2.748</td>
<td>.068</td>
<td>.411</td>
</tr>
<tr>
<td><strong>CEI-II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.674</td>
<td>.433</td>
<td>.327***</td>
<td>6.183</td>
<td>1.824</td>
<td>3.524</td>
</tr>
<tr>
<td>Stretching</td>
<td>1.578</td>
<td>.266</td>
<td>.370***</td>
<td>6.978</td>
<td>1.134</td>
<td>2.023</td>
</tr>
<tr>
<td>Embracing</td>
<td>1.096</td>
<td>.258</td>
<td>.230***</td>
<td>4.242</td>
<td>.588</td>
<td>1.603</td>
</tr>
<tr>
<td><strong>S-UPPS-P</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Perseverance</td>
<td>-.041</td>
<td>.036</td>
<td>-.064</td>
<td>-1.131</td>
<td>-.112</td>
<td>.030</td>
</tr>
<tr>
<td>Lack of Premeditation</td>
<td>-.083</td>
<td>.038</td>
<td>-.126*</td>
<td>-2.169</td>
<td>-.159</td>
<td>-.008</td>
</tr>
<tr>
<td>Sensation Seeking</td>
<td>.075</td>
<td>.043</td>
<td>.102</td>
<td>1.753</td>
<td>-.009</td>
<td>.159</td>
</tr>
<tr>
<td><strong>IUS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 1</td>
<td>-.695</td>
<td>.622</td>
<td>-.056</td>
<td>-1.050</td>
<td>-1.997</td>
<td>.607</td>
</tr>
<tr>
<td><strong>ECQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>-.428</td>
<td>.234</td>
<td>-.108</td>
<td>-1.832</td>
<td>.068</td>
<td>-.887</td>
</tr>
</tbody>
</table>

Note: “5-DC” refers to the Five-Dimensional Curiosity Scale. Items under CEI-II refer to the Curiosity and Exploration Inventory. “S-UPPS-P” refers to the Impulsive Behavior Scale. “IUS” refers to the Intolerance of Uncertainty Scale. “ECQ” refers to the existential concern questionnaire. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). *** Correlation is significant at the 0.001 level (2-tailed).
Interestingly, correlation data shows that the total curiosity score from the CEI is not significantly associated with a lack of premeditation ($r(396) = .040, p = .428$). The two factors of the CEI taken separately, however, are both significantly associated with a lack of premeditation in opposing directions: stretching ($r(396) = -.138, p < .01$), embracing ($r(396) = .363, p < .001$). This suggests that the motivation to seek out new experiences is associated with reduced impulsivity while embracing novelty and uncertainty is associated with increased impulsivity via lack of premeditation.

With this in mind, and because we have no evidence to suggest the order of a causal relationship between stretching and embracing, it was decided to test a parallel mediation model that examines the mediating effect of stretching and embracing in the relationship between awe and impulsivity (lack of premeditation). We performed a multiple mediation analysis with 5,000 bootstrap iterations via SPSS PROCESS macro version 4.2 (Hayes, 2013) to ascertain the specific indirect effects of stretching and embracing in the relationship between awe and impulsivity. For an illustration of this model, see Figure 7 located in appendix. For both standardized and unstandardized coefficients as well as confidence intervals, see Table 3 located in this chapter.

Results show that the indirect effects of both stretching (95% CI = -.14, -.07) and embracing (95% CI = .08, .17) were both significant, indicating that both stretching and embracing are partial mediators in the relationship between dispositional awe and impulsivity. Awe was related to increased stretching and embracing, stretching was associated with reduced impulsivity while embracing was associated with increased impulsivity. This shows that while awe is ultimately associated with lower impulsivity
(via lack or premeditation), awe is further predictive of both increases and decreases in impulsivity by its association with increased curiosity in general.

**Awe and Intolerance of Uncertainty**

Before looking at awe and existential thinking, we must first gain a better understanding of the relationship between awe and intolerance of uncertainty. While awe was significantly negatively related to IUS factor 1 (Uncertainty has negative behavioral and self-referent implications), awe was not a distinct predictor of factor 1. As mentioned above, love, pride, and contentment were all predictors of factor 1 in the model. To better understand the relationship between awe and intolerance to uncertainty, a multiple mediation model was constructed with 5,000 bootstrap iterations via SPSS PROCESS macro version 4.2 (Hayes, 2013) to ascertain the specific indirect effects of love pride and contentment as mediators in the relationship between awe and Factor 1. For an illustration of this model see Figure 8 in the appendix. For both standardized and unstandardized coefficients as well as confidence intervals, see Table 4 in this chapter.

Results show that the indirect effects of love (95% CI = .21, 1.14), contentment (95% CI = -2.43, -88), and pride (95% CI = -1.20, -80), were significant. The direct effect was insignificant ($p = .67$). This indicates that love, contentment, and pride fully mediated the observed negative association between awe and IUS factor 1. Awe was positively related to love contentment and pride while contentment and pride were associated with reduced intolerance to uncertainty. Interestingly, love was associated with increased intolerance to uncertainty and awe was associated with increased intolerance to uncertainty through the love pathway.
Table 3. **Full parameters of each path in the parallel mediation model examining the mediating role of curiosity in the relationship between dispositional awe and impulsivity.** (N = 398)

<table>
<thead>
<tr>
<th>Type</th>
<th>Path</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>P</th>
<th>95% CI</th>
<th>LLCI</th>
<th>ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component:</td>
<td>Awe &gt; Stretching</td>
<td>1.78</td>
<td>0.19</td>
<td>0.41</td>
<td>&lt; .001</td>
<td>1.39</td>
<td>2.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Awe &gt; Embracing</td>
<td>1.78</td>
<td>0.22</td>
<td>0.37</td>
<td>&lt; .001</td>
<td>0.04</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stretching &gt;</td>
<td>-0.06</td>
<td>0.01</td>
<td>-0.37</td>
<td>&lt; .001</td>
<td>-0.08</td>
<td>-0.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Embracing &gt;</td>
<td>0.07</td>
<td>0.01</td>
<td>0.50</td>
<td>&lt; .001</td>
<td>0.05</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Impulsivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>Awe &gt; Impulsivity</td>
<td>-0.11</td>
<td>0.03</td>
<td>-0.17</td>
<td>&lt; .001</td>
<td>-0.17</td>
<td>-0.05</td>
<td></td>
</tr>
<tr>
<td>Direct:</td>
<td>Awe &gt; Impulsivity</td>
<td>-0.13</td>
<td>0.03</td>
<td>-0.20</td>
<td>&lt; .001</td>
<td>-0.20</td>
<td>-0.06</td>
<td></td>
</tr>
<tr>
<td>Indirect:</td>
<td>Awe &gt; Stretching &gt;</td>
<td>-0.10</td>
<td>0.02</td>
<td>-0.16</td>
<td>--</td>
<td>-0.14</td>
<td>-0.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Embracing &gt;</td>
<td>0.12</td>
<td>0.02</td>
<td>0.19</td>
<td>--</td>
<td>0.08</td>
<td>0.17</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Standard errors (SE) and confidence intervals (95% CI) were computed with bootstrap percentiles for indirect effects.*
Table 4. Full parameters of each path in the parallel mediation model examining the mediating role of love, contentment, and pride in the relationship between dispositional awe and intolerance to uncertainty factor 1. (N = 398)

<table>
<thead>
<tr>
<th>Type</th>
<th>Path</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LLCI</td>
</tr>
<tr>
<td>Component:</td>
<td>Awe &gt; Love</td>
<td>0.42</td>
<td>0.06</td>
<td>0.34</td>
<td>&lt; .001</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>Awe &gt; Contentment</td>
<td>0.58</td>
<td>0.06</td>
<td>0.44</td>
<td>&lt; .001</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Awe &gt; Pride</td>
<td>0.45</td>
<td>0.06</td>
<td>0.37</td>
<td>&lt; .001</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>Love &gt; Factor 1</td>
<td>1.53</td>
<td>0.51</td>
<td>0.15</td>
<td>= .002</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>Contentment &gt; Factor 1</td>
<td>-2.76</td>
<td>0.55</td>
<td>-0.29</td>
<td>&lt; .001</td>
<td>-3.83</td>
</tr>
<tr>
<td></td>
<td>Pride &gt; Factor 1</td>
<td>-3.03</td>
<td>0.56</td>
<td>-0.30</td>
<td>&lt; .001</td>
<td>-4.13</td>
</tr>
<tr>
<td>Total:</td>
<td>Awe &gt; Factor 1</td>
<td>-2.60</td>
<td>0.61</td>
<td>-0.21</td>
<td>&lt; .001</td>
<td>-3.80</td>
</tr>
<tr>
<td>Direct:</td>
<td>Awe &gt; Factor 1</td>
<td>-0.27</td>
<td>0.63</td>
<td>-0.02</td>
<td>= .667</td>
<td>-1.50</td>
</tr>
<tr>
<td>Indirect:</td>
<td>Awe &gt; Love &gt; Factor 1</td>
<td>0.64</td>
<td>0.24</td>
<td>0.05</td>
<td>--</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>Awe &gt; Contentment &gt; Factor 1</td>
<td>-1.61</td>
<td>0.40</td>
<td>-0.13</td>
<td>--</td>
<td>-2.43</td>
</tr>
<tr>
<td></td>
<td>Awe &gt; Pride &gt; Factor 1</td>
<td>-1.36</td>
<td>0.31</td>
<td>-0.11</td>
<td>--</td>
<td>-1.20</td>
</tr>
</tbody>
</table>

Note: Standard errors (SE) and confidence intervals (95% CI) were computed with bootstrap percentiles for indirect effects.
Table 5. Full parameters of each path in the parallel mediation model examining the mediating role of curiosity and intolerance of uncertainty in the relationship between dispositional awe and existential thinking. \((N = 398)\)

<table>
<thead>
<tr>
<th>Type</th>
<th>Path</th>
<th>(B)</th>
<th>(SE)</th>
<th>(\beta)</th>
<th>(p)</th>
<th>95% CI</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Awe &gt; Curiosity</td>
<td>0.43</td>
<td>0.19</td>
<td>0.43</td>
<td>&lt; .001</td>
<td>2.83</td>
<td>4.28</td>
</tr>
<tr>
<td></td>
<td>Awe &gt; IUS</td>
<td>-3.35</td>
<td>1.06</td>
<td>-0.16</td>
<td>= .002</td>
<td>-5.44</td>
<td>-1.26</td>
</tr>
<tr>
<td></td>
<td>Curiosity &gt; SET</td>
<td>0.33</td>
<td>0.08</td>
<td>0.23</td>
<td>&lt; .001</td>
<td>0.18</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>IUS &gt; SET</td>
<td>0.13</td>
<td>0.03</td>
<td>0.24</td>
<td>&lt; .001</td>
<td>0.08</td>
<td>0.19</td>
</tr>
<tr>
<td>Total:</td>
<td>Awe &gt; SET</td>
<td>4.35</td>
<td>0.56</td>
<td>0.36</td>
<td>&lt; .001</td>
<td>3.25</td>
<td>5.45</td>
</tr>
<tr>
<td>Direct:</td>
<td>Awe &gt; SET</td>
<td>3.62</td>
<td>0.60</td>
<td>0.30</td>
<td>&lt; .001</td>
<td>2.44</td>
<td>4.80</td>
</tr>
<tr>
<td>Indirect:</td>
<td>Awe &gt; Curiosity &gt; SET</td>
<td>1.19</td>
<td>0.30</td>
<td>0.10</td>
<td>--</td>
<td>0.62</td>
<td>1.81</td>
</tr>
<tr>
<td></td>
<td>Awe &gt; IUS &gt; SET</td>
<td>-0.46</td>
<td>0.18</td>
<td>-0.04</td>
<td>--</td>
<td>-0.86</td>
<td>-0.14</td>
</tr>
</tbody>
</table>

Note: “Curiosity” refers to the total average of the Curiosity and exploration inventory. “IUS” refers to the intolerance of uncertainty scale, unidimensional. “SET” refers to the scale for existential thinking. Standard errors (SE) and confidence intervals (95% CI) were computed with bootstrap percentiles for indirect effects.
**Awe and Existential Thinking**

Finally, we found that awe was a distinct positive predictor of existential thinking. Both curiosity via CEI-II total ($r(396) = .270, p < .001$) and intolerance to uncertainty via IUS total ($r(396) = .270, p < .001$) were significantly associated with existential thinking. Therefore, these data were subjected to a fourth parallel mediation analysis with 5,000 bootstrap samples. For an illustration of this model, see Figure 9 in the appendix. For standardized and unstandardized coefficients as well as confidence intervals, see Table 5 located in this chapter.

Results show that the indirect effects of both curiosity (95% CI = 0.62, 1.18) and intolerance to uncertainty (95% CI = -0.86, -0.14) were both significant. This indicates that curiosity and Intolerance to uncertainty partially mediated the relationship between dispositional awe and existential thinking. Once again, we observe competing pathways. Awe is associated with increased curiosity which is associated with increased existential thinking. Awe is also associated with reduced intolerance to uncertainty which increases existential thinking. This path results in decreased existential thinking. Ultimately, however, awe is associated with increased existential thinking, partially mediated by curiosity.

**Discussion**

Regarding the relationship between awe and curiosity, our hypotheses were confirmed. Awe was positively associated with both measures of curiosity used in the study. These findings indicate that those with higher dispositional awe were more likely to: 1) find the world intriguing, 2) experience frustration when knowing what one doesn’t
know while devoting energy towards exploring for information to remedy that frustration, 3) tolerate the anxiety involved with novel or uncertain stimuli, 4) be curious about other people, and 5) find the arousal involved in novel or uncertain situations intrinsically valuable. Further, awe was a distinct predictor of all curiosity measures when controlling for other positive emotions, with the exception of stress tolerance. While there was an association with stress tolerance, this relationship is considerably weaker. As the results show, awe is also associated with deprivation sensitivity, the anxiety that follows the understanding that one is lacking information. Thus, those with higher dispositional awe experience enhanced epistemic anxiety, but only experience a nominal improvement in the ability to cope with that anxiety. This is somewhat at odds with recent work by Thompson (2022a, 2022b) that shows awe leads to enhanced resiliency.

Looking more closely at the individual items of the stress tolerance subscale, only two of the five are significantly correlated to awe: “The smallest doubt can stop me from seeking out new experiences” and “I cannot handle the stress that comes from entering uncertain situations.” This shows that those with higher dispositional awe are more likely to seek new experiences in the face of doubt and are more able to handle the stress that comes from uncertainty. There was, however, no effect when exploration or concentration might be hindered by a lack of confidence in oneself, questions about safety, or potential surprise. Perhaps awe only influences certain facets of stress tolerance. Future research should address this possibility.

Awe was associated with reduced impulsivity as far as premeditation, perseverance, and sensation-seeking are concerned. It was not, however, associated with the sort of impulsivity associated with affective reactivity. Only lack of premeditation
was distinctly predicted by dispositional awe. While not hypothesized, this is explicable within the theoretical framework. The theoretical approach is mostly concerned with systematic exploration or planning. Thinking of awe as a positive emotion, an important facet of the proposed function of awe is enhanced premeditation prior to action. Overall, our results indicate that those who experience awe more often tend to engage in premeditation and may be more likely to persevere and sensation seek. They seem, however, to be as susceptible to passions as anyone else.

Our hypothesis was that impulsivity would be a mediating variable between dispositional awe and curiosity. The results, however, painted a more complex picture. With awe only being associated with premeditation, we noticed that premeditation was not associated with curiosity in general. It was, however, competitively associated with stretching and embracing subscales. Mediation analysis showed that, through the stretching path, impulsivity was reduced via increased motivation to seek experiences and information from stimuli that involve novelty and complexity. Through the embracing path, impulsivity was enhanced via an increased willingness to embrace novelty and uncertainty.

Importantly, the relationship between awe and impulsivity (via premeditation) is negative and these paths were only partial mediators. This indicates that the relationship between awe and premeditation is more complicated than the current study could shed light on. We hope, however, that these findings can serve as a foundation for further understanding the processes that underly the relationship between awe and impulsivity. One important future direction that stems from this model is to gain a better understanding of how awe might influence different facets of curiosity. Do some stimuli
cause more stretching rather than embracing? Might an appraisal process or certain personality features mediate the effect of awe on stretching and embracing? Future work will have to address these questions.

Our hypothesis that awe would be negatively correlated with intolerance to uncertainty was partially confirmed. This correlation was weak and further examination showed that awe was only significantly related to factor 1 (“Uncertainty has negative behavioral and self-referent implications”), on the IUS. This significance disappeared when controlling for six other positive emotions. Because an understanding of the relationship between uncertainty and awe is crucial to the theoretical approach, we further probed these findings with two multiple mediation models. While awe was not a distinct predictor of IUS factor 1, love, contentment, and pride were significant predictors. With this in mind, we set love, contentment, and pride as mediating variables in the relationship between awe and IUS factor 1. These variables fully mediated the observed negative relationship between awe and IUS factor 1. Interestingly, only pride and contentment were negative pathways. Dispositional love showed a positive relationship with IUS factor 1. This shows that the relationship between awe and factor 1 intolerance to uncertainty is likely indirect. Perhaps awe increases contentment and pride which then affects intolerance to uncertainty, which the model suggests. Most likely, however, there are more variables and interactions to contend with than presented in the current model. Future research should work to expand the mechanisms behind the association with awe and the experience that uncertainty leads to negative effects.

One of the more surprising findings in the current study is that awe was not significantly related to IUS factor 2 (“Uncertainty is unfair and spoils everything”). Both
our hypotheses and the data at hand, particularly the positive relationship with embracing, suggested a negative relationship between awe and IUS factor 2 should be observed. Recent work by Whitecross & Smithson (2023) may help clear up this discrepancy. Their findings show that interest type curiosity leads to a positive view of uncertainty while deprivation-type curiosity leads to negative views of uncertainty. Interest refers to the “anticipation of enjoyment from learning.” Of our measures, we believe joyous exploration best captures this factor of curiosity due to its description as “a positive experience of finding the world intriguing.” Deprivation sensitivity best captures the deprivation type. Therefore, our findings suggest that awe is significantly positively associated with both joyous exploration and deprivation sensitivity.

Our hypotheses regarding existential thinking and existential anxiety were partially confirmed. Awe was both associated with and distinctly predictive of the likelihood of existential thinking. Those who experience more awe in daily life tend to be more likely to ponder existential questions. Awe was not, however, associated with general existential anxiety or death anxiety. While not addressed in the results, the correlations show that positive aspects of curiosity such as joyous exploration, and the CEI subscales (particularly embracing) are negatively associated with existential anxiety. Negative aspects such as deprivation sensitivity are positively associated with existential anxiety. Avoidance was significantly negatively associated with awe. It was not, however, a distinct predictor. This suggests that awe likely has little to no effect on existential anxiety.

Our final hypothesis was that the relationship between awe and existential thinking would be mediated by intolerance to uncertainty and curiosity. Both intolerance
to uncertainty and curiosity were indeed partial mediators. Contrary to the hypothesis, however, intolerance to uncertainty was associated with a lower likelihood of existential thinking. Our thinking prior to the study was that an intolerance to uncertainty would lead one to ruminate on topics high in uncertainty. Intolerance to uncertainty has been shown to be associated with negative forms of rumination (Satici, Saricali, Satici & Griffiths, 2022). There are, however, other findings that show religiosity acts as a buffer in the relationship between intolerance of uncertainty and depression (Bardeen & Michel, 2017). Perhaps those who are intolerant of uncertainty are more likely to turn to a doctrine that provides structure and order, rather than ponder inherently uncertain topics.

All said, the current study provides evidence that awe is related to epistemic dispositions such as curiosity, intolerance to uncertainty, impulsivity (lack of premeditation), and the likelihood of existential thinking. Of these target variables, the positive aspects of curiosity (Joyous exploration, CEI-II subscales) have by far the strongest relationship with awe. Next is the likelihood of existential thinking, followed by negative aspects of curiosity (deprivation sensitivity). Awe’s relationship with impulsivity and intolerance to uncertainty was weaker and likely the result of indirect effects. More work must be done to unravel the mechanisms of these relationships. The study has further provided potential pathways that explain the inner workings of these relationships to be used as footholds for future research.
CHAPTER III:

STUDY 2
Introduction

One of the main predictions in the theory proposed by Richesin and Baldwin (2023) is that awe will have a distinct effect on risk-taking and exploration. Study two utilized an established behavioral measure of risk-taking, the Columbia card task. In addition, various physiological measures were taken in order to determine if awe elicits a pattern of ANS activity distinct from fear and curiosity.

While the theoretical approach highlights risk taking, little research has been done to understand risk taking behaviors in response to an awe experience. Lv, Shi, Yu, & Zhang (2023) showed that both dispositional awe and an awe experience were significant predictors of increased risk-taking preferences. This study, however, did not examine any observable risk-taking behaviors. Study two aims to introduce behavioral data to study the dynamic between awe and risk taking. Risk-taking was operationalized as:

1) Number of Cards Taken per Round
2) Total Score
3) Time Spent on Each Trial

Number of Cards per Round and Total score display a high degree of overlap but are not identical. Time spent on each trial is meant to indicate a more measured approach to the risk-taking task. It is hypothesized that the curiosity group will be most willing to take risks, the fear group will be least willing to take risks, and the awe group will fall between these two groups in the number of cards taken per trial.

From a physiological perspective, fear is well-documented to increase sympathetic activity such as heart rate (HR), skin conductance (SC), and respiration rate (Hyde, Ryan & Waters, 2019; Levenson, 2003). Awe on the other hand has produced
results that indicate both sympathetic and parasympathetic activation. For instance, in separate studies, awe has been shown to raise, lower, and have no demonstrated effect on HR (Bernstein, 2022; Gordon et al., 2017.) Increased heart rate, however, was associated with a fearful appraisal of the awe-eliciting stimulus. Both awe and fear have been shown to increase respiration rate. The increase in respiration as a result of the fear response tends to be erratic with many peaks and valleys in the breaths per minute measures (Jerath & Beveridge, 2020). Although studies are limited, one study found the experience of awe facilitated a significant but moderate increase of ~1.5 breaths per minute (Shiota, Neufeld, Yeung, Moser & Perea, 2011).

Surprisingly, relatively few studies have looked at the autonomic effects of curiosity. Those that have generally show an increase in autonomic arousal. This, however, is thought to be an optimal level of arousal while other states like fear would be considered high levels of arousal (Litman, 2005).

Overall, the understanding of how awe differs from other arousing emotional states is unclear. Studies two and three aim to shed light on the physiological pattern of awe with respect to ANS modalities such as HR, SC, respiration rate, and alpha-amylase (sAA). We expect fear to be significantly more arousing than curiosity, while awe will be more arousing than curiosity but less arousing than fear.

**Methods**

**Participants**

Initially, 159 participants from introductory psychology classes participated in the study. Data from 2 participants were deleted due to missing data. Data from 1 participant
was deleted due to previous viewing of the fear stimulus, leaving a total of 156 participants. The average age of participants was 19.3 (SD = 2.6). 71.1% (n = 113) of participants identified as female, 26.4% (n = 42) of participants identified as male, 1 participant identified as non-binary. In terms of ethnicity, 78.6% (n = 125) identified as “White, non-Hispanic”, 6.3% (n = 10) identified as “Black or African American”, 5% (n = 8) identified as “Hispanic, Latino, or Spanish origin”, 6.9% (n = 11) identified as Asian, .6% (n = 1) identified as middle eastern, .8% (n = 3) and .6% (n = 1) identified as American Indian or Alaska Native. Participation in this study was voluntary and all participants provided consent prior to participation. This study was approved by the university’s IRB.

Materials Used

A desktop Dell computer with a 22-inch color monitor was used to administer the surveys. In an adjacent examination room, a gigabyte Aero 15 laptop was connected to a 32-inch Samsung television. All priming videos and the Columbia card task were displayed in 1080p on the television.

Awe eliciting stimulus

The awe-eliciting stimulus used was a video entitled “The beauty of earth” (2019), a compilation of clips from the series “our planet”. This video contains various awe-inspiring scenes ranging from an overview of the earth from space to vast landscapes around the globe. Pure landscape scenes are often juxtaposed with wildlife. There is also a sparing use of time-lapse photography throughout.
Fear eliciting stimulus

The fear-eliciting stimulus was a scene from the movie Mulholland Drive (2001). This scene is often referred to as “the diner scene.” The scene begins with two people meeting in a diner. One man tells the other that he invited him to the diner because he has had a dream about this diner that involves the other man. They converse about the dream, where there is a horrible-looking man that can be seen through the wall. The horrible-looking man is the one that is “doing it,” however, it is not clear what this means. After a conversation, a situation occurs that alludes to the main character realizing the events are exactly like the dream. The two walk around to the back of the diner to attempt to show there is nothing to be afraid of. They slowly approach a wall beside a dumpster, when they reach the corner, a scary face slides out from behind the wall and the main character collapses. The face then retreats behind the wall and the scene ends.

Curiosity eliciting stimulus

The curiosity-eliciting stimulus consists of videos of magic tricks compiled from a database of “magic curiosity arousing tricks” (MagicCATs) produced by Ozano and colleges (2021). I have acquired permission from Ozano to download and edit these videos for the purposes of this research program. To my knowledge, this is the only tested and published means of eliciting curiosity in a passive video format. These videos were designed and validated as curiosity-eliciting stimuli. Each video clip was rated on how much it elicited curiosity in the viewer. In order to create a similar length of video, six videos with the highest average curiosity rating were compiled. These six videos have been edited together with a five second gap between each video. This order was, S4, H35, S32, H4 long, Trick 33, Trick 19. All videos were 5 minutes in length.
Dispositional awe and demographics

Identical to study 1.

State Awe

The awe experience scale (AWE-S) is the only state measure of awe. It is meant to capture a number of dimensions of an awe experience, largely derived from Keltner and Haidt’s (2003) framework (Yaden et al., 2019). The dimensions in the AWE-s include a perception of vastness, feelings of connectedness, need for accommodation, loss of self, alteration of the sense of time, and physiological reactions. Cronbach alpha was reported at .92 for the global total and all subscales were reported at > .80. Scores ranged from 31 to 217, and higher scores indicate a more intense experience of awe.

Heart Rate (HR)

Heart Rate (HR) is the frequency of heartbeats measured in beats per minute (Bedford, 1951). Studies have shown HR as a reliable indicator of arousal in situations where participants are exposed to psychosocial stressors (Kirschbaum, Pirke, & Hellhammer 1993; Stein & Kleiger 1999). Higher levels of self-reported awe have been associated with lower HR (Bernstein, 2022). This, however, may be dependent on individual appraisal as awe-eliciting experiences appraised as fearful led to increased HR (Gordon et al., 2017). HR was collected using a Blood Volume Pulse (BVP) Sensor – SA9308 M (Thought Technology Montreal, Canada). The sensor was be connected to the multichannel Procomp Infiniti hardware interfaced with the Biograph software from Thought Technology (Montreal, Canada) and collected at 2048 Hz.
**Skin Conductance (SC)**

Skin conductance (SC) is a measurement of the electrical conductance on the surface of the skin. Sympathetic arousal leads to increased activation of sweat glands and moisture on the skin surface. This increase in moisture leads to greater conductivity and higher measures of SC (Hall, 2015). SC is positively correlated with increases in levels of stress (Perala & Sterling 2007; Sharma, Khera, Mohan, Gupta, & Ray 2006). A study by Shiota and colleagues (2011) found a decrease in SC as a result of awe. This corroborates the thought that positive awe decreases sympathetic activation. SC was be measured using an SC-Flex/Pro Skin Conductance sensor (Thought Technology Montreal, Canada). The sensor was be connected to a multichannel Procomp Infiniti hardware interfaced with the Biograph software from Thought Technology (Montreal, Canada) and collected at 256 Hz.

**Respiration**

Respiration rate is simply the number of breaths per minute. Increased or irregular patterns of respiration are associated with negative effects such as anxiety (Van Diest, Thayer, Vandeputte, Van de Woestijne, & Van den Bergh, 2006). Conversely, regulated breathing has positive outcomes for autonomic stress reactivity, anxiety levels, and mood (Brown, Gerbarg, & Muench, 2013; Jerath, Crawford, Barnes, & Harden, 2015; Sakakibara & Hayano, 1996). While there has been little research conducted on respiration rate in conjunction with awe, one study shows that awe led to increased respiration while other positive emotions raised respiration similarly (Shiota, Neufeld, Yeung, Moser & Perea, 2011). Respiration rate was measured using a Respiration Belt.
Sensor – SA9311M (Thought Technology Montreal, Canada). The sensor was connected to the multichannel Procomp Infiniti hardware interfaced with the Biograph software from Thought Technology (Montreal, Canada) and collected at 256 Hz.

*Salivary alpha-amylase (sAA)*

sAA is a biomarker of ANS activity, and it is an abundant salivary enzyme in humans (Nater & Rohleder, 2009). A saliva sample to obtain measurements of sAA was collected from all participants at two different points. Participants were first asked to wash their mouths out with water to ensure the absence of foreign particles that may decrease the quality of the analysis. Next, participants were asked to let saliva collect in their mouth for 1 min. After 1-minute participants drooled collected saliva into a 50 mL test tube. This “pooling and drooling” protocol was repeated a total of 3 times (Navazesh, 1993). The saliva samples were then centrifuged, aliquoted into 1.5 mL microtubes, and stored in an ultra-freezer at -70 degrees Celsius until analysis. sAA concentrations were determined via an assay kit (Salimetrics, State College, PA) and expressed in U/mL. Samples were analyzed using a Multiskan™ FC Microplate Photometer with a wavelength of 405 nm. Raw data was converted to U/mL using the SkanIt™ Software for Microplate Readers. To my knowledge, there have been no studies to examine the relationship between awe and sAA. Higher levels of sAA are indicative of higher levels of ANS activity.

*Columbia Card Task (cold)*

The Columbia card task is a measure of risk-taking in a decision-making process (Figner et al. 2009). In this task, participants are shown a grid of 32 face-down cards. Within each grid, there are gain cards and loss cards. Generally, there are significantly
more gain cards, but they are worth far fewer points (10-30 points gained) than the loss cards (250-750 points deducted from the score). The goal of the task is to maximize the number of points earned over 54 trials. In this cold version of the task, participants are asked how many cards they would like to turn over. The end of maximizing points incentivizes turning more cards over while the risk of encountering large point deductions incentivizes turning fewer cards over. Thus, to get the best outcome, participants must properly weigh risk vs reward. The cold version differs from the hot version in its non-engagement of affective processes. In the hot version, the cards are immediately turned over, so the outcome is immediately known with each card rather than a blanket decision for the full grid. The time to complete this card task is about twenty minutes. The number of cards taken, and the time spent on each trial were the units of analysis.

**Procedure**

Upon arrival at the laboratory, participants were greeted and presented with the informed consent document. Participants were instructed to read the informed consent carefully and to relay any questions to the experimenter if they arise.

After consent, they were instructed to complete the demographic questionnaire and the dispositional awe scale. After filling out the questionnaires, the participants were escorted into the adjacent room to take physiological measures. Participants were seated in a comfortable chair and fitted with thought technology sensors. The BVP sensor was fitted on the middle finger of the non-dominant hand. The SC sensor was fitted on the pointer and ring finger of the non-dominant hand. The respiration strap was fitted around the chest, just below the sternum. Participants were then asked to sit still for five minutes.
while baseline measures were taken. At the end of the five minutes, participants were asked to render a saliva sample using the pool and drool method.

Upon completion of the baseline measures, participants progressed to the manipulation portion of the experiment. Participants were informed that the physiological sensors must remain attached so that measurements may be taken during the manipulation. Participants were further instructed to remain as still as possible during the manipulation in order to reduce any artifacts in the physiological recordings. Each participant watched a video (approximately 5 minutes in time) primed to elicit awe, fear, or curiosity. After the manipulation, participants were asked to render a second saliva sample to determine post-manipulation levels of sAA.

Following manipulation and saliva sample collection, all participants were asked to fill out the state awe questionnaire as a manipulation check. Finally, all participants completed the cold version of the Columbia card task in order to record a quantitative measure of strategic risk-taking. Each participant had the rules of the task explained to them and were then given a chance to ask questions prior to the beginning of the task. Once the task began, the experimenter did not interfere with the completion of the task. Upon completion of the task (8-12 minutes), participants were debriefed, asked if they had any questions, thanked for their participation, and awarded the allotted points in SONA.
Results

Manipulation Check

All statistical analysis for this study were completed using IBM SPSS Statistics version 29. To examine if those in the awe experiencing group reported more awe than the fear or curiosity groups, participants were given the awe experience scale after the priming videos as a manipulation check. To check for between-group differences an ANOVA was performed. For a pictorial representation see Figure 1 in this chapter. Results show there was indeed a significant difference between the experimental groups on the awe experience scale ($F(2, 153) = [29.079]$, $p < .001$, $\eta^2 = .28$). A post hoc Tukey (HSD) test was used to examine the difference between individual groups. Results show that the awe group (M= 131.7, SD= 26.65) scored significantly higher than both the fear (M= 113.42, SD= 28.02) ($p < .01$, 95% C.I. = [5.99, 30.40]) and curiosity (M= 91.9, SD= 26.65) ($p < .001$, 95% C.I. = [27.45, 52.17]) groups. The fear group also scored significantly higher than the curiosity group, $p < .001$, 95% C.I. = [9.09, 33.94]. This indicates that the awe group experienced the most awe, curiosity the least, and fear fell between the awe and curiosity groups. Each group was significantly different from the other.

Between Group Differences

Next, a series of ANOVAs were performed to determine if there were any between group differences on the average number of cards per round, average total score, and the average amount of time spent on each round on the Columbia card task. As
expected, there was a significant between group effect for both average number of cards per round \((F(2, 153) = [9.184], \ p < .001, \ \eta^2 = .11)\) and the overall total score \((F(2, 153) = [7.108], \ p < .001, \ \eta^2 = .09)\) on the task. For means and standard deviations for these variables see table 6 located in text.

A further post-hoc Tukey (HSD) shows that the fear group (M= 11.21, SD= 4.21) averaged significantly fewer cards per round than both the awe (M= 14.37, SD= 3.91) \(p < .01, 95\% \text{ C.I.} = [-1.02, -5.30]\) and curiosity (M= 14.77, SD= 5.64) \(p < .001, 95\% \text{ C.I.} = [-5.72, -1.40]\) groups. There was, however, no significant difference between the awe and curiosity groups in terms of average number of cards, \(p = .90, 95\% \text{ C.I.} = [-2.55, 1.75]\). For a visualization of this interaction see figure 2 in this chapter.

Similarly, results of a second post-hoc Tukey (HSD) shows the fear group averaged significantly fewer cards per round than both the awe \((p < .01, 95\% \text{ C.I.} = [-5163.12, -646.71])\) and curiosity \((p < .01, 95\% \text{ C.I.} = [-5603.41, -1042.71])\) groups. There was, however, no significant difference between the awe and curiosity groups in terms of average number of cards, \(p = .90, 95\% \text{ C.I.} = [-2688.13, 1851.20]\). These findings indicate that risk taking was only affected by the fear prime.

**Dispositional Awe as a Predictor**

To examine the potential predictive effect of dispositional awe on the dependent variables average number of cards, cards score and card time, a series of linear regressions were performed. These models were run on within group data with dispositional awe as the predicting variable.
Figure 1. Study Two, Manipulation Check.

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awe Experience Scale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>131.7</td>
<td>26.65</td>
</tr>
<tr>
<td>Curiosity</td>
<td>91.9</td>
<td>26.65</td>
</tr>
<tr>
<td>Fear</td>
<td>113.42</td>
<td>28.02</td>
</tr>
<tr>
<td><strong>Average Cards Per Round</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>14.37</td>
<td>3.91</td>
</tr>
<tr>
<td>Curiosity</td>
<td>14.77</td>
<td>5.64</td>
</tr>
<tr>
<td>Fear</td>
<td>11.21</td>
<td>4.21</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>14501.7</td>
<td>4362.1</td>
</tr>
<tr>
<td>Curiosity</td>
<td>14929.2</td>
<td>5895.4</td>
</tr>
<tr>
<td>Fear</td>
<td>11606.2</td>
<td>5895.5</td>
</tr>
<tr>
<td><strong>Time Per Round</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>5819.1</td>
<td>1672.2</td>
</tr>
<tr>
<td>Curiosity</td>
<td>5384.8</td>
<td>2101.2</td>
</tr>
<tr>
<td>Fear</td>
<td>5282.6</td>
<td>2011.2</td>
</tr>
</tbody>
</table>

*Note:* Time per round is expressed in milliseconds.
Figure 2. Average Number of Cards Per Trial.
Within the awe group, dispositional awe was predictive of both the average number of cards ($R^2 = .09, F(1, 51) = 5.22, \beta = .31, p < .03, 95\% \text{ CI} [0.21, 3.17]$) and the card score ($R^2 = .17, F(1, 51) = 10.48, \beta = .41, p < .01, 95\% \text{ CI} [968.54, 4129.55]$). There was no relationship between dispositional awe and card time ($R^2 = .01, F(1, 51) = .810, \beta = -.12, p = .37, 95\% \text{ CI} [95.58, 36.42]$).

Within the curiosity group, dispositional awe was predictive of the average number of cards ($R^2 = .17, F(1, 49) = 10.53, \beta = .42, p < .01, 95\% \text{ CI} [1.29, 5.51]$), the card score ($R^2 = .15, F(1, 49) = 8.45, \beta = .39, p < .01, 95\% \text{ CI} [1002.10, 5482.56]$), and the average time spent on each trial ($R^2 = .13, F(1, 49) = 7.23, \beta = -.36, p < .01, 95\% \text{ CI} [-188.63, -27.25]$).

Within the fear group, dispositional awe was not predictive of any of the target variables average number of cards ($R^2 = .03, F(1, 50) = 1.73, \beta = -.18, p = .19, 95\% \text{ CI} [-2.55, 0.53]$), card score ($R^2 = .01, F(1, 50) = 1.76, \beta = -.185, p = .19, 95\% \text{ CI} [-2599.62, 530.03]$), nor card time ($R^2 = .04, F(1, 50) = 2.19, \beta = -.21, p = .15, 95\% \text{ CI} [-127.57, 19.24]$). These findings indicate that there is a significant predictive effect of dispositional awe on the average number of cards and total score within the awe and curiosity groups but not the fear group. This suggests that the fear prime nullified or overpowered the predictive effect of awe on risk taking.

As seen, within both the awe and curiosity groups, dispositional awe predicted both the average number of cards per round and total card score. The scores for these groups were combined so that the models would have a larger sample and to aid in visualizing this effect. Similar to the findings above dispositional awe was predictive of both the average number of cards ($R^2 = .13, F(1, 102) = 15.65, \beta = .365, p < .001, 95\% \text{ CI}$...
and the total score ($R^2 = .15$, $F(1, 102) = 10.48$, $\beta = 18.43$, $p < .001$, 95% CI [1550.92, 4214.85]). For a scatter plot of these data points see figures 10 and 11 in the appendix.

**Discussion**

The major hypothesis for risk taking behavior in study 2 was that the curiosity group will be most willing to take risks, the fear group will be least willing to take risks, and the awe group will fall between these two groups in the number of cards taken per trial. Our hypotheses were partially confirmed in regard to cards per round and total score. The fear group took significantly less risk than the awe and curiosity groups. This finding corroborates findings by Lerner and Keltner (2001) showing that fearful individuals show less-optimistic risk-taking preferences. Indicating that they would make less risky decisions. There was, however, no difference between the awe and curiosity groups. The data show that the awe and curiosity groups took ~ 3 cards more per trial and totaled ~ 3000 more points than the fear group.

Contrary to the hypothesis, there was no difference between groups on the time spent per trial. Further, there were no differences between the awe and curiosity groups on any of the observed risk-taking behaviors. These findings indicate that fear does indeed lead to less risk taking relative to awe. They do not, however, provide any evidence that awe produces a more measured or less risky approach than the curiosity group on a probabilistic risk-taking task.

One possible explanation for this lack of differentiation between the awe and curiosity groups could be explained by the fact that there were no rewards outcomes for
playing the card task. Wu (1999) makes the case that all probability weighting is done in the context of anticipated reward. Participants in the current study were given no reward to influence the processing of probability in the risk-taking task.

Research design regarding curiosity might also explain why the awe and curiosity groups show no differences. Past work has shown that eliciting curiosity does have significant effects on subsequent behavior, however, the changes in behavior were relevant to the content of the curiosity evoking stimulus (Polman, Ruttan & Peck, 2022). These results were also observed when the curiosity evoked was resolved. As mentioned previously, curiosity is often considered a drive or appetitive state (Berlyne, 1960). If curiosity is evoked and not resolved, then a psychological tension is left behind. This may lead to more negative affect than a situation where curiosity is resolved, which is generally considered a positive experience (Loewenstein, 1994). Kuhnen & Knutson (2011) have found that positive affect is associated with greater risk taking while negative affect is related to greater risk aversion. This pattern seems to be fairly consistent in the literature (Bassi et al., 2013, Campos-Vazquez & Cuilty, 2014, Kassas, Palma, & Porter, 2022).

There are at least two implications that can be drawn from the findings listed above. One is that curiosity does not lead to significant effects when the risk-taking in question is not relevant to the curiosity or as a tool to satisfy the drive to search for information that might resolve the tension inherent in curiosity. If this is the case, then the only effect curiosity would have on risk-taking in an irrelevant context would be directly related to how the state of curiosity and its outcome influence the overall affective state of the individual.
Building from this idea, a different possibility is that the tension left behind by an unresolved state of curiosity may have had an effect on risk taking. We hypothesized that curiosity would take the greatest amount of risk. The tension of unresolved curiosity may have reduced risk-taking relative to what might have been observed if that tension had been resolved prior to the risk-taking task. Future studies should address this possibility by resolving curiosity in the priming stage of the study.

Further analysis showed that dispositional awe showed a small predictive effect on risk-taking in the awe and curiosity groups. This further indicates the similarities between these groups in terms of risk-taking approach. Interestingly, dispositional awe was not predictive of risk-taking in the fear group, indicating that the fear manipulation likely suppressed the observed effect of dispositional awe. This may be the result of fear simply being a more powerful motivator than dispositional positive affective states.
CHAPTER IV:

STUDY 3
Introduction

Study 3 introduces a novel experimental task in order to take behavioral measures of exploration in a physical space. The Columbia card task in study 2 was designed to measure probabilistic risk. Meaning that there is enough information given so that participants could determine the likelihood of choosing a loss card. The risk was also clearly defined and there were no consequences beyond the points in the task. Recall the constituents of the awe experience from chapter 1, vastness and the need for accommodation. The inability to assimilate an experience into one’s view of the world does not generally arise from the probabilistic uncertainty encountered in study 2.

Knight (1921) has defined risk as a situation where the outcome is unknown, but the probability distribution governing that outcome is known. Uncertainty is defined as a situation where neither the outcome nor the probability distribution governing the outcome are known. Importantly, as Anderson and colleagues (2019) note, uncertainty is not just a lack of knowledge. It is the conscious awareness of that lack of knowledge. This is important because creating a situation where the probability distribution and outcome are unknown does not guarantee a state of uncertainty, on some level the individual must possess an understanding of their situation.

Classic awe eliciting experiences generally contain some degree of uncertainty. Study 3 works to create an uncertain scenario in a laboratory setting so that participant behaviors can be recorded and observed. I believe this goes beyond Study 2 by allowing individuals to approach and explore an object that better tracks the concept of uncertainty.
than the card task. Study three will be identical to study two except for the task portion of the study.

In the current study, individuals primed with various emotions will be asked to determine the contents of an uncertain object. Various behaviors and the time spent engaging in those behaviors will be operationalized as risk-taking behaviors. In general, we expect reduced risk-taking behaviors in the fear group compared to the awe and curiosity groups. We further expect the curiosity group to display greater risk-taking behaviors than both the awe and fear groups.

Methods

Participants

Initially, 159 participants from introductory psychology classes participated in the study. Data from 2 removed for missing data, 3 removed for task behaviors not conducive to video scoring, 1 removed for technical issues (recording), and 1 removed for having seen the fear video. The final sample size was 152 participants. The average age of participants was 18.6 (SD = 0.89). 67.1% (n = 102) of participants identified as female, 32.2% (n = 49) of participants identified as male, 1 participant identified as non-binary. In terms of ethnicity, 81.6% (n = 124) identified as “White, non-Hispanic”, 6.6% (n = 10) identified as “Black or African American”, 6.6% (n = 10) identified as “Hispanic, Latino, or Spanish origin”, 4.6% (n = 7) identified as Asian, .7% (n = 1) identified as middle eastern, .8% (n = 3). Participation in this study was voluntary and all participants provided consent prior to participation. This study was approved by the university’s IRB.
Materials Used

Both self-report, physiological measures, and experimental manipulation were identical to Study 2. There are, however, a few differences after the priming videos: 1) The black box task, and 2) The video recording of behavioral observation.

Black Box Task

The black box was a 4x2x2 wooden box with a hole cut into the face. This hole is the only entry point into the box. The box was painted black both inside and out. The box was also fitted with a hinging lid held closed with a padlock. Participants were given free rein in the experimental room to explore the box and its surroundings. An image of the box can be viewed in figure 3 in this chapter.

Video Recording for Behavioral Observation

All participants were recorded throughout the black box task. While all participants were informed that filming could take place at any time during the study, a go pro hero 9 (GoPro, Inc) was hidden on a nearby cabinet. The purpose of the recording was to document the behaviors associated with the exploration of the unknown box content. Recordings were examined for specific behaviors and frequency of behaviors. An observation sheet was used by trained reviewers to document these behaviors.

The time it took for participants to enter their hand into the box was measured. Scoring for this behavior began upon the closing of the door, which signals the beginning of the task. Whether or not the participant chose to enter their hand into the box in the three-minute time frame was also recorded. Entering one’s hand into the box was operationalized as entering one’s hand into the hole up to mid forearm and leaving the
hand in the box for at least 2 seconds. Behaviors where participants began to enter their hand into the box but quickly retracted the hand were not considered to be exploratory.

One exploratory style was named “Hole Search,” this consisted of trying to see into the hole without entering one’s hand. To be considered hole search, the participant had to be engaged in some way, such as leaning forward or crouching to help them see into the hole. The participant also had to be within two feet of the box for the action to be considered. Participants who stood back from the box staring at its face were not considered as hole search.

A second exploratory style was called “Box Search,” this consisted of behaviors such as jiggling the lock, looking at the sides or back of the box for alternative ways into the box that don’t involve entering their hand. The box sat on caster wheels so it could be moved from its beginning position against the wall.

A third exploratory style was “Room Search/Scanning,” this consisted of either physically searching around the room or clear visual scanning of the room. Visual scanning was operationalized as an active prolonged visual search. Participants had to be standing and engaged in visual scanning for at least 5 seconds. Looking around the room while sitting in the chair was not considered as active exploration.

Participants also had the opportunity to use tools to make it possible to see the inner contents of the box without putting their hand into the box. There was a small red flashlight and small round convex mirror placed on the table about ~ 3 feet from the box. Whether or not the participant used the tool and how long they used the tools for was recorded.
All of the behaviors mentioned above were treated as specific exploratory behaviors and times for each were recorded when the behavior was observed. Because each is an exploratory behavior the times for Hole Search, Box Search, and Room Scanning/Exploration were tallied to make a composite “Total Exploration” score. Tool use was not used in the total score because tool use fell under either hole search, box search, or room search/scanning behavior.

Videos were scored by two trained reviewers blind to conditions. Each reviewer was trained to score pilot videos individually. They were then brought together to score pilot videos as a team. The videos used in the analyses were scored by each reviewer individually with no communication. Any disagreement in dichotomous variables or time discrepancy of greater than 10 seconds was further reviewed by a 3rd reviewer, also blind to condition, to correct the discrepancy. The time data used in analysis was the average score between the two reviewers. The scoring sheet is located at the end of the appendix.

**Procedure**

The procedure for Study 3 was identical to Study 2 with the exception of the experimental task (black box exploration).

Following the baseline, priming manipulation, and saliva sample collection, all participants were asked to fill out the awe experience questionnaire to ensure the manipulation causes higher levels of awe in the awe-experiencing group. This questionnaire was completed in a room adjacent to the experimental room. Thus, physiological measures were not taken at this point. While participants filled out the manipulation check, the experimenter closed the door to the experimental room, wheeled
the box into position, and ensured the cameras were working correctly. Participants did not see the box until it was time for the task to begin.

Once the questionnaire was complete, participants were brough back into the experimental room and asked to have a seat in a chair about 15 feet away from the box. Participants were told, “This is the black box task. The goal of the task is very simple, we just want you to find out what is inside the box. How you do that, or if you do that, will be up to you. I will leave the room for a few minutes while you complete the task. If you figure out what is in the box or if you are done looking before I return, please have a seat in the chair you are currently seated in, and I will be back shortly.” If participants asked any further questions about the content of the box the experimenter would reply with, “I cannot give any more information about the task.”

Filming began as the experimenter closed the door and ended at the three-minute mark. At the end of the 3-minute period, the experimenter reentered the room and asked the participant what they thought was in the box. Following their answer, they were informed of the contents of the box. Finally, participants were debriefed, asked if they had any questions and thanked for their participation.

Results

Manipulation Check

To test if those in the awe experiencing group experienced more awe than the fear or curiosity groups, participants were given the awe experience scale after the priming videos as a manipulation check. To check for differences between groups an ANOVA was performed. Results show there was indeed a significant difference between the
experimental groups on the awe experience scale, \((F(2, 149) = [40.522], p < .001, \eta^2 = .35)\) A post hoc Tukey (HSD) test was used to examine the difference between individual groups. Results show that the awe group (M= 135.98, SD= 20.31) scored significantly higher than both the fear (M= 111.96, SD= 27.73) \((p < .001, 95\% \text{ C.I.} = [12.26, 35.77])\) and curiosity (M= 91.3, SD= 26.09) \((p < .001, 95\% \text{ C.I.} = [32.91, 56.42])\) groups. The fear group also scored significantly higher than the curiosity group, \(p < .001, 95\% \text{ C.I.} = [8.95, 32.34]\). This indicates that the awe group experienced the most awe, curiosity the least, and fear fell between the awe and curiosity groups. Each group was significantly different from the other.

**Dichotomous Variables**

A number of dichotomous variables were recorded for the current study. To view percentages of engagement for each behavior, see Table 7 in this chapter. In order to test if there were any between group differences on the occurrence of these behaviors, multiple chi squared analyses were performed. Results show that there was no difference between groups in terms of the likelihood of entering ones hand into the box \((\chi^2(2, N=152) = 2.52, p = .28, \varphi = .13)\), engaging in “hole search” behavior \((\chi^2(2, N=152) = 2.09, p = .35, \varphi = .12)\), engaging in “box search” behavior \((\chi^2(2, N=152) = .008, p = .99, p = .35, \varphi = .007)\), engaging in “room search” behavior \((\chi^2(2, N=152) = 2.68, p = .26, \varphi = .13)\), engaging in “tool use” behavior \((\chi^2(2, N=152) = 0.72, p = .70, \varphi = .07)\), or continuing search once the item had been found \((\chi^2(2, N=152) = 4.23, p = .12, \varphi = .17)\). This indicates that there is no between group effects on engaging in any of the target behaviors.
Table 7. Percentages of Behavior Engagement.

<table>
<thead>
<tr>
<th>Variable</th>
<th>% Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hand</strong></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>88.0%</td>
</tr>
<tr>
<td>Curiosity</td>
<td>94.1%</td>
</tr>
<tr>
<td>Fear</td>
<td>84.3%</td>
</tr>
<tr>
<td><strong>Hole Search</strong></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>96.0%</td>
</tr>
<tr>
<td>Curiosity</td>
<td>92.1%</td>
</tr>
<tr>
<td>Fear</td>
<td>88.2%</td>
</tr>
<tr>
<td><strong>Box Search</strong></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>62.0%</td>
</tr>
<tr>
<td>Curiosity</td>
<td>62.7%</td>
</tr>
<tr>
<td>Fear</td>
<td>62.7%</td>
</tr>
<tr>
<td><strong>Room Search</strong></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>48.0%</td>
</tr>
<tr>
<td>Curiosity</td>
<td>35.2%</td>
</tr>
<tr>
<td>Fear</td>
<td>33.3%</td>
</tr>
<tr>
<td><strong>Tool Use</strong></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>20.0%</td>
</tr>
<tr>
<td>Curiosity</td>
<td>17.6%</td>
</tr>
<tr>
<td>Fear</td>
<td>13.7%</td>
</tr>
</tbody>
</table>

*Note:* “% Yes” refers to the percentage of participants that engaged in the behaviors associated with each variable.
Table 8. *Means and Standard Deviations for Study 3.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Exploration Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>55.67s</td>
<td>26.65s</td>
</tr>
<tr>
<td>Curiosity</td>
<td>36.22s</td>
<td>36.18s</td>
</tr>
<tr>
<td>Fear</td>
<td>34.15s</td>
<td>33.34s</td>
</tr>
<tr>
<td><strong>Hand Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>36.38s</td>
<td>32.01s</td>
</tr>
<tr>
<td>Curiosity</td>
<td>21.09s</td>
<td>13.92s</td>
</tr>
<tr>
<td>Fear</td>
<td>36.77s</td>
<td>32.88s</td>
</tr>
<tr>
<td><strong>Hole Search Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>23.36s</td>
<td>28.64s</td>
</tr>
<tr>
<td>Curiosity</td>
<td>13.99s</td>
<td>15.78s</td>
</tr>
<tr>
<td>Fear</td>
<td>20.26s</td>
<td>25.58s</td>
</tr>
<tr>
<td><strong>Box Search Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>23.19s</td>
<td>36.56s</td>
</tr>
<tr>
<td>Curiosity</td>
<td>16.99s</td>
<td>24.44s</td>
</tr>
<tr>
<td>Fear</td>
<td>10.84s</td>
<td>13.95s</td>
</tr>
<tr>
<td><strong>Room Search Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>9.12s</td>
<td>17.03s</td>
</tr>
<tr>
<td>Curiosity</td>
<td>5.25s</td>
<td>9.17s</td>
</tr>
<tr>
<td>Fear</td>
<td>3.05s</td>
<td>5.63s</td>
</tr>
<tr>
<td><strong>Tool Use Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>6.04s</td>
<td>14.51s</td>
</tr>
<tr>
<td>Curiosity</td>
<td>3.04s</td>
<td>8.19s</td>
</tr>
<tr>
<td>Fear</td>
<td>3.21s</td>
<td>10.18s</td>
</tr>
</tbody>
</table>
**Time Variables**

For descriptive statistics for time variables, see Table 8 in this chapter. To determine if there were any between group effects on time spent engaging in various target behaviors, a series of ANOVAs was performed. To examine if there were between group differences in hand time and box search time, a Welch’s ANOVA was performed as the variances were not homogenous.

Results show that there were between group differences in the amount of time it took to for participants to enter their hand into the box \((F(2, 71.39) = [7.361], p < .001, \eta^2 = .07)\), the total aggregate exploration time \((F(2, 149) = [4.656], p < .01, \eta^2 = .06)\), and the amount of time searching the exterior of the box \((F(2, 53.34) = [4.208], p < .05, \eta^2 = .07)\). There was no between-group effect on the time spent engaging in hole search behavior \((F(2, 149) = [2.013], p = .14, \eta^2 = .02)\), Room Search behavior \((F(2, 56) = [2.164], p = .12, \eta^2 = .07)\), nor tool use time \((F(2, 24) = [2.047], p = .15, \eta^2 = .07)\).

Due to the aforementioned heterogenous variances, a Games-Howell post hoc test was conducted to better understand the between group effect for Hand Time. Results show that both the awe (M= 36.38s, SD= 32.01) \((p < .05, 95\% \text{ C.I.} = [2.71, 27.87])\) and fear (M= 36.77s, SD= 36.77) \((p < .05, 95\% \text{ C.I.} = [2.67, 28.69])\) groups took significantly more time than the curiosity group (M= 21.09, SD= 13.92) to enter their hand into the box. There was no difference between the awe and fear groups \((p = .99, 95\% \text{ C.I.} = [-16.99, 16.21])\). Indicating that the curiosity group was more likely to put their hand in the box more quickly than either the fear or awe groups. For a bar graph illustrating this difference see figure 4 in the chapter. The average difference between the curiosity group and the awe and fear groups was \(~ 15\) seconds.
Figure 4. Mean Hand Time by Group.
Figure 5. Mean Box Search Time by Group.
Figure 6. Total Exploration by Group.
A second Games-Howell was conducted to understand the between group dynamics for box search time. Results showed that the awe group spent significantly more time in box search behavior than the fear group ($p < .05$, 95% C.I. = [0.54, 37.36]). There was no difference between the curiosity group and either the awe ($p = .53$, 95% C.I. = [-11.31, 29.63]) or fear ($p = .16$, 95% C.I. = [-2.89, 22.49]) groups. See figure 5 in this chapter for an illustration.

In terms of total exploration, a post hoc Tukey (HSD) revealed that the awe group (M = 55.67, 46.40) spent significantly more time exploring than both the fear (M = 34.15, SD = 33.34) ($p < .05$, 95% C.I. = [3.12, 39.89]) and curiosity (M = 36.22, SD = 36.18) ($p < .05$, 95% C.I. = [-37.83, -1.05]) groups. There was no significant difference between the fear and curiosity groups ($p = .96$, 95% C.I. = [-20.36, 16.22]). For a visualization, see figure 6 in this chapter.

**Physiological Variables**

The methods for studies two and three are identical until the final task. Due to this design, we combined the physiological data for studies two and three to examine both pre to post differences and between group differences. Extreme outliers were removed prior to analysis. To determine if there are any between group difference in the significant changes noted above, multiple ANOVAs were conducted. The results only show a significant group difference for respiration, ($F(2, 306) = [3.515], p = .03, \eta^2 = .02$) and sAA ($F(2, 306) = [6.473], p < .01, \eta^2 = .04$). There were no between group differences for heart rate ($F(2, 292) = [1.021], p = 0.36, \eta^2 = .01$) and skin conductance ($F(2, 306) = [1.482], p = .23, \eta^2 = .01$).
<table>
<thead>
<tr>
<th>Variable</th>
<th>ΔM</th>
<th>ΔSD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heart Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>-6.44</td>
<td>6.92</td>
</tr>
<tr>
<td>Curiosity</td>
<td>-6.32</td>
<td>5.19</td>
</tr>
<tr>
<td>Fear</td>
<td>-5.38</td>
<td>5.95</td>
</tr>
<tr>
<td><strong>Skin Conductance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>0.81</td>
<td>1.38</td>
</tr>
<tr>
<td>Curiosity</td>
<td>0.64</td>
<td>1.08</td>
</tr>
<tr>
<td>Fear</td>
<td>0.84</td>
<td>1.40</td>
</tr>
<tr>
<td><strong>Respiration Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>1.27</td>
<td>1.99</td>
</tr>
<tr>
<td>Curiosity</td>
<td>1.67</td>
<td>1.50</td>
</tr>
<tr>
<td>Fear</td>
<td>0.90</td>
<td>1.95</td>
</tr>
<tr>
<td><strong>Alpha-amylase</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>5.79</td>
<td>47.11</td>
</tr>
<tr>
<td>Curiosity</td>
<td>7.27</td>
<td>53.98</td>
</tr>
<tr>
<td>Fear</td>
<td>29.84</td>
<td>59.49</td>
</tr>
</tbody>
</table>

*Note:* “Δ” indicates the change from pre to post readings. Heart rate is expressed in Beats per minute. Skin conductance is expressed in micro siemens. Respiration rate is expressed in breaths per minute. Alpha-amylase is expressed in u/ml/min.
A post-hoc Tukey (HSD) test revealed that there were no significant differences between the awe group (M= 1.27, 1.20) and either the curiosity (M= 1.69, SD= 1.92) ($p = .28$, 95% C.I. = [-2.04, -1.91]) or fear (M= 0.95, SD= 2.17) ($p = .41$, 95% C.I. = [-3.02, 0.91]) groups in terms of respiration rate. There was a small significant effect between the fear and curiosity groups ($p < .05$, 95% C.I. = [-1.42, -0.08]). sAA was significantly increased in comparison to both the awe ($p < .01$, 95% C.I. = [-41.83, -6.46]) and curiosity ($p < .01$, 95% C.I. = [-40.21, -4.93]) groups. There was no difference between the awe and curiosity groups in terms of sAA ($p = .98$, 95% C.I. = [-19.16, -16.02]). Thus, the hypothesis was partially confirmed. The fear group displayed greater sympathetic arousal than the other groups.

**Discussion**

Study 3 shows partial support for the hypotheses. We looked first at the between-group differences in engagement. Contrary to the hypotheses there was no difference between groups in the likelihood of engaging in any of the observed behaviors. This indicates that emotional priming had negligible effect on the initial engagement in exploratory and risk-taking behaviors.

As expected, the awe group did take longer than the curiosity group to enter their hand into the box. There was, however, no difference between the awe and fear group in terms of hand time. Fitting with the theoretical approach, the curiosity group did seem to take a more impulsive approach, taking significantly less time to insert their hand into an uncertain object. Interestingly, the findings do not support the idea that an awe experience
would lead to a more risky approach than the fear group. At least in this task, awe and fear seem to have a similar effect on risk taking strategies.

We also found that the awe group displayed more total exploration than both the fear and curiosity groups. There was no difference between the fear and curiosity groups in terms of total exploration. This suggests that the experience of awe influenced exploration not present in experiences of fear and curiosity. While awe was expected to spend more time in exploration, we also predicted that the fear and curiosity groups to display differences. Perhaps the reduced exploration in the curiosity group was driven by curiosity while the fear group was driven by caution. This could mean that the awe group possessed both caution and curiosity, leading to the observed increase in exploration time.

Of the individual behaviors, the results show only one significant group difference for box time scores. The awe group spent more time engaging in box search behavior than the fear group. Recall there was no significant effect on engagement. The fear group was just as likely as the awe group to engage in box search. There were no significant effects for hole search, room search/scan, nor tool use.

Taken together, the observational data show that those who experience awe take longer to engage in the risky behavior of entering one’s hand into an uncertain object, comparable to fear. Interestingly, only the awe group showed greater exploration than the curiosity group. The fear group took the same amount of time to enter their hand into the box but did not spend as much of that time exploring. This difference seems to be largely driven by the fact that the fear group spent significantly less time engaging in box searching behaviors.
From a physiological perspective, Shiota and colleagues (2011) found that awe significantly increased respiration rate. They also found, however, that awe significantly reduced skin conductance. Our findings show That fear facilitated greater activation than awe. The study by Shiota and colleagues (2011) used 6 slides to elicit awe whereas the current study utilized a 5-minute video to elicit emotion. It may be that the more immersive stimuli led to increased arousal. Recent research on this topic does support the possibility. Horvat, Kukolja & Ivanec (2015) conclude that curated video sequences produce a more intense and more accurate emotional response than a series of images. Taken together, the current study findings seem to point to less sympathetic activation and more parasympathetic activation with awe in comparison with fear, further studies are warranted.
CHAPTER V:

DISCUSSION
This dissertation was designed to address our theoretical conception of awe as a fundamentally epistemic emotion via correlational and experimental research methodologies. The following discussion will review the 4 goals of the study introduced at the beginning of the introduction. For a table illustration hypothesis and results see Table 10 in the appendix.

**Goal 1: To determine if dispositional measures of awe are associated with various other epistemic dispositional measures.**

Awe was largely associated with the epistemic dispositions in question. Exceptions, such as the intolerance to uncertainty subscale, seem to be explicable when considering past work on the subject. Recall the work by Whitecross & Smithson, (2023) showing that *interest type* curiosity leads to a positive view of uncertainty while *deprivation-type* curiosity leads to negative views of uncertainty. With this in mind, an exploratory linear regression model was constructed for this discussion with both joyous exploration and deprivation sensitivity as predictors on IUS factor 2. Supporting Whitecross & Smithson (2023), joyous exploration was a significant negative predictor, while deprivation anxiety was a significant positive predictor of IUS factor 2. This suggests that awe’s positive relationship to curiosity in general may be associated with competing pathways which nullify any direct effect of awe on IUS factor 2. Future inquiries should work to better understand the underpinnings of the relationship between awe and tolerance to uncertainty.

Awe shows a high degree of overlap with other positive emotions. Those positive emotions may produce competing pathways that influence awe’s effect on uncertainty.
tolerance. In terms of other positive emotions, researchers may want to examine more refined measures of the positive emotions implicated in the first study. For example, a recent meta-analytic review reports that intolerance of uncertainty is inversely related to emotion regulation (Sahib et al., 2023). Pride on the other hand is associated with enhanced emotion regulation. A series of studies conducted by Lin and colleagues (2019) found that authentic (genuine self-worth) pride was related to enhanced emotion regulation via the downregulation of negative emotions through cognitive reappraisal. Hubristic (self-aggrandizing) pride, however, was negatively related to cognitive reappraisal. With this in mind, we would expect awe to be positively associated with authentic pride and negatively associated with hubristic pride as a positive relationship has been observed between awe and humility (Stellar et al., 2018).

Study 1 also shows that those who tend to experience awe more often do think about existential issues more often but experience the same anxiety as those with less dispositional awe. As mentioned previously, work by both Thompson (2022a, 2022b) and Braswell & Prichard (2023) show that awe is related to resiliency. Our results show that this relationship is likely not explained by a reduction in anxiety or stress tolerance, at least towards existential issues. Future work should aim to understand how awe can enhance resiliency without directly affecting anxiety toward the uncertain situations that provoke it. Perhaps it comes from an interpretive cognitive process after the awe experience. One place to begin thinking about this possibility might be recent work showing awe to be associated with optimism (Nelson-Coffey et al., 2019; Sun, Su, Guo & Tian, 2021) or work by Edwards and colleagues (2023) that shows different experiences or interpretations of the same construct may lead to very different outcomes. Perhaps also
relevant to this line of thinking is recent work that suggests awe alters thinking patterns and elicits a more “abstract mindset” (Septianto, Seo, Li, & Shi, 2023).

The negative relationship between awe and existential thinking is partially mediated by the positive aspects of curiosity. Future work should look to better understand this relationship. A classic mediator in the awe literature, the small self, could be a good place to start. The previously mentioned work by Edwards and colleagues (2023) found that while awe was ultimately negatively related to existential isolation, feeling that one is physically small (a facet of small self) led to increased existential isolation.

*Goal 2: To determine if awe leads to a more systematic approach to the uncertainty involved in a risk-taking task.*

While the fear group did display reduced risk taking in the second study, there was no difference between the awe and curiosity groups as hypothesized. There are a number of potential possibilities for this finding. The most obvious is that awe simply does not have an effect on probabilistic risk taking, at least not in comparison to the curiosity group.

It may also be a result of the use of the cold version of the Columbia Card Task rather than the hot version. Recall that the cold version does not provide feedback between rounds, this was used because we hoped this would stimulate planning. This approach, however, eliminates learning from feedback throughout the trials. Stress literature has shown that stress influences risk-taking when there is immediate feedback (Lejuez et al., 2002; Porcelli and Delgado, 2009; Preston et al. 2007). There are, however,
mixed results when feedback is not provided. Some recent work has found a significant stress effect on risk taking behaviors. However, other recent studies find no effect when there is no immediate feedback (Buckert et al., 2014; Lempert et al., 2012; Starcke et al., 2008). It is possible that affect follows a similar trend. Perhaps the lack of immediate feedback, and subsequently learning, stifles the effects of certain emotional states on risk-taking. This would suggest that awe does not affect risk-taking per say but may influence how one adjusts risk-taking based on feedback. This is, however, quite speculative. More research must be done to understand the relationship between affect and feedback learning during a risk-taking process.

Further, Rottenstreich & Hsee (2001) show that the effect on probability weighting, which leads to risk-taking behaviors, depends on the intensity of affect produced by the outcome. They find that the promise of “affect rich” outcomes have a much larger effect on subsequent probability weighting. Tamir and Robinson (2007) have also shown that individuals who were deemed happier tend to focus more on reward. As discussed previously, awe leads to increases life satisfaction and wellbeing. It is possible that those who experienced awe were more likely to focus on rewards. Of course, there were no rewards present in the study. Perhaps the reason why there was no distinct effect for the awe group was because the effect rests upon attention to reward and there was no “affect rich” reward to provide a boon to awe’s effect on risk-taking behavior. Future studies should examine the role of rewards in the relationship between awe and risk-taking.

Regarding the current studies finding that dispositional awe positively predicted risk taking, there is precedence in the literature for positive emotion influencing risk
taking. Affect has long been associated with probability weighting. One approach suggests that risk taking is affected by anticipation that is informed by the affective state (Gul, 1991). For instance, someone in a positive mood will anticipate a good outcome and will estimate probabilities more optimistically than someone in a negative mood, who would anticipate a negative outcome. Presumably, this would lead to more risky behaviors for those with a higher degree of positive affect.

Further, it has been shown that “happy” people make more risky decisions than “sad” people (Johnson and Tversky, 1983). Kliger and Levi (2008) provide evidence that seasonal changes in mood may influence risk taking with less optimistic probability weighting in the lower light conditions of the winter months. Affective states resulting from music have also been shown to have a similar effect on probability weighting (Schulreich, et al.). With past evidence suggesting that positive affect in general leads to greater risk-taking behavior, combined with the small size of the observed effect in this study, it may be that this the predictive effect of dispositional awe on risk-taking could be better explained with a more general measure of dispositional positive affect.

**Goal 3: To determine if awe leads to greater exploratory behaviors toward an uncertain object.**

The hypothesis that the awe group would engage in more exploration than both comparison groups was partially confirmed in study 3. It was found that the awe group: 1) took significantly longer to put their hands into the box than the curiosity groups, 2) spent more time in total exploration than both the fear and curiosity groups and 3) spent more time engaging in box search behavior than the fear group. The awe group was
significantly more cautious about entering their hand into the box than the presumably (per theory) more impulsive curiosity group. Interestingly, the caution seemed to be no different than the increase seen in the fear group. While this study cannot shed light on the internal facets that underly the observed behavior, the data suggests that those who experience awe show similar hesitation to engage in a risky activity in the face of uncertainty.

It must be noted that the differences between studies 2 and 3 might explain why there was a behavioral effect on the uncertainty in the box task but not the risk of the card task. Bar-Anan and colleagues (2009) have studied a phenomenon called “uncertainty intensification”. This is where uncertainty seems to amplify unrelated emotions. Priming with uncertain phrases led to participants to rate positive videos as more positive and negative videos as more negative. Perhaps the uncertainty of the black box worked to amplify the affective priming of the video, making the effect strong enough to be significant. More work, however, would need to be done in this area to draw this conclusion as the videos were shown after the uncertain priming by Bar-Anan and colleagues (2009). It is not clear if this effect remains if the uncertain stimulus comes after and emotional stimulus.

The awe group engaged in significantly more box search behavior than did the fear group. What is interesting about this finding is that box search was the only significant difference between the groups in terms of exploration besides the total aggregate score. We might start by thinking of each type of exploration as a broadening of focus. The hole search behavior is a tight focus on the uncertainty as the black hole was designed so that participants could see nothing from the outside. The box search
moves away from the uncertainty itself and focuses on the more certain parts of the uncertain object. The room search and tool use, then, show movement away from the uncertain stimuli entirely to look for information.

The finding that the fear group engaged in less box search behavior could indicate that fear made it more likely for the participant to focus tightly on the uncertainty of the hole or move away from the box entirely. The awe group on the other hand spent time in the middling level of focus, looking for information close to but not at the site of the uncertainty. Recent work in vision science examined the effect of awe on visual attention (Erol & Mack, 2019). Researchers asked participants to identify a letter in the center of the visual field and then attempt to identify letters in their periphery and various degrees away from the center of the visual field. Their findings show that awe led to a greater breadth of spatial attention. A different study from the same author's dissertation work reveals that awe led to increased global rather than local visual processing compared to amusement and control, further providing evidence that awe may increase the breadth of visual attention (Erol, 2019).

We have long known that fear-evoking stimuli drive attention toward the stimulus in question more quickly than neutral or positive stimuli (Öhman, Flykt, & Esteves, 2001). Other findings suggest fear leads to difficulty in disengaging from this initial driving of attention toward the fearful stimulus (Gerdes, 2008, 2009). Taken together with the finding that awe increases the breadth of visual information, one way to interpret the current study’s findings is that the fear group had an initial focus and sustained attention on the most fearful part of the stimuli, the hole itself. The awe group, however, may have been more able to break free of the local attentional bias and use a more global approach.
to exploration. Future work in this area should utilize eye tracking technologies to examine how awe might differentiate from other emotions when scanning an uncertain scene or environment.

While there was a difference between awe and fear, there seemed to be no difference in the breadth of exploration between the awe and curiosity groups. The only difference was in overall time spent exploring. Work by Risko and colleagues (2012) suggests that higher dispositional curiosity is predictive of greater exploration of a scene as measured by eye movements. Lowenstein (1994) suggests that impulsivity is a constituent component of curiosity. More recent work has also shown evidence that the neural underpinnings of curiosity and impulsivity show a high degree of overlap (Marvin, Tedeschi & Shohamy, 2020). Multiple studies of curiosity have shown that individuals are willing to risk physical harm to sate their curiosity about trivial information (Lau, et al. 2020; Hsee & Ruan, 2016).

Much like the proposed theoretical approach to the design of this current study, awe fits between curiosity and fear. Awe seems to have the breadth of exploration seen in curiosity without impulsivity. Awe also shows the tentative behavior of the fear group in terms of actually taking a risk. As predicted by the theory, this yields a form of exploration that overcomes the aversion associated with fear while reducing the impulsivity associated with curiosity. This would hypothetically lead to a relatively safe exploration of the unknown.
Goal 4: To document group differences in physiological effects of awe as manifested in ANS activity.

The current study found that individuals in the fear group were more sympathetically aroused than the other groups in terms of respiration rates and sAA levels. The finding that awe had no demonstrated effect on physiology was somewhat puzzling. However, there is evidence that increased realism enhances both emotional experience and the physiological reaction to the experience (Chirico et al., 2017). Participants who experienced awe in immersive virtual reality reported greater experience of awe as well as increased parasympathetic activity. It is plausible that the awe video facilitated an enhanced reality which negated a potential stress response.

In terms of the salivary data, it must be noted that sAA often shows discrepancies from sympathetic measures (Folklaw, 2000). It has also been shown that sAA secreting glands can be activated independently of sympathetic nerve fibers (Proctor and Carpenter, 2007). This has caused some to question if sAA is a direct measure of sympathetic activation rather than a measure of other mechanisms related to sympathetic activation (Bosch, Veerman, de Geus, & Proctor, 2011).

One potential issue must be noted in terms of the findings that fear was the most physiologically arousing, but only in two of the modalities. This finding may be due to the design of the scene that was used for the fear stimulus. The scene could be described as a slow burn. The majority of the scene is increasingly uncomfortable dialogue. The actual “fear” component of the scene does not occur until over 4 minutes into the 5-minute video. Recall that the physiological data is an average across the five minutes.
The saliva sample, on the other hand, happened after the prime. This could be responsible for alpha amylase showing the largest physiological effect.

**Limitations and Conclusions**

The first limitation of this study was the use of convenience sampling. The sample consists of young, mostly white, mostly female college students. For this reason, results cannot be generalized to the larger population. With this comes the fact that most of the participants also likely come from a relatively privileged socioeconomic background. While there is no convincing evidence to our knowledge, it has been suggested that socioeconomic privilege may influence dispositional awe (Keltner & Haidt, 2003; Konečni, 2005). These results must be replicated in more diverse populations prior to any generalized claims.

Perhaps the largest limitation of study 1 is the use of mediation analysis on cross-sectional data. While this practice is widely utilized, the practice of deriving causal directionality from cross-sectional models has been criticized (Maxwell, Cole & Mitchell, 2011). Due to this fact, we have been cautious not to use causal language in the interpretation of mediational results and we further caution the reader that the causal ordering of these models, while based on a theoretical approach, remains presumptuous. Even though the approach is limited, we believe this downside comes with an exploratory study. There is currently very little literature examining awe and existential dispositions. The overarching goal of this study was to explore and attempt to provide a more refined picture of the relationship between awe and existential dispositions. We believe that goal was accomplished with the current approach.
The lack of a comprehensive positive emotion scale in the experimental studies is a further limitation of the current study. The results of the second study make this limitation most clear. It is a widespread practice in the awe literature to form models that control for other positive emotions to ensure that the significant effect remains. We were unable to perform this analysis because only the awe subscale was used. While we did find a significant effect, we cannot show that dispositional awe is a distinct predictor. This effect could be due to other dispositions toward positive emotions. Future studies should include a more complete survey for dispositional positive emotions.

The use of the cold version of the Columbia card task is a potential limitation. The cold version was chosen because it was more indicative of planning. As discussed above, however, this task might benefit from the immediate feedback after each trial. Because of this limitation, it is not clear if awe has trivial effect on risk taking or if awe only has negligible effect on risk taking in a situation without feedback. Researchers should look at awe’s effects at various risk-taking methodologies before concluding awe has no effect on risk taking in general.

Another limitation is the use of an uncertain object in a laboratory setting. While I believe the black box was much better than any classic risk-taking task at evoking feelings of uncertainty, the knowledge of being in a study does work to narrow the possibilities. The participants of this study were made up of students in introductory psychology classes and research methods. Anyone with a basic understanding of research ethics should be able to deduce that there could be nothing in the box that might cause serious physical harm. The fact that nearly 89 % of individuals did put their hand in the box confirms that most participants were able to determine that whatever was in the box,
they were not in immediate danger. To increase uncertainty for a similar observational study, the uncertain object would likely need to be in a more naturalistic setting where potential participants are not aware that a study is taking place.

In terms of physiology, one limitation is the lack of measurement after the task itself. This would have allowed us to see how the participants physiology responded to either risk-taking or uncertainty. The current study showed similarity between emotional primes in terms of physiology, apart from sAA. As discussed previously, the delayed timing of the saliva sample may have given more time for physiological changes to occur. Perhaps adding a post prime physiological measure immediately after the task would yield the expected group differences.

Taken all together, this project suggests that awe is associated with many of the epistemic dispositions hypothesized such as curiosity, impulsivity, and epistemic thinking. Indicating that awe is indeed related to the drive for information search, even when faced with vast uncertainty in the case of epistemic dispositions. This along with a negative relationship to facets of impulsivity such as lack of premeditation and perseverance. The experimental studies paint a similar picture but only in the case of uncertain stimuli. There seems to be no unique effect of awe on probabilistic risk taking. When exploring uncertainty, however, awe led to a greater depth of exploration (total time) than either fear or curiosity while also showing a greater breadth of exploration than the fear group. These findings suggest that awe can produce the functional advantages of both fear (caution) and curiosity (breadth of exploration). When faced with uncertainty, awe overcame the functional downsides of a fearful or curious approach by
allowing for broad exploration while simultaneously staying impulsive risk-taking. This allows for information search of the unknown without the enhanced risk of impulsivity.


Kashdan, T. B., Stiksma, M. C., Disabato, D. J., McKnight, P. E., Bekier, J., Kaji, J., & Lazarus, R. (2018). The five-dimensional curiosity scale: Capturing the
bandwidth of curiosity and identifying four unique subgroups of curious people. *Journal of Research in Personality, 73*, 130-149.

https://doi.org/10.1016/j.jrp.2017.11.011


https://doi.org/10.1080/02699930302297


https://doi.org/10.1080/02699931.2022.2149473


https://doi.org/10.1196/annals.1280.016


https://doi.org/10.3389/fnhum.2022.983674


Litman, J. A. (2010). Relationships between measures of I- and D-type curiosity, ambiguity tolerance, and need for closure: An initial test of the wanting-liking


338-347. https://doi.org/10.1080/17439760.2019.1615106

electrodermal activity and subjective stress responses to the Mannheim
Multicomponent Stress Test (MMST). *Psychiatry research, 198*(1), 106-111.

Richesin, M. T., & Baldwin, D. R. (2023). How Awe Shaped Us: An Evolutionary
https://doi.org/10.1177/1754073922113689


Rudd, M., Vohs, K. D., & Aaker, J. (2012). Awe Expands People’s Perception of Time,
Alters Decision Making, and Enhances Well-Being. *Psychological Science,

emotion regulation: A meta-analytic and systematic review. *Clinical Psychology

parasympathetic response to threat. *Psychosomatic Medicine, 58*(1), 32-37.

and mental wellbeing: Serial mediation by rumination and fear of COVID-
https://doi.org/10.1007/s11469-020-00305-0

https://doi.org/10.1080/00913367.2021.1931578


https://doi.org/10.1002/jclp.22474


multifactorial measure for a complex emotion. *The journal of positive psychology*, 14(4), 474-488


https://doi.org/10.1017/prp.2016.8
Figure 7. The parallel mediating effect of curiosity subscales in the relationship between dispositional awe and Impulsivity.

Note: Standardized coefficients are shown. The coefficient of the total path (Dispositional awe > Impulsivity) is shown in parenthesis. *** p < .001.
Figure 8. The multiple mediating effect of love, contentment, and pride in the relationship between dispositional awe and factor 1 of the intolerance to uncertainty scale.

Note: Standardized coefficients are shown. The coefficient of the total path (Dispositional awe > IUS Factor 1) is shown in parenthesis. ** p < .01, *** p < .001.
Figure 9. The parallel mediating effect of curiosity and intolerance of uncertainty in the relationship between dispositional awe and existential thinking.

*Note:* Standardized coefficients are shown. The coefficient of the total path (Dispositional awe > Existential thinking) is shown in parenthesis. ***p < .001
Figure 10. Dispositional Awe > Average Card.
Figure 11. Dispositional Awe > Total Score.
Table 10. *Hypothesis vs Results*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispositional awe will be positively associated with Curiosity and likelihood of existential thinking.</td>
<td>Dispositional awe was significantly positively associated with both curiosity and existential thinking. Stronger association with exploration-focused curiosity measures.</td>
</tr>
<tr>
<td>Dispositional awe will be negatively associated with impulsivity and intolerance to uncertainty.</td>
<td>Dispositional awe was negatively associated with a lack of premeditation. There was a small association with intolerance to uncertainty, but this effect is likely explained by other positive affective states.</td>
</tr>
<tr>
<td>Participants primed with fear will take the least risk, participants primed with curiosity will take the most risk, and participants primed with awe will fall between these in risk-taking.</td>
<td>Participants primed with fear did take the least risk. There seemed to be no distance effect for participants primed with awe, in comparison to participants primed with curiosity.</td>
</tr>
<tr>
<td>The fear group will take the longest time to insert their hand into the box, the curiosity group will be the fastest to insert their hand, and the awe group will fall between these two.</td>
<td>Both the awe and fear groups took significantly longer to insert their hand into the box than the curiosity group. There was no difference between the awe and fear groups.</td>
</tr>
<tr>
<td>The awe group will display more exploratory behavior than the curiosity group.</td>
<td>The awe group spent more time in total exploring than either the curiosity or fear groups.</td>
</tr>
</tbody>
</table>
Recruitment Advertising Materials Study 1

Study Name: Function of Awe

Brief Abstract:
In this study, you will be asked to answer survey questions about various trait measures of positive emotions and other dispositional qualities potentially associated with them.

Detailed Description: As indicated above, the study is expected to take 60 minutes, but its duration varies. You will receive 0.5 Sona credits for every half hour (or portion thereof) that you spend on it. See brief abstract.

Eligibility Requirements:
None

Preparation:
You must be at a computer, not a mobile device. Please be sure that you’re in a quiet room. Prior to beginning, ensure have an hour of uninterrupted time to complete this study.

Study Type:
This study is an online study on another website. To participate, sign up, and then you will be given access to the website to participate in the study.

Credits: 1 credit
Duration: 1 hour

Researcher: Matthew Richesin
Principal Investigator: Debora Baldwin

PS: Following initial data collection, we will review how long it is taking participants to complete our survey with the Sona administrator. If the duration estimates we have provided above are inaccurate, we will revise the Credit and Duration fields accordingly.
Recruitment Advertising Materials Study 2

Study Name: Awe and Risk-Taking

Brief Abstract:
In this study, you will be asked to watch a video, in order to understand the effect that certain emotions have on later behaviors. Behavioral measures will be recorded via software on a decision-making task. You will also be asked to render biological measurements including a saliva sample.

Detailed Description:
The study is expected to take ~ 60 minutes, but its duration varies. You will receive 0.5 Sona credits for every half hour (or portion thereof) that you spend on it. See brief abstract.

Eligibility Requirements:
None

Preparation:
Please do not eat or drink anything other than water for at least 30 minutes prior to the study start time.

Study Type:
This is a standard lab study. To participate, sign up for a timeslot and be sure you have at least one hour to spend in the laboratory. Finally, you will report to room 337 in the Ken and Clair Mossman building a few minutes prior to the scheduled time.

Credits: 1 credit

Duration: 1 hour

Researcher: Matthew Richesin

Principal Investigator: Debora Baldwin
Recruitment Advertising Materials Study 3

**Study Name:** Awe and Uncertainty

**Brief Abstract:**
In this study, you will be asked to watch a video, in order to understand the effect that certain emotions have on later behaviors. Behavioral measures will be recorded via software on a decision-making task. You will also be asked to render biological measurements including a saliva sample. The study will take place in a video surveilled space.

**Detailed Description:**
The study is expected to take ~ 60 minutes, but its duration varies. You will receive 0.5 Sona credits for every half hour (or portion thereof) that you spend on it. See brief abstract.

**Eligibility Requirements:**
None

**Preparation:**
Please do not eat or drink anything other than water for at least 30 minutes prior to the study start time.

**Study Type:**
This study is an in-person study. To participate, sign up for a timeslot that you can attend. Be sure you have at least one hour to spend in the laboratory. Finally, you will report to room 337 in the Ken and Clair Mossman building a few minutes prior to the scheduled time.

**Credits:** 1 credit

**Duration:** 1 hour

**Researcher:** Matthew Richesin

**Principal Investigator:** Debora Baldwin
Consent for Research Participation Study 1

Research Study Title: The Role of Awe in Risk Taking

Researcher(s):
Matthew Richesin, University of Tennessee, Knoxville (Graduate Student)
Lahai Wicks, University of Tennessee, Knoxville (Graduate Student)
Dr. Debora Baldwin, University of Tennessee, Knoxville (Faculty Advisor)

Purpose
Thank you for your interest in our research study. The purpose of this study is to examine the relationship between awe and risk-taking behaviors in comparison to other emotional and motivational states.

Participation
If you choose to participate in this study, we ask you to read and accept consent to participate prior to answering the online survey questions. The full study will take approximately 45 minutes. Being in this study is up to you. You can say no now or leave the study later. Either way, your decision will not affect your grades, your relationship with your instructors, or your experience at UT. Your participation is completely voluntary, and you may choose to withdraw at any time without penalty. Even if you decide to be in the study now, you can change your mind and stop at any time. If you decide you no longer wish to participate in our study, please inform the researcher. No information will be collected from you.

Risks
We don’t know of any risks to you from participation in the study. You may be exposed to frightening images. If this concerns you, please voice those concerns to the researcher.

Benefits
We do not expect you to benefit from being in this study. Participants are not paid for their service. However, your participation may help provide a better understanding of the role that awe plays in certain behaviors. This may lead to future interventions with practical benefits in the future.

Confidentiality
Consent for Research Participation Study 1 continued

The results of this research study will be used for scientific purposes only (e.g., published in a scholarly journal and/or conference presentation). Please note that only summary data will be presented. Your name and other personal information will not be used. We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what information came from you. We will keep your information to use for future research studies for three years before it is deleted. Your name will not be attached to the collected data. Although it is unlikely, there are times when others may need to see the information we collect about you. These include:
· People at the University of Tennessee (UT), Knoxville who oversee research to ensure it is conducted properly.
· Government agencies (such as the Office for Human Research Protections in the U.S. Department of Health and Human Services), and others responsible for watching over the safety, effectiveness, and conduct of the research.
· If a law or court requires us to share the information, we would have to follow that law or final court ruling.

Compensation
For fully completing this study, each participant will be offered 1 SONA credit.

Contact Information
If you have questions or concerns about this study or have experienced a research-related problem or injury, contact the researchers:

**Principal Investigator:** Matthew Richesin (mrichesi@vols.utk.edu)
**Faculty Advisor:** Debora Baldwin, PhD (dbaldwin@utk.edu)

For questions or concerns about your rights or to speak with someone other than the research team about the study, please contact:
Consent for Research Participation Study 1 continued

Institutional Review Board
The University of Tennessee, Knoxville
1534 White Avenue
Blount Hall, Room 408
Knoxville, TN 37996-1529
Phone: 865-974-7697
Email: utkirb@utk.edu

By clicking the ‘next’ button below, I consent to take part in this study.
Consent for Research Participation Study 2

Research Study Title: The Role of Awe in Risk Taking

Researcher(s):
Matthew Richesin, University of Tennessee, Knoxville (Graduate Student)
Lahai Wicks, University of Tennessee, Knoxville (Graduate Student)
Dr. Debora Baldwin, University of Tennessee, Knoxville (Faculty Advisor)

Purpose
Thank you for your interest in our research study. The purpose of this study is to examine the relationship between awe and risk-taking behaviors in comparison to other emotional and motivational states.

Participation
If you choose to participate in this study, we ask you to read and accept this consent to participate prior to answering the survey questions. In this study, you will answer survey questions, watch a short video clip, and complete a computerized card task. Some of the video clips may make you feel tense or afraid. This study will also require the collection of biological data in the form of heart rate, skin conductance, respiration, and two saliva samples. The full study will take approximately 45 minutes. Being in this study is up to you. You can say no now or leave the study later. Either way, your decision will not affect your grades, your relationship with your instructors, or your experience at UT. Your participation is completely voluntary, and you may choose to withdraw at any time without penalty. Even if you decide to be in the study now, you can change your mind and stop at any time. If you decide you no longer wish to participate in our study, please close out of this browser session and inform the researcher. No information will be collected from you.

Risks
We expect minimal risk in participating in this study, however, biological data will be collected. There are no names required on the study measures. Therefore, your identity cannot be linked to the study data. The data will be coded and entered on a password-protected computer. Only the research team will have access to this data. We will make
Consent for Research Participation Study 2 continued

every effort to prevent anyone who is not on the research team from knowing that you participated in this study.

Benefits
We do not expect you to benefit from being in this study. Participants are not paid for their service. However, your participation may help provide a better understanding of the role that awe plays in certain behaviors. This may lead to future interventions with practical benefits in the future.

Confidentiality
The results of this research study will be used for scientific purposes only (e.g., published in a scholarly journal and/or conference presentation). Please note that only summary data will be presented. Your name and other personal information will not be used. We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what information came from you. We will keep your information to use for future research studies for three years before it is deleted. Your name will not be attached to the collected data. Although it is unlikely, there are times when others may need to see the information we collect about you. These include:
· People at the University of Tennessee (UT), Knoxville who oversee research to ensure it is conducted properly.
· Government agencies (such as the Office for Human Research Protections in the U.S. Department of Health and Human Services), and others responsible for watching over the safety, effectiveness, and conduct of the research.
· If a law or court requires us to share the information, we would have to follow that law or final court ruling.

Compensation
For fully completing this study, each participant will be offered 1 SONA credit.

Contact Information
If you have questions or concerns about this study or have experienced a research-related problem or injury, contact the researchers:
Consent for Research Participation Study 2 continued

Principal Investigator: Matthew Richesin (mrichesi@vols.utk.edu)
Faculty Advisor: Debora Baldwin, PhD (dbaldwin@utk.edu)

For questions or concerns about your rights or to speak with someone other than the research team about the study, please contact:

Institutional Review Board
The University of Tennessee, Knoxville
1534 White Avenue
Blount Hall, Room 408
Knoxville, TN 37996-1529
Phone: 865-974-7697
Email: utkirb@utk.edu

Statement of Consent
I have read this form, been given the chance to ask questions and have my questions answered. If I have more questions, I have been told whom to contact. By signing this document, I am agreeing to be in this study. I will receive a copy of this document after I sign it.

________________________________________________________________________
Name                                                         Signature                                                      Date

Researcher Signature I have explained the study to the participant and answered all their questions. I believe that they understand the information described in this consent form and freely consent to be in this study.

________________________________________________________________________
Name                                                         Signature                                                      Date

137
Consent for Research Participation Study 3

Research Study Title: Awe and Uncertainty

Researcher(s):
Matthew Richesin, University of Tennessee, Knoxville (Graduate Student)
Lahai Wicks, University of Tennessee, Knoxville (Graduate Student)
Dr. Debora Baldwin, University of Tennessee, Knoxville (Faculty Advisor)

Purpose
Thank you for your interest in our research study. The purpose of this study is to examine the relationship between awe and exploratory behaviors. In this study, you will be primed with various emotions and asked to complete an exploratory task.

Participation
If you choose to participate in this study, we ask you to read and accept this consent to participate prior to answering the survey questions. In this study, you will answer survey questions, watch a short video clip, and conduct a black box task. In this task, you will be asked to determine the contents of a box. Some of the video clips may make you feel tense or afraid. This study will also require the collection of biological data in the form of heart rate, skin conductance, respiration, and two saliva samples. Heart rate and skin conductance sensors will be attached to the fingers of your non-dominant hand.
Respiration will be measured with a belt that goes around your abdomen. All of this will take place in a video-surveilled space. The full study will take approximately 45 minutes. Being in this study is up to you. You can say no now or leave the study later. Either way, your decision will not affect your grades, your relationship with your instructors, or your experience at UT. Your participation is completely voluntary, and you may choose to withdraw at any time without penalty. Even if you decide to be in the study now, you can change your mind and stop at any time. If you decide you no longer wish to participate in our study, please close out of this browser session and inform the researcher. No information will be collected from you.

Risks
We expect minimal risk in participating in this study, however, biological data will be collected. There are no names required on the study measures. Therefore, your identity
Consent for Research Participation Study 3 continued

cannot be linked to the study data. The data will be coded and entered on a password-protected computer. All laboratory video and audio surveillance will be kept in a secure lab setting with access only being granted to authorized members of the research team. All identifying information unnecessary for analysis will be removed from any video or audio surveillance data as well. All recordings will be destroyed after data analysis. Only the research team will have access to this data. We will make every effort to prevent anyone who is not on the research team from knowing that you participated in this study.

Benefits
We do not expect you to benefit from being in this study. Participants are not paid for their service. However, your participation may help provide a better understanding of the role that awe plays in cognition. This may lead to future interventions with practical benefits in the future.

Confidentiality
The results of this research study will be used for scientific purposes only (e.g., published in a scholarly journal and/or conference presentation). Please note that only summary data will be presented. Your name and other personal information will not be used. We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what information came from you. We will keep your information to use for future research studies for three years before it is deleted. Your name will not be attached to the collected data. Although it is unlikely, there are times when others may need to see the information we collect about you. These include:

- People at the University of Tennessee (UT), Knoxville who oversee research to ensure it is conducted properly.
- Government agencies (such as the Office for Human Research Protections in the U.S. Department of Health and Human Services), and others responsible for watching over the safety, effectiveness, and conduct of the research.
- If a law or court requires us to share the information, we would have to follow that law or final court ruling.
Consent for Research Participation Study 3 continued

Compensation
For fully completing this study, each participant will be offered 1 SONA credit.

Contact Information
If you have questions or concerns about this study or have experienced a research-related problem or injury, contact the researchers:

Principal Investigator: Matthew Richesin (mrichesi@vols.utk.edu)
Faculty Advisor: Debora Baldwin, PhD (dbaldwin@utk.edu)

For questions or concerns about your rights or to speak with someone other than the research team about the study, please contact:

Institutional Review Board
The University of Tennessee, Knoxville
1534 White Avenue
Blount Hall, Room 408
Knoxville, TN 37996-1529
Phone: 865-974-7697
Email: utkirb@utk.edu

Statement of Consent
I have read this form, been given the chance to ask questions and have my questions answered. If I have more questions, I have been told whom to contact. By signing this document, I am agreeing to be in this study. I will receive a copy of this document after I sign it. I freely volunteer to take part in this study.
Consent for Research Participation Study 3 continued

Printed Name of Subject __________________________ Signature of Subject __________________________ Date __________

Researcher Signature

I explained the study to the participant and answered all their questions. I believe that they understand the information described in this consent form and freely consent to be in this study.

__________________________ __________________________ __________
Demographics

1. Gender (mark one)
   Male, Female, Transgender, Non-Binary/Non-Conforming, Questioning/Unsure, Other

2. Age ___

3. Religion (mark one)
   A. Christian/Catholic, B. Christian/Non-Catholic, C. Jewish, D. Muslim, E. Agnostic, F. Atheist
   G. Other: ___

4. Do you attend church? (mark one)
   Yes No

5. What kind of area were you raised in? (mark one)

6. Political Orientation (mark one)
   A. Very conservative, B. Conservative, C. Moderate, D. Liberal, E. Very liberal

7. Please report an estimate of your household’s combined annual income in thousands of dollars:

   ________

8. Please mark one of the following to indicate your primary ethnic identity:
   A. Black or African American, B. American Indian or Alaska Native, C. Native Hawaiian or Other Pacific Islander, D. Hispanic or Latino or Spanish Origin, E. White, non-Hispanic, F. Asian, G. Middle Eastern
Dispositional Positive Emotion Scale

The Dispositional Positive Emotion Scale consists of seven subscales (joy, contentment, pride, love, compassion, amusement and awe) that measure one’s dispositional tendencies to feel positive emotions towards others in their daily life. 7 point Likert scale ranging from 1, “strongly disagree” to 7, “strongly agree”.

Joy

- I often feel bursts of joy.
- I am an intensely cheerful person.
- I am often completely overjoyed when something good happens.
- On a typical day, many events make me happy.
- Good things happen to me all the time.
- My life is always improving.

Contentment

- I am generally a contented person.
- I am at peace with my life.
- When I think about my life I experience a deep feeling of contentment.
- I feel satisfied more often than most people.
- My life is very fulfilling.

Pride

- I feel good about myself.
- I am proud of myself and my accomplishments.
- Many people respect me.
- I always stand up for what I believe.
- People usually recognize my authority.

Love

Dispositional Positive Emotion Scale continued
• Other people are generally trustworthy.
• I develop strong feelings of closeness to people easily.
• I find it easy to trust others.
• I can depend on people when I need help.
• People are usually considerate of my needs and feelings.
• I love many people.

Compassion

• It’s important to take care of people who are vulnerable.
• When I see someone hurt or in need, I feel a powerful urge to take care of them.
• Taking care of others gives me a warm feeling inside.
• I often notice people who need help.
• I am a very compassionate person.

Amusement

• I find humor in almost everything.
• I really enjoy teasing people I care about.
• I am very easily amused.
• The people around me make a lot of jokes.
• I make jokes about everything.

Awe

• I often feel awe.
• I see beauty all around me.
• I feel wonder almost every day.
• I often look for patterns in the objects around me.
• I have many opportunities to see the beauty of nature.
• I seek out experiences that challenge my understanding of the world.
Curiosity and Exploration Inventory (CEI-II)

Instructions: Rate the statements below for how accurately they reflect the way you generally feel and behave. Do not rate what you think you should do, or wish you do, or things you no longer do. Please be as honest as possible.

1. Very Slightly or Not At All
2. A Little
3. Moderately
4. Quite a Bit
5. Extremely

1. I actively seek as much information as I can in new situations. 1 2 3 4 5
2. I am the type of person who really enjoys the uncertainty of everyday life. 1 2 3 4 5
3. I am at my best when doing something that is complex or challenging. 1 2 3 4 5
4. Everywhere I go, I am out looking for new things or experiences. 1 2 3 4 5
5. I view challenging situations as an opportunity to grow and learn. 1 2 3 4 5
6. I like to do things that are a little frightening. 1 2 3 4 5
7. I am always looking for experiences that challenge how I think about myself and the world. 1 2 3 4 5
8. I prefer jobs that are excitingly unpredictable. 1 2 3 4 5
9. I frequently seek out opportunities to challenge myself and grow as a person. 1 2 3 4 5
10. I am the kind of person who embraces unfamiliar people, events, and places. 1 2 3 4 5
Five-Dimensional Curiosity Scale (5DC)

Below are statements people often use to describe themselves. Please use the scale below to indicate the degree to which these statements accurately describe you. There are no right or wrong answers.

1 – Does not describe me at all
2 – Barely describes me
3 – Somewhat describes me
4 – Neutral
5 – Generally describes me
6 – Mostly describes me
7 – Completely describes me

Joyous Exploration:
1. I view challenging situations as an opportunity to grow and learn.
2. I am always looking for experiences that challenge how I think about myself and the world.
3. I seek out situations where it is likely that I will have to think in depth about something.
4. I enjoy learning about subjects that are unfamiliar to me.
5. I find it fascinating to learn new information.

Deprivation Sensitivity:
6. Thinking about solutions to difficult conceptual problems can keep me awake at night.
7. I can spend hours on a single problem because I just can't rest without knowing the answer.
8. I feel frustrated if I can't figure out the solution to a problem, so I work even harder to solve it.
9. I work relentlessly at problems that I feel must be solved.
10. It frustrates me not having all the information I need.

Stress Tolerance: (entire subscale reverse-scored)
11. The smallest doubt can stop me from seeking out new experiences.
12. I cannot handle the stress that comes from entering uncertain situations.
13. I find it hard to explore new places when I lack confidence in my abilities.
14. I cannot function well if I am unsure whether a new experience is safe.
15. It is difficult to concentrate when there is a possibility that I will be taken by surprise.

Social Curiosity:
16. I like to learn about the habits of others.
17. I like finding out why people behave the way they do.
18. When other people are having a conversation, I like to find out what it's about.
19. When around other people, I like listening to their conversations.
20. When people quarrel, I like to know what's going on.

Five-Dimensional Curiosity Scale (5DC) Continued
**Thrill Seeking:**
21. The anxiety of doing something new makes me feel excited and alive.
22. Risk-taking is exciting to me.
23. When I have free time, I want to do things that are a little scary.
24. Creating an adventure as I go is much more appealing than a planned adventure.
25. I prefer friends who are excitingly unpredictable.

**Scoring instructions:**
Compute the average for each dimension and analyze each dimension separately (remember to reverse score the items for Stress Tolerance). Randomizing the items will likely lead to similar results. Please use this citation when using the scale. As of today, there are two items in this document that are different than the online journal article. We made a mistake in the publication.

**USE THE ITEMS ABOVE – THIS DOCUMENT HAS THE FINAL 25 ITEMS.**

Kashdan, T.B., Stiksma, M.C., Disabato, D., McKnight, P.E., Bekier, J., Kaji, J., & Lazarus, R. (in press). The five-dimensional curiosity scale: Capturing the bandwidth of curiosity and identifying four unique subgroups of curious people. *Journal of Research in Personality*
Impulsive behavior scale (Short UPPS-P)

Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement. If you Agree Strongly choose 1, if you Agree Somewhat choose 2, if you Disagree somewhat choose 3, and if you Disagree Strongly choose 4. Be sure to indicate your agreement or disagreement for every statement below.

1. I generally like to see things through to the end.
2. My thinking is usually careful and purposeful.
3. When I am in great mood, I tend to get into situations that could cause me problems.
4. Unfinished tasks really bother me.
5. I like to stop and think things over before I do them.
6. When I feel bad, I will often do things I later regret in order to make myself feel better now.
7. Once I get going on something I hate to stop.
8. Sometimes when I feel bad, I can’t seem to stop what I am doing even though it is making me feel worse.
9. I quite enjoy taking risks.
10. I tend to lose control when I am in a great mood.
11. I finish what I start.
12. I tend to value and follow a rational, "sensible" approach to things.
13. When I am upset I often act without thinking.
14. I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional.
15. When I feel rejected, I will often say things that I later regret.
16. I would like to learn to fly an airplane.
Impulsive behavior scale (Short UPPS-P) continued

17. Others are shocked or worried about the things I do when I am feeling very excited

18. I would enjoy the sensation of skiing very fast down a high mountain slope

19. I usually think carefully before doing anything.

20. I tend to act without thinking when I am really excited.
Intolerance to uncertainty scale

You will find below a series of statements which describe how people may react to the uncertainties of life. Please use the scale below to describe to what extent each item is characteristic of you. Please choose a number (1 to 5) that describes you best.

1= Not at all characteristic of me, 2= Not very characteristic of me, 3= Somewhat characteristic of me, 4= Characteristic of me, 5= Entirely characteristic of me

1. Uncertainty stops me from having a firm opinion.
2. Being uncertain means that a person is disorganized.
3. Uncertainty makes life intolerable.
4. It's unfair not having any guarantees in life.
5. My mind can't be relaxed if I don't know what will happen tomorrow.
6. Uncertainty makes me uneasy, anxious, or stressed.
7. Unforeseen events upset me greatly.
8. It frustrates me not having all the information I need.
9. Uncertainty keeps me from living a full life.
10. One should always look ahead so as to avoid surprises.
11. A small unforeseen event can spoil everything, even with the best of planning.
12. When it's time to act, uncertainty paralyses me.
13. Being uncertain means that I am not first rate.
14. When I am uncertain, I can't go forward.
15. When I am uncertain I can't function very well.
16. Unlike me, others always seem to know where they are going with their lives.
Intolerance to uncertainty scale continued

17. Uncertainty makes me vulnerable, unhappy, or sad.

18. I always want to know what the future has in store for me.

19. I can't stand being taken by surprise.

20. The smallest doubt can stop me from acting.

21. I should be able to organize everything in advance.

22. Being uncertain means that I lack confidence.

23. I think it's unfair that other people seem sure about their future.

24. Uncertainty keeps me from sleeping soundly.

25. I must get away from all uncertain situations.

26. The ambiguities in life stress me out.

27. I can't stand being undecided about my future.
Scale for Existential Thinking

1= No or rarely.
2= Sometimes.
3= Often.
4= Almost all the time.
5= All the time.
6= I don’t know.

Circle answers that best fit for you either now or in the past.

1. Do you ever reflect on your purpose in life?

2. Do you ever think about the human spirit or what happens to life after death?

3. Have you ever spent time reading, thinking about, or discussing philosophy or beliefs?

4. Do you have a philosophy of life that helps you to manage stress or make important decisions?

5. Do you think about ideas such as eternity, truth, justice and goodness?

6. Do you spend time in meditation, prayer, or reflecting on the mysteries of life?

7. Do you discuss or ask questions to probe deeply into the meaning of life?

8. Do you ever think about a “grand plan” or process that human beings are a part of?

9. Have you ever thought about what is beyond the “here and now” of your daily life?

10. Do you ever think about life’s Big Questions?

11. Have you ever reflected on the nature of reality or the universe?
Existential concern questionnaire

Please choose the answer that best describes you, there are no right or wrong answers.
1= Completely disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Completely agree

1. The question of whether life has meaning makes me anxious.
2. It frightens me when I realize how many choices life offers.
3. I worry about not being at home in the world, as if I do not belong here.
4. I worry about the meaning of life.
5. I get anxious because of losing touch with myself.
6. I struggle with the feeling that in the end I am on my own in life.
7. I worry about not living the life that I could live.
8. The awareness that other people will never know me at the deepest level frightens me.
9. It frightens me that things I once considered important seem meaningless when I look back on them.
10. I am afraid that I do not get out of life what is in it.
11. I have the anxious feeling that there is a gap between me and other people.
12. I am afraid that I will never know myself at the deepest level.
13. It frightens me that at some point in time I will be dead.
14. It makes me anxious that my life is passing by.
15. I worry that, out of the blue, something terrible might happen to me.
16. Existence feels threatening to me, as if at any moment something terrible could happen to me.
Existential concern questionnaire continued

17. I become anxious when I realize how vulnerable my body is to the dangers of life.

18. I worry about having to let go of everything at the moment of my death.

19. I try to forget that all my choices have consequences.

20. When the question of whether life has meaning enters my mind, I try to think quickly about something else.

21. I try to avoid the question of who I really am.

22. I try to push away the thought that life will end.
Awe Experience Scale

With the memory of the video you just watched, please answer the following questions about how you felt. While you may have had other experiences that are relevant to the following questions, please answer only about the video in question. Each question will be scored on a 7 point likert scale from 1 “Strongly Disagree” to 7 “Strongly Agree”.

- I sensed things momentarily slow down.
- I experienced a reduced sense of self.
- I had chills.
- I experienced a sense of oneness with all things.
- I felt that I was in the presence of something grand.
- I felt that my sense of self was diminished.
- I noticed time slowing.
- I had the sense of being connected to everything.
- I felt small compared to everything else.
- I perceived vastness.
- I felt challenged to understand the experience.
- I felt my sense of self shrink.
- I felt closely connected to humanity.
- I gasped.
- I felt my sense of self become somehow smaller.
- I had a sense of complete connectedness.
Awe Experience Scale Continued

- I struggled to take in all that I was experiencing at once.
- I felt my eyes widen.
- I experienced something greater than myself.
- I found it hard to comprehend the experience in full.
- I perceived something that was much larger than me.
- I felt my sense of time change.
- I felt my jaw drop.
- I felt challenged to mentally process what I was experiencing.
- I had the sense that moment was lasting longer than usual.
- I felt in the presence of greatness.
- I felt a sense of communion with all living things.
- I had goosebumps.
- I experienced the passage of time differently.
- I tried to understand the magnitude of what I was experiencing.
Video Scoring

1) Time Spent at Various Distances (provide the time stamp for passing the threshold):
   - Beyond (9) Feet: ____________
   - Beyond (6) Feet: ____________
   - Within (3) Feet: ____________

2) Did the Participants Hand Enter the Box?  Yes ____  No ____
   If Yes, Provide Time Stamp: ____________
   If participant removed item from box, provide time stamp: ____________

3) Did the Participant Retract Hand from the Box? If This Occurs Multiple Times, Place Tally Marks
   Next to “Yes”.  Yes _______  No _______
   If Yes, How Far Did the Hand Go into the Box, use arm below: _______

4) Did the Participant Display Searching Behaviors such as:
   1. Scanning/Search the room:  Yes ____  No ____
      IF yes, approximate time spent: ____________
   2. Attempting to Find Other Ways into the Box (looking at sides or back, jiggling lock)
      Yes ____  No ____
      IF yes, approximate time spent: ____________
   3. Trying to see Into Hole Without Putting Hand in.  Yes ____  No ____
      IF Yes, Approximate Time Spent: ____________
   4. Did the participant use a tool to try and see into or open the box?
      Yes ____  No ____  IF Yes, Approximate Time Spent: ____________
      IF Yes, briefly describe the tool and use: ____________________________

5) Did the Participant Display any of the Following Fearful Behaviors (use tally marks):
   1. Yelling, Exclaiming  Yes _____  No _____  2. Gasping  Yes _____  No _____
   3. Cursing  Yes _____  No _____  4. Talking to Self  Yes _____  No _____
VITA

Matthew Thomas Richesin was born in Johnson City, Tennessee. He moved to the Knoxville area at an early age. He was raised by his parents Jill Blankenship and Bruce Richesin. He is the oldest of three children, one brother and one sister. Matthew was educated through the Alcoa City School System from middle school through high school. After graduation, Matthew decided to attend Pellissippi State Community College where he graduated with an associate degree in psychology. Next, Matthew transferred to the University of Tennessee to pursue a Bachelor of Arts degree in psychology. He achieved this goal with a minor in Philosophy. He then accepted a graduate teaching assistantship at the University of Tennessee – Knoxville in Experimental Psychology under the supervision of Dr. Debora Baldwin. Upon completion of his Master of Arts in Experimental Psychology, Matthew decided to further his education by pursuing a Ph.D. at The University of Tennessee. He worked under the supervision of Dr. Debora Baldwin while pursuing his doctorate degree.