"Awe- Shucks": Uncovering the Relationship Between Awe and Domains of Humility

David Racioppa

Department of Psychology

Lakehead University

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Supervisor: Dr. Laurence Fiddick

Internal examiner: Dr. Beth Visser

External examiner: Dr. Michael Ashton

Abstract

The current study sought to examine the relationship between awe (both valences) and domains of humility. In a preregistered study, 268 participants completed an online questionnaire with 12 measures of humility (ethical, intellectual, epistemic, environmental, religious, Einsteinian, self-abasing, modesty, sincerity, fairness, greed avoidance, and valuing humility) along with a video and written task meant to induce positive or negative awe. Of all the domains of humility used, it was hypothesized that positive awe (elicited and dispositional) would be best predicted by intellectual humility whereas negative awe (elicited and dispositional) would be best predicted by self-abasing humility. Results showed partial support for these hypotheses. Elicited positive awe from the videos was best predicted by epistemic humility followed by a facet of intellectual humility (appropriate discomfort of limitations) which were not significantly different. Religious humility was the best predictor of elicited positive awe from the written task and valuing humility was the best predictor of dispositional (positive) awe. Elicited negative awe from the videos was best predicted by religious humility however "meek self-abasing humility" was the best predictor amongst the emergent 18 humility factors. Modesty was the best predictor for elicited negative awe from the written task and dispositional negative awe was best predicted by appropriate discomfort of limitations followed by self-abasing humility which were not statistically different. Overall, cognitive domains of humility were better predictors of awe than (pro)social domains of humility which may have implications for the function of awe.

Keywords: Positive awe, negative awe, intellectual humility, self-abasing humility, self-diminishment, bottom-up processing

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Introduction

Conceptualizing Awe

Experiences of awe are complex and not yet fully understood. The Merriam-Webster dictionary describes awe as "an emotion variously combining dread, veneration, and wonder that is inspired by authority or by the sacred or sublime" (Merriam Webster, n.d.). This definition closely aligns with the psychological conception of awe that also views awe as an emotion that can have a valence ranging from positive to negative. The prototypical awe experience is commonly assumed to be predicated on two features or appraisals: perceived vastness and a need for cognitive accommodation (Keltner & Haidt, 2003). There are many awe-like emotions or similar feelings such as surprise, aesthetic pleasure, wonder, elevation, reverence, and admiration. What distinguishes these states of mind from awe is that experiences of awe (or at least prototypical experiences of awe) require perceived vastness and a need for cognitive accommodation (Keltner & Haidt, 2003; Valdesolo et al., 2017).

The experience of awe can be referred to as "elicited awe" whereas the tendency to experience awe can be called "dispositional awe". Awe is often evoked by "physical elicitors" such as waterfalls, mountains, starry skies, stunning art, and grandiloquent music (Keltner & Haidt, 2003). Awe can also be triggered by "social elicitors" (e.g., celebrities, inspiring leaders, displays of virtue) and "cognitive elicitors" (e.g., having an epiphany, learning about a grand theory, or contemplating the vastness of the universe; Gordon et al., 2017; Graziosi & Yaden, 2021; Keltner & Haidt, 2003; Shiota et al., 2007) however awe evoked by physical elicitors tends to be more intense than awe evoked by social elicitors (Graziosi & Yaden, 2021). Prototypical

experiences of awe are thought to be "rare and fleeting" unlike most emotions (Keltner & Haidt, 2003).

Perceived Vastness

The term vastness has been used to describe any stimulus that is powerful, profound, information rich, conceptually vast, or perceptually vast that exceeds a person's usual frame of reference (Keltner & Haidt, 2003; Shiota et al., 2007; Taylor & Uchida, 2019). Put differently, vast stimuli deviate from stimuli people are accustomed to (Shiota et al., 2007), which is a type of stimuli that is obscure, a feature that has been thought to characterize the sublime (Keltner & Haidt, 2003). A stimulus needs to be appraised as vast, therefore *perceived* vastness and not vastness per se is an antecedent of awe. Physical elicitors such as waterfalls, mountains, and starry skies are often used to evoke a sense of vastness as vastness often conveys "extreme spatial depth" (Klatzky et al., 2017) which is salient and easy to perceive. This salient perceptual vastness that is often characteristic of physical elicitors may explain why elicitors like nature evoke more intense feelings of awe than social elicitors (Graziosi & Yaden, 2021). The type of vastness from social elicitors may be more akin to power which may not be perceived as genuinely vast as stimuli that is perceptually or spatially vast. Importantly, all types of vast stimuli differ from the kinds of stimuli individuals are usually exposed to, explaining why vast stimuli induces a need for cognitive accommodation, the second requirement for the prototypical awe experience.

The Need for Cognitive Accommodation

Cognitive accommodation (sometimes called knowledge restructuring or conceptual change) is a Piagetian concept that refers to modifying schemata or creating new schemas to

make sense of stimuli that is incongruent with current schemas (Shiota et al., 2007; Valdesolo et al., 2017). If incoming sensory information matches or is consistent with existing schemas then that information is cognitively assimilated (Keltner & Haidt, 2003). During cognitive assimilation, schemas are used to interpret and filter what we perceive (McVee et al., 2005). Schemas can be defined as "unconscious mental structures organized into generic cognitive representations" based on past knowledge (Brewer & Nakamura, 1984) akin to implicit beliefs and implicit expectations (Taylor & Uchida, 2019). Or as Kant put it, possibly the first to conceptualize schemas, they "shape and are shaped by experience" (McVee et al., 2005). Schemas then can also be thought of as a frame of reference or a mode of attention which shapes and structures one's thoughts and perception. If information cannot be adequately comprehended from the lens of schemas, then schemas are violated, and past knowledge structures need to be refined (cognitive accommodation).

It has been pointed out that cognitive accommodation aligns with or coincides with bottom-up processing (Taylor & Uchida, 2019); when encountering information that is incongruent with schemas, more attention is allocated towards the schema incongruent stimuli to facilitate schema revision. Top-down schema driven processing is no longer sufficient to make sense of the unexpected stimuli, and if this is dialed down then bottom-up processing is presumably increased. Of import is that vast stimuli are thought to evoke a *need* for cognitive accommodation, therefore an experience of awe does not mean that accommodation will be successful (Keltner & Haidt, 2003). Rather, vast stimuli are difficult or impossible to assimilate into ordinary schemas, accounting for that "mind blowing" aspect of awe. The valence of awe is likely partly determined by how difficult accommodation is or whether it is successful (Keltner & Haidt, 2003). The extent of bottom-up processing should influence whether schema revision

or accommodation is achieved, and so a need for cognitive accommodation should attenuate top-down schema processing to increase bottom-up attention, but this may not always be the case. The relationship between bottom-up and top-down processing as well as the overlap between awe and bottom-up processing will be discussed in greater detail later.

There may also be different types of schema violation or schema incongruence that influence the valence of awe. Although this is often not explicitly stated, much of the awe literature talks about schema violation (e.g., Chirico et al., 2018; Keltner & Haidt, 2003; Gordon et al., 2017; Stellar et al., 2018) as well as schema expansion (Negami, 2020; Shiota et al., 2007; Taylor & Uchida, 2019). The difference may be that the former contradicts schemas including explicit assumptions whereas the latter builds upon or strengthens schemas in unexpected ways. Both deviate from the original schema however having a schema challenged or contradicted may induce more negative affect than having a schema reaffirmed or expanded in some capacity. For example, Taylor & Uchida (2019) delineate two types of schema incongruence (instances where stimuli cannot be assimilated into schemas): vastness and extremity. Within this framework, vastness is thought to reflect a "spatial or conceptual expansiveness" such that expectations related to scale or magnitude (Taylor & Uchida, 2019) which deviates from a person's ordinary frame of reference by definition (Shiota et al., 2007). If one encounters a waterfall that exceeds the size of previous waterfalls they have seen, their worldview or a "core schema" has not been violated which corresponds to a schema incongruence of extremity. It may be possible for vast stimuli to alter one's core schema (e.g., the "overview effect"; Kahn & Cargile, 2021) and so there may be different types of vast stimuli that prompt schema violation that undermines one's worldview or schema expansion. The former may be associated with a more negative valence of awe whereas the latter may be associated with a more positive valence (Negami, 2020).

Negative Awe

An experience of awe can be infused with positive affect (positive awe), negative affect (negative or threat-based awe), or a blend of the two (sometimes called ambiguous awe; Gordon et al., 2017). Both valences of awe are elicited by vast stimuli that prompts a need for cognitive accommodation, however negative awe also triggers fear and anxiety, at least partly explaining why positive and negative awe activate different neural networks (Gordon et al., 2017; Guan et al., 2019b; Takano & Nomura, 2020). Some elicitors of negative awe include natural disasters, oppressive leaders, contemplating unsettling truths like the fragility of existence, or a collective threat like a pandemic (Gordon et al., 2017; Keltner & Haidt, 2003; Sun et al., 2021; Taylor & Uchida, 2019).

While the type of elicitor largely determines the valence of awe, individual differences are another pertinent factor. Specifically, those with a lower tolerance of uncertainty (more uncomfortable with uncertainty) or a higher need for cognitive closure are more prone to negative awe given that schema violation is associated with feelings of confusion and uncertainty (Gordon et al., 2017; Valdesolo & Graham, 2014; Valdesolo et al., 2017). Negative awe is also similar to horror in that both are emotional reactions to schema incongruence. Unlike negative awe, experiences of horror follow from greater schema incongruence (extremity or core schema violations as opposed to vastness) and elicits more fear as it is a response to an immediate threat (Taylor & Uchida, 2019). Presumably, vast stimuli that pose a real immediate threat may elicit too much fear impeding feelings of awe as one would have to attend to and engage with vast stimuli to feel awe as opposed to fleeing from it out of fear or horror.

Dispositional Awe

There are individual differences regarding people's proclivity for experiencing positive awe- called dispositional (positive)- and for experiencing negative awe- called dispositional negative awe. Individuals higher in dispositional positive awe tend to seek out physical awe elicitors of awe (e.g., nature) while also being more likely to feel awe (or a stronger intensity of awe) when exposed to an awe elicitor (Shiota et al., 2007). Dispositional positive awe has been correlated with openness to experience (Nakayama et al., 2020; Shiota et al., 2007), curiosity (Anderson et al., 2020), extraversion (Dong & Ni, 2020), and brain regions responsible for detecting incongruity (Guan et al., 2018). Presumably, curious and open-minded individuals would be more inclined to seek out and notice incongruities or aspects of the world that cannot be immediately comprehended, which can elicit awe. Indeed, one study found that openness to experience was a better predictor of (positive) awe proneness than extraversion despite past findings that extraversion reliably predicts the tendency to experience positive emotion (Silvia et al., 2015). Conversely, dispositional negative awe was negatively correlated with openness to experience and extraversion while being positively correlated with neuroticism (Nakayama et al., 2020). Dispositional positive awe was also associated with a low need for cognitive closure (Shiota et al., 2006) suggesting individuals prone to feeling positive awe are more comfortable with uncertainty which helps explain why they are more inclined to seek experiences of awe.

Cultural Differences

Awe research has documented some differences in awe proneness between western and eastern cultures. Specifically, North Americans are more likely to report feeling positive awe from physical elicitors (e.g., nature) whereas many Eastern cultures are more likely to report

feeling negative awe from social elicitors (e.g., people with prestige, people who demonstrate great virtue, or people with extraordinary competence or mastery at something; Bai et al., 2017; Chen, 2020; Nakayama et al., 2020). This cultural difference is also reflected to some degree in the two measures of dispositional awe (positive and negative). The awe subscale of the Dispositional Positive Emotions Scale (DPES; Shiota et al., 2006) which is frequently used to measure dispositional awe, focuses on physical elicitors (e.g., "I have many opportunities to see the beauty of nature"), and is typically used amongst WEIRD (western, educated, industrialized, rich, democratic) samples. On the other hand, the awe subscale of the Trait Respect-Related Emotions Scale (TRRES; Muto, 2016) validated on a Japanese sample, measures dispositional negative awe from mostly social elicitors (e.g., "When I meet people who have some overwhelming ability or talent, I often feel weak with fear or intimidation"). North Americans are also more likely to feel awe from their own accomplishments compared to Chinese participants (Bai et al., 2017). Despite these cultural differences, aspects of elicited awe such as perceived vastness, a need for cognitive accommodation, and self-diminishment remain prevalent across cultures (Bai et al., 2017).

Other Features of Awe

Although perceived vastness and cognitive accommodation may be the necessary elements for the prototypical awe experience, the literature has identified other features for a broader range of awe experiences. This is succinctly depicted in the "Awe Experience Scale" (AWE-S; Yaden et al., 2019) — a novel measurement of positive awe. The AWE-S outlines six separate components of the experience of positive awe: perceived vastness, cognitive accommodation, self-diminishment, time dilation (although this has recently been challenged by van Elk & Rotteveel, 2020), connectedness (with the world and others), and physical sensations

(e.g., chills or goosebumps). Regarding experiences of negative awe, other researchers identify four key components: perceived vastness, a need for cognitive accommodation, self-diminishment, physical sensations, and feelings of oppression rather than connectedness (Krenzer et al., 2020; Krogh-Jespersen et al., 2020). Indeed, a study at a museum found that reports of negative awe had high feelings of oppression and low feelings of connection (Krogh-Jespersen et al., 2020). This suggests that connectedness may be largely driving the positive affect associated with positive awe, whereas feelings of confinement or oppression are what largely colour the negative valence of awe.

Self-diminishment and Connectedness

Although self-diminishment was not identified as one of the prerequisites for the prototypical experience of awe, there is a cogent theoretical and empirical basis for suspecting that self-diminishment is a core feature of the prototypical awe experience. Self-diminishment has been frequently reported following experiences of both positive and negative awe (Piff et al., 2015; Yaden et al., 2019), it is found across cultures, and it may have a wide range of behavioural implications (Bai et al., 2017). For example, individuals tend to underestimate their body size after experiencing both valences of awe (Negami, 2020; van Elk et al., 2016). Induced awe also led to increased identification with a rubber hand in a rubber hand experiment suggesting that awe can weaken a sense of body ownership as identifying with a rubber hand presumably requires one to feel less ownership over their actual hand (Takano & Nomura, 2021). However, a more extreme degree of weakened body ownership may result in less identification with one's hand *and* the rubber hand which may be emblematic of a vast self or a significantly reduced saliency of the self which more extreme awe experiences can certainly elicit. Perceived vastness is often a key contributor to this self-diminishment or reduced saliency of the self, as

people tend to feel smaller in comparison to something grand or vast (Negami, 2020; Piff et al., 2015). Indeed, some research indicates that the feeling of a small self has a perceptual component, which may be caused by stimuli that are physically large and vast (Price et al., 2021). Indeed, a recent awe scale even conceptualizes vastness and the feeling of a small in the same facet (Krezner et al., 2018). Encountering large stimuli expands or exceeds a person's usual frame of reference, or their ordinary schemas, and so vastness often prompts a need for cognitive accommodation (Bai et al., 2017; Shiota et al., 2007; Taylor & Uchida, 2019). It would also seem that schema violation and the process of cognitive accommodation means that one has to shift attention outward away from internal self related processing. Both antecedents of the prototypical awe experience— perceived vastness and a need for cognitive accommodation— seem highly conducive for fostering self diminishment. Unsurprisingly then, many regard self-diminishment as an integral feature of awe experiences (Bai et al., 2017; Piff et al., 2015; Yaden et al., 2019).

Self-diminishment is often referred to as the feeling of a "small self". These terms however are used to describe both the sense of feeling physically smaller (e.g., "I felt physically smaller" from the situational awe scale measuring a small self in a vast world, Krezner, 2018) and the reduced saliency of the self (e.g., "I felt that my sense of self was diminished" from the AWE-S; Yaden et al., 2018). There is often not an explicit distinction made between the salience of the self (the spectrum of ego dissolution to a hyperegoic state) and the perceived size of oneself; oftentimes a "small self" and self-diminishment are used interchangeably. Such a distinction was drawn by Shiota and colleagues (2007) when reporting that experiences of awe are associated with "a sense of smallness of the self…as well as some disengagement from awareness of the self". Although reporting that one's sense of self has shrunk seems similar to

reporting that one's sense of self is less salient, conflating the two can blur real distinctions, such as the difference between a "small self" and a "vast self".

A sense of extreme connectedness largely overlaps with feelings of a "vast self". This can be conceptualized as a unitive experience— a feeling of oneness with the environment such that one no longer feels like a separate subject from the world (Weger & Wagemann, 2018). A vast self does not mean that one's *ordinary* sense has expanded. Indeed, extreme feelings of connectedness are a common marker of psychedelic or mystical experiences which correlates with ego dissolution, the feeling that the self or ego has dissipated (Carhart-Harris et al., 2018). Therefore, a vast self or a unitive experience implies that one's ego or ordinary sense of self vanishes, leaving a sense of oneness with the world. In other words, a vast self is contingent on self-diminishment (as defined as ego dissolution), which is an entirely separate subjective phenomenon from a small self (as defined as feeling physically smaller).

Distinguishing between the salience of the self from a small self as opposed to labeling them both instances of self-diminishment helps make sense of different kinds of awe experiences. For example, one could feel physically small in comparison to looking up at tall trees, yet the salience of their small self could still be intact wherein they feel separate from the trees. In contrast, it is also possible to look up at tall trees and feel a sense of oneness (a vast self) such that one does not feel like a separate subject but feels like the trees and the world around them is temporarily a part of their "self". It may not make sense to talk about the perceived physical size of oneself during experiences of extreme connectedness as one's sense of body ownership presumably dissipates, however during feelings of hyperegoic activity it may be possible to feel physically small or physically large. Distinguishing between the felt size of the self and the salience of the self or ego also helps differentiate between positive and negative awe.

As mentioned, negative awe induces a feeling of oppression rather than connectedness which makes sense given that a vast self and feeling oppressed must be incompatible. Feeling oppressed requires the standard subject/object distinction— the subject feels oppressed by an object. Feeling oppressed then seems commensurate to a small self that is also salient which should not be possible if there were no difference between the salience of the self and the felt size of the self in comparison to the world.

Given that connectedness and oppression are antithetical, it seems that a vast self is more likely to arise during experiences of positive awe while a small self can be present with either valence of awe. In other words, it's possible to feel a sense of union with nature (connectedness) or to feel small in comparison to nature (small self) which can both be pleasant experiences, although feeling small can also be uncomfortable. The experience of a vast self can still be unpleasant or even terrifying at its most extreme such as with complete ego dissolution from psychedelics (Carhart-Harris et al., 2018). However, it seems reasonable to regard connectedness as typically positive during awe experiences given that this is in line with past research that also finds oppression— the opposite of connectedness— to be associated with negative affect (Krezner et al., 2021).

Neural Correlates of Awe

As mentioned, an experience of awe ranges from a negative to a positive valence and individuals have varying proclivities for experiencing both types of awe. This means there are at least four ways of testing awe— elicited positive awe, elicited negative awe, dispositional (positive) awe, and dispositional negative awe. Although there have not been many

investigations of the neural basis of each of these types of awe, there is an empirical and theoretical basis for suspecting that the brain's default mode network (DMN) is highly relevant.

The Default Mode Network

The DMN is a central hub of dense subsystems that uses more metabolic resources than any other neural network (Carhart-Harris et al., 2014; Raichle, 2015). Some key brain regions in the DMN include the posterior cingulate cortex, medial prefrontal cortex, ventral medial prefrontal cortex, adjacent precuneus, and lateral parietal cortex (Raichle, 2015). It is a domain general module with the largest amount of functional connectivity of any brain network and has even been referred to as the "conductor of global brain function" (Barrett, 2017; Carhart-Harris-2014). The DMN is categorized as an intrinsic mode network and a task negative network as it tends to be active during rest states (when the brain is supposedly in a default setting) in the absence of any cognitive or goal directed task (Chiesa et al., 2012; Mars et al., 2012). The DMN may still be active during the completion of tasks requiring low cognitive effort (Weber et al., 2021) and can disrupt task performance when task positive networks are online (Wen et al., 2013). Activity in the DMN has been associated with a myriad of spontaneous stimulus-independent thought such as autobiographical memory, introspection, self-awareness, emotional processing and regulation, planning, mind wandering, mental time travel, recalling past events, metacognition, and possibly theory of mind (Andrews-Hanna et al., 2010; Carhart-Harris et al., 2014; Davey et al., 2016; Raichle, 2015; Sheline et al., 2009). A review delineates three related but separate functions of the DMN: emotional processing, self-referential processing, and recalling past experiences (Raichle, 2015) however accumulating research suggests that the DMN mostly corresponds to self-referential processing (Andrews-Hanna et al., 2010; Davey et al., 2016). Many regions of the DMN have significantly expanded in our evolutionary history

and the DMN is more developed in adulthood with less functional connectivity in childhood, late adulthood, and especially in other animals like dogs (Carhart-Harris et al., 2014; Kyathanahally et al., 2015).

In contrast to the DMN is a domain general task positive network recently called the extrinsic mode network (EMN) (Hugdahl et al., 2019). The DMN is frequently inversely correlated with the EMN. While the DMN is associated with low environmental demands the EMN is often activated as environmental demands increase (Hugdahl et al., 2019; Weber et al., 2021). Domain specific networks like the salience network and attention networks (both typically classified as task positive networks) likely influence the activation of both networks as they may help with the detection of environmental demands (Hugdahl et al., 2019).

Awe and the Default Mode Network

Recent research has discovered that the DMN is less active during experiences of awe (van Elk et al., 2019). This is consistent with the common feeling of self-diminishment from experiences of awe as the DMN largely undergirds one's sense of self. Another study while not focusing on the default mode network found that the deactivation of the middle temporal gyrus (MTG) was common during experiences of positive and negative awe in comparison to other mental states (Takano & Nomura, 2020). The MTG may be implicated in matching schemas to environmental input, therefore less activity in this brain region may signal reduced cognitive assimilation, consistent with current theorizing on awe (Guan et al., 2018; Takano & Nomura, 2020). Consistent with this finding, a neuroimaging study found that individuals with higher dispositional awe scores had reduced volume in the MTG suggesting that at default these individuals rely less on cognitive assimilation (or schema driven processing) when attending to

the world (Guan et al., 2018). Interestingly, the MTG is part of the DMN and intersects with dorsal attention and frontoparietal networks which are both implicated in attention (Zhang et al., 2019). This suggests that part of the DMN may be associated with cognitive assimilation or schema driven processing.

Dispositional awe and elicited positive awe were both correlated with brain regions that are associated with emotional reward processing (Guan et al., 2018; Takano & Nomura, 2020). This suggests that part of the DMN (specifically the PCC) may be more active during elicited positive awe, but regions associated with self-referential processing are likely attenuated (Pelowski et al., 2017; van Elk et al., 2019). This may be related to research finding increased activity of parts of the DMN associated with emotional processing during the experience of "being moved" by art (Vessel et al., 2012). The authors attributed this as the art resonating with a person's self-concept (Vessel et al., 2012). In contrast to positive awe, elicited negative awe showed greater amygdala activity which may highlight the additional fear and salience from elicitors of negative awe (Guan et al., 2018). Experiences of negative awe also showed greater reduction in MTG which may signify greater schema violation from reduced reliance on schemas (Guan et al., 2018). While not explicitly studying awe experiences, viewing sublime landscapes (which were presumably spatially vast) attenuated parts of the DMN (the MPFC and ACC) while activating brain regions associated with novelty processing and schema revision such as the hippocampus and the frontal gyri (Pelowski et al., 2017).

The association between experiences of awe and the downregulation of the DMN is consistent with the self-diminishment component of awe. Given the previous distinction made between how salient the self is and how physically large the self feels, the DMN seems to be more associated with the former. Self-referential likely buttresses a sense of self. Feeling

physically small or physically large are both types of self-referential processing— they are concerned about the size of the self. Therefore, self-diminishment as a reduced saliency of the self should correspond with less activity in the DMN but feeling physically small on its own may not predict less activity in the DMN. Accordingly, then, negative awe marked by increased feelings of oppression (feeling small and confined) may represent an experience of awe that is not associated with less activity in the DMN, however the DMN is composed of multiple substrates further complicating the relationship between awe and the DMN. Nonetheless, it seems reasonable (empirically and theoretically) to suspect that experiences of positive awe with a reduced saliency of the self should correspond to an overall weakened DMN.

Awe and Prosocial Behavior

The self-diminishing feature of elicited awe helps explain observations of prosocial behaviours that follow from awe experiences (Bai et al., 2017; Perlin et al., 2020). Induced positive awe has been found to increase generosity (Stellar et al., 2017; Bai et al., 2017), willingness to volunteer (Guan et al., 2019a), helping behaviour (Piff et al., 2015), and reduce selfish and materialistic motivations (Jiang et al., 2018). Awe's facilitation of prosocial behavior is commonly thought to be mediated by self-diminishment (Bai et al., 2017; Stellar et al., 2018). After experiencing self-diminishment, individuals presumably think less about their own concerns and shift more of their focus on the interests of others.

However, one study inducing awe with virtual reality found mixed effects on prosociality and found that the positive valence of awe may be a better mediator of prosociality than self-diminishment (Kahn & Cargile, 2021). Yet prosocial behaviours have also been observed after people witnessed natural disasters (Guan et al., 2019a; Oishi et al., 2017; Septianto et al., 2021;

Uchida et al., 2014) — a common trigger of negative awe, suggesting that it's more than the positive valence of awe that leads to prosocial behaviour. Self-diminishment is a good candidate for awe's prosical function, however cognitive accommodation and connectedness may also be relevant. Feeling connected to others may increase empathy (Blatchford et al., 2021) or enhance feelings of closeness, both of which may mediate the relationship between connectedness and prosociality. Elicited awe may also broaden a person's typical egocentric priorities by having their usual frame of reference exceeded. This is captured well in an item from the small self state questionnaire: "In the grand scheme of things, my own issues and concerns did not matter as much" (Piff et al., 2015). Experiencing awe may be one such way of realizing the grand scheme of things or the larger network of people one is embedded, consistent with the overview effect astronauts experience when viewing Earth (Kahn & Cargile, 2021). This transcendent experience of awe can motivate many people to act less selfishly, although it does not seem obvious why this is so. Realizing that the self is just one entity amongst a vast number of other beings could also induce feelings of greater competition, therefore fostering an impetus for more selfish behavior.

It is interesting that an attenuation of the DMN may mediate altruistic behavior given that the DMN partly underlies social cognition (Mars et al., 2012). One might expect that being motivated to engage in more prosocial behavior depends on some kind of social cognition. Ordinary social cognition however likely depends on self/other distinctions, such that one still feels separate from other agents presumably from self-referential processing. Down regulating activity in the DMN may therefore extinguish this feeling of separateness (bolstering feelings of connectedness) which can increase the likelihood of altruistic behavior. The connectedness aspect of awe (along with self-diminishment) may be the most germane. According to

relationship regulation theory, Rai and Fiske (2011) propose that humans are motivated to form four distinct types of relationships, one of these being communal sharing relationships. These relationships are characterized by a sense of oneness and unity with one's group. A feeling of being moved or touched called "kama muta", a similar feeling to awe, is hypothesized to arise when one feels a sense of unity with other people, animals, nature, the cosmos, or even a deity (Petersen et al., 2019). Experiences of awe with high levels of connectedness (which may be contingent on self-diminishment as ego dissolution) may be similar or even a manifestation of this motivation for unity. Therefore, experiences of awe with high levels of connectedness may facilitate prosocial behavior only in the context of forming communal sharing relationships. Negative awe with feelings of oppression however may facilitate deference to high ranked individuals (an "authority ranking" based relationship, not communal sharing), therefore the type of awe experience may be relevant for predicting the type of prosocial behavior following from awe. Prosocial behavior could occur in the context of communal relationships (perhaps by feelings of connectedness) or in the context of authority ranking relationships (from an oppressive primordial awe).

For these reasons, many researchers categorize awe as a prosocial, collective, moral, elevated interpersonal, or self-transcendent emotion (Bai et al., 2017; Chen & Mongrain, 2020; Guan et al., 2018; Keltner & Haidt, 2003; Piff et al., 2015; Piff & Keltner, 2015; Silva et al., 2015; Yaden et al., 2017). Although some possible explanations were offered as for how awe can facilitate prosocial behaviour, the theoretical case has been lacking— why would an emotional response to perceived vastness that prompts a need for cognitive accommodation have evolved to foster prosocial behavior? While self-diminishment tends to yield an altruistic orientation (Yaden et al., 2017) at least in certain contexts, there are reasons to be skeptical of the claim that the

primary function of awe, or perhaps the main reason awe evolved, is to facilitate prosociality. As alluded to, there are many instances of prosocial behavior, and mental mechanisms would have likely evolved to facilitate prosocial behavior in a respective domain (e.g., familial relationships, hierarchical relationships, reciprocal relationships). Further, if awe promotes selfless behavior from an attenuation of the DMN, a domain general mechanism, this implies the DMN is primarily undergirding selfish behaviors. The DMN may be responsible for self-referential processing, but this is not necessarily selfish and socially undesirable. It would seem odd if the default mode of human beings was exploitative and uncooperating as this does not explain our daily interactions with others which require cooperation. The DMN is a domain general mechanism, therefore the activation and weakening of this network should have many implications for behavior and cognition as opposed to simply affecting how selfish one behaves. This would also imply that those with high levels of DMN activity, such as people with depression, are the least prosocial which seems doubtful. Perhaps the biggest hint of the function of awe is related to the proposed antecedent of vast stimuli- a need for cognitive accommodation.

The Case for Classifying Awe as an Epistemic Emotion

While awe is often classified as a prosocial or moral emotion, many others regard it as primarily an epistemic or knowledge-based emotion akin to surprise, curiosity, and wonder (Briñol et al., 2018; Gottlieb et al., 2018; Shiota et al., 2014; Valdesolo et al., 2017). It is theorized that these emotions are activated when incoming information is not easily comprehended and requires cognitive assimilation (surprise, curiosity, and wonder) or cognitive accommodation (awe), as the latter cannot be fully comprehended through existing schemas (Paulson et al., 2020; Valdesolo et al., 2017). According to one model, surprise follows from

something unexpected which can be immediately assimilated, as long as it does not expose a gap in one's knowledge (Valdesolo et al., 2017). If the surprising event does reveal a gap in one's knowledge, and this gap does not violate schemata, then wonder and curiosity will follow to facilitate assimilation. But if this gap in knowledge violates schemas and cannot be processed through one's current mental representations, then awe will arise to facilitate stimulus driven processing and schema revision (McPhetres, 2019; Valdesolo et al., 2017).

Awe shares many similarities with epistemic emotions. For instance, awe has a similar facial expression to surprise (Campos et al., 2013) which often entails an upward gaze and a slightly open mouth (Arcangeli et al., 2020). Awe is also frequently conflated with curiosity and wonder, and wonder is even part of the definition of awe in Merriam Webster's dictionary (Gordon et al., 2017; Weger & Wagemann, 2018). Even the dispositional awe scale includes an item about a person's tendency to feel wonder ("I feel wonder almost every day"; Shiota et al., 2006). Insofar as wonder and curiosity are attempts at assimilation after having a gap in knowledge made salient, these inquisitive states may expose another gap in knowledge that requires cognitive accommodation, therefore wonder and curiosity can invoke awe. For example, students told to observe a raisin with a mindset of wonder reported feeling awe (Weger & Wagemann, 2018) which seems to coincide with the finding that a penchant for becoming absorbed in external stimuli predicts feeling awe (van Elk et al., 2016). This also implies that schema driven processing can be inhibited by intentionally sustaining wonder and absorption which may not require a gap in one's knowledge to be made salient.

Despite similarities between awe and other epistemic emotions, it should be underscored that unlike awe, most epistemic emotions do not require cognitive accommodation. There is some evidence that suggests surprise prompts cognitive assimilation given that feelings of

surprise correlate with the activation of regions in the DMN (Brandman et al., 2020). Another difference between awe and surprise is that gaining knowledge can lead to more awe experiences, whereas gaining knowledge should make feeling surprised experiences less likely. One study found that participants reported feeling more awe from a museum if they had more knowledge about topics they encountered at the exhibits (Price et al., 2021). Accruing knowledge may help expose intellectual gaps or the inadequacy of existing schemas (Price et al., 2021) which could elicit a need for cognitive accommodation and then possibly an experience of awe. Some instances of knowledge acquisition may require building or revising schemas which may explain how induced awe facilitates learning (Price et al., 2021).

Awe's dissociation with schema driven processing may help explain many other epistemic functions that are bolstered by induced awe. For example, awe makes people less susceptible to dubious arguments by reducing reliance on heuristics (Griskevicius et al., 2010) which are often formed from past experience and therefore schemas. Relatedly, induced awe prompts creativity (Chirico et al., 2018; Danvers & Shiota et al., 2014) which may also be due to disengaging from schema driven processing to generate novel ideas that diverge from one's past experiences. Interestingly, dispositional awe predicted a greater tendency to favour scientific thinking (e.g., a willingness to regard evolution as true and creationism as false) better than openness to experience, level of education, and dispositions for other positive emotions in a series of studies (Gottlieb et al., 2018) however the conception of "scientific thinking" in this research may be politically biased towards beliefs endorsed by liberals. Unlike the majority of positive emotions, awe entails a sense of uncertainty which is similar to other positive epistemic emotions (Briñol et al., 2018; Valdesolo & Graham, 2014). This is consistent with a need for cognitive accommodation, as experiencing schema violation should cast doubt in the validity of

one's schemata, making the current experience more challenging to understand. A sense of uncertainty may also arise from other peculiar features of awe such as time dilation or self-diminishment. In fact, self-diminishment may violate schemas related to the self and time dilation may violate schemas related to the passage of time, both of which may require additional accommodation and schema revision.

Awe and Altered States of Consciousness

Just as there are parallels between awe and epistemic emotions, there are various states of consciousness that share important similarities with awe. For example, experiences of mindfulness meditation and awe have both been correlated with reduced DMN activity (Garrison et al., 2015; van Elk et al., 2016) and experienced meditators show less activation in the DMN (Brewer et al., 2011). Indeed, the goal of mindfulness meditation is often to broaden attention by reducing mind wandering, rumination, and self-referential thought (Sheldon et al., 2015). This aligns with findings suggesting that awe is marked by increased feelings of absorption as becoming absorbed in external stimuli presumably requires less attention directed towards internal processes (van Elk et al., 2016). However, the relationship between mindfulness and absorption is somewhat mixed and depends on how mindfulness is conceptualized (Leppanen & Kim, 2021). One difference between states of mindfulness and awe may be that attention is more externally oriented in experiences of awe. Awe is evoked by vast stimuli which is where attention is primarily directed. Somewhat paradoxically, focusing on vast stimuli may require a broadening of attention or an expansion of one's frame of reference, however during mindfulness attention may be broader considering that attention is also directed on various interoceptive processes like one's breathing and physical sensations. In other words, attention during awe may be more confined than during mindfulness; individuals are absorbed in vast stimuli neglecting

other stimuli during awe whereas during mindfulness one's attention is less discriminating and can subsume all kinds of stimuli (external and internal). This may imply that the DMN may be less active during experiences of awe than during states of mindfulness which also coincides with research showing that meditation is not also associated with increased bottom-up processing like awe (this will be explored later in greater detail).

Another state marked by reduced DMN activity and self-referential processing is flow (Domenico & Ryan, 2017; Ulrich et al., 2014; Yelamanchili, 2018). States of flow occur when one is highly engaged, immersed, and focused on a task (van der Linden et al., 2021). Indeed, one of the key markers of flow was originally described as a "loss of reflective self-consciousness (i.e., loss of awareness of oneself as a social actor)" (Nakamura & Csikszentmihalyi, 2014). This loss of reflective self-consciousness helps explain why states of flow are characterized by less activity in the DMN. Flow has also been described as "complete absorption in what one does" (Nakamura & Csikszentmihalyi, 2014) which is similar to feelings of heightened absorption during awe experiences. An important difference however is that flow often occurs when completing an activity whereas awe arises from passively observing vast stimuli. This may explain why time seems to pass by quickly during flow states unlike with time dilation during awe experiences (Im & Varma, 2018). Flow states are also thought to occur in a state of moderate arousal, therefore awe experiences may be associated with more arousal and physical sensations than states of flow (Nakamura & Csikszentmihalyi, 2014).

The fact that people enter flow states when concentrating on a challenging or engaging task helps explain why the central executive network (CEN) may be activated during states of flow (van der Linden et al., 2021). The CEN— a task positive network— is implicated during goal directed cognitive tasks that require working memory, switching between different task

requirements, and neglecting irrelevant information (Chiesa et al., 2013; van der Linden et al., 2021). Interestingly, the DMN and CEN are normally inversely correlated within an individual which is thought to be mediated by the salience network (Sridharan et al., 2008). It is unclear if the CEN is also more active during experiences of awe; it may be the case that additional cognitive bandwidth from the CEN is needed to accommodate schema incongruent information, however the CEN is often evoked for intentional goal directed tasks requiring working memory whereas awe is thought to arise involuntarily to vast incongruent stimuli.

Lastly and perhaps most pertinently, there is overlap between feelings of awe and psychedelic or mystic experiences. Consistent with mindfulness and flow states, activity in the DMN is also mollified during psychedelic experiences, which is marked by feelings of "ego dissolution" or a reduced saliency of the self (Pollan, 2019). The typical connection between the DMN and medial temporal lobes (MTL) is also significantly reduced in psychedelic experiences (Carhart-Harris et al., 2014). The MTL is associated with memory and includes the medial temporal gyrus (MTG) which is at least partially responsible for schema driven processing. This implies that past knowledge (i.e., schemas) is less of a guide or filter of psychedelic experiences than during normal consciousness. Unlike flow states and mindfulness, all the other aspects of awe (time dilation, connectedness, etc.) seem to be present during psychedelic experiences, perhaps in a more prolonged and amplified manner than during experiences of awe during normal consciousness. A common theme of psychedelic experiences is the reported feeling of connectedness with the world, others, and even with oneself (Carhart-Harris et al., 2018). This may be made possible by not just reducing activity in the DMN, but also by the decoupling of the DMN from the MTL. Regardless, complete ego dissolution or a vast self (not merely a small self) is correlated with connectedness or a unitive experience (Carhart-Harris et al., 2018). Ego

dissolution and connectedness may be more common (and more intense) in psychedelic experiences than during experiences of awe that are not pharmacologically induced.

The entropic brain hypothesis has been useful for explaining psychedelic experiences (Carhart-Harris et al., 2018) and may be highly applicable for understanding awe as well. According to this proposal, psychedelics increase entropy in the brain by inhibiting the DMN which normally suppresses entropy (Carhart-Harris et al., 2014). Interestingly, entropic brain states are marked by high information content and uncertainty about subsequent brain states (Carhart-Harris, 2018) which maps on very nicely with both requirements of the prototypical awe experience— perceived vastness and a need for cognitive accommodation, respectively. Vast stimuli often include stimuli that is information rich and a need for cognitive accommodation is an indicator of uncertainty. A subjective experience of uncertainty or bewilderment is different from the predictability of future brain states; however, these may overlap, if a volatile or entropic brain state would elicit a feeling of uncertainty which is expected when the DMN deactivates as the DMN likely undergirds a sense of self (Davey & Harrison, 2016). Brain states characterized by high information content may also be an indicator of increased bottom-up information flow, which corresponds to the heightened environmental sensitivity induced by psychedelics (Carhart-Harris, 2018). Under this framework, psychedelics are thought to "relax beliefs", by quieting the DMN to increase entropy and bottom-up processing as a result (Carhart-Harris & Friston, 2019). It will be argued that the function of awe similarly might involve inhibiting the DMN to maximize bottom-up information flow and facilitate schema revision when vast stimuli cannot be assimilated.

Awe and Bottom-up Processing

Bottom-up processing (sometimes called stimulus driven processing, bottom-up information flow, or bottom-up attention) refers to perception that is primarily oriented towards the processing of sensory input from environmental stimuli. In contrast, top-down (or schema driven) processing utilizes past knowledge to predict, anticipate, and make sense of our experience. Although there may be different types of top-down and bottom-up processing, top-down processing tends to be easier to control and driven by intentional goals whereas bottom-up processing is typically automatic, involuntary, driven by environmental inputs, and often occurs after a prediction error or when something unexpected happens (Chiesa et al., 2013; Pelowski et al., 2017; Rauss & Pourtois, 2013). These distinct modes of attention and information processing constantly interact with one another and work in tandem (Awh et al., 2012; Rauss & Pourtois, 2013), however the degree of top-down or bottom-up information flow does fluctuate. Two main attention mechanisms— the dorsal attention network (DAN) and the ventral attention network (VAN) have been implicated in voluntary attentional processing and the orientation towards unexpected salient stimuli, respectively (Onofrj et al., 2022). Therefore, the DAN seems to map on to top-down processing and the VAN with bottom-up processing, although this may be a simplification. Interestingly, the VAN is still sensitive to potentially relevant stimuli and later updates spatial expectations (Chica et al., 2014) which may be indicative of schema revision.

There is good reason to suspect that experiences of awe are marked by increased bottom-up information flow. After schema violation, bottom-up processing likely facilitates cognitive accommodation and schema revision, whereas cognitive assimilation likely represents a type of top-down processing (Taylor & Uchida, 2019; Valdesolo et al., 2017). Bottom-up attention is amplified when schemas fail to predict incoming sensory information, similar to schemas being

unable to accommodate external stimuli. In these instances, schemas or top-down predictions are no longer adequate to make sense of the world, therefore additional attention is allocated to raw sensory data that is not guided or filtered by schemas. Therefore, prediction error— a common antecedent of bottom-up processing— aligns with schema violation. Cognitive accommodation requires schema revision which could refer to assumptions about and the self and the world needing revision in extreme cases. Many kinds of prediction error are not contingent on those kinds of explicit beliefs being undermined; a prediction error can refer to an implicit expectation about a very narrow or specific situation that was violated. Some prediction errors can also be readily assimilated (like surprise) meaning one expectation can be violated yet more fundamental schemas can make sense of the surprising event making accommodation or schema revision unnecessary. And so, the kind of schema violations that foster awe refer to a subset of prediction errors (vast stimuli).

Although awe follows schema violations which seems akin to top-down prediction error, not all kinds of bottom-up processing are experiences of awe— only those that follow from perceived vastness. Stimuli that is not vast may still be incongruent with schemas prompting bottom-up processing, yet this type of bottom-up processing would not be classified as an awe experience (one's frame of reference may not be exceeded for example). There may also be forms of bottom-up processing that do not require prediction error, such as meditation. Nonetheless, not all kinds of bottom-up processing are emblematic of experiences of awe, yet all forms of awe may be an incidence of bottom-up processing. To borrow terminology from Arcangelia and colleagues (2020) who were trying to distinguish awe from the sublime, awe could be said to be a "species of bottom-up processing". More accurately though, all awe experiences likely dial up bottom-up attention yet there may still be a degree of top-down

processing co-occurring. Top-down processing would presumably be needed to identify schema incongruent stimuli and it may be the case that some schemata are not violated during experiences of awe which may help guide perception. Presumably top-down schema processes try to assimilate vast stimuli, as this may be the default mode of perception, and once assimilating is not possible one experiences a need for accommodation. This is presumably treated as a prediction error and prompts bottom-up stimulus driven processing.

Some research has shown partial support for experiences of awe converging with bottom-up attention. In one study, induced awe led to more stimulus driven processing of visual stimuli and the author concluded that there is partial support for the association between awe and bottom-up processing (Ihm, 2021). The reduced activity in the DMN from awe likely functions to direct attention outward on challenging and information rich stimuli that is incongruent with current schemas, consistent with bottom-up processing (Taylor & Uchida, 2019). Indeed, the DMN and EMN are anticorrelated as the EMN is related to processing environmental stimuli. As mentioned, the DMN is associated with planning and mind wandering, and so many have speculated that the DMN helps with prediction which is akin to top-down processing (Dohmatob et al., 2020). For example, experienced meditators— the most likely to disengage from self-referential thought and have reduced activity in the DMN— show more signs of bottom-up processing than novice meditators (Chiesa et al., 2012). Brain imaging research has also demonstrated that bottom-up processing is more likely to occur after activity in the DMN has been reduced (Hinz et al., 2019). The DMN is also less active when one is engaged with a cognitive task while being more active during social cognition (Mars et al., 2012). This aligns with research showing that ordinary social situations fail to elicit awe (Shiota et al., 2007). It has been found that the tendency to get absorbed in one's experience makes awe more likely to arise

(van Elk et al., 2016). This suggests that awe requires a receptive state to maximize attention on the awe-inducing stimulus which is also consistent with qualitative accounts reporting absorption, immersion, and heightened sensations as themes of awe (Bonner & Friedman, 2011; van Elk et al., 2016). Taken together, this suggests that awe may have evolved to quiet the DMN to increase stimulus driven processing which may incidentally prompt prosocial behaviour as a by-product.

Importantly, the six features of awe laid out in the AWE-S— perceived vastness, a need for cognitive accommodation, self-diminishment, connectedness, time dilation, and physical sensations— can all be construed as markers or facilitators of increased bottom-up processing. As previously discussed, stimuli that exceed one's usual frame of reference (perceived vastness) are incongruent with ordinary schemata prompting increased bottom-up information flow. The need for cognitive accommodation should also prompt bottom-up processing, not only to rely less on schema driven processing, but also to facilitate schema revision. Allocating more attentional resources towards the challenging stimulus should result in clearer and more comprehensive processing of that stimulus, and this information could help with the modification of existing schemas or with the formation of new schemas. Engaging in stimulus driven processing also weakens the DMN, presumably to direct attention away from internal processes so more attentional resources can process external stimuli. A downregulated DMN is associated with a reduced saliency of the self and likely undergirds self-diminishment. Another sign that awe maximizes stimulus driven processing is the "connectedness" aspect of awe. Feelings of connectedness are not entirely emblematic of increased prosociality given that this encompasses feeling connected to any external stimuli. Three of the five items measuring connectedness on the AWE-S are not just reserved for feeling connected to living beings, but include feeling

"connected to everything", "a sense of oneness with all things", and "a sense of complete connectedness" (Yaden et al., 2019). Connectedness may not be a necessary consequence of self-diminishment in the same way that vast stimuli exceed one's usual frame of reference leading to self-diminishment and bottom-up processing. As discussed, negative awe is characterized by oppression, not connectedness, meaning that one feels oppressed by and therefore separate to a vast stimulus. It may be the case that losing one's sense of self and connectedness are two sides of the same coin. Indeed, ego dissolution and connectedness are highly correlated in psychedelic experiences (Carhart-Harris et al., 2018), however during ordinary states of consciousness it seems possible to still maintain a sense of self while feeling connectedness (e.g., empathizing with another person). However, in instances where one has completely lost their sense of being a separate self from the world (self-diminishment), by definition they must feel immersed with the world without a any sense of division from it.

Further, time dilation and physical sensations are also indicative of increased bottom-up processing. Time dilation (i.e., the feeling that time has slowed down) is also common during experiences of psychedelics and even during accidents (Taylor, 2020). Time dilation can boost alertness (Taylor, 2020) which can be especially useful during accidents, presumably to enable one to process the dangerous situation in greater detail. Alertness or heightened awareness aligns well with bottom-up processing given that both direct attention on external stimuli rather than internal processing. Consistent with this, qualitative reports of awe experiences often mention that sensations are heightened (Bonner & Friedman, 2011). A neuroimaging study found a link between reports of awe and arousal (Vessel et al., 2012) which is also indicative of physical sensations— the last feature of awe. Bottom-up processing is harder to control than schema-driven or top-down processing, and involuntary feelings of physical sensations are often

indicative of bottom-up processing (Pelowski et al., 2017). Indeed, one neuroimaging study found that awe-eliciting images fostered physical sensations by activating the nucleus accumbens (Pelowski et al., 2017) which may be a sign of reinforcement learning. A breakdown of how the six features of positive awe could be interpreted as fulfilling an epistemic or prosocial function is summarized in Table 1.

It does seem likely that different "flavours of awe" may vary in regard to their conduciveness towards a prosocial or epistemic function. For example, feeling awe-inspired and connected to someone deeply admired is a distinct experience from feeling challenged by nature's vastness— both experiences of awe may lead to and be infused with other emotions and cognitions meaning the former could be more about strengthening relationships than learning and updating schemas. Nonetheless, if a need for cognitive accommodation and perceived vastness are the most common and foundational elements of feeling awe, then we maintain that awe is best construed as fulfilling an epistemic function.

Table 1

Construing Awe as an Epistemic and Prosocial Emotion

Feature of Awe	Potential Epistemic Function	Potential Prosocial Function
Perceived Vastness	Indicator of information rich stimuli	Large stimuli can foster self-diminishment which prompts prosociality; one feels like their concerns are more insignificant
Need for Cognitive Accommodation	Ordinary schemas or knowledge structures are inadequate to process vast stimuli, so schemas need to be augmented	Schema violation can disrupt habitual ways of thinking leading to more self-reflection and prosociality as a result

Self-diminishment	Weakened DMN aids cognitive tasks and bottom-up sensory attention which are both conducive for schema revision	Focusing less on oneself could lead to focusing more on the well-being of others; realization that one's well-being should not be privileged
Connectedness	Further indicator of stimulus driven processing; attention directed outward on sensory experience	Feeling connected to others (divide between subject and object dissipates) could foster a motivation to strengthen relationships
	A marker of increased psychological entropy akin to psychedelic experiences	Feeling connected to nature and others may be undergirded by the same feeling— a motivation for seeking communal sharing relationships
Time Dilation	Bolstered alertness and heightened awareness from sense of time slowing down facilitates bottom-up processing and therefore schema revision	People could feel like they have more time to help others
Physical Sensations	Indicator of involuntary bottom-up processing; possibly a marker of reinforcement learning	Chills and goosebumps could make experience seem more meaningful and inspiring

Notes. Much of these are functions are speculative. Although oppression from negative awe is not included, it seems to align with fear and reverence of primordial awe therefore leading to compliance and obedience to powerful leaders. The epistemic function of oppression seems unclear although negative affect during experiences of awe is partly attributable to the uncertainty of schema violation.

Evolutionary Explanations for Awe

Since the inception of awe in psychological research, it was not only theorized that awe promotes humility, but that awe's capacity to foster humility towards higher ranked individuals was the function of primordial awe (Keltner & Haidt, 2003). Displaying humility and deference towards leaders or prestigious individuals would be advantageous for those with a lower status as they could potentially gain much-needed protection and resources. This view, that awe first evolved to instill humility has been called the "social first theory" of awe, which posits that awe originally fostered humility and then later became a response to physical and cognitive elicitors

(Chirico & Yaden, 2018). If true, this theory would help buttress the classification of awe as a kind of prosocial, moral, and self-transcendental emotion.

While this theory of awe is quite common, it leaves open many questions. For instance, why was primordial awe elicited by vast social elicitors rather than vast physical or cognitive elicitors that our ancestors were also encountering? Presumably it would have taken considerable time for a response to prestigious individuals to become our response to vast natural vistas. Vast natural vistas were present at the same time as prestigious individuals meaning that people already had a disparate response to vast natural vistas while supposedly experiencing primordial awe in social settings. And so, why, or how would primordial awe become the new response to vast sceneries in nature over time? Not only did the emotional response of awe have to extend from social elicitors to a plethora of physical and cognitive elicitors, but the valence also had to change from negative to positive as people often feel positive awe from nature. This also means that awe experiences started in hierarchical relationships and then expanded to communal sharing contexts, given that positive awe contains feelings of connectedness and unity. Awe could also be felt in hierarchical relationships, but by high ranked individuals being astounded or amazed by lower ranked individuals, unlike with primordial awe. If awe was originally undergirded by a mental mechanism that is responsive to powerful leaders that creates an output of fear and reverence, then this mental mechanism would have to presumably become modified over time to produce different outputs that constitute positive awe. This seems dubious especially with recent neuroscience research that shows different brain regions implicated in negative and positive awe. More still, if awe originated as a social elicitor, then why is nature not only a widespread elicitor of awe (Bai et al., 2017), but also an even more potent elicitor of awe than social elicitors (Chirico & Yaden, 2018; Graziosi & Yaden, 2021)? Even if awe originally

evolved as an adaptive response to social elicitors like prestigious individuals, the function of awe may have been to facilitate learning and schema revision which would presumably be best accomplished through increased bottom-up attention. Not to mention, the prerequisites of the proposed prototypical awe experience suggest that awe signals a need for accommodation in certain contexts, naturally then it would seem that this emotion should facilitate accommodation and schema revision. This seems like an internal cognitive and perhaps a domain general process that could therefore have many behavioral implications, beyond prosocial behavior. It is also not obvious why other animals do not experience awe given that they arrange themselves in hierarchies just like us, which supposedly set the conditions for primordial awe. These hurdles do not necessarily imply that the social first theory is impossible, but this original social first theory of awe does seem unlikely considering these unanswered questions and concerns.

The "nature first" theory and the "prospect and refuge" theory better accounts for the ubiquity and potency of physical elicitors of awe. In this view, a sweeping vast view from a high vantage point is the prototypical elicitor of awe as it signals safety (Chirico & Yaden, 2018). This theory offers a plausible candidate for the original elicitor of awe, however it is less clear how an emotion that signals safety became implicated in response to high ranked individuals or even to music. Both approaches still struggle to explain how awe transitioned across elicitors and situations, and so a theory of awe can circumvent this by focusing on awe as a general response to vast stimuli. Indeed, evolutionary explanations for other emotions like happiness, fear, and sadness do not posit a specific scenario that first gave rise to such an emotion. Rather, an emotion like fear evolved to pique avoidance behaviour from any stimulus deemed threatening. Some emotions like disgust may have a narrower set of elicitors, however it seems unlikely that awe experiences originated from any specific elicitor given that awe arises from a vast array of

elicitors, all of which can be highly potent, dependent in large part on a person's past experience and preconceptions.

A commonality across vast stimuli— physical, social, and cognitive elicitors— is that there is high information content that exceeds a person's typical frame of reference. Schema driven processing is appropriate when predicting and encountering stimuli that we're accustomed to that is not loaded with high information content. However, when we do perceive vastness, increasing bottom-up processing may be ideal to better process the vast stimuli and revise schemas appropriately. Therefore, awe may have evolved as a mechanism to amplify bottom-up processing in response to any kind of stimuli that is perceived as salient and vast (i.e., high information content). Bottom-up processing is an old form of attention that need not be explained evolutionarily for our purposes. The kind of bottom-up processing from perceived vastness not only diminishes one's sense, but it violates schemas and requires schema revision, which is a process human brains presumably had to develop to learn more generally, therefore awe experiences make use of cognitive processes that did not evolve specifically for vast stimuli. Vast stimuli represent a class of stimuli that are probably effective at diminishing one's sense of self, exceeding our usual frame of reference which is likely cognitively demanding explaining reduced activation in the DMN, time dilation, and amazing us in an exhilarating way (for positive awe) or frightening and overwhelming us in the case of negative awe.

This view can also account for why humans are more awe prone than other animals. Other animals arrange themselves in hierarchies and do show deference to alpha males for example, yet the presence of awe in other species is not so clear. Similarly, other animals also learn and encounter vast stimuli, yet show little signs of feeling awe. According to the entropic brain hypothesis, humans underwent significant "entropy expansion", meaning our brains are

capable of creating a larger array of mental states than other animals (Carhart-Harris et al., 2014). Some research suggests that more brain entropy is related to greater intelligence (Saxe et al., 2018). To manage this great capability of entropy, a mechanism for entropy suppression developed, the DMN (Carhart-Harris et al., 2014). Entropy suppression is not always the best mode of being however, as it stifles bottom-up processing and therefore learning. Increasing bottom-up information flow is a way of increasing entropy, as mentioned earlier, psychological entropy can be defined as high information content and high uncertainty— akin to perceived vastness and schema violation. Therefore, awe experiences are emblematic of increased psychological entropy and increased bottom-up information flow.

Another possibility, that won't be explored much here, is that the emotional reaction to typical physical and social elicitors of awe are in fact different emotions. Keltner and Haidt (2003) speculated that there are "different flavours of awe" such as threat, beauty, and admiration. This raises the question of whether the awe that arises in response to physical and social elicitors, for example, are different emotions that evolved in parallel to solve different adaptive problems but are still classified under the same emotion label. It may also be possible that positive and negative awe are better distinguished as two different emotions. They are often triggered by different elicitors (physical elicitors tend to evoke positive awe and social elicitors tend to evoke negative awe) and they are underpinned by different neural mechanisms and dispositions as previously discussed. Nonetheless, both valences of awe and various elicitors of awe all seem contingent on perceived vastness and a need for cognitive accommodation.

Given that the myriad of effects from awe aid epistemic functions and promote helping behaviours, there has been no unanimous classification of awe as primarily an epistemic or a prosocial emotion. Based on the empirical data reviewed above along with the impressive

overlap between the six components of positive awe and bottom-up processing, this paper will assume that awe is best classified as an epistemic emotion that gives rise to prosocial benefits as a by-product of its epistemic bottom-up processing function. Quieting the DMN may mark a shift from typical schema driven processing to bottom-up processing yet reducing activity in the DMN could inadvertently produce prosocial effects. Although the DMN contains multiple substrates and is regarded as a domain general mechanism (Barrett et al., 2016), one of the functions of the DMN and social cognition might be convincing others of one's benevolence and effectiveness (sometimes called "beneffectiveness"; Kurzban, 2011; Wright, 2017). Therefore, it may be possible that less activity in the DMN increases receptivity to others as attention is directed outwards which can increase the probability of engaging in prosocial behaviours.

The evolutionary function of the DMN is not fully settled, however it does seem clear that this network comes online during predictable situations with low environmental and cognitive demands. The DMN is unsurprisingly then, associated with more automatic behavior—in the absence of anything new or challenging, it is safer to act on "autopilot". The DMN has also been proposed to reduce entropy as defined as increased information content and uncertainty. This less entropic default state of consciousness may be less metabolically consuming and allow for increased internal processing like metacognition which is not risky in safe and predictable environments where one can rely on habitual behaviors. If the DMN suppresses uncertainty, then it may also dampen bottom-up processing as allocating attention to the external environment can inundate one with sensory input and consequently undermine a sense of agency or control, which can induce anxiety (another entropy signal). Entropy suppression then seems conducive for energy conservation and even reality testing (Carhart-Harris et al., 2014). Vast stimuli that require cognitive accommodation to fully process signifies

new and challenging stimuli as well as a cognitive environmental demand, hence why the DMN might become less active during experiences of awe.

If the primary function of awe is prosocial, one would expect that the six features of positive awe would in some way, facilitate or be reflective of a prosocial function. Although the six features of positive awe could be foster prosociality in some way, it seems that these six features are more pertinent for bottom-up or stimulus-driven processing, suggesting awe evolved to solve a primarily epistemic operation. This is consistent with the notion in evolutionary psychology that emotions coordinate psychological mechanisms by inhibiting certain modules in the brain and activating others to solve a recurrent adaptive problem (Cosmides & Tooby, 2000). Processing information rich stimuli that are incongruent with schemas would have likely been a recurrent problem faced by our ancestors, however it is not entirely clear what the cost of failing to accommodate schema violating stimuli would entail, which would be necessary for establishing awe as an emotion that facilitates bottom-up processing. It is worth underscoring that this paper is not suggesting that all experiences of bottom-up processing are experiences of awe, however it seems plausible that all experiences of awe require some form of bottom-up processing. Therefore, there may not exist a specific mechanism dedicated to the facilitation of awe experiences; rather general attention mechanisms may make awe experiences possible.

Further, if awe did evolve to address a strictly social function like deference to leaders, then this would have to account for the epistemic functions documented from elicited awe such as increased creativity and learning. One might argue that the increased humility and awareness of one's limitations facilitates epistemic functions— feeling inferior should make one more open to learning and perhaps to divergent thinking (creativity) to potentially aid problem solving. The awareness of one's limitations coincides with schema violation which can occur in many

contexts from a plethora of stimuli that need not be vast or information dense. Therefore, schema violation in a social context from a powerful leader may be more likely to yield prosocial effects like deference, however the underlying goal of any type of schema violation is schema revision. This general process of cognitive accommodation that is facilitated by bottom-up processing suggests that awe and the process of cognitive accommodation from vast stimuli supports a fundamentally cognitive role of schema revision. Although schema violation from physical elicitors may still lead to prosocial behavior, this can be explained as a by-product of bottom-up processing that reduces self-referential processing.

This paper will adopt the perspective that awe, in all its flavours, evolved to maximize bottom-up processing to accommodate vast schema incongruent stimuli by reducing entropy suppression from the DMN. Awe then is a mechanism for attenuating the DMN to disengage from schema processing to direct attention outward. Vast information rich stimuli may be appraised as salient thereby activating the SN which may mollify the DMN. Bottom-up information flow is useful when stimuli cannot be assimilated into current schemas; when current schemas cannot be relied on to construe environmental input, increasing attentional resources to the vast and challenging stimuli should facilitate the comprehension and processing of such stimuli. This increased processing of external stimuli should be useful for the construction or revision of schemas. It may be the case that extreme experiences of awe are marked by schema violation, making schema revision more necessary— reducing future prediction error should be advantageous for successful planning and for pursuing one's goals. However, encountering vast or information stimuli may not prompt bottom-up processing due to prediction error or schema violation, but perhaps because increasing bottom-up information flow ensures more holistic or accurate processing of vast stimuli. Therefore, schema revision may not

be crucial in those instances, rather dialing down schema driven processing is an optimal mode of information processing when faced with high information content. Whether some sort of schema revision must follow bottom-up processing from vast stimuli is an open question, yet the point remains that in an ordered brain that normally suppresses entropy and bottom-up processing, there should be mechanisms to reduce entropy suppression to adequately process information that exceeds our accustomed frame of reference.

If this description of awe is accurate, then awe is best construed as primarily an epistemic emotion that has prosocial by-products. DMN attenuation or self-diminishment during awe experiences did not evolve to foster deference, but rather to increase bottom-up information flow for the processing of vast stimuli that is incongruent with ordinary schemata. This has implications for what the relationship between awe and different domains of humility might look like. Before reviewing research investigating the relationship between awe and humility, domains of humility will be discussed.

Humility

As with psychological research on awe, psychological investigations of humility have been underway for approximately two decades. While there is no agreed-upon definition of (general) humility (Weidman et al., 2018) there are several common themes. Humility is often conceptualized as a virtuous trait that lies in between arrogance and diffidence (Church & Barrett, 2016; Haggard et al., 2018). This is consistent with the notion that a humble person would have an accurate self-concept as self-aggrandization and self-deprecation should often rely on distorted self-concepts (Davis et al., 2016a; Van Tongeren et al., 2019). A common elicitor or opportunity for one to express humility is following a perceived success or

accomplishment, and so humility is thought to involve a lack of egotism and hubristic pride about their accomplishments (Weidman et al., 2018). Humility has also been posited as requiring a "low self-focus" or a "hypoegoic state", suggesting that humbler individuals don't think about themselves often and instead have a more outward focus that prioritizes and/or appreciates the contributions of others (Krumrei-Mancuso & Rouse, 2016; Kruse et al., 2014; Van Tongeren et al., 2019; Wright et al., 2018). This conception of humility then is often regarded as socially desirable given that it is prosocial (e.g., appreciating others, presumably less selfish inclinations from having a more outward focus) and rests on an accurate view of the self, which people may find appealing for themselves and those around them. This prosocial and appreciative conceptualization of humility dominates much of the literature and has been associated with empathy, Big 5 agreeableness, and Big 5 openness to experience (Kähli, 2021; McElroy-Heltzel et al., 2019; Weidman et al., 2018).

Domains of Humility

In the same way that researchers distinguish between elicited and dispositional awe, humility has also been parsed as a temporary mental state (state humility) and as an enduring trait (trait humility). It is often accepted within the humility literature that there are different domains of humility (McElroy-Heltzel et al., 2019) which can each be described as a state or a trait. However, it is not entirely clear if these domains are all manifestations of the same general disposition (often called "general humility") or if these reflect different types of humility, presumably undergirded by disparate mental mechanisms and traits. General humility has been construed as maintaining an accurate self-concept while lacking feelings of superiority (Davis et al., 2016a) as well as having a low self-focus (Stellar et al., 2018; Wright et al., 2018) both of which could occur in a variety of contexts. The latter view is supported by factor analyses of

domains of humility that distinguish general humility from both modesty and intellectual humility (Davis et al., 2016a; Davis et al., 2016b). However, a critical review of 22 humility measures reveals that modesty correlates quite well with general humility such that the authors recommend incorporating modesty into the general conception of humility (McElroy-Heltzel et al., 2019). There are novel types of humility that have yet to be tested in factor analyses which will be discussed below.

HEXACO Humility

Perhaps the most studied variant of humility that is supported cross-culturally is the Honesty-Humility dimension of the HEXACO personality model (Lee & Ashton, 2018). The most germane facet that reflects humility is arguably modesty, given modesty's correlation with general humility (McElroy-Heltzel et al., 2019). This is also echoed in Leary and Banker's (2019) definition of humility as the disinclination to regard oneself as superior and entitled to special treatment irrespective of one's accomplishments or status. Unsurprisingly, this lines up quite nicely with the modesty facet from the Honesty-Humility dimension (e.g., "I sometimes feel I am entitled to more respect and authority than the average person"; Lee & Ashton, 2018) which is reverse scored, and quite similar to the Brief State Humility Scale (BSHS; Kruse et al., 2017; e.g., "I feel that I do not deserve more respect than other people."). This disclination to regard oneself as superior is similar to cultural humility— the tendency to avoid viewing one's own culture as dominant or superior to other cultures (McElroy-Heltzer et al., 2018). Some humility researchers object that humility is different from modesty although being very similar (Weidman et al., 2018). This study will treat modesty as a domain of humility, given that it belongs to the Honesty-Humility dimension of the HEXACO, shares conceptual commonalities with general humility, and has been recommended as a suitable proxy for general humility

(McElroy-Heltzel et al., 2019). It could also be argued then that modesty aligns with general humility, however some research castes doubt on this assertion (Davis et al., 2016a) as general humility is theorized to encompass additional features, like an accurate assessment of one's strengths and weaknesses or a low self-focus.

Intellectual Humility

Individuals can also demonstrate humility by recognizing their intellectual limitations. This has been referred to as "intellectual humility". Intellectual humility could vary across intellectual domains as well; the same person can be reluctant to admit gaps in their political knowledge and yet they may have no problem admitting the limits of their scientific knowledge for example (Haggard et al., 2018). There is, however, disagreement surrounding how exactly intellectual humility is best construed as there are multiple intellectual humility models with similar but varying facets. Depending on the construal, intellectual humility can encompass the disinclination to privilege one's own ideas over others (Gregg & Mahadevan, 2014), an adaptive midpoint between intellectual arrogance and diffidence (Church & Barrett, 2016; Haggard et al., 2018; Leary et al., 2018), the ability to negotiate ideas fairly (Davis et al., 2016), or the openness to revise one's viewpoints and respecting viewpoints from others (Krumrei-Mancuso & Rouse, 2016).

One theme across various conceptions of intellectual humility is that it requires a non-threatening awareness or acknowledgment of one's intellectual fallibility (Haggard et al., 2018; Krumrei-Mancuso & Rouse, 2016). In other words, the intellectually humble person can admit their intellectual fallibility without feeling uncomfortable or threatened. This is similar to the notion that general humility requires an accurate self-concept, or an accurate view of one's

strengths and weaknesses. In the case of intellectual humility, one has an accurate view of their intellectual limitations rather than underestimating or overestimating the breadth and accuracy of their knowledge (avoiding intellectual servility and intellectual arrogance). General humility also tends to require a low self-focus which aligns with some aspects of intellectual humility that have been proposed such as the independence between the intellect and ego (Krumrei-Mancuso & Rouse, 2016), low concern for intellectual status (Church & Barrett, 2016), and possibly lacking intellectual arrogance or diffidence (Haggard et al., 2018) assuming that arrogance and diffidence are both marked by a high self-focus. However, the common denominator of intellectual humility is likely not a low self-focus, but rather the awareness of one's intellectual limitations.

The "limitations owning" conception of intellectual humility by Haggard and colleagues (2018) captures two elements of this awareness of one's intellectual limitations— how readily one acknowledges their limitations and how comfortable one feels admitting their intellectual limitations. These makes up the "limitations owning" facet and the "appropriate discomfort of intellectual limitations" facet respectively. The third facet is a "love of learning". Another advantage of this model is that intellectual humility is not equated with intellectual diffidence which is in keeping with a common view of humility as requiring a balanced and accurate view of oneself (or of one's intellectual limitations in the case of intellectual humility). Although other models of intellectual humility also distinguish intellectual diffidence from the more adaptive intellectual humility, the limitations owning intellectual humility scale does not heavily overlap with open mindedness (the ability to change one's position) and also captures a general proclivity to obtain knowledge (the love of learning facet; Haggard et al., 2018).

While most "appreciative" forms of humility correlate with agreeableness, intellectual humility is better predicted by other measures, like cognitive flexibility and intelligence. Cognitive flexibility and intelligence represent distinct pathways for facilitating intellectual humility (Zmigrod et al., 2019). Interestingly, high intelligence coupled with high cognitive flexibility doesn't seem to provide significant gains in intellectual humility (Zmigrod et al., 2019). Intellectual humility has also been predicted from levels of curiosity (Krumrei-Mancuso et al., 2020). The "love of learning" facet from Haggard's conception of intellectual humility seems relevant for curiosity, cognitive flexibility, and potentially intelligence.

Einsteinian Humility

Another type of humility encompasses how personally responsible one feels for their accomplishments. This has been deemed "Einsteinian humility". Albert Einstein refused to take credit for his success and claimed that his career was determined by "various factors over which I have no control" (Earp et al., 2018). This underscores an appreciation of the contributions from others coupled with a low self-focus, both of which are common features of general humility. Einsteinian humility shares some conceptual overlap with self-effacement, which captures the disinclination to engage in self-praise in front of others (Xiaohua Chen et al., 2009). Conversely, Einsteinian humility likely refers to a general belief about the self that one presumably holds in private. Indeed, Einsteinian humility is unsurprisingly highly correlated with free will skepticism (Earp et al., 2018) given the overlap between believing in free will and feeling personally responsible for one's actions. Ergo, self-effacement may be a reflection of Einsteinian humility, but it may also be deployed in social settings as a "politeness tactic" and possibly as a strategy to avoid drawing attention to oneself (Xiaohua Chen et al., 2009) regardless of how personally responsible one feels for their accomplishments. Insofar as self-effacement is a manifestation of

politeness, those who engage in self-effacement may acknowledge the contributions of others more than the role of luck or external factors which may not be a pattern found in Einsteinian humility. Therefore, it seems reasonable to parse self-effacement from Einsteinian humility and to regard the latter as potentially more indicative of humility as opposed to a politeness tactic.

The Dual Dimension Model of Humility

Consistent with the prevalent conception of humility as an appreciative and socially desirable trait, the Dual Dimension model of humility proposes four kinds of humility that each require a low self-focus or hypoegoic state. These include ethical or other-oriented humility (a low self-focus coupled with the prioritization of others' welfare), environmental humility (a low self-focus coupled with valuing the environment and animals), epistemic or cosmic humility (e.g., feeling small when contemplating one's place in the universe), religious humility, and an indirect measure of general humility based on the extent one values humility (Wright et al., 2018). Cosmic and religious humility have been categorized as representing two different types of epistemic humility. Specifically, cosmic humility has been described as representing an accurate perception of one's place in the universe (Earp et al., 2018). Religious humility however may not necessarily portray an accurate description of one's place in the universe, therefore it seems more fitting to separate religious humility from epistemic humility, in keeping with previous research conceptualizing a distinct religious domain of humility which also rest on a low self-focus (Davis et al., 2010; Wright et al., 2018). Therefore, cosmic humility could be referred to as epistemic humility, in keeping with previous research (Earp et al., 2018). This version of epistemic humility is different than intellectual humility as having an accurate perception of one's place in the universe does not necessarily mean one has an awareness of their

intellectual limitations. This study will refer to cosmic humility as epistemic humility, which is similar to but distinct from intellectual humility.

It may be worth reiterating a potential distinction between a low self-focus (reduced saliency of the self) and a small self (feeling small). Like the awe literature, these differences are sometimes conflated in humility research. For instance, epistemic humility includes items that mention feeling tiny and small in comparison to the vast universe which suggests that the self is still salient. Ethical and environmental humility by contrast seem to encompass a low self-focus better as each item pertains to focusing on others or the environment without any reference to the felt size of the self.

To date, only one study assessed correlations between personality facets (from the Big 5) with the Dual Dimension model of humility. Ethical or other-oriented humility was associated with agreeableness in an adult sample (but not for students), environmental humility was linked to openness to experience (for adults and students), epistemic humility was related to openness to experience (for students), and religious humility was associated with conscientiousness (for adults) (Ross & Wright, 2021). When exploring psychological well-being correlates with different domains of humility, personal growth was associated with epistemic and environmental humility, religious humility was linked to self-acceptance, and ethical humility predicted positive relationships (Ross & Wright, 2021).

As each of these domains of humility all require a low self-focus, it's certainly possible for someone to manifest each type of humility. However, each domain accompanies different cognitions, most notably, religious humility requires a belief in a supernatural deity. Some research suggests that the Honesty-Humility dimension of the HEXACO is the best trait at

predicting religiosity; while facets like fairness were positively correlated with religious belief, modesty had a negative correlation (Silvia et al., 2014). Moreover, something like environmental humility constitutes more than a low self-focus coupled with a focus on nature— this variant of humility requires believing that humans should protect nature and other species while also feeling "in touch" with nature (Wright et al., 2018).

Interestingly, each domain of humility in the dual dimension model could be construed as a predilection towards forming a communal sharing based relationship in various domains. As briefly mentioned, Rai and Fiske (2011) propose that communal sharing relationships are one of four types of relationships humans are motivated to form (communal sharing is arguably the most foundational one). The prototypical communal sharing relationship is family and intimate romantic relationships— there is a sense of oneness, help is given based on need not reciprocity, and it feels intrinsically rewarding and meaningful. Petersen and colleagues propose that the feeling of being moved or touched (kama muta) emerges when a communal sharing relationship is felt with other people, animals, nature, the cosmos, or even a deity (Petersen et al., 2019). This covers each of the four domains within the dual dimension model of humility, and so ethical humility may refer to a person's desire to form a communal relationship, those with environmental humility may be more likely of feeling a sense of oneness with nature, and so forth. This potential overlap is less clear with epistemic or cosmic humility, however those who do feel touched by or a harmony with the cosmos should report higher epistemic or cosmic humility. This sense of oneness is facilitated or at least made possible by the hypothesized low self-focus, the common denominator of these four domains of humility. Indeed, communal sharing relationships are characterized by thinking of oneself less while identifying with the broader ingroup.

Self-abasing Humility

While the bulk of the humility literature accepts a prosocial, low self-focus, and appreciative construal of general humility that is also reflected in many specific domains of humility, another type of humility has emerged that is less desirable and prosocial. This has been referred to as "self-abasing humility" which tends to follow from perceived failures leading to negative self-perceptions and a motivation to withdraw from social interactions (Weidman et al., 2018). These action tendencies seek to mitigate humiliation as individuals become acutely aware of their weaknesses in a way that feels threatening. Rather than treating humility as an adaptive midpoint between arrogance and diffidence, self-abasing humility is tantamount to diffidence or self-deprecation. This kind of humility is associated with introversion, neuroticism, and feelings of shame as one's weaknesses and inferiority become salient (Weidman et al., 2018). Although this domain of humility generally manifests itself after perceived failures, those with a tendency to feel shy, embarrassed, and inferior are more likely to experience self-abasing humility (Weidman et al., 2018).

Prosocial and Cognitive Domains of Humility

Given that there are many domains of humility, they can be categorized to better understand how they are similar and different from each other. As there is dispute whether awe is better classified as a prosocial or epistemic emotion, domains of humility can also be grouped into these two (inexhaustive) categories. Prosocial domains of humility would then facilitate altruistic, ethical and/or selfless behavior whereas epistemic or cognitive forms of humility may also be socially desirable but facilitate knowledge acquisition and information processing.

Ethical humility from the dual dimension model is probably the prototypical prosocial domain of humility whereas intellectual humility would be the prototypical form of cognitive humility. An outward focus on others from ethical humility may often translate into showing appreciation or concern for others which could lead to prosocial behaviour. Additionally, environmental humility can also be classified as a prosocial domain of humility as it may lead to environmentally friendly behaviours that help protect or preserve nature and other animals. Further if one's empathic concern is what's driving them to care about other animals, then this will likely translate to other people as well. Modesty may also be prosocial given that the modesty facet belongs to the Honesty-Humility dimension that also includes fairness and sincerity. The Honesty-Humility dimension reliably predicts integrity related behaviors (Lee & Ashton, 2018) and modesty specifically predicts more fair treatment in economic games (Hilbig & Zettler, 2009). The association between religiosity and the fairness facet of Honesty-Humility may suggest that religious humility could also foster prosocial behaviour, however religiosity has been negatively correlated with modesty (Silva et al., 2014). The willingness to attribute one's accomplishments to a supernatural deity may also lead to prosocial behaviour, although this link doesn't seem as clear as the link between valuing fairness and engaging in prosocial behaviour. Religious humility mostly captures a perception one has about themselves in relation to a creator which is not conceptually related to helping others in the same overt way that ethical humility and fairness depict treating others well. Religious humility may therefore be difficult to categorize as either a prosocial or cognitive form of humility.

Other domains of humility such as epistemic, Einsteinian, and intellectual humility do not seem to fit well as prosocial domains of humility. Although it is possible that thinking about the fragility of existence for instance may motivate one to help others, such an effect likely heavily

varies across people. Epistemic humility encompasses an accurate perception of one's place in the universe as well as a potential proclivity to feel awe from cognitive elicitors. Therefore, it is about a way of thinking that is not inherently about a concern for the welfare of others, nor is this outlook necessarily virtuous or morally upstanding. This domain of humility may be associated with prosocial behavior but it would seem like a by-product rather than the primary effect of epistemic humility, akin to the possible relation between awe and prosociality. Self-effacement may be a politeness tactic, yet it is less clear whether Einsteinian humility is inherently prosocial or instead a sober assessment of the causes preceding one's accomplishments that is unmotivated by any prosocial goal. While it is also unclear if intellectual humility is emblematic of a politeness tactic, there is good reason to think otherwise. Although intellectual humility can assuage social tensions (Davis et al., 2016b; Zachry et al., 2018), the awareness of one's intellectual limitations— the core theme of all depictions of intellectual humility— is not prosocial in nature, nor does it seem to be motivated as a politeness tactic or as a means of bonding with others. Interestingly, the flexibility facet of agreeableness from the HEXACO contains some items that map onto intellectual humility (e.g., "I am usually quite flexible in my opinions when people disagree with me"; Ashton & Lee, 2018). As previously mentioned, cognitive flexibility, intelligence, and curiosity are predictors of intellectual humility, suggesting that intellectual humility is not best construed as a prosocial type of humility, but as a cognitive or epistemic form of humility.

Those with self-abasing humility are more prone to feeling small as opposed to having a low self-focus, the difference being that the self is more salient. Weidman and colleagues (2018) accurately point out that this type of humility is less socially desirable than appreciative forms of humility, although it's not yet clear if self-abasing humility could lead to prosocial or helping

behaviours. Presumably state self-abasing humility could motivate one to engage in self-sacrificing or prosocial behaviour to enhance their self-image to alleviate feelings of embarrassment and gain acceptance or validation from others, however the primary motivation from self-abasing humility is the inclination to withdraw from others. Therefore, self-abasing humility, like religious humility, may not neatly correspond to prosocial or cognitive forms of humility.

The Relationship Between Awe and Humility

The relationships between awe and specific types of humility may be best described as bi-directional: humbler individuals may feel more awe and feeling awe can boost state humility (potentially trait humility over time). Researchers investigating the relationship between awe and humility do not always distinguish between state humility (i.e., temporarily feeling or displaying humility) and trait humility (i.e., how prone one is to feel state humility) as well as distinguish between different domain specificities of humility. or these disparate forms of humility. Some past research implies that awe inductions bolster trait humility given that measures of trait humility were used following awe inductions (e.g., Preston & Shin, 2017) however in the absence of longitudinal data, such data seem better interpreted as finding an increase in state humility. Measures of trait humility may act as a proxy for state humility, although it is certainly possible that extreme experiences of awe can alter trait humility. The following will review past research and potential pathways for experiences of awe bolstering (state) humility as well as how humility may predict awe proneness.

Awe Predicts Humility

As discussed, one integral feature of awe experiences (positive and negative) is self-diminishment. This overlaps nicely with a core component of many domains of humility— a low self-focus or hypoegoic state. Therefore, elicited awe may temporarily bolster state humility by reducing the saliency of the self during and possibly after an awe experience. Stellar and colleagues (2018) theorized that self-diminishment "motivates a stronger focus on others" while discouraging positive illusions and ego-defensiveness, which should bolster state humility. "Peak experiences" from psychedelic substances often encompass awe, amazement, ego dissolution, and feelings of humility or state humility (Haijen et al., 2018; Pollan et al., 2019). Dispositional awe predicted modesty scores from the HEXACO scale when Zhong-Yong thinking styles (nuanced thinking that avoids extreme conclusions) were used as a mediator (Lin et al., 2020). Additionally, various research demonstrates that induced positive awe leads to more feelings of general humility and causes participants to divulge more of their weaknesses as compared to controls (Gallagher et al., 2015; Preston & Shin, 2017; Quesnel & Riecke, 2018; Stellar et al., 2018). It's not clear, however, whether the increased focus on weaknesses reflects a more honest and accurate self-assessment than the controls' self-assessments (if the control group were prone to self-enhancement biases for example) or whether the weaknesses divulged are more indicative of self-abasing humility (possibly if the weaknesses were exaggerated or if they were accompanied by negative affect).

There is also some indication that induced awe bolsters Einsteinian humility. Although the results were not described in this way, participants were more likely to attribute their personal successes to external factors (e.g., luck, help from others) after gazing at a vast landscape and feeling awe (Stellar et al., 2018). Interestingly, awe mediated the relationship

between perceived vastness and (Einsteinian) humility, as well as the relationship between the need for accommodation and humility. However, perceived vastness and a need for cognitive accommodation did not mediate the relationship between awe and humility, suggesting that there are other elements of an awe experience (e.g., self-diminishment, connectedness) that are key contributors to state humility. Although not directly studied, many of the prosocial and helpful behaviours after experiences of awe may be emblematic of ethical humility (i.e., low self-focus and high other focus).

Experiences of awe (especially from physical elicitors like nature) may also boost environmental humility. As mentioned earlier, connectedness is a feature of positive awe, and feeling connected to nature (with a low self-focus) is part of environmental humility. For example, two items from environmental humility read "I often feel in touch with Mother Nature" and "We should always try to be in harmony with Mother Nature" (Wright et al., 2018). Feeling awe from nature may not guarantee that one would believe that humans should protect the Earth and other species, although it seems likely that feeling awed by nature makes those beliefs more likely to arise. Indeed, research indicates that induced (positive) awe increases environmentalism— self-sacrificing behaviour that benefits the environment— by weakening participant's social dominance orientation (the "preference for group-based hierarchy and inequality"; Zhao et al., 2018).

Insofar as domains of humility from the dual dimension model represent, at least in part, the tendency to feel a sense of communion with each respective domain, the connectedness feature of awe could be germane for boosting these domains of humility. For instance, feeling awe-inspired by another person may boost feelings of connectedness which may foster "kama muta" (feeling touched or moved). This heartwarming feeling can motivate self-sacrificing

behaviour (ethical humility) as this could be an attempt to sustain a communal sharing relationship. Pro environmental behaviours following feeling awe from nature could be interpreted in the same way— to feel in harmony with nature in keeping with an item from environmental humility. Nonetheless, feelings of connectedness are just one feature of positive awe, and it is arguably not as prevalent as perceived vastness, a need for cognitive accommodation, or self-diminishment. Self-diminishment may lead to feelings of connectedness, although strong feelings of connectedness (a sense of oneness) may be quite rare in comparison to perceived vastness and cognitive accommodation.

There is also a strong basis for hypothesizing that elicited awe can raise state intellectual humility. To our knowledge, this has only been directly assayed once with participants recalling a spiritual experience that elicited awe. In this study, only the non-religious participants reported a meager increase in trait intellectual humility after the awe induction (which again, may be best interpreted as a raise in state intellectual humility) whereas the religious group reported no increase in intellectual humility after feeling awe (Preston & Shin, 2017). The reason for this disparity is not clear, however it may be possible that the non-religious participants felt more awe from recalling spiritual experiences, assuming this evoked more uncertainty or a need for cognitive accommodation amongst this group as they could not readily explain their mystical experience in a ready-made religious way. Awe's self-diminishment is a possible mechanism for this effect as a hypoegoic state from feeling awe may bolster some aspects of intellectual humility such as an appreciation of other people's ideas and intellectual contributions (Krumrei-Mancuso & Rouse, 2015). It also seems likely that experiencing schema incongruence make one's intellectual limitations (the limitations of one's past knowledge, expectations, and beliefs) more salient, thereby increasing state intellectual humility. Some research also shows that awe

makes gaps in one's knowledge salient and leads to a greater desire to learn more about certain topics like science (McPhetres, 2019). Such findings suggest that experiences of awe can spark curiosity and galvanize learning, which is often associated with intellectual humility (Haggard et al., 2018). There is also recent work demonstrating that induced positive awe mollifies ideological convictions on contentious topics while fostering tolerance of others' views (Stancato & Keltner, 2019). Thus, elicited awe may boost state intellectual humility and prompt behaviours consistent with being intellectually humble.

Humility Predicts Awe

Past research suggests that (trait) humility predicts awe proneness. This can be gauged by testing whether humility predicts higher ratings of elicited awe or by assessing the correlation between humility and dispositional awe, although the correlational approach does not reveal causality. Most of the preliminary evidence shows correlations between dispositional awe and certain types of humility. For instance, dispositional awe had a weak correlation with modesty but a stronger correlation with the fairness facet of the Honesty-Humility dimension (Stellar et al., 2016), although fairness may be more emblematic of honesty than humility. Dispositional awe was also associated with the other enhancement facet of the Modest Behaviour Scale (MBS), which taps into politeness and the tendency to praise others (Xiaohua Chen et al., 2009). Regarding general humility, those who scored higher in dispositional awe were rated as humbler by their family and peers than those who scored lower in dispositional awe (Stellar et al., 2018).

The previous findings can be explained through the link between hypoegoism and self-diminishment which similarly helps explains how elicited awe boosts state humility. If humbler individuals tend to be more hypoegoic and outwardly focused, then they may be more

susceptible to feeling awe, as awe is associated with a less active DMN and less self-referential processing (Takano & Nomura, 2020; van Elk et al., 2019). However, humble individuals who tend to focus on themselves less may not necessarily have a less active DMN. To date there does not appear to be any research confirming that humbler individuals do in fact show less activity in the DMN at rest. It may be possible that a proclivity to display humility is only activated in certain situations which will then attenuate the DMN, meaning humbler individuals may not have a weaker DMN across all situations. Part of the DMN is also responsible for mind-wandering and social cognition which need not require self-referential processing (Marchetti et al., 2012; van Elk et al., 2019). Therefore, one may have a low self-focus but a somewhat active DMN if they are prone to mind wandering and thinking about others, making them less awe prone. It may also be the case that individuals with ethical humility are most prone to feeling awe from social elicitors given their high "other focus", particularly when seeking to form communal sharing relationships as this involves increased feelings of connectedness. Those with ethical humility may not be more likely to feel awe from powerful or admirable individuals, however those with an appreciative type of humility might.

It seems likely that epistemic humility— the tendency to feel humble when pondering one's place in the universe— would make one more likely to feel awe, at least in response to cognitive elicitors. For instance, one item on the epistemic humility subscale reads, "I feel awe towards the mysteries and complexities of life" (Wright et al., 2018). Epistemic humility is conceptually similar to dispositional awe, however dispositional awe captures one's tendency to feel positive awe primarily from physical elicitors like nature, whereas epistemic humility focuses more on cognitive elicitors of awe, such as marveling at the complexity of existence.

Epistemic humility has also been associated with a low self focus (Wright et al., 2018) which may be conducive for self-diminishment and therefore awe.

Intellectual Humility and Awe

There is ample reason to suspect that those who score high on measures of trait intellectual humility will be more likely to experience awe. A good indicator of this supposition are the similarities between dispositional awe and intellectual humility. For instance, both dispositional awe and intellectual humility are positively correlated with curiosity, unlike other domains of humility (Anderson et al., 2020; Krumrei-Mancuso et al., 2020). Importantly, experiencing awe frequently would require a willingness to engage in schema revision as opposed to schema driven processing. Therefore, those who lack intellectual humility may be less likely or less motivated to acknowledge the limitations of their current schemas and transcend them. Presumably, they would be more motivated to make sense of the world through their existing knowledge and schemata than those with high intellectual humility. Given that top-down or schema driven processing is often goal driven, those who are more confident in their understanding of the world (presumably those who are intellectually arrogant) may be less likely to suspend schema driven processing rendering them less likely to experience awe. A tendency to avoid knowledge restructuring or schema revision impedes learning which can also make experiencing awe less likely in the future (Price et al., 2021).

It is possible that both dispositional awe and intellectual humility are driven by a more fundamental trait like openness to experience, given that both are correlated with openness to experience. It is also possible that openness to experience is a broader disposition, such that dispositional awe and intellectual humility requires one to be open to experience, yet not

everyone who scores highly on openness to experience will necessarily score high on dispositional awe and intellectual humility. In other words, only a subset of individuals who are open to experience may also have high scores of dispositional awe and intellectual humility, insofar as these are separate proclivities. Different facets of openness to experience may be differentially related to dispositional awe. For instance, the aesthetic appreciation and inquisitiveness facets of openness to experience from the HEXACO may be more relevant for a person's awe proneness than the unconventionality and creativity facets. It also seems reasonable that aesthetic appreciation may be correlated with dispositional awe (e.g., "I see beauty all around me) and that inquisitiveness is related to intellectual humility while not fully encompassing intellectual humility.

As mentioned earlier, garnering knowledge can make individuals more likely to experience awe, as this makes their intellectual limitations salient. This corresponds well with an item in the dispositional awe scale that reads, "I seek out experiences that challenge my understanding of the world" (Shiota et al., 2006). Seeking out challenging experiences can promote learning and has the potential to violate schemas and elicit awe. Some construals of intellectual humility include a penchant for learning (Haggard et al., 2018) therefore those with intellectual humility may be more likely to gain knowledge by seeking out challenging experiences, increasing their likelihood for experiencing awe.

Intellectual humility may be predictive more so of positive awe than negative awe due to a potential link between intellectual humility and a lower need for cognitive closure. Cognitive flexibility is one pathway for intellectual humility and the ability to flexibly change one's mind might be negatively related to a need for cognitive closure. When those with a high need for cognitive closure experience schema violation they are more prone to feeling negative affect as

they are more uncomfortable with uncertainty. Those with a low need for cognitive closure should at least be least susceptible to feeling negative affect from schema violation. Moreover, those who love learning (a facet of intellectual humility) may enjoy schema violation and therefore be more inclined to feel positive awe. A love for learning should be related to a low need for cognitive closure insofar as learning entails having one's beliefs challenged.

Recall earlier that deliberately perceiving an object with a mindset of wonder can also elicit awe (Wager & Wagemann, 2018). This seems quite similar with the tendency to get absorbed in one's experience which predicts feeling awe (Bonner & Friedman, 2011; van Elk et al., 2019). This suggests that the likelihood of feeling awe is not simply gauged by how often one encounters vast and challenging stimuli, but also how willing or motivated one is to engage with and get absorbed in external stimuli. It would seem reasonable that a motivation to disengage from our usual schema driven processing is an important factor for feeling awe. Indeed, experienced meditators can voluntarily quiet their DMN and engage in bottom-up processing (Chiesa et al., 2013). This is not the same as experiencing awe, yet it does reveal that top-down processing and the DMN can be willfully attenuated, therefore engaging in bottom-up processing and feeling awe need not always have to be a spontaneous and involuntary experience. Given that those with intellectual humility are more curious and motivated to learn, they may be more inclined to disengage from schema-driven processing which can quiet the DMN making feelings of absorption, wonder, and awe more likely to arise. For these reasons, intellectual humility appears to be the most germane domain of humility to predict a person's likelihood for experiencing awe and the intensity of their awe experiences.

Self-abasing Humility and Negative Awe

In Keltner & Haidt's seminal proposal, they reference McDougall's account of awe (which helped form their conception of primordial awe as being threat based) that includes a feeling of self-abasement. Although both valences of awe may be fulfilling a primarily cognitive information processing function, negative awe has a lot of conceptual similarity with self-abasing humility (neither a prosocial nor cognitive domain of humility). The type of humility supposedly evoked form primordial awe (or negative awe from social elicitors) was marked by fear and respect. Self-abasing humility also involves feeling fear, however it may be more akin to fear of embarrassment or social rejection, whereas the fear evoked by primordial awe is directed towards a powerful leader and also gives rise to reverence and deference. Although the amount of activity in the DMN during experiences of negative awe remains an open question, instances of negative awe and state self-abasing humility both include an unpleasant feeling of smallness. This feeling of smallness may be infused with feelings of insignificance and worthlessness which drive the negative affect common to both. Both are also correlated with neuroticism. Additionally, self-abasing humility primarily arises in social settings and negative awe, especially in the dispositional negative awe scale, is often thought to arise from social elicitors as well. One's limitations are salient during instances of self-abasing humility as this is thought to follow from perceived failure, whereas an oppressive vast negative awe stimulus may also expose one's limitations.

The Present Investigation

While prior research demonstrates a link between awe and humility, it has not been firmly established how both valences of awe might be related to different domains of humility. To the authors' knowledge, no study has directly compared how the awe-humility relationship

may vary across different domains of humility. Much of the existing literature has documented the phenomenon of elicited awe bolstering general state humility, whereas the possibility of trait humility predicting experiences of awe has received less attention. Humility is often construed as a socially desirable trait; therefore, research of a less desirable self-abasing humility has been novel (Weidman et al., 2018). While a negative valence of awe is not new (Keltner & Haidt, 2003), there are far more investigations of positive awe than negative awe (at least with Western samples), and to the author's knowledge, the relationship between negative awe (elicited and dispositional) and domains of humility has yet to be tested. With many new domains of humility emerging in recent years, it has also not been clear how distinct these purported domains of humility are from each other.

There also lacks a consensus regarding the evolutionary function of awe. Past research and theorizing in this area attempt to gauge the function of awe by assessing the impact this experience has on people, which is perfectly reasonable. The function of awe however may also be inferred at least in part by the types of proclivities and traits that tend to facilitate or predict feeling awe. Indeed, taking a functionalist evolutionary approach would mean considering the broader environment and context that predicts awe experiences rather than solely focusing on the effects of awe in a decontextualized way. Investigating the relationship between awe and humility may offer additional insight into the function of awe by comparing awe's possible association with (pro)social domains of humility and with cognitive domains of humility. As awe is often theorized to have a prosocial and cognitive function, uncovering whether awe is associated more so with prosocial or with cognitive domains of humility may shed light on the nature and function of awe.

While awe and humility likely have a bi-directional relationship, this study is only testing how various domains of trait humility can predict different types of awe. Specifically, this investigation will test four different kinds of awe (elicited positive awe, elicited negative awe, dispositional positive awe, and dispositional negative awe) and 12 measures of humility (ethical humility, intellectual humility, environmental humility, epistemic humility, religious humility, valuing humility, modesty, fairness, sincerity, greed avoidance, Einsteinian humility, and self-abasing humility). Intellectual humility was assessed by its three facets totaling 14 humility measures (when replacing average scores of intellectual humility with the three facets of intellectual humility). Two largely exploratory factor analyses pertaining to humility measures were also conducted, one at the item level and one assessing average scores of the humility measures to verify if there are distinct domains and even "meta-domains" of humility.

Objectives and Hypotheses

This study has three objectives. The primary objective is to clarify the relationship between awe and domain specificities of humility. Doing so may also be informative for the classification of awe— a secondary objective— as either a prosocial emotion (if awe is strongly associated with prosocial forms of humility) or an epistemic emotion (if awe tends to be associated with intellectual and epistemic humility). Thirdly, this study aims to test the notion that there are indeed different domains of humility as delineated by past research. The hypotheses for this study are as follows:

H1: Dispositional (positive) awe will be positively correlated with intellectual humility; this correlation will be higher than any potential positive correlations between another domain of humility and dispositional positive awe.

Rationale: Dispositional positive awe and intellectual humility are both associated with Big 5 Openness to Experience, curiosity, and a low need for cognitive closure whereas other types of humility correlate more with agreeableness.

H2: Those with higher scores of intellectual humility will experience more positive awe from the positive awe manipulations; intellectual humility will be the best predictor of positive awe ratings across all the domains of humility being tested.

Rationale: Those with intellectual humility should be more curious and motivated to engage with potentially challenging stimuli, therefore they should be more inclined to experience awe. This hypothesis rests in large part on the veracity of the first hypothesis; if intellectual humility is positively correlated with dispositional awe, then it should predict the tendency to feel awe as captured by the dispositional awe scale.

H3: Those with higher scores of self-abasing humility will experience more negative awe from the negative awe manipulations than those with high scores on other types of humility; self-abasing humility will be the best predictor of elicited negative awe of all the humility measures.

Rationale: Negative awe and self-abasing humility are both associated with neuroticism and the tendency to feel small and submissive. Those higher in self-abasing humility should therefore be more prone to negative emotion and feeling small in response to vast and challenging stimuli.

H4: Dispositional negative awe will be positively correlated with self-abasing humility; of all the domains of humility, self-abasing humility will have the largest association with dispositional negative awe.

Rationale: Self-abasing humility follows from perceived failures and is measured as one's tendency to feel shy, small, stupid, etc and the operationalization of dispositional negative awe largely refers to social elicitors such as one's proclivity to feel small and inferior in the presence of individuals perceived to be outstanding or excellent.

H5: While no specific hypotheses are made regarding the exploratory factor analysis of humility measures, it is expected that there will be at least two distinct factors corresponding to intellectual humility and social humility.

Method

Participants

Three hundred and seven students from Lakehead University were awarded course credit for participating in the online study and were awarded with course credit on SONA. Of the 307 participants, 268 participants responses were retained after excluding participants for failing attention checks. 223 were females, 71 males, and 4 non-binary. 166 participants identified as Canadian, 10 identified as Indian, 8 identified as Nigerian, 4 identified as Dutch, 4 identified as Finnish, and 15 participants did not provide a nationality. Other nationalities included but were not limited to African, Kenyan, Korean, Chinese, and Indigenous. The majority of the participants (253) resided in Canada at the time of the study and the mean age was 22.2 (*SD*= 5.78).

Measures

Personality

Personality was measured with the HEXACO-100 (Lee & Ashton, 2018) which has six higher order dimensions (Honesty-Humility, Extraversion, Emotionality, Conscientiousness, Agreeableness, and Openness to Experience) with four facets for each dimension totalling 24 distinct facets. Participants answered all 100 items on a 7-point Likert scale ranging from 1 (*strongly disagree*), 2 (*disagree*), 3 (*slightly disagree*), 4 (*neither agree nor disagree*), 5 (*slightly agree*), 6 (*agree*), and 7 (*strongly agree*).

Dispositional Positive Awe

The six items from the awe subscale of the Dispositional Positive Emotion Scale (DPES; Shiota et al., 2006) were used to measure people's proclivity for experiencing positive awe. Some items include "I often feel awe", "I often look for patterns in the objects around me", "I seek out experiences that challenge my understanding of the world", and "I see beauty all around me". Participants will be asked to indicate how strongly they agree with each statement on the same 7-point Likert scale as above.

Dispositional Negative Awe

The six items from the awe subscale of the Trait Respect-Related Emotions Scale (TRRES; Muto, 2016) will be used to capture dispositional negative awe. Some items include, "There are many people around me who are overwhelmingly more excellent than me", "When I meet people who have some overwhelming ability or talent, I often feel weak with fear or

intimidation", and "I often feel weak with fear or intimidation" (Muto, 2016). The items will be rated on the same 7-point Likert scale as above.

Dual Dimension Humility Scale

This scale developed by Wright and colleagues (2018) includes four domains of humility along with an indirect measure of humility (valuing humility). Each of the four domains have a low self-focus along with a high focus on others (ethical humility), the cosmos (cosmic or epistemic humility), nature (environmental humility), or a deity (religious humility). Each of these five measures has five items and was presented with the same seven-point Likert scale used above.

Intellectual Humility

This will be measured with the Limitations Owning Intellectual Humility Scale (L-OIHS; Haggard et al., 2018). It is a 12-item scale with three facets (love of learning, limitations owning, and an appropriate discomfort of limitations) with an overall Cronbach's α of .86 when first tested. Haggard and colleagues (2018) used a nine-point Likert scale however to ensure consistency with the other measures we had participants use the same 7-point Likert scale as above. Some items include: "I have a hard time admitting when one of my beliefs is mistaken" (reverse coded), "I care about truth", and "When I think about the limitations of what I know, I feel uncomfortable" (reverse coded).

Einsteinian Humility

A technique adapted from Earp and colleagues (2018) measured how personally responsible participants feel for their greatest accomplishments. Participants were asked to

briefly write about three of their perceived top accomplishments in any order. They were then told to "rate how personally responsible you feel for each accomplishment" on a seven-point Likert scale ranging from 1 (*not at all personally responsible*) to 7 (*completely personally responsible*).

Self-abasing Humility

A technique adapted from previous research (Weidman et al., 2018; Werz, 2017) gauged trait self-abasing humility. Participants were instructed to "rate how often you generally feel this way" for six items with a Cronbach's alpha of 0.75 (Werz, 2017) on a 7-point Likert scale ranging from 1 (not at all) to 7 (extremely). The six items are "meek", "shameful", "small", "submissive", "unimportant", and "worthless".

Procedure

After participants enrolled in the study, they were directed to the online survey. They were provided with an information letter and a consent form (see Appendix A and B) and then indicated their consent to participate. Participants answered some demographic information (age, gender, ethnicity, nationality) before completing the awe subscale of the Dispositional Positive Emotions Scale (DPES), and the awe subscale of the Trait Respect Related Emotions Scale (TRRES). Demographic questions are shown in Appendix C.

Participants were then randomly assigned to watch one of seven videos— three conditions sought to elicit positive awe, another three attempted to evoke negative awe, and the final condition was meant to elicit a mixture of positive and negative awe. The three positive awe videos were BBC's *Planet Earth* trailer (one condition keeping the soundtrack and another

condition with the music removed) and the third positive awe condition will play a BBC video of ibex goats climbing a dam that was selected based on a pilot study. The three negative awe videos were BBC's *Birth of a Tornado* video (one condition with the original soundtrack and another condition with the music removed) and the third condition will show a video of a tsunami that was used in a pilot study. The final video meant to elicit positive and negative awe is a video revealing the massive size of the universe which has been used in past research (Gordon et al., 2017). The Planet Earth trailer and the Birth of a Tornado video have also been used in past research and reliably elicit positive and negative awe respectively (Gordon et al., 2017; Stellar et al., 2018).

Immediately after each video there was a manipulation check asking what the video was about. The four response options following the positive awe videos were: "Wild goats climbing a damn", "A nature compilation", "The seven wonders of the world", and "None of the above" and the four response options following the other four videos were: "Water mains bursting in an earthquake, causing city streets to flood", "Water flowing over barriers, causing city streets to flood", "Tornadoes", "Tornadoes and hail stones shattering a car windshield", and "Zooming out in space". There was also a question asking if there were any technical difficulties with the video that participants could answer as a written response. After the manipulation check, participants were asked to indicate how they felt along with a list of emotions that participants will endorse as currently feeling on a scale ranging from 1 (*none at all*) to 7 (*an extreme amount*). The list of emotions was the same for all conditions which included: positive awe, negative awe, surprise, joy, fear, calmness, sadness, and compassion. Positive awe was defined as "a strong positive feeling of wonder or admiration" and negative awe was defined as "a strong feeling of fear and wonder", which are descriptions adapted from previous research (Gordon et al., 2017).

After answering the questions pertaining to the randomly selected video was a written task that has been used in prior research to elicit awe. Participants wrote about a past experience of positive or negative awe depending on their condition (the valence will match the video assigned to them, it was random for the space condition). After writing they rated how much awe they felt in that past event as well as how much awe they currently feel after recalling that event. Both ratings were be answered on a seven-point Likert scale ranging from 1 *(none at all)* to 7 (*an extreme amount).* Hence, participants assigned to one of the positive awe conditions were asked to write about a past experience of positive awe whereas participants who viewed one of the negative awe videos were asked to write about a past experience of negative awe (adapted from Graziosi & Yaden, 2021; Negami, 2020; see Appendix E). All participants then completed the same questions from the Dual Dimension Humility scale, intellectual humility, self-abasing humility, Einsteinian humility, and then the full HEXACO-100 which can be found in Appendix D. All participants were then debriefed, thanked, and compensated for their participation (survey materials are shown in Appendices A, B, and C).

Results

This section is organized into two main parts— preliminary analyses and hypothesis testing. Preliminary analyses assessed descriptive statistics, the effectiveness of the awe elicitors used, the distinctiveness of purported domains of humility, and the relationship between domains of humility and personality characteristics. These preliminary tests were helpful for subsequent hypothesis testing, and even necessary for hypothesis testing, as hypotheses are based on the assumption that there are distinct domains of humility for example. All analyses were conducted with SPSS.

Preliminary Analyses

Data Analysis Strategy

For hypothesis testing, humility measures were treated as independent variables and the awe measures (elicited and dispositional) were the dependent variables. Multiple linear regressions were conducted to determine the significance of the humility and awe relationships, with p values <.05 deemed statistically significant. Every linear regression contained multiple independent variables (the domains of humility with the largest zero order correlations). Afterwards, the Cummings (2009) method was used to compare beta coefficients to determine if the differences between humility measures was statistically significant. Beta coefficients were deemed significantly different if their 95% confidence intervals had an overlap of less than 50%. Hypotheses were concerned with the best humility measure at predicting a particular variant of awe, irrespective of whether the humility measure was statistically significant (p <.05) or significantly greater than the beta coefficients from other humility measures that were not addressed by the hypotheses.

Given the large number of humility measures, bivariate correlations were conducted prior to linear regressions to filter out humility measures with relatively low correlations before performing linear regressions. This was done to avoid overfitting linear regression models by ensuring no more than ten independent variables were included in any one linear regression. There is also a concern of neglecting humility measures that would be statistically significant in linear regression models if they failed to exceed an unreasonably high r value. To strike a reasonable middle ground, any humility measure with a correlation of at least .2 was retained for the linear regression. In some instances, fewer than 3 variables had a correlation above .2, so the threshold was set to .1 if fewer than 10 humility measures had a correlation above .1. If more

than 10 humility measures had a correlation exceeding .2 then only those with a correlation above .25 were used in the subsequent linear regression.

The presence of multicollinearity was tested by checking if any bivariate correlations between the independent variables (the humility measures) surpassed .8, in line with previous recommendations (Alin, 2011). No correlations exceeded .8, and so unstandardized dependent and independent variables were used. However, variance inflation factor (VIF) and tolerance values were also computed with the linear regressions to check for any multicollinearity issues amongst the unstandardized variables. In line with previous recommendations, a VIF surpassing 5 would be considered highly correlated, a value in between 1 and 4 is moderately correlated, and a value of 1 is not correlated (Daoud, 2017). Tolerance scores below .10 would indicate collinearity (Daoud, 2017). Therefore, collinearity will be corrected only if tolerance levels fall below .1 or if VIF values surpass 5.

Exclusion Criteria

There were three attention check items spread out throughout the survey (not including the video attention checks). One was placed within the dual dimension humility items, and two more were placed within the HEXACO. If participants failed the first attention check, their responses for the dual dimension domains of humility (and intellectual humility and self-abasing humility) were excluded. If participants failed the second or third attention check, then their responses to the HEXACO were excluded. Responses to dispositional awe items, the written task, and video ratings were still included for participants who failed all three attention checks. In total, 27 participants failed at least one attention check. Responses to videos were excluded if participants failed the manipulation check asking what the video was about (11 participants

failed the video manipulation check). Ratings of awe from the written task were excluded if there was no writing, or if they did not write about a past experience of awe (this applied to 16 participants). Ratings of Einsteinian humility were also omitted if participants gave a rating without writing about a personal accomplishment (this applied to 3 participants). There was also a question at the end of the survey asking participants about the quality of their responses and if we should use their data or not. Participants who indicated that their data should not be used resulted in the exclusion of all their responses, even if they did not fail any attention or manipulation check items (this applied to 8 participants).

Missing Values

Mean imputation or mean substitution was used to account for missing items. This method was selected to retain more data (as opposed to a complete case analysis or listwise deletion) that should still be viable if that participant passed attention checks. Mean imputation was opted for due to ease of use, instead of other options like regression imputation which has similar advantages and disadvantages such as adding no novel information and increasing the sample size (Kang, 2013). However, it seemed problematic to rely on mean substitution if that mean does not even account for half of the items for a particular measure. For example, self-abasing humility has six items, so if a participant only answered one or two self-abasing questions, then an average self-abasing humility score was not calculated and their responses to this measure were excluded. In total, 53 participants skipped a question or more.

Descriptive Statistics

Means, standard deviations, and Cronbach's alphas are shown in Table 2. There was little variability amongst intellectual humility scores ($SD = .6$) perhaps due to the student sample who

are most keen on learning (love of learning had the highest mean and lowest SD of the three

intellectual facets). Religious humility had the most variability ($SD = 1.9$) probably because

responses to this measure depend on the abstract belief of a supernatural deity which is

categorical. Those who are not religious cannot possess any degree of religious humility

therefore they would be expected to give the lowest score possible.

Table 2

Descriptive Statistics for Dispositional Awe Measures and Humility Domains

Scales	N	M	SD	Cronbach's α	Skewness	Kurtosis
Dispositional awe	267	4.95	.84	.71	-.45	.10
Dispositional negative awe	267	4.59	1.09	.81	-.28	-.44
Ethical humility	246	5.08	.98	.84	-.36	-.43
Intellectual humility	246	4.78	.63	.70	.25	-.13
Love of learning	246	5.95	.84	.60	-.29	.32
Limitations owning	246	4.72	.93	.67	-.29	-.06
Appropriate discomfort of limitations	246	3.66	1.03	.63	.29	-.04
Epistemic humility	243	5.33	1.05	.80	-.61	.24
Environmental humility	243	5.84	.78	.75	-.72	.46
Valuing humility	243	5.87	.66	.70	-.64	.42
Religious humility	243	3.55	1.91	.95	.26	-1.10
Self-abasing humility	243	3.17	1.22	.81	.29	-.59
Einsteinian humility	238	2.10	.85	.51	-.67	.05
Modesty	237	5.47	.93	.66	-.49	-.18

Sincerity	237	4.29	1.18	.73	-.02	-.61
Fairness	237	4.78	1.36	.77	-.28	-.60
Greed avoidance	237	4.01	1.44	.82	.07	-.76

Notes. All measurements used a seven-point Likert scale. For all measurements except Einsteinian humility, each response option was labeled: 1 (*strongly disagree*), 2 (*disagree*), 3 (*slightly disagree*), 4 (*neither agree nor disagree*), 5 (*slightly agree*), 6 (*agree*), 7 (*strongly agree*). Einsteinian humility ranged from 1 (*completely responsible*) – 7 (*not at all responsible*).

Normality

Values from skewness and kurtosis were used to determine whether each of the variables were normally distributed or not. Data was considered normally distributed if skewness and kurtosis fall between -1 and 1 (Brown, 2011). All measures were normally distributed with the exception of religious humility which had a kurtosis of -1.103. Again, this is likely due to religious humility being contingent on a belief in a supernatural deity. A histogram of religious humility scores was computed to observe the frequency distribution of average scores; the highest peak was at the far left and the second highest peaks were in the middle and on the far right, roughly resembling a skewed "W" shape with various peaks and valleys.

Internal Consistency

Cronbach's α were computed to determine the internal consistency for all the two dispositional awe scales and all the humility measures. Alpha scores of at least .7 were considered satisfactory in line with previous interpretations (Bland & Altman, 1997). Therefore, all scales had at least a satisfactory or acceptable alpha except for Einsteinian humility, modesty, and the three facets of intellectual humility.

Einsteinian humility had the lowest α of .517 ($N = 236$) however this may not necessarily be problematic. The scale is unique in that participants are asked to select any three of their personal accomplishments, therefore responses to each scenario can vary considerably. Recalling three accomplishments should eliminate noise or irrelevant factors from a particular scenario. This should underscore the common denominator of all three scenarios, which is how the person perceives their accomplishment. Therefore, the sampling from three random accomplishments is expected to vary producing a low alpha, but the average personal responsibility rating from the three scenarios should be indicative of Einsteinian humility. These measures with unsatisfactory alphas were still used as they have shown satisfactory alphas in past research, however, the following factor analyses will derive modified versions of each of these facets which have higher internal consistency ratings and were also used in subsequent data analyses.

Awe and Humility Correlations

Zero order correlations amongst all awe measures (elicited positive and negative awe from the videos, past and current ratings of both valences of awe from the written or recall task, and both dispositional awe scales) and all humility measures was computed (see Tables 3, 4, and 5). The hypothesis tests follow up from the results shown in Table 4 (the relationship between awe and humility) and the proceeding factor analyses further investigate the interrelatedness of humility measures shown in Table 5. There were no specific hypotheses regarding the relationships between various awe measures, however one would expect some similarity across the positive awe measures as well as across the negative awe measures, which was largely found. Interestingly, dispositional positive awe had larger correlations with elicited positive (from the videos and recall task) than the correlations between dispositional negative awe and measures of elicited negative awe. This could partly be attributed to the fact that the dispositional positive

awe scale and awe videos utilized physical elicitors whereas the dispositional negative awe scale also includes fewer physical elicitors and more social and cognitive elicitors. Nonetheless it may be considered problematic that the dispositional negative awe scale did not have meaningful correlations with elicited negative awe. Unexpectedly, dispositional positive awe had a significant correlation with past ratings of negative awe from the recall task and dispositional negative awe had a significant correlation with past ratings of positive awe from the recall task.

Table 3

Correlations Amongst Awe Measures

| | Awe from Videos | | Awe from Recall Task | | | | Dispositional Awe | |
| | | | Past Ratings | | Current Ratings | | | |
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Positive Awe (videos)	--	-.42***	.19*	-.13	.25**	-.19*	.15*	.03
Negative Awe (videos)	--	--	-.08	.16	.06	.17	.02	.09
Past Positive Awe (recall)	--	--	--	--	.40*	--	.06	.20*
Past Negative Awe (recall)	--	--	--	--	--	.51*	.22*	.07
Current Positive Awe (recall)	--	--	--	--	--	--	.16	.07
Current Negative Awe (recall)	--	--	--	--	--	--	.09	.03
Dispositional Positive Awe	--	--	--	--	--	--	--	.06

Note. A * indicates correlations where $p < .05$ in a two tailed test; ** indicates a p value of <.01; *** indicates a p value <.001.

Table 4

Correlations Between Awe and Humility Measures

	Awe from videos		Awe from Recall Task				Dispositional Awe	
			Past Ratings		Current Ratings			
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Sincerity	.12	-.03	.04	.14	-.03	.01	.16*	-.05
Fairness	.15*	.02	-.00	.09	.22*	.18*	.16*	-.06
Greed avoidance	.16*	-.15*	-.08	-.05	.01	-.13	.08	-.05
Modesty	.09	-.13*	.09	.07	.09	-.19*	.08	.09
H-H	.19*	-.09	-.01	.09	.08	-.01	.17*	-.03
Love of learning	.03	.04	-.11	.08	-.02	.18*	.13*	-.13*
Limitations owning	-.00	.03	.06	.11	.17	.15	.22***	-.09
Appropriate discomfort of limitations	.10	-.11	-.01	-.07	-.04	-.11	-.07	-.45***
Intellectual humility	.09	-.04	-.01	.05	.07	.10	.14*	-.35***
Ethical	.09	-.06	.08	.08	.14	.14	-.01	.06
Environmental	.17*	-.04	.14	.20*	.11	.11	.24***	.04
Epistemic	.22***	.02	.13	.15	.05	.12	.23***	.35***
Valuing	.15*	.06	.25**	.28**	.24***	.15	.31***	.17**
Self-abasing	.00	.12	.02	.25**	-.05	.04	.04	.49***
Religious	.01	.15*	-.06	.09	.27**	.20*	.19**	.08
Einsteinian	.09	.03	-.01	-.02	.06	.05	.10	-.03

Note. A * indicates correlations where $p < .05$ in a two tailed test; ** indicates a p value of $<.01$; *** indicates a p value $<.001$.

Table 5

Correlations Amongst Humility Measures

	Sincerity	Fairness	Greed avoid	Modesty	H-H	Learn	Limit	A.D. L	Intel	Ethical	Epistemic	Enviro	Valuing	Self-abasing	Religious	Einsteinian
Sincerity	--	.42**	.37**	.32**	.73**	.21**	.19*	.08	.22*	.16*	.07	.02	.13*	-.03	.07	.06
Fairness	--	--	.35**	.31**	.73**	.21*	.23**	.07	.24**	.17*	.05	-.01	.18	-.15*	.22**	.06
Greed avoidance	--	--	--	.55**	.74**	.17*	.10	.06	.14*	.25**	.14*	.03	.08	-.00	-.13*	-.19*
Modesty	--	--	--	--	.69**	.16*	.20*	.04	.18*	.28**	.12	.04	.18*	.09	-.17*	-.10
H-H	--	--	--	--	--	.27**	.25**	.09	.28**	.27**	.14*	.02	.19*	-.04	.03	-.05
Learn	--	--	--	--	--	--	.26**	.06	.59**	.08	.10	.12	.10	-.14*	.03	.11
Limits	--	--	--	--	--	--	--	.32**	.76**	.04	.07	.10	.25**	-.07	.11	.13*
A.D. L	--	--	--	--	--	--	--	--	.70**	-.22**	-.20*	.02	-.01	-.39**	-.08	.07
Intel	--	--	--	--	--	--	--	--	--	-.07	-.03	.11	.15	-.30**	.03	.16*
Ethical	--	--	--	--	--	--	--	--	--	--	.22**	.05	.10	.28**	.05	-.04
Epistemic	--	--	--	--	--	--	--	--	--	--	--	.34**	.28**	.30**	.09	-.01
Enviro	--	--	--	--	--	--	--	--	--	--	--	--	.20*	.03	-.06	.18*
Valuing	--	--	--	--	--	--	--	--	--	--	--	--	--	.06	.23**	.16
Self-abasing	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.15	-.08
Religious	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.01

Notes. A * indicates correlations where $p < .05$ in a two tailed test; ** indicates a p value of <.001. "Greed avoid" is short for "Greed avoidance", "H-H is short for "Honesty-Humility", "Learn" is short for "Love of learning", "Limit" is short for "Limitations owning", "ADL" is short for "Appropriate discomfort of limitations", "Intel" is short for "Intellectual humility", and "Enviro" is short for "Environmental humility".

Factor Analyses

This study used 12 measures of humility (14 when including each of the intellectual humility facets as opposed to average intellectual humility scores) from various scales that have never been analyzed together. To determine if these 14 measures do in fact represent distinct domains of humility, two factor analyses were performed— one at the level of the humility measures and one at the item level. Assessing all the individual items was expected to reveal whether the 14 measures of humility were distinct or not while the factor analysis at the humility measure level would reveal how if at all these measures cluster together, potentially revealing broader "meta" domains of humility (such as prosocial or cognitive forms of humility). It was also of interest to factor analyze the items from both measures of dispositional awe (positive and negative). A proclivity for feeling one valence of awe may be associated with awe proneness for the other valence given the overlap between positive and negative awe. To the author's knowledge, these dispositional awe measures have yet to be factor analyzed together. For all three factor analyses, eigenvalues that were 1 or greater were used to determine the number of factors as an eigenvalue above 1 indicates that the factor explains more variance than the average factor. There are of course other viable methods for extracting factors, such as the scree plot method which yielded similar if not identical results for all three factor analyses as the eigen value method. However, it is ambiguous at times to determine where the exact cut off point is on a scree plot, and so the eigen value method was used for simplicity and to reduce ambiguity.

Dispositional Awe (Positive and Negative) Items

A factor analysis with the 6 items from dispositional positive awe and the 6 items from dispositional negative awe was conducted. Although it was expected that these two dispositional

constructs should emerge in the factor analysis, an exploratory factor analysis was conducted as this analysis has never been done and there may be distinct components within a construct or shared features across both constructs. Given that both valences of awe rest on similar features such as perceived vastness and a need for cognitive accommodation, both dispositional awe scales may be correlated which is why an oblique rotation was used. A principal axis factoring with the regression method was used with a Promax rotation due to the possible overlap of dispositional awe measures. Kappa was set to 4 and 6 iterations were required to complete the factor analysis. Three factors emerged with eigen values greater than 1, encompassing 58.75% of the total variance. The first factor has an eigenvalue of 3.2, the second factor has an eigenvalue of 2.7, and the last factor has an eigenvalue of 1.2. Results can be found in Table 6.

The three items with a factor loading greater than .4 on the first factor all pertain to feeling negative awe in the presence of a person from the dispositional negative awe scale. Two of these items suggest that the social elicitor is perceived as a threat given the mention of feeling fear and intimidation. The scale for dispositional negative awe split into two factors whereas dispositional (positive) awe formed a separate factor. Interestingly, one item from dispositional (positive) awe had a higher loading with a factor pertaining to dispositional negative awe. The reason dispositional negative awe split into two factors seems to be due to differences in elicitors of negative awe between the first and third factor. The item with the highest loading on factor 3 makes no mention of other people, but rather describes feeling negative awe from space and nature. The item with the second highest loading on factor 3 mentions feeling negative awe from nature and people. The third item of dispositional negative awe relevant for factor 3 only mentions feeling negative awe from people. Further these items that loaded on the third factor seem less threatening than the items that loaded on factor 1 as they do not mention feeling fearful

or intimidated. The lack of a fearful valence may explain why this item about feeling negative awe from people did not load on to the first factor with more social elicitors. It is also not immediately obvious why the item from dispositional positive awe about searching for patterns is more related to this factor of dispositional negative awe than with the other dispositional (positive) awe items in factor 2. As the first factor includes more social elicitors that evoke a fear response compared to the third factor, it will be referred to as "social dispositional negative awe" whereas the third factor will be referred to as "non social dispositional negative awe" while recognizing that the third factor also includes social elicitors. The original dispositional positive awe scale and dispositional negative awe scale were also correlated with each other (r = .06) which was not statistically significant.

Table 6

Factor Analysis of Dispositional Awe Measures

	Social Dispositional Negative Awe Factor (26.5%)	Dispositional Awe Factor (22.2%)	Non-social Dispositional Negative Awe Factor (10.1%)
I often feel awe. +	.24	**.76**	-.14
I see beauty all around me. +	-.00	**.80**	-.06
I feel wonder almost every day. +	.12	**.74**	-.11
I have many opportunities to see the beauty of nature. +	-.10	**.64**	.18
I often look for patterns in the objects around me. +	-.04	.22	**.45**
I seek out experiences that challenge my understanding of the world. -	-.33	**.47**	.39
There are many people around me who are overwhelmingly more excellent than me. -	.31	-.20	**.54**
I often feel that people and the nature around me have large presences that make me realize my own limitations. -	.17	.01	**.72**

I often feel that things like myself are tiny compared to the vastness of space and nature. -	.00	-.10	**.76**
When I talk with someone who is outstanding in some way, I often feel intimidated, with feelings of fear and respect. -	**.83**	.09	.09
When I meet people who have some overwhelming ability or talent, I often feel weak with fear or intimidation. -	**.91**	.09	.01
I feel small whenever I meet some great person. -	**.88**	-.01	.05

Notes. A "+" indicates an item from the dispositional (positive) awe scale whereas a "–" indicates an item from the negative dispositional awe scale. Percentages in the top row indicate the % of variance accounted for by each factor. Factor loadings above .4 are in bold.

Humility Domains

Two exploratory factor analyses were conducted to clarify the nature or distinctiveness of humility domains. The first factor analysis assessed the similarity between the 14 humility measures (ethical humility, love of learning, limitations owing, comfort of limitations, epistemic humility, environmental humility, valuing humility, religious humility, self-abasing humility, Einsteinian humility, modesty, sincerity, fairness, and greed avoidance) to see what kinds of "meta-domains" of humility might emerge. It was posited that domains of humility could be assorted into at least two categories— (pro)social domains and cognitive domains. Humility domains that pertain to the former may have a social function such as facilitating cooperation or trust whereas cognitive domains of humility would have a cognitive function and help an individual process information and make sense of the world. Therefore, it was assumed that there would be at least two meta-domains of humility, one that pertains to a social and another that fulfills a cognitive function.

Principal axis factoring was used with a Promax rotation to factor analyze the 14 humility measures (factor scores were saved using the regression method). From these 14 measures, four factors emerged with an eigenvalue greater than 1 explaining 54% of the variance. The full results are shown in Table 7 and are construed as "meta-domains" of humility as each factor includes multiple domains of humility. Somewhat surprisingly, the three facets of intellectual humility did not load on the same factor, and so there is not a clear cognitive meta-domain of humility. The first factor appears to capture a prosocial meta domain of humility as it includes the four facets from Honesty-Humility which largely entail a person's proclivity to not exploit others, along with ethical humility. The second factor may capture humility accompanied by negative affect given that self-abasing humility has the highest loading and the negative relation of appropriate discomfort of limitations. The third factor seems to correspond to an appreciative form of humility as that can explain the link between environmental humility (appreciating nature), Einsteinian humility (appreciating the contributions of others), and valuing humility (appreciating humility and humble individuals). The fourth factor primarily captures religious humility which may be somewhat appreciative (of a divine being) and prosocial given the relevance of fairness, however religious humility seems the most unique from the other measures of humility.

Table 7

Factor Analysis of Humility Measures— Meta-Domains of Humility

	Prosocial factor (19.6%; 2.7)	Negative affect factor (13.7%; 1.9)	Appreciative factor (11.7%; 1.6)	Religious factor (9.1%; 1.3)
Ethical humility	**.42**	**.54**	-.01	.07
Love of learning	.28	-.16	.38	.02
Limitations owning	.22	-.27	**.48**	.17
Appropriate discomfort of limitations	.11	**-.73**	.21	-.18
Epistemic humility	.07	**.57**	**.45**	-.04
Environmental humility	-.11	.12	**.72**	-.38
Religious humility	-.17	.25	.07	**.88**
Self-abasing humility	-.03	**.78**	-.05	.15
Einsteinian humility	-.29	-.19	**.58**	.08
Valuing humility	.07	.16	**.57**	.27
Sincerity	**.61**	-.07	.03	.20
Fairness	**.57**	-.09	.06	**.41**
Greed avoidance	**.85**	.05	-.14	-.24
Modesty	**.80**	.08	-.02	-.25

Notes. Parentheses include the % of variance explained by that factor along with the eigenvalue. Bolded values indicate factor loading greater than .4.

Humility Items

The second and perhaps more informative factor analysis included all 62 items from the

14 humility measures. This would determine if there are indeed 14 separate domains of humility.

It was expected that there would be some correlations between the items, especially items from

the same measure, therefore a ProMax rotation was used with Kappa set to 4 (the default).

Principal axis factoring was the chosen method and there were no fixed number of factors set as

this was an exploratory analysis. After 73 iterations, 18 factor scores (saved as factor scores from

the regression method) emerged with an eigenvalue greater than 1 accounting for 70.5% of the

total variance. Each of the original 14 humility measures largely corresponded to one of the 18

factor scores with results presented in Table 8. Four of the original 14 humility measures

(valuing humility, love of learning, limitations owning, and self-abasing humility) loaded onto

two factors, resulting in 18 factors. Given that each of the factors largely reflected an existing

humility measure and that each measure had around five items, showing the most pertinent five

items for each factor does not omit any key items (although self-abasing humility has six items,

not all six items loaded on a single factor). The eigenvalue method seemed appropriate here as

all 18 factors encompassed each aspect of the humility domains. The factors with the lowest

eigenvalues above 1 captured an aspect of a particular humility domain that was neglected. For

example, the final 18th factor had the highest factor loading for an item of valuing humility that

did not load with the other four valuing humility items on the sixth factor.

The first five factors had items with a loading above .4 from their respective domain of

humility (for example, the items with the highest loadings on the religious humility factor score

were all from religious humility). The four items with a loading greater than 0.4 on factor 6 were

from valuing humility, however the remaining item of valuing humility did not have a loading

above .4. This fifth item from valuing humility had a high loading on the last factor, along with an item from sincerity. Self-abasing humility was also captured by two factors. The items pertaining to feeling "worthless" and "unimportant" had high loadings on the seventh factor whereas the two items about feeling "meek" and "submissive" had a loading below .4 on this factor (the reverse result occurred for the thirteenth factor). The two remaining self-abasing humility items about feeling "small" and "shameful" were relevant to both self-abasing humility factors, suggesting that feeling small and shameful may be at the core of this particular operationalization of self-abasing humility. Therefore, the factor analysis suggests that feeling "meek" and "submissive" are similar, which both differ from feeling "unimportant" and "worthless". It may be the case that feeling meek and submissive is more likely to be a response to social elicitors, whereas feeling unimportant and worthless represents more of a global evaluation of oneself made across contexts with and without social elicitors. The seventh factor will be named "Worthless self-abasing humility" as feeling worthless had the highest factor loading whereas the thirteenth factor will be named "Meek self-abasing humility" as feeling meek had the highest factor loading for this factor.

Amongst the three facets of intellectual humility, only the four items from the appropriate discomfort of limitations loaded together on a single factor. Three of the four love of learning items loaded on the tenth factor (the item "I care about truth" was not relevant) and this excluded item loaded on the seventeenth factor. Three of the four items from the limitations owning facet loaded on the eleventh factor; the item from this facet that did not load on this factor was, "I have a hard time admitting when one of my beliefs is mistaken". Interestingly, an item from appropriate discomfort of limitations also loaded with these three limitations owning items in the eleventh factor. The item from limitations owning, "I have a hard time admitting when one of my

beliefs is mistaken" loaded on the sixteenth factor with another item from the limitations owning facet.

Table 8

Factor Analysis of Humility Items

Humility Factor Scores	Highest Loading				
Religious humility factor (11.5%; 7.1)	My Creator works through me in all my good actions (.96)	God requires us to be humble (.95)	Ultimately, there is a Supreme Being who gets all of the credit and glory for our individual accomplishments (.94)	I accept my total dependence upon the grace of God. (.93)	I often feel humble when I think of a Higher Power (.88)
Greed avoidance factor (8.6%; 5.3)	I would like to live in a very expensive, high-class neighborhood (.89)	I would get a lot of pleasure from owning expensive luxury goods (.83)	I would like to be seen driving around in a very expensive car (.74)	Having a lot of money is not especially important to me (.71)	I want people to know that I am an important person of high status (.54) *
Epistemic humility factor (8.0%; 5.0)	I often find myself pondering my smallness in the face of the vast universe (.84)	I frequently think about how much bigger the universe is than our power to comprehend (.83)	I often think about the fragility of existence (.83)	I feel awe towards the mysteries and complexities of life (.80)	When I look up at the stars at night, I am often deeply humbled (.52)
Ethical humility factor (6.2%; 3.8)	My actions are often aimed towards others (.89)	I often place the interests of others over my own interests (.83)	I always find myself making sacrifices for others (.80)	My friends would say I focus more on others than I do myself (.78)	I care about the welfare of others, at times more than my own welfare (.54)
Environmental humility factor (4.3%)	We should always be in harmony with Mother Nature (.89)	I often feel in touch with Mother Nature (.85)	It's important from time to time to commune with nature (.72)	Caring for humanity requires us to care about the environment (.44)	--
Valuing humility factor 1 (3.9%)	Humility is a virtue (.86)	Teaching kids the value of humility is very important to their development (.74)	I find humble people to be very admirable (.71)	A good dose of humble pie is often necessary (.65)	--
Worthless self-abasing humility factor (3.4%)	Worthless (.91)	Unimportant (.90)	Small (.46)	Shameful (.45)	--
Fairness factor (3.1%)	I would be tempted to buy stolen property if I were financially tight (.85)	I would be tempted to use counterfeit money if I were sure I would get away with it (.84)	If I knew that I could never get caught I would be willing to steal a million dollars (.66)	I would never accept a bribe even if it were very large (.50)	--
Sincerity factor (2.9%)	If I want something from a person I dislike, I will act very nicely towards that person in order to get it (.84)	If I want something from someone, I will laugh at that person's worst jokes (.78)	I wouldn't pretend to like someone just to get that person to do favors for me (.71)	I wouldn't use flattery to get a raise or promotion at work, even if I thought it would succeed (.52)	--
Love of learning factor 1 (2.8%)	When I don't understand something, I try hard to figure it out (.84)	I love learning (.81)	If I don't understand something, I try to get clear about what exactly is confusing me (.64)	--	--

Limitations owning factor 1 (2.5%)	I feel comfortable admitting my intellectual limitations (.87)	I am quick to acknowledge my intellectual limitations (.78)	When someone points out a mistake in my thinking, I am quick to admit I was wrong (.41)	I tend to get defensive about my intellectual limitations and weaknesses (.40) *	--
Appropriate discomfort of limitations factor (2.3%)	When I know that I have an intellectual weakness in one area, I tend to doubt my intellectual abilities in other areas as well (.84)	When I think about the limitations of what I know, I feel uncomfortable (.79)	I tend to get defensive about my intellectual limitations and weaknesses (.47)	I focus on my intellectual limitations and weaknesses (.40)	--
Meek self-abasing humility factor (2.1%)	Meek (.88)	Submissive (.74)	Shameful (.51)	Small (.47)	--
Modesty factor (2.0%)	I am an ordinary person who is no better than others (.76)	I think I am entitled to more respect than the average person is (.71)	I wouldn't want people to treat me as though I were superior to them (.52)	I want people to know that I am an important person of high status (.40)	--
Einsteinian humility factor (1.8%)	Personal responsibility rating for second accomplishment (.91)	Personal responsibility rating for third accomplishment (.79)	Personal responsibility rating for first accomplishment (.45)	--	--
Limitations owning factor 2 (1.8%)	I have a hard time admitting when one of my beliefs is mistaken (1.05)	When someone points out a mistake in my thinking, I am quick to admit that I was wrong (.52)	--	--	--
Love of learning factor 2 (1.7%)	I care about truth (.88)	If I don't understand something, I try to get clear about what exactly is confusing me (.44)	--	--	--
Valuing humility factor 2 (1.6%)	It's important to always keep one's accomplishments in perspective (.97)	I wouldn't use flattery to get a raise or promotion at work, even if I thought it would succeed (.47) *	--	--	--

Notes. The first column includes the name assigned to each factor in italics along with the % of variance accounted for by each factor and the eigenvalue (for the first four factors). Only items with a factor loading of .4 or greater are displayed. A * was used to mark any item that belongs to a disparate construct of humility from the other relevant items for that particular factor (this only happened in two factors).

Domains of Humility and Personality

To ensure that the domains of humility used in the study are not merely redundant features of more general personality constructs, bivariate correlations between domains of humility and the HEXACO facets were conducted. This may also help elucidate differences between domains of humility. The four facets from the Honesty-Humility dimension were not tested with the other HEXACO facets as they are supposedly orthogonal to the other HEXACO facets, and they are being treated as humility measures for the purpose of this study. Linear

regressions were used to assess the relationships between the domains of humility and the facets of personality; however, zero order correlations were computed first to identify the most pertinent facets to include in the regression to avoid overfitting the regression model. Personality facets that had a correlation above .2 with the humility domain of interest were typically retained for the regression afterwards. Facets with correlations exceeding .15 were included in the regression if fewer than 3 facets had a correlation above .2.

Table 9a

Correlations Between HEXACO Facets and Humility Measures

HEXACO facets	Ethical humility	Intellectual humility	Love of learning	Limitations owning	Appropriate discomfort of limitations	Epistemic humility
Sincerity	.16	.22*	.21*	.19	.08	.07
Fairness	.17	.24*	.21*	.23*	.07	.05
Greed avoidance	.25*	.14	.17	.10	.05	.14
Modesty	.28*	.18	.16	.20*	.04	.12
Fearfulness	-.11	-.19	-.11	-.12	-.18	.02
Anxiety	.22*	-.21*	.03	-.18	-.27*	.18
Sentimentality	.09	.01	-.02	.04	.00	.03
Dependence	.06	-.16	-.06	-.06	.20	.01
Social self-esteem	-.22*	.37*	.11	.24*	.39*	-.21*
Social boldness	.06	.17	.10	.18	.08	-.17
Sociability	.07	.18	.14	.18	.05	-.07
Liveliness	.00	.26*	.12	.21*	.21*	-.07
Forgivingness	.07	.26*	.17	.24*	.14	.15
Gentleness	.14	.29*	.12	.30*	.20*	.13

Flexibility	.10	.28*	.03	.41*	.15	.13
Patience	.18	.33*	.20*	.29*	.20*	.17
Organization	-.05	.17	.14	.10	.11	-.03
Diligence	.24*	.35*	.35*	.28*	.12	.20*
Prudence	.06	.27*	.25*	.23*	.09	.01
Perfectionism	.06	.21*	.32*	.10	.03	.15
Aesthetic appreciation	.10	.14	.14	.14	.04	.35*
Inquisitiveness	.06	.16	.25*	.09	.01	.20*
Creativity	-.01	.10	.15	.03	.03	.26*
Unconventionality	-.02	.19	.28*	.11	.04	.11

Note. Correlations equal to or greater than .2 are marked with an * unless the correlation was rounded up to .2.

Table 9b

Correlations Between HEXACO Facets and Humility Measures

HEXACO facets	Environmental humility	Valuing humility	Religious humility	Self-abasing humility	Einsteinian humility
Sincerity	.02	.13	.07	-.03	-.06
Fairness	-.01	.19	.22*	-.15	-.06
Greed avoidance	.03	.09	-.13	-.00	.19
Modesty	.04	.19	-.17	.09	.10
Fearfulness	-.11	-.11	.02	.09	-.07
Anxiety	.08	-.06	-.25*	.23*	-.09
Sentimentality	.03	-.02	.02	-.10	-.16
Dependence	.11	-.01	-.11	-.08	.04
Social self-esteem	.04	.11	.05	-.55*	-.13

Social boldness	.01	-.02	.02	-.33*	-.05
Sociability	.03	-.04	.11	-.20*	-.05
Liveliness	.18	.17	.15	-.40*	-.23*
Forgivingness	.08	.16	.24*	-.05	.09
Gentleness	.14	.17	.13	-.00	-.05
Flexibility	.09	.23*	.26*	-.03	.01
Patience	.08	.27*	.12	-.14	.08
Organization	.01	-.00	.11	-.23*	-.04
Diligence	.24*	.17	.07	-.23*	-.16
Prudence	.00	.07	.05	-.24*	.09
Perfectionism	.15	.17	-.03	-.17	-.09
Aesthetic appreciation	.32*	.11	-.01	.06	-.02
Inquisitiveness	.23*	-.05	-.07	-.06	.01
Creativity	.24*	.04	-.07	-.01	.09
Unconventionality	.18	.01	-.14	.04	.15

Note. Correlations equal to or greater than .2 are marked with an * unless the correlation was rounded up to .2.

Table 10a

Regression Results from Pertinent HEXACO Facets and Humility Measures

HEXACO facets	Ethical humility	Intellectual humility	Love of learning	Limitations owning	Appropriate discomfort of limitations	Epistemic humility
Sincerity	--	.07	.08	--	--	--
Fairness	--	.04	.02	.05	--	--
Greed avoidance	.04	--	--	--	--	--

Modesty	.16*	--	--	.12	--	--
Anxiety	.10	--	--	--	-.08	--
Dependence	--	--	--	--	-.20**	--
Social self-esteem	-.26***	.31***	--	.20*	.42***	-.24***
Liveliness	--	-.06	--	-.01	-.10	--
Forgivingness	--	.04	--	.03	--	--
Gentleness	--	.15	--	.09	.12	--
Patience	--	.09	.06	-.01	.09	--
Flexibility	--	.09	--	.29***	--	--
Diligence	.28***	.10	.15	.07	--	.21**
Prudence	--	.13	.07	.12	--	--
Perfectionism	--	--	.16*	--	--	--
Aesthetic appreciation	--	--	--	--	--	.23**
Inquisitiveness	--	--	.08	--	--	.03
Creativity	--	--	--	--	--	.10
Unconventionality	--	--	.22**	--	--	--

Notes. HEXACO facets with a correlation of .2 or greater from Table 9a were used as independent variables predicting a measure of humility. A * indicates that *p* is <.05; ** means *p* is <.01; *** means *p* is <.001. Given that more than 10 facets had a correlation above .2 with intellectual humility, only those facets with a correlation greater than .25 were tested in a regression with intellectual humility as the dependent variable.

Table 10b

Regression Results from Pertinent HEXACO Facets and Humility Measures

HEXACO facets	Environmental humility	Valuing humility	Religious humility	Self-abasing humility	Einsteinian humility
Fairness	--	-.05	.20**	--	--
Greed avoidance	--	--	--	--	.22**

Modesty	--	.21**	-.24***	--	--
Anxiety	--	--	-.14	.06	--
Sentimentality	--	--	--	--	.07
Social self-esteem	--	--	--	-.41***	--
Social boldness	--	--	--	-.15	--
Sociability	--	--	--	.07	--
Liveliness	.14	.10	--	-.08	-.16*
Forgivingness	--	.05	.08	--	--
Gentleness	--	-.04	--	--	--
Patience	--	.12	--	--	--
Flexibility	--	.14	.17*	--	--
Organization	--	--	--	-.04	--
Diligence	.14	-.00	--	.00	.14
Prudence	--	--	--	-.13	--
Perfectionism	--	.12	--	--	--
Aesthetic appreciation	.22**	--	--	--	--
Unconventionality	--	--	.22*	--	--

Notes. HEXACO facets with a correlation of .2 or greater from Table 9b were used as independent variables predicting a measure of humility. A * indicates that p is <.05; ** means p is <.01; *** means p is <.001. The correlation threshold was set to .15 for valuing humility and Einsteinian humility as there were less than 3 HEXACO facets with correlations above .2 for both of these humility domains.

Personality and Dispositional Awe (Positive and Negative)

The same data analysis strategy employed with personality and humility domains was utilized here. Results from the bivariate correlation and linear regressions are shown in Table 13. The most germane facet for both valences of dispositional awe is liveliness from extraversion

(positively associated with dispositional awe and negatively associated with dispositional negative awe). The HEXACO facets were better at predicting dispositional negative awe than dispositional positive awe given that none of the facets were statistically significant for predicting dispositional awe and three facets were significant predictors of dispositional negative awe.

Table 11

Relationship Between HEXACO facets and Dispositional (Positive and Negative) Awe

HEXACO facets	Dispositional Awe		Dispositional Negative Awe	
	Correlation	Beta Coefficient	Correlation	Beta Coefficient
Sentimentality	.21	.13	--	--
Fearfulness	--	--	.22	.17*
Anxiety	--	--	.23	.05
Social self-esteem	--	--	-.41	-.38***
Social boldness	--	--	-.37	-.24***
Liveliness	.29	.15	-.20	.15
Forgivingness	.23	.13	--	--
Flexibility	.24	.13	--	--
Patience	.27	.02	--	--
Diligence	.30	.09	--	--
Perfectionism	.23	.14	--	--

Notes. Only HEXACO facets with a correlation of .2 or greater are displayed and were used as independent variables in a subsequent linear regression predicting a measure of dispositional awe. A * indicates that p is $<.05$; ** means p is $<.01$; *** means p is $<.001$.

Video Attention Checks

One of seven videos were randomly shown to each participant, three were intended to induce positive awe, three were intended to induce negative awe, and the final video was meant to induce both valences of awe. A one-way ANOVA with a Tukey post hoc test was conducted to determine if the positive awe videos did in fact elicit more positive awe. Results indicated that indeed the positive awe videos (Ibex goats and Planet Earth trailers) did elicit a significantly greater amount of positive awe than the negative awe videos (the tsunami video and tornado videos). The tsunami video elicited significantly less positive awe than the tornado videos and the space video. Table 12 reports the mean amount of positive and negative awe elicited from each manipulation. The Planet Earth trailer (with sound) elicited the most positive awe, but it was not significantly greater than the amount of positive awe evoked by the Ibex goat video or the Planet Earth trailer without sound.

Table 12

Mean Awe Ratings from Manipulations

	Elicited Positive Awe			Elicited Negative Awe		
	N	*M*	*SD*	*N*	*M*	*SD*
Ibex Goat video	44	4.95	1.43	44	2.91	1.76
Planet Earth trailer	35	5.26	1.17	34	1.53	.99
Planet Earth trailer (no audio)	32	4.87	1.58	33	1.73	1.35
Tsunami video	36	1.72	1.27	36	5.50	1.32
Tornado video	42	3.45	1.43	42	3.31	1.58
Tornado video (no audio)	36	3.31	1.63	36	4.06	1.71

Space video	22	4.41	1.53	23	3.30	1.84
Written task (past awe)	119	6.29	.76	129	5.60	1.16
Written task (current awe)	119	4.91	1.39	129	3.85	1.53

Note. All response options were presented on a seven-point Likert scale.

Table 13

Emotion Correlations with Awe Ratings from Video Manipulations

	Joy	Calmness	Negative awe	Sadness	Surprise	Fear	Positive awe	Compassion
Correlation with Positive Awe	.72*	.46	-.42	-.41	.25	-.23	--	.16
Correlation with Negative Awe	-.44	-.48	--	.70	.24	.78*	-.42	.09

Note. A * marks the highest correlation with positive awe on the second row and with negative awe on the third row.

Table 14

Mean Positive Awe Differences Across Videos

	Planet Earth	Planet Earth (no audio)	Tsunami	Tornado	Tornado (no audio)	Space
Ibex goats	-.31	.08	3.20***	1.54***	1.65***	.55
Planet Earth	--	.39	3.53***	1.81***	1.96***	.86
Planet Earth (no audio)	--	--	3.15***	1.42***	1.57***	.91
Tsunami	--	--	--	-1.73***	-1.58***	-2.69***
Tornado	--	--	--	--	.153	-.96

					-1.10
Tornado (no audio)	--	--	--	--	--	-1.10

Note. A * Indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001.

There were three videos meant to induce negative awe— the tsunami video, a tornado video, and the same tornado video without sound. The space video has been shown to induce both positive and negative awe. A one-way ANOVA with a Tukey post hoc test was conducted to examine if the negative awe videos did elicit more negative awe than the positive awe videos (see Table 15). Somewhat surprisingly, the tsunami video which has only been used in our previous pilot study was the best elicitor of negative awe. The tsunami video elicited a significantly greater amount negative awe than every other video, including the tornado videos also meant to evoke negative awe. Interestingly, the tornado and space video did not elicit a significantly greater amount of negative awe than the Ibex goat video. Ratings of negative awe across all the videos correlated most with ratings of fear while having the weakest association with feelings of compassion (see Table 13).

Table 15

Mean Differences in Elicited Negative Awe Across Video Manipulations

	Planet Earth	Planet Earth (no audio)	Tsunami	Tornado	Tornado (no audio)	Space
Ibex goats	1.38**	1.16*	-2.59***	-.40	-1.15*	-.23
Planet Earth	--	-.22	-3.97***	-1.78***	-2.53***	-1.61**
Planet Earth (no audio)	--	--	-3.75***	-1.56***	-2.31***	-1.39*
Tsunami	--	--	--	2.19***	1.44**	2.36***

Tornado	--	--	--	--	-.75	.17
Tornado (no audio)	--	--	--	--	--	.92

Note. A * Indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001

Hypothesis Testing

Hypothesis 1: Is Intellectual Humility the Best Predictor of Elicited Positive Awe?

The results revealed partial support for this hypothesis. After conducting bivariate correlations to determine which humility measures would be used as independent variables for the subsequent linear regression, epistemic humility (β = .194, *p* < .01), not intellectual humility, was the best predictor of elicited positive awe from the video manipulations (see Table 16). Intellectual humility did not meet the correlation threshold to be included in the linear regression. However, appropriate discomfort of limitations (β = .183, *p* < .01), a facet of intellectual humility, was the second-best predictor of positive awe from the videos. Epistemic humility and appropriate discomfort of limitations were not statistically different for predicting elicited positive awe from the videos (as determined by the Cumming, 2009, method). Religious humility (β = .225, *p* < .05) was the best predictor of elicited positive awe from the written task. Although it was the only independent variable that was statistically significant, it was not statistically different from fairness (β = .159, *ns*) or valuing humility (β = .157, *ns*) at predicting positive awe from the written task.

Table 16

Relationships Between Positive Awe Ratings and Pertinent Domains of Humility

Humility measures	Awe from videos		Written task (past awe)		Written task (current awe)	
	R	β	r	B	r	β
Epistemic humility	.22	.19** (.09, .60)	.13	.11 (-.07, .23)	--	--
Appropriate discomfort of limitations	.10	.18** (.10, .58)	--	--	--	--
Intellectual humility	.09	--	-.01	--	.07	--
Fairness	.15	.10 (-.09, .43)	--	--	.22	.16 (-.02, .34)
Environmental humility	.17	.09 (-.09, .41)	.14	.07 (-.13, .26)	--	--
Greed avoidance	.16	.08 (-.08, .27)	--	--	--	--
Valuing humility	.15	.05 (-.13, .34)	.25	.26** (.08, .48)	.24	.16 (-.05, .66)
Sincerity	.12	.01 (-.20, .23)	--	--	--	--
Religious humility	--	--	--	--	.27	.23* (.03, .30)
Love of learning	--	--	-.11	-.18 (-.35 .00)	--	--

Notes. Only correlations that were used in the subsequent linear regression were included. Correlations for intellectual humility are still shown as this was relevant for the hypothesis although intellectual humility was not used in the subsequent linear regression. There was only one humility measure with a correlation above .2 for positive awe ratings from the videos and ratings of past awe from the written task, so all humility measures with a correlation above .1 were shown. The correlation threshold was .2 for elicited awe from the written task as there were 3 humility measures with a correlation above .2. Beta coefficients are displayed with 95% CIs in parenthesis. A * indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001. All tolerance and VIF scores were acceptable.

The 18 factor scores derived from the previous factor analysis of all 62 humility items were also tested with elicited positive awe (see Table 17). These results largely mirror the results from the 14 humility domains. The epistemic humility factor was the best predictor of elicited positive awe from the videos and the religious humility factor was the best predictor of elicited positive awe from the recall task.

Table 17

Relationships Between Positive Awe Ratings and Pertinent Humility Factors

Humility Factors	Elicited Positive Awe from Videos		Elicited Positive Awe from Written task	
	Correlation	Beta coefficient	Correlation	Beta coefficient
Epistemic humility factor	.25	.23** (.16, .67)	--	--
Appropriate discomfort of limitations factor	.10	.19** (.09, .57)	--	--
Environmental humility factor	.17	.11 (.14, -.06)	--	--
Religious humility factor	--	--	.31	.25** (.10, .62)
Valuing humility factor 1	--	--	.27	.18 (-.015, .48)
Limitations owning factor 1	--	--	.23	.14 (-.06, .40)
Fairness factor	--	--	.20	.15 (-.04, .44)

Notes. All tolerance and VIF scores were acceptable. * Indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001.

Hypothesis 2: Is Intellectual Humility the Best Predictor of Dispositional Awe?

The results do not find support for the hypothesis that intellectual humility is the best predictor of dispositional awe (see Table 18). Using the same data analysis strategy described previously, valuing humility (β = .220, p <.001) emerged as the best predictor of dispositional awe, followed by environmental humility (β = .144, p<.05), and the limitations owning facet of intellectual humility (β = .117, ns). When assessing humility factor scores, the second limitations owning factor (β = .209, p <.001) is the third best predictor and the most statistically significant independent variable although it is not significantly different from the valuing humility factor (β = .214, p <.01) or the environmental humility factor (β = .214, p <.01). Assessing the relationship between humility and the second factor score of dispositional awe items that largely corresponded to dispositional awe yielded similar findings. Of note, the environmental humility factor (β = .288, p <.001) was the best independent variable at predicting the factor score of dispositional awe.

Table 18

Dispositional Awe and Pertinent Humility Domains

Humility measures	Dispositional Awe		Dispositional Awe Factor	
	Correlation	Standardized beta coefficient	Correlation	Standardized beta coefficient
Valuing humility	.32	.22*** (.08, .30)	.30	.23*** (.16, .53)
Environmental humility	.24	.14* (.02, .23)	.24	.18** (.08, .39)
Limitations owning	.22	.12 (-.00, .20)	.21	.11 (-.01, .26)
Epistemic humility	.23	.11 (-.02, .20)	--	--
Intellectual humility	.13	--	.15	--

Factors of humility

Epistemic humility factor	.22	.11 (-.02, .20)	--	--
Environmental humility factor	.29	.21** (.07, .29)	.31	.29*** (.16, .41)
Valuing humility factor 1	.30	.21** (.07, .29)	.29	.23*** (.10, .34)
Love of learning factor 1	.20	.14* (.01, .22)	--	--
Limitations owning factor 2	.20	.21*** (.07, .28)	.22	.23*** (.10, .35)

Notes. Correlations that exceeded the threshold of .2 are shown (intellectual humility correlations are still displayed as this was relevant to the hypothesis). 95% Confidence intervals are shown in brackets after beta coefficients. * Indicates a *p* value <.05; ** indicates a *p* value <.01; *** indicates a *p* value <.001. Humility measures and factors of humility were tested separately.

Hypothesis 3: Is Elicited Negative Awe Best Predicted by Self-abasing Humility?

This hypothesis received partial support. Religious humility (β =.105, *ns*) was the best predictor of negative awe from the videos and modesty (β =-.241, *p* <.05) was the best predictor of elicited negative awe from the written task (see Table 19). However, when humility factor scores were analyzed, the meek self-abasing humility factor (β = .164, *p* <.05) was the best predictor of negative awe from the videos and the second valuing humility factor (β = .283, *p* <.01) was the best predictor of elicited negative awe from the written task (see Table 20). Religious humility was not significantly different from greed avoidance, appropriate discomfort of limitations, self-abasing humility, or modesty when predicting negative awe from the videos. Modesty was also not significantly different from the other humility measures predicting elicited negative awe from the written task.

Table 19

Domains of Humility and Elicited Negative Awe

Humility measures	Awe from Videos		Written task (past awe)		Written task (current awe)	
	R	B	r	β	r	β
Religious humility	.15	.11 (-.05, .47)	--	--	.20	.12 (-.10, .46)
Greed avoidance	-.15	-.10 (-.49, .12)	--	--	--	--
Appropriate discomfort of limitations	-.11	-.07 (-.43, .14)	--	--	--	--
Self-abasing humility	.12	.06 (-.16, .42)	.25	.26** (.11, .50)	--	--
Modesty	-.13	.09 (-.09, .41)	--	--	-.19	-.24* (-.63, -.08)
Fairness	--	--	--	--	.18	.11 (-.12, .48)
Environmental humility	--	--	.20	.18* (.01, .41)	--	--
Valuing humility	--	--	.31	.25** (.09, .52)	--	--
Love of learning	--	--	--	--	.18	.14 (-.06, .47)
Limitations owning	--	--	--	--	.15	.14 (-.10, .62)

Notes. Only correlations that were used in the subsequent linear regression are shown. The correlation threshold for the videos was .1 as there were fewer than 3 humility measures with a correlation above .2 for those conditions. The correlation threshold for elicited awe from the written task was .15 as there were also fewer than 3 humility measures with a correlation exceeding .2 but there were more than 10 humility measures with a correlation above .1. A * indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001. 95% CIs are shown in brackets. All tolerance and VIF scores were acceptable.

Table 20

Humility Factor Scores and Elicited Negative Awe

Humility Factor Scores	Elicited Negative Awe from Videos		Elicited Negative Awe from Written task	
	Correlation	Beta coefficient	Correlation	Beta coefficient
Meek self-abasing humility factor	.17	.16* (.06, .60)	--	--
Appropriate discomfort of limitations factor	-.13	-.12 (-.52, .03)	--	--
Religious humility factor	.11	.08 (-.12, .43)	.23	.12 (-.10, .46)
Greed avoidance factor	-.13	-.13 (-.54, .00)	--	--
Modesty factor	--	--	-.16	--
Valuing humility factor 2	--	--	.29	.28** (.13, .70)
Love of learning factor 1	--	--	.25	.28** (.16, .76)

Notes. A * Indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001. All tolerance and VIF scores were acceptable.

Hypothesis 4: Is Self-abasing Humility the Best Predictor of Dispositional Negative Awe?

This hypothesis also received partial support. Although self-abasing humility had the largest correlation with dispositional negative awe, an appropriate discomfort of limitations (β = -.313, *p* <.001) was the best predictor of dispositional negative awe in the subsequent linear regression. However, self-abasing humility (β =.300, *p* <.001), was the second-best predictor of dispositional negative awe and it was not significantly different from an appropriate discomfort of limitations (see Table 21). Further, self-abasing humility (β = .280, *p* <.001) was the best predictor of the social threat dispositional negative awe factor although this was not significantly

different appropriate discomfort of limitations (β = -.262, *p* <.001). Epistemic humility (β = .273,

p <.001) was the best predictor of the less threatening non-social dispositional negative awe.

Self-abasing humility then was not the best predictor of dispositional negative awe, but it was the

best predictor of the social threat portion of dispositional negative awe.

Table 21

Humility and Dispositional Negative Awe

Domains of humility	Dispositional Negative Awe		Social Threat Dispositional Negative Awe		Non-social Dispositional Negative Awe	
	r	β	r	B	r	β
Appropriate discomfort of limitations	-.45	-.31***(-.49, -.18)	-.46	-.26*** (-.41, -.10)	-.31	-.21*** (-.32, -.09)
Self-abasing humility	.49	.30*** (.17, .363)	.42	.28*** (.13, .32)	.37	.19** (.05, .25)
Epistemic humility	.35	.20*** (.10, .32)	--	--	-.42	.27*** (.15, .36)
Intellectual humility	-.35	-.04 (-.32, .17)	-.39	-.13 (-.45, .03)	--	--
Valuing humility	--	--	--	--	.25	.13* (.02, .36)
Modesty	--	--	--	--	.25	.18* (.08, .31)
Humility factor scores						
Appropriate discomfort of limitations factor	-.46	-.38***(-.52, -.28)	-.44	-.38***(-.49, -.25)	-.28	-.20** (-.32, -.07)
Meek self-abasing humility factor	.30	.18** (.07, .31)	.25	.23*** (.12, .35)	.24	.05 (-.08, .17)

Worthless self-abasing humility factor	.34	.16** (.05, .29)	.28	.08 (-.05, .20)	.275	.20** (.08, .33)
Epistemic humility factor	.32	.27*** (.16, .40)	--	--	.42	.36*** (.23, .48)
Love of learning factor	-.21	-.20**(-.32, -.10)	-.28	-.22** (-.34, -.11)	--	--
Sincerity factor	--	--	-.21	-.13* (-.25, -.02)	--	--
Valuing humility factor	--	--	--	--	.25	.16* (.04, .28)

Notes. All tolerance and VIF levels were acceptable for linear regressions (the highest VIF scores were 2.03 and 2.18 for intellectual humility and appropriate discomfort of limitations, respectively). Domains of humility and humility factor scores were tested separately. A * indicates a *p* value < .05; ** indicates a *p* value <.01; *** indicates a *p* value <.001.

Discussion

This study had three objectives. The primary goal was to clarify the relationship between awe proneness (positive and negative) with various domains of humility. A second objective was to investigate how distinct domains of humility are from each other (an assumption the primary objective rests on), and a tertiary goal was to shed light on the nature and function of awe by using the results from the first objective. It was expected that the function of awe is primarily cognitive, not prosocial, therefore cognitive domains of humility should be more frequently associated with awe proneness than prosocial domains of humility. However, negative awe was expected to be best predicted by self-abasing humility (which is neither a prosocial or cognitive domain of humility) given various conceptual commonalties such as feeling small and threatened.

This study included nine different domains of humility— ethical humility, intellectual humility, epistemic/cosmic humility, environmental humility, religious humility, self-abasing

humility, Einsteinian humility, greed avoidance, and modesty. Sincerity and fairness may be more reflective of the "honesty" aspect of the honesty-humility dimension of the HEXACO; however, they were treated as humility measures given that they belong to the honesty-humility dimension. Likewise, "valuing humility" was also treated as a humility measure as it is a part of the dual dimension model of humility scale and is considered an indirect measure of general humility. Intellectual humility was treated as a distinct type of humility, however each of the three facets were also treated as separate humility measures. In total then, there were 14 humility measures. The relationship between these 14 humility measures and personality facets from the HEXACO were assayed to ensure that these measures of humility were not merely redundant features of personality from the HEXACO under different names. Nearly all correlations were weak (below .4) indicating that these humility measures are capturing a substantial amount of variance that is not subsumed by the HEXACO.

Two factor analyses of humility measures were also conducted to corroborate the assumptions that there are distinct domains of humility as well as different meta-domains of humility. The factor analysis of all 62 individual items from the 14 humility measures revealed that there are (18) different domains of humility (within this study), and the factor analysis of average scores from the 14 humility measures revealed four meta-domains of humility (prosocial, negative affect, appreciative, and religious). Unexpectedly, there was no meta-domain that seemed to fulfill a primarily cognitive function. In general, these results cast doubt on the view that humility measures are all manifestations of one general humility trait manifesting in various contexts.

The three facets of intellectual humility along with epistemic humility were classified as cognitive domains of humility whereas the facets from the honesty-humility dimension along

with ethical humility were treated as prosocial domains of humility. Although the four purported cognitive domains of humility did not group together in the factor analysis of humility measures, the three facets of intellectual humility are components of the same overarching measure, and cosmic or epistemic humility has been conceptualized as an epistemic variant of humility as it involves an accurate view of oneself in relation to the vast universe (Earp et al., 2018).

Awe and Domains of Humility

It was expected that of all the humility measures used in this study (1) elicited positive awe would be best predicted by intellectual humility; (2) dispositional awe would be best predicted by intellectual humility; (3) elicited negative awe would be best predicted by self-abasing humility; (4) dispositional negative awe would be best predicted by self-abasing humility. A discussion of the findings for each hypothesis will follow, along with a discussion of the study's other objectives, an evaluation of the study's strengths, shortcomings, and suggestions for future research in this area.

Elicited Positive Awe and Humility

Epistemic or cosmic humility, not intellectual humility, was the best predictor of elicited positive awe from the awe videos, however the appropriate discomfort of limitations facet from intellectual humility was the second-best predictor. Epistemic humility was not a significantly better predictor of positive awe than appropriate discomfort of limitations. While the first hypothesis was not fully supported, these results lend support to the more general view that cognitive domains of humility are more relevant for predicting experiences of positive awe than (pro)social domains of humility (the presupposition that led to the hypothesized link between intellectual humility and positive awe). Ethical humility was considered the prototypical

prosocial domain of humility and intellectual humility was treated as the prototypical cognitive domain of humility, and the latter was more relevant for predicting positive awe than the former. An ancillary regression was conducted to test if these cognitive domains were better predictors of positive awe than dispositional positive awe. If epistemic humility, appropriate discomfort of limitations, and dispositional positive awe are entered as independent variables predicting positive awe from the videos, epistemic humility is still the best predictor (β =.238, p <.001) followed by appropriate discomfort of limitations (β =. 199, p <.01) and then dispositional positive awe (β =.126, p =.056). Dispositional positive awe was also correlated with elicited positive awe from the videos (r = .15) which was a larger correlation than appropriate discomfort of limitations and positive awe (r =.10) but not larger than epistemic humility and positive awe (r =. 23).

Epistemic humility has been construed in the present investigation as largely reflecting a tendency to feel awe (both valences) from cognitive elicitors (and perhaps physical elicitors that depict the vastness of space). Indeed, four of the items are about thinking of the universe, and many items are related to awe or a component of awe (e.g., feeling tiny, perceiving the universe as vast, feeling humbled from the stars, feeling awe towards mysteries). It was assumed that the tendency to feel awe from cognitive elicitors (e.g., pondering the size of the universe) would differ from the tendency to feel awe from physical elicitors (e.g., nature) from the videos, however these results suggest a lot of overlap between the two, assuming these are two distinct tendencies which may easily not be the case.

An appropriate discomfort of limitations implies feeling positive affect (or at least an absence of negative affect) when one's intellectual limitations are made salient. For example, one item from the subscale reads, "I get defensive when thinking about my intellectual

limitations" (reverse coded). Scoring high on the appropriate discomfort of limitations requires disagreeing with each item, as each item expresses feeling negative affect. Disagreeing with each item then implies that people could feel comfortable with their intellectual limitations (experience positive affect), or they are indifferent and simply don't feel uncomfortable without feeling much positive affect from acknowledging their limitations. Those who feel positive affect when their intellectual limitations are made salient should be more likely to experience positive awe, insofar as an experience of awe makes one's intellectual limitations salient. The prototypical awe experience does violate schemas, which would presumably expose one's intellectual limitations. If one is not comfortable with their intellectual limitations, then they may be more likely to experience negative awe, and indeed, appropriate discomfort of limitations was negatively correlated with elicited negative awe as will be discussed later.

The results seem to suggest that the relevance of cognitive domains of humility for positive awe depended on the awe manipulation. Specifically, positive awe induced from the videos was better predicted by cognitive domains of humility than positive awe from the written or recall task. Religious humility— the best predictor of positive awe from the written task— is arguably neither a cognitive nor social domain of humility. Indeed, the factor analysis of humility measures revealed that religious humility largely formed its own factor score with slight loadings from the fairness facet. These results suggest that the type of elicitor is relevant when considering which domains of humility will predict experiences of awe. The videos presented novel or unfamiliar physical elicitors to participants which may have been more challenging to process than recalling an experience of awe. This can explain why cognitive domains of humility (epistemic humility and appropriate discomfort of limitations) were the only statistically significant predictors of positive awe from the videos. Recalling an experience of awe that

someone already experienced may be less challenging and evoke less schema violation as they have already had time to process the event.

It was unexpected that religious humility would be the best predictor of elicited positive awe from the written task and the only domain of humility that was statistically significant in this analysis. Religious humility also had a higher correlation with elicited positive awe from the written task (r =.26) than did dispositional positive awe (r =.16). As mentioned, religious humility is also the most unique variant of humility that is distinct from the other three meta-domains of humility discovered (the prosocial, negative affect, and appreciative meta-domains). The uniqueness of religious humility likely has to do with its contingency on religious belief unlike any other domain of humility. One explanation why religious humility was the best predictor of elicited positive awe from the recall task is that those with religious humility may use their faith or belief system to make sense of their awe experience. This may have helped to elicit positive affect and reduce uncertainty associated with the awe experience which would presumably attenuate negative affect. Indeed, preliminary analyses revealed that religious humility was negatively associated with anxiety (a likely consequence from uncertainty) from the HEXACO. Past research also suggests that attributing an experience of awe to an agent (like a deity) can reduce feelings of uncertainty (Valdesolo & Graham, 2014). Instructions in the written task did ask participants to write about an experience that was amazing and *challenging*, and challenging experiences should be associated with more uncertainty. Those with religious humility may have also been more likely to write about a religious experience which might be rated as more meaningful and awe-inspiring than nonreligious awe experiences. Indeed, prior research found that those who recalled a spiritual experience of awe reported less of a need for cognitive accommodation or uncertainty than those who did not recall a spiritual experience of

awe (Preston & Shin, 2017). Although greater uncertainty or a heightened need for cognitive accommodation may signal a more intense experience of awe, too much uncertainty may impede cognitive accommodation and foster additional stress or negative affect.

Dispositional Positive Awe and Humility

Contrary to the second hypothesis, intellectual humility (or any cognitive domain of humility) was not the best predictor of dispositional positive awe (valuing humility was). One potential reason intellectual humility was not relevant for dispositional positive awe is that the dispositional awe scale does not capture a need for cognitive accommodation (or perhaps a tendency to question the validity of one's schemas and preconceptions) very well. One item does mention seeking out challenging experiences however the remaining five items do not likely involve schema violation or feeling challenged as they are about seeing beauty, feeling wonder, finding patterns, and seeing nature. The item "I often feel awe" relies on the lay conception of awe and some research suggests that this is akin to wonder and therefore milder than the scholarly conception that requires schema violation (Bonner & Friedman, 2011; Shiota et al., 2006; Weger & Wageman, 2018).

Only valuing humility and environmental humility were statistically significant when predicting positive dispositional awe (limitations owning was the third best predictor). The possible connection between each of these three domains of humility and dispositional positive awe can be made on an individual basis (for example, dispositional awe includes physical elicitors of awe like beauty and nature, and those with environmental humility find nature valuable and are therefore more likely to see the beauty in nature). However, it is telling that valuing humility, environmental humility, and limitations owning, each load on the appreciative

meta-domain of humility. If factor scores from the four meta-domains of humility are entered as independent variables predicting dispositional awe, then the appreciative meta-domain humility was unsurprisingly the best predictor ($\beta = .324$, $p < .001$). Einsteinian humility also loaded on this appreciative meta-domain however, it was not relevant for predicting dispositional positive awe, perhaps because dispositional positive awe does not mention feeling awe from social elicitors and those with Einsteinian humility may be more likely to appreciate the contributions of others. Nonetheless, the correspondence between the appreciative meta-domain of humility and dispositional positive awe may suggest that the dispositional awe scale reflects an appreciative form of awe (e.g., appreciating beauty, nature, and patterns).

These analyses do not reveal whether dispositional awe is what leads to an increase in valuing humility, or vice versa, or if a third variable is responsible for both. All three scenarios seem possible— those who experience awe on a regular basis may feel more "humbled" and therefore recognize the value of humility. Those who see humility as a virtue may be humbler themselves, meaning they have a low self-focus which may give them a predilection towards feeling awe. Valuing humility has been construed as a proxy for a general domain of humility (Wright et al., 2018). Indeed, it was best predicted by modesty from the HEXACO in preliminary analyses, and modesty has been recommended to be used as a proxy for general humility from a recent meta-analysis (McElroy-Heltzel et al., 2019); however, modesty was not relevant for predicting dispositional positive awe, suggesting that something else about valuing humility, such as the appreciative component of it, is important for predicting proneness to positive awe.

The second limitations owning factor (from the factor analysis of individual humility items) was the most germane aspect of intellectual humility for predicting one's proneness to

positive awe. This factor mainly encompasses two items from limitations owning: "When someone points out a mistake in my thinking, I am quick to admit that I was wrong" and "I have a hard time admitting when one of my beliefs is mistaken" (reverse coded). These items both describe how easily one can admit they were mistaken when an error in their thinking is brought to light. This may imply that one is more willing to disengage from schema driven processing in order to revise their schemas or intellectual limitations, which can be associated with feeling awe in certain contexts.

To gain more insight into predictors of dispositional positive awe, an ancillary regression was conducted using the six HEXACO dimensions as independent variables with dispositional positive awe as the dependent variable. Interestingly, agreeableness was the best predictor of dispositional positive awe (β= .225, p <.01) although preliminary analyses revealed that diligence (from conscientiousness) was the most pertinent facet. Amongst the agreeableness facets, dispositional awe was most related to flexibility (r = .24) and patience (r = .27), and flexibility had the highest correlation with limitations owning (r = .41) of all the HEXACO facets. Flexibility from the HEXACO largely has to do with having flexible opinions, such as when others have dissenting views (e.g., "I am usually quite flexible in my opinions when people disagree with me"). Maintaining flexible opinions could be seen as a sign of agreeableness as it can be a tactic for reducing interpersonal conflict. However, this need not be the only motive for having flexible opinions- one may prefer thinking in nuanced or flexible ways for example. Additionally, the association between dispositional awe and patience might imply that a proneness to feeling anger (the opposite of patience from the HEXACO) can interfere with one's opportunities for feeling awe, explaining why anger proneness might be negatively correlated with positive awe proneness. Further, if one is patient, they might be less likely to move hastily

ignoring their surroundings and more likely to notice everyday sources of beauty in their environment. However, patience from the HEXACO largely has to do with keeping one's composure during interpersonal conflicts, and so it is unclear if this extends to other contexts.

Elicited Negative Awe and Humility

It was hypothesized that self-abasing humility would be the best domain of humility for predicting elicited negative awe from the videos and written task. When the original humility measures were used, religious humility was the best predictor of elicited negative awe from all seven videos, but it was not statistically significant. When humility factor scores were assessed, the meek self-abasing humility factor was the best predictor and the only humility factor that was statistically significant, although it was not significantly greater than the greed avoidance factor. Self-abasing humility was the best predictor of past ratings of negative awe in the written task whereas modesty was the best predictor of elicited (current ratings of) negative awe in the written task. Our hypothesis then was at minimum partially supported. Interestingly, if meek self-abasing humility and dispositional negative awe are tested as independent variables in a linear regression predicting elicited negative awe from the videos, meek self-abasing humility (β = .150, p <.05) is a better predictor than dispositional negative awe (β = 083, ns). Another ancillary analysis found that dispositional negative awe had a weak association with elicited negative awe from the videos (r =.09) and with elicited negative awe from the written task (r = .03).

Interestingly, the worthless self-abasing humility factor was not relevant for elicited negative awe, instead meek self-abasing humility was relevant. Negative awe from the videos was defined as a feeling of "fear and wonder" in line with past research (Gordon et al., 2018).

Feeling meek and submissive might be prompted by (or even include) fear whereas the connection between fear with feeling unimportant and worthless seems less clear. To compare the associations between ratings of fear from the videos and the six self-abasing humility items, bivariate correlations were conducted. Feeling meek ($r = .16$) and submissive ($r = .19$) had higher correlations with feelings of fear than did feeling unimportant ($r = .00$) and worthless ($r = .02$). Feeling unimportant and worthless might also inhibit feeling wonder or curiosity to a greater extent than feeling meek and submissive. Furthermore, a case could be made that worthless self-abasing humility is more prosocial than meek self-abasing humility as the former has strong negative association with social self-esteem and those with a low self-esteem may be more motivated to help others to avoid further rejection (Leary, 1999). Therefore, the relevance of meek self-abasing humility in these analyses over worthless self-abasing humility may suggest that negative awe is not carrying out a primarily prosocial function.

To better understand why religious humility was the best predictor of negative awe from the videos amongst the original 14 humility measures, correlations were computed between religious humility and each of the self-abasing humility items. The tendency to feel meek had the highest correlation with religious humility ($r = .31$) which would be expected as meek self-abasing humility was the best predictor of negative awe amongst the 18 humility factor scores. This might suggest that having religious humility might partially involve feeling meek, perhaps towards a deity.

Contrary to the broader assumption that awe should be associated with cognitive domains of humility more so than with (pro)social domains of humility, modesty was the best predictor of elicited negative awe from the written task. It may be the case that modest individuals are more prone to feeling insignificant and therefore negative awe after recalling threatening experiences

that challenge their worldview. However, the robustness of this result is called into question given that the modesty factor score was not relevant for predicting negative awe from the written task amongst the 18 factors of humility. Indeed, the second valuing humility factor was the best predictor, followed by the first love of learning factor. The second valuing humility factor does include an item from sincerity, another prosocial domain of humility. However, the highest loading on this factor was about the importance of keeping one's accomplishments in perspective, which may be similar to or an incidence of adopting a modest perspective. Despite this potential conceptual similarity, modesty and the second valuing humility factor likely differ in important ways given that they are distinct factors. The possibility that adopting a modest perspective can increase feelings of recalled negative awe does not however seem to explain the relevance of the first love of learning factor.

It seems that feeling negative awe from the videos was more akin to feeling fear whereas feeling negative awe from the recall task was predicted more so by one's willingness to take a modest perspective of the situation they wrote about. The written task did ask participants to write about an experience that did evoke fear, however recalling a frightening event is likely to evoke less fear in hindsight. Indeed, past ratings of negative awe were larger than current ratings of negative awe as shown in descriptive statistics. This may also explain why self-abasing humility was more relevant for past ratings of negative awe from the written task and from the videos, but not for elicited negative awe from the written task. To simplify then, these results suggest that those who are meek are more prone to feeling negative awe from threatening stimuli (specifically from physical elicitors like natural disasters) whereas those incline to take a modest perspective might be more prone to feeling negative awe upon recollection, however this second claim is more tenuous than the first.

Dispositional Negative Awe and Humility

Despite the presupposition that both valences of awe should be more associated with cognitive domains of humility than (pro)social domains of humility, it was originally hypothesized that self-abasing humility would be the best predictor of dispositional negative awe, given various overlaps between the two measures such as the proclivity for feeling small. Self-abasing humility was the second-best predictor after the appropriate discomfort of limitations facet which was negatively associated with negative awe. Indeed, an ancillary linear regression using the four meta-domains of humility as independent variables predicting dispositional negative awe showed that the "negative affect" meta-domain (the second factor score) was unequivocally the best predictor amongst the four meta-domains ($\beta = .571$, $p < .001$).

Unlike dispositional positive awe, dispositional negative awe separated into two factors from the factor analysis of the 12 items from both dispositional awe scales. Of the 14 meeasures of humility, self-abasing humility was the best predictor of the social threat dispositional negative awe factor and epistemic humility was the best predictor of the non-social dispositional negative awe factor. These results seem to provide partial support for the more general assumption that awe is more associated with cognitive domains of humility than prosocial domains (assuming self-abasing humility ought to not be regarded as a prosocial domain of humility) given the relevance of appropriate discomfort of limitations *and* epistemic humility.

The relevance of appropriate discomfort of limitations may be straightforward. This facet of intellectual humility was also pertinent for predicting positive awe experiences (from the videos), but in the opposite direction, meaning that the more discomfort people feel from thinking about their intellectual limitations, the more likely they are to feel negative awe. Awe

experiences challenge a person's schemas, which presumably exposes their intellectual limitations. Feeling uncomfortable is an indication of negative affect, explaining the negative valence of awe. This discomfort in the wake of realizing or reflecting on one's intellectual limitations may also been entangled with fear, which is often assumed to be an element of negative awe. This fear may arise from a sense of uncertainty after having one's limitations exposed, especially if someone has a high need for cognitive closure. If one's understanding of the world is shown to be inadequate in some way, it seems reasonable that the negative affect this would produce is more likely to resemble something like fear or anxiety as opposed to sadness or anger. Although the dispositional negative awe scale never mentions feeling "awe", it uses words like fear, intimidated, and small in response to powerful, vast, and overwhelming stimuli, therefore this scale includes the necessary prerequisites of negative awe.

The link between self-abasing humility and the social threat portion of dispositional negative awe is consistent with the conception of self-abasing humility as a means for withdrawing from uncomfortable social settings. Indeed, feelings of abasement should be more common in response to social elicitors as opposed to nature given that people can judge us for our inadequacies. These results suggest that self-abasing humility may be most predictive of negative awe proneness from social elicitors specifically, as opposed to negative awe from physical or cognitive elicitors whereas epistemic humility should be more predictive of feeling negative awe from physical and cognitive elicitors. Given that the meek self-abasing humility factor was more relevant for social elicitors of negative awe whereas the worthless self-abasing humility factor was more relevant for cognitive elicitors of negative awe, this may support the view that the tendency to feel "meek" and "submissive" is more likely to arise from social elicitors than the tendency to feel "worthless" and "unimportant". However, the social elicitors in

the dispositional negative awe scale are also threatening, and meek self-abasing humility was the best predictor of negative awe from the videos which showed physical elicitors of awe (natural disasters). Therefore, the more accurate interpretation consistent with all findings seems to be that meek self-abasing humility is more predictive of negative awe from threatening elicitors than worthless self-abasing humility.

Summary of Hypothesis Tests

Overall, hypotheses received partial support, however the purported link between negative awe and self-abasing humility seems to have been supported more so than the purported link between positive awe and intellectual humility. Positive awe was not only associated with cognitive domains of humility, but also with appreciative (e.g., valuing humility and environmental humility) domains of humility as well with religious humility. There did not appear to be a clear link between negative awe and appreciative domains of humility. Although the associations with awe and cognitive domains of humility was moderate, there was no evidence of an association between awe and prosocial domains of humility apart from modesty and negative awe from the written task which did not replicate in the follow up analysis with the 18 humility factors.

It seems that cognitive domains of humility were most relevant for predicting positive awe from the videos which participants would likely have been unfamiliar with, suggesting these could have been more challenging elicitors of awe whereas appreciative forms of humility and religious humility were relevant for the more retrospective measures of awe (the written task and dispositional awe). Although this was not predicted, it seems reasonable to assume that processing something unfamiliar would require less schema driven processing and more bottom-

up information flow which should be better predicted by cognitive domains of humility than social or appreciative domains. This distinction between unfamiliar and familiar elicitors of awe from retrospective reports may therefore be important to consider for the results obtained here and in future research.

It is also interesting to consider why cognitive domains of humility were less relevant for elicited negative awe than elicited positive awe in this study. Although the negative awe videos were like the positive awe videos in that they were also more unfamiliar to participants and therefore presumably more challenging to process than retrospective accounts of awe, the negative affect induced from the negative awe videos may have primarily been due to fear than schema violation. Indeed, negative awe had a higher correlation with fear than with surprise which could be a proxy for schema violation or feeling challenged. Although self-abasing humility is negatively related to the appropriate discomfort of limitations facet (they both had the highest loadings, in opposite directions, on the negative affect meta-domain), self-abasing humility (as operationalized in this study) arguably encompasses the tendency to feel negative affect from a larger variety of sources. The appropriate discomfort of limitations facet mainly captures feeling negative affect from the acknowledgement or exposure of one's intellectual limitations. Considering that meek self-abasing humility was the best predictor of negative awe from the videos, this suggests that the videos evoked negative awe and negative affect from the threatening natural disasters, making people feel meek and submissive, and so these videos did not make one's intellectual limitations salient. If they did, then the appropriate discomfort of limitations facet should have been more relevant. The videos then may have made one's physical limitations more salient.

Regarding self-abasing humility, it was relevant for both elicited negative awe and dispositional negative awe, although it seemed more relevant for the latter. Self-abasing humility in this study was operationalized as a general tendency to feel small, meek, shameful, etc., and so these feelings are not constrained to a particular elicitor. The negative awe videos contained physical elicitors whereas the dispositional negative awe scale included social, physical, and cognitive elicitors of negative awe. While the meek factor of self-abasing humility was most relevant for the social threat factor of dispositional negative awe, it was also the most relevant for predicting negative awe from the physical elicitors shown in the videos. Perhaps feelings of meek and submissiveness are not more likely to arise from social elicitors per se, but instead are more likely to arise when one feels confronted by a threatening stimulus (social or physical). This casts more doubt of awe having a social (or prosocial) function. Indeed, the description of negative awe ratings from the videos mention feeling fear and the social threat factor of dispositional negative awe also includes feeling fear. Feeling unimportant and worthless therefore may not coincide with feeling afraid given that worthless self-abasing humility was not relevant for predicting negative awe from the videos, rather meek self-abasing humility was. Perhaps then negative awe fulfills a similar function to fear, but with more of an emphasis on processing the potentially threatening stimuli than fear.

Interestingly, some humility measures were pertinent for both valences of awe. Valuing humility was the best predictor of past ratings of positive awe from the written task and the second-best predictor of past ratings of negative awe from the written task. Epistemic humility was the best predictor of elicited positive awe from the videos, and it was the best predictor of the non-social dispositional negative awe factor that encompasses cognitive and physical elicitors. Lastly, the appropriate discomfort of limitations facet was the second-best predictor of

elicited positive awe from the videos, and it was the best predictor of dispositional negative awe. This facet of intellectual humility was positively associated with elicited positive awe and negatively associated with dispositional negative awe. The relevance of these cognitive domains of humility (epistemic humility and appropriate discomfort of limitations) and the lack of (pro)social domains of humility predicting both valences of awe might suggest that awe may be fulfilling a more cognitive function.

The results of the study that pertain to the four hypotheses can be summarized by the following:

- Elicited positive awe from the videos was best predicted by epistemic humility and the appropriate discomfort of limitations facet of intellectual humility was the second-best predictor (the only two statistically significant results; see Table 16)

- Elicited positive awe from the written task was best predicted by religious humility (the only statistically significant result) and valuing humility was the best predictor of past ratings of awe (the only statistically significant result; see Table 16)

- Dispositional positive awe was best predicted by valuing humility and environmental humility (the only two statistically significant results; see Table 18)

- Elicited negative awe from the videos was best predicted by religious humility; however, this was not statistically significant. Of the 18 humility factor scores, meek self-abasing humility was the best predictor of elicited negative (only statistically significant result; see Table 19).

- Elicited negative awe from the recall task was best predicted by modesty (the only statistically significant result) and past ratings of negative awe from the recall task were best predicted by self-abasing humility (see Table 20)

- Dispositional negative awe was best predicted by an appropriate discomfort of limitations followed by self-abasing humility and epistemic humility (the only three statistically significant results; see Table 21)

Domains of Humility

Of the 62 individual humility items, a factor analysis found 18 distinct domains of humility, and of the 14 humility measures, a factor analysis found four meta-domains of humility. Interpreting the 18 humility factor scores was more straightforward as most of them replicated an existing humility measures. Only four humility measures were best captured by two factors: valuing humility (one of the five items loaded on another factor), self-abasing humility, love of learning, and limitations owning. To better uncover the differences between the two distinct factors that captured the same original humility measure, zero order correlations with the HEXACO facets were conducted. The first valuing humility factor pertained mostly to agreeableness ($r = .32$) whereas the second valuing humility factor mainly reflected introversion ($r = -.15$ with extraversion). The first love of learning factor was mostly correlated with conscientiousness ($r = .39$), particularly diligence ($r = .46$) and the second love of learning factor was mostly associated with extraversion ($r = .22$). Conceptually, the inquisitiveness facet seems most germane to love of learning of all the humility domains, so interestingly, the first love of learning factor was positively associated with inquisitiveness ($r = .39$) whereas the second love of learning facet was not associated with inquisitiveness ($r = -.08$). The main difference between these factors was that the item "I care about truth" loaded on the second love of learning factor

but not the first one. The two limitations factors seemed related to the HEXACO in similar ways; both were mostly associated with agreeableness (the flexible facet in particular). Lastly, both self-abasing humility factors were negatively associated with extraversion, however the worthless self-abasing humility factor had a stronger negative correlation with conscientiousness ($r = -.34$) than the meek self-abasing humility factor ($r = -.06$). Worthless self-abasing humility also had a much larger negative correlation with social self-esteem ($r = -.61$) than meek self-abasing humility ($r = -.22$). As mentioned, this may imply that worthless self-abasing humility fulfills more of a prosocial function than meek self-abasing humility, assuming that a low social self-esteem does motivate prosocial behavior. Consistent with this, ethical humility is also negatively linked with social self-esteem ($r = -.22$) however the negative association between social self-esteem and prosociality is quite speculative and it may be the case that too little social self-esteem is debilitating or enervating, therefore hindering any impetus for prosocial behavior.

Regarding the four meta-domains of humility, the first factor— the "prosocial meta-domain"— had the highest loadings from sincerity, fairness, greed avoidance, modesty, and ethical humility. The honesty-humility dimension was originally theorized to predict the proclivity to forgo cheating or exploitative behavior to facilitate reciprocal altruism (Ashton & Lee, 2007) and has subsequently predicted prosocial behavior (Fang et al., 2019). Indeed, it is not surprising then that of the remaining humility measures, ethical humility was the most relevant for this factor. Ethical humility, however, had a higher loading on the second factor, which has been construed as the "negative affect" factor (it could also be called the self-abasing factor however negative affect seems to better encompass the other humility measures).

Bivariate correlations between these four meta-domains and HEXACO facets were conducted to gain more insight into what each meta-domain may represent. Fittingly, the

negative affect meta-domain was most notably negatively correlated with social self-esteem ($r =$ -.57), liveliness ($r = -.33$), and positively associated with anxiety ($r = .31$). Each of these correlations indicates negative affect or the absence of positive affect. As mentioned, ethical humility is also negatively associated with social self-esteem and positively correlated with anxiety which can be explained by the sociometer theory (Leary, 1999). Interestingly, the third factor- the "appreciative meta-domain" was most correlated with diligence ($r = .43$) of all the HEXACO facets; however, this factor had a larger correlation with agreeableness ($r = .38$) than with conscientiousness ($r = .31$).

This third appreciative factor was also considered to represent a positive affect meta-domain of humility. To test if this factor was mainly predicting positive affect proneness, the four meta-domains were entered as independent variables predicting joy and then positive awe. The third factor was the best predictor of joy ratings from the videos ($\beta = .244$, $p <.01$) and the best predictor of positive awe ($\beta = .210$, $p <.01$) of all four meta-domains. To further elucidate the nature of this third meta-domain, a linear regression was conducted with the six HEXACO dimensions as independent variables with the third meta-domain as the dependent variable. This third meta-domain was best predicted by agreeableness ($\beta = .288$, $p <.001$) and openness to experience ($\beta =.275$, $p <.001$), not extraversion (.064, *ns*) which is commonly regarded as the personality trait most associated with a proneness to positive emotion (Silva et al., 2015). This result still holds if extraversion is replaced with liveliness ($\beta = .126$, *ns*), arguably the most germane facet of extraversion capturing a tendency to feel positive affect. Indeed, a recent literature review identified an overarching appreciative meta-domain of humility that is not just capturing humility measures associated with feeling positive affect (Weidman et al., 2018). Of the six HEXACO dimensions, agreeableness seems the most germane for predicting an

appreciative tendency as agreeable people do not harshly judge others (the gentleness facet) and are forgiving and accepting of people's faults. This is not to say that agreeableness necessarily implies being appreciative of others but compared to the other HEXACO dimensions it may be most related to being appreciative and grateful. Of the facets from openness to experience, aesthetic appreciation had the highest correlation with the appreciative meta-domain (r = .33) further suggesting an appreciative component to this third factor.

Although these factor analyses were largely exploratory with no concrete hypotheses, it was expected that there would be a prosocial meta-domain of humility and a cognitive meta-domain of humility. There did seem to be a prosocial meta-domain but not a cognitive one. It was especially surprising that the three facets of intellectual humility did not load on the same factor or meta-domain; appropriate discomfort of limitations loaded with self-abasing humility on the negative affect factor and the other two facets loaded on the appreciative meta-domain.

The Classification and Function of Awe

One objective of the study was to clarify whether awe is best construed as a cognitive/epistemic or a social/prosocial emotion, depending on which types of humility it is most frequently associated with. There was some support for the view that awe is associated with cognitive domains of humility— epistemic humility was the best predictor of elicited positive awe from the videos, the non-social aspect of dispositional negative awe, and the appropriate discomfort of limitations facet of intellectual humility was the best predictor of dispositional negative awe. There was less support for the view that awe is associated with prosocial forms of humility. Of the arguably five prosocial domains of humility (ethical humility and the four facets from honesty-humility), modesty was the best predictor of elicited negative awe from the written

task. This was the only instance of a prosocial domain of humility being the best predictor of a particular measure of awe.

Predictors of awe not only depended on the valence, but also on the elicitor. There are certainly limitations from this study worth considering, however if the predictors of awe even vary across elicitors for the same valence of awe, then it may be difficult to assign a specific function to awe that applies to these various contexts. There did appear to be some patterns within positive and negative awe, more so from negative awe. Indeed, negative awe was often associated with meek self-abasing humility; this domain of humility was the best predictor of negative awe from the videos, past ratings of negative awe from the written task, and of the social threat aspect of dispositional negative awe (it was the second-best predictor of the original dispositional negative awe measure). It was argued earlier that meek self-abasing humility may be less prosocial than worthless self-abasing humility and that meek self-abasing humility may represent a proclivity for feeling negative awe from a threatening physical elicitor. If those who are most prone to feeling meek, submissive, and fearful are most likely to feel negative awe (at least from a threatening physical elicitor) then the experience of negative awe might be to signal threat and powerlessness. Or perhaps these types of negative awe experiences function to elicit a certain kind of self-abasing humility, one marked by meekness and submission more so than feelings of worthlessness or unimportance.

The pattern for positive awe seems less clear although appreciative domains of humility were relevant for predicting dispositional awe and awe from the written task (past and current ratings of awe). Those who tend to be appreciative of others and nature may be more willing to focus less on themselves and subsequently feel more awe towards their surroundings. Positive awe might heavily overlap with admiration then; however, those with epistemic humility and an

appropriate discomfort of limitations were most likely to feel positive awe from more unfamiliar elicitors (the awe videos). Those with epistemic humility are more willing to ponder an altered frame of reference, that is, how our existence is nested within the vast universe. An altered frame of reference can expose our limitations, including our intellectual ones, and so those who are more willing to take this altered perspective and find comfort from it seem more prone to positive awe from unfamiliar elicitors. Positive awe then might facilitate a transition into an expanded frame of reference from novel elicitors. The purpose of this expanded frame of reference is not immediately obvious; it may help with the processing of novel, challenging, and vast stimuli, however an incidental effect or by-product of this "self-transcendence" may include an increased willingness to be prosocial.

It was suggested earlier that awe coincides with increased bottom-up processing which can be construed as a general mechanism of broadened attention and information processing. A domain general mechanism rather than a domain specific mechanism is likely needed to make sense the various domains of humility that were pertinent for all measures of elicited awe from this study. The tendency to be meek, submissive, or fearful (relevant predispositions for predicting negative awe) and the proclivity to be appreciative (relevant for predicting positive awe) all imply paying more attention towards external stimuli (or towards one stimulus). Positive and negative awe may suggest different affective motivations for engaging in stimulus driven processing of vast stimuli, however it is also possible that vast stimuli is usually salient and instigates bottom-up processing. The potential threateningness of typical negative awe elicitors may be what gives the stimuli it's salience (which fosters bottom-up processing and therefore awe) whereas the increased bottom-up processing may be a function of appreciating typical elicitors of positive awe. Increased bottom-up processing is often indicative of a prediction error

which is akin to schema violation, however the nature of the schema violation is not always obvious for awe and wonder that is experienced often. Prediction error or schema violation may be a frequent antecedent of increased bottom-up processing, but it may not be necessary to increase bottom-up processing. Vast information rich stimuli may be best comprehended by increasing bottom-up processing, and so vast stimuli may signal a need for directing additional attention more so than a need for cognitive accommodation and schema revision. This need not always happen automatically as some research shows that intentionally sustaining mindfulness increases bottom-up processing and sustaining wonder even towards banal stimuli can lead to awe (Weger & Wagemann, 2018). Given that *perceived* vastness and not vastness is regarded as common appraisal for awe, this leaves open the possibility that vast stimuli do not always evoke awe (one may need to be motivated to increase bottom-up processing or the vast stimuli would have to violate schemata to automatically increase bottom-up processing) and that one can perceive vastness in the absence of vast stimuli.

The (evolutionary) function of awe may be nebulous, however it may be productive to construe awe as an instance of bottom-up processing. Specifically, bottom-up processing that occurs in response to vast stimuli. Vast stimuli are likely comprehended best by increasing bottom-up processing which reduces self-referential processing, allocating more attentional resources outward. Bottom-up processing of stimuli that is not perceived to be vast may still reduce self-referential processing yet fail to result in a small self or a sense that one has exceeded their usual frame of reference. A perceived sense of vastness seems pertinent for both of those features of awe. Future work may consider exploring why perceiving vastness prompts increased bottom-up processing. It has been suggested that it is the information richness of vastness, however being confronted by too much information can also be overwhelming. Perhaps certain

kinds of information are more likely to be perceived as vast. However, perceptual vastness may not always contain a lot of information, per se; it contains a lot of visual depth but that seems different than being information rich. Further, future work could consider how individuals can perceive vastness, intentionally, even in ordinary situations. Feeling like a small self may not always require being in the presence of something vast. If people can perceive vastness in ordinary situations and experience self-diminishment and awe, then this likely has implications of awe's evolutionary and psychological roots. At present, perceived vastness and bottom-up processing (not cognitive accommodation and schema violation) seem adequate to account for both valances of awe and for the fact that awe can be experienced involuntarily and perhaps voluntarily.

Strengths

To the author's knowledge, this is the first study to assess both valences of awe with different domains of humility (explicitly stated) including a socially undesirable form of humility (self-abasing humility). Prior work suggests that positive awe is related to various forms of humility- general and specific; however, no study has assessed how the strength of the relationship between awe and humility may change as a consequence of the domain of humility. Stellar and colleagues (2018) conducted perhaps the most intensive and detailed investigation of awe and humility to date, with five studies revealing a relationship between awe and humility (either general humility or with a specific domain of humility). However, none of their studies included (or at least specified) multiple types of humility with awe, and the different forms of humility used across studies were not delineated as such, rather they were all treated as a proxy for general humility. Past research regarding awe and humility has also tended to focus on awe's

ability to foster state humility with less attention directed at trait humility's ability to predict elicited awe.

Clarifying the relationship between awe and domains of humility rests on the assumption that there are varieties of humility. This assumption was validated at the construct level (revealing "meta-domains" of humility) and at the item level (revealing additional domains of humility posited from the literature). Most of the humility measures used in this study are quite novel (formulated around 2017) except for the Honesty-humility dimension from the HEXACO. Self-abasing humility is seldom measured as there currently lacks a validated scale to measure it. This study followed the same operationalization of self-abasing humility from Werz (2017) providing further support for this methodology due to the satisfactory internal consistency of the six self-abasing humility items, however the emergence of two factor scores pertaining to self-abasing humility suggests the existence of meaningful distinctions amongst these six items. Although the HEXACO is not new, this may have been the first-time various domains of humility were correlated with the HEXACO. The HEXACO was of course fitting given the honesty-humility dimension, however it has several advantages over the Big 5 for capturing personality (see Lee & Ashton, 2016 for a synopsis). There were some notable correlations, such as the association between self-abasing humility and social self-esteem (r = -.55) and the worthless self-abasing humility factor with social self-esteem (r = -.61) in particular. There were also some perhaps unexpected correlations such as the negative correlation between religious humility and modesty, intellectual humility having the strongest association with agreeableness, and dispositional awe having a higher correlation with agreeableness and conscientiousness than with openness to experience.

This project along with the pilot study also introduced new videos for eliciting awe- the Ibex goat video for inducing positive awe and the tsunami video for inducing negative awe. The Ibex goat video did not elicit more positive awe than the validated Planet Earth trailer although it did evoke more surprise which is similar to awe. Unexpectedly, the new tsunami video proved to be the best elicitor of negative awe when compared to the BBC Tornado video and the space video. This suggests that tsunamis may be a more potent physical elicitor of negative awe than tornadoes. This could be due to witnessing the damage from the tsunami coupled with hearing the horror and panic from other people amplifying feelings of fear, or tsunamis evoke more vastness than tornados which may consequently elicit more negative awe. Although a standard video for inducing positive and negative awe were used, they were also shown without sound which to the author's knowledge is the first time this has been done. The hope was to try to disentangle joy from positive awe— presumably the uplifting music would drive much of the positive affect and joy which may or may not be significantly contributing to ratings of positive awe. Although the Planet Earth trailer with music elicited more joy than the Planet Earth trailer without music, an independent samples t-test found that the means were not statistically different (t [66] = -2.42, p = .114). We also assumed that the natural landscapes are more germane to feeling awe than the music as they seem to better display vastness; however, music is presumably very attention grabbing and if awe is a type of stimulus driven processing, then music could increase bottom-up processing potentially fostering awe.

Limitations

This study has several limitations and areas for improvement worth discussing. Starting with generalizability and methodological issues, most participants were female, undergrads, and Canadian, and so these results may not generalize to other groups of people. For this reason, a

follow-up study on MTurk is being strongly considered. The current study was online and relied on self-reports. The use of self-reports is not inherently a weakness given that many domains of humility may be best assessed by what a person thinks and feels rather than how they act (e.g., epistemic humility, intellectual humility, Einsteinian humility), however the longevity and intensity of awe experiences may be difficult to gauge through self-reports. Further, measures like dispositional awe and past ratings of awe in the written task rely on retrospection which is susceptible to recall errors and biases. There is also a risk of self-report covariance whereby some participants may answer Likert scales in a uniform way (e.g., opting for middle options and avoiding extreme values).

Another methodological weakness that is certainly not limited to the present study is the effectiveness of online videos and written tasks at inducing awe characterized by schema violation and perceived vastness. Although these manipulations may evoke a sense of vastness and prompt cognitive accommodation for some participants, this possibility remains a speculation as participants were not directly asked if the videos were challenging or conveying vastness. Real life elicitors of awe (or virtual reality) would be more ideal for inducing a genuine and longer lasting experience of awe. Exposing participants to real life elicitors of awe such as a museum, waterfall, or a symphony should be more awe-inspiring than experiencing the same event from watching a video (or writing about it). Even if ratings of awe on a Likert scale are similar between a group of participants who watch a video of a waterfall and another group who view an actual waterfall like Niagara Falls, any meaningful difference will likely not be captured here. Those brought to Niagara Falls would probably have a higher mean rating of positive awe than those watching a video of a waterfall, but the depth, profundity, and enduringness of the experience will likely not be adequately portrayed in the mean difference of awe ratings (this

would be better assessed by the AWE-S as it is intended for more extreme experiences of awe). The relationship between awe and humility may be better evaluated with more extreme or genuine awe elicitors. If there is a measure of humility that has a strong correlation with deeper experiences of awe, this would have been difficult to identify in the current study, although participants may have chosen to reflect on a meaningful experience of awe in the written task. It is unclear however if recalling a past experience of awe can evoke a sense of vastness, or the degree of perceived vastness recalling an

The discrepancy between the scholar definition of awe and the definition (or lack of one) supplied to participants can be problematic. Researchers in this area often do not acknowledge this discrepancy and consequently interpret their data using the scholar definition of awe. Therefore, it cannot be definitively concluded that perceived vastness and a need for cognitive accommodation are responsible for the effects of induced awe researchers observe. The positive affect from being amazed or from any aesthetic pleasure may be a better approximation of the type of awe induced from videos. Positive awe is often defined to participants as a feeling of wonder or amazement, which may be a good proxy of awe, however some argue that wonder, unlike awe, is underlined by cognitive assimilation, not cognitive accommodation (Valdesolo et al., 2018). Researchers may want to avoid using complicated concepts to define awe for participants and instead ask participants to indicate if they felt challenged as a proxy for cognitive accommodation, however cognitive assimilation can also be challenging. A need for cognitive accommodation would require that one's existing beliefs and assumptions cannot make sense of the experience, or perhaps that one's ordinary frame of reference is exceeded to accommodate the breadth of the stimuli.

It should also be noted that the definition of awe was not operationalized consistently across all of the awe measures in this study, although they were similar. The dispositional (positive) awe scale has one item asking about awe, but awe is not defined, so this draws on lay conceptions of awe. Other items mention feeling wonder, seeing beauty, looking for patterns, and seeking challenging experiences. Elicited positive awe from the videos was defined as a "strong positive feeling of admiration or wonder" consistent with past research (Gordon et al., 2018) which also includes feeling wonder. The written task defined positive awe as something vast and astonishing that alters our understanding of the world (see Appendix E), and so cognitive accommodation would have been more likely to have occurred at least in the past ratings of awe participants recalled. As the dispositional awe includes one item about seeking challenging experiences, this implies that the definition of positive awe from the videos may have been the least cognitively challenging of the three definitions. The description of negative awe from the written task mentions that the vast and astonishing experience challenges our understanding of the world, rather than modifying it, consistent with Graziosi & Yaden (2021). This lends credence to the claim that there may be two different kinds of need for cognitive accommodation which should be explicitly stated and directly tested further. Nonetheless, this definition also includes feeling fear and wonder, consistent with the definition of negative awe from the videos. While the dispositional negative awe scale mentions feeling fear, intimidation, and overwhelmed, it does not explicitly include feelings of wonderment. And so, these subtle yet important differences of the definitions of elicited and dispositional awe should be kept in mind when interpreting the study's findings. The inclusion of feeling fear and wonder for negative awe from the videos and negative awe from the written task may help explain why an appropriate discomfort of limitations was only relevant for dispositional negative awe, which does not include feeling wonder. Given that the written task for positive and negative awe included the

most comprehensive definition of awe (referencing vastness directly and cognitive accommodation indirectly), the relevant predictors of awe for this task may be the best predictors for genuine experiences of awe. This may explain why religious humility was the best predictor of positive awe from the recall task.

Feeling awe from a video and the written task may be quite different, not just due to the disparate definitions utilized in this study, but also due to the nature of each task and what it entails. It was suggested earlier that the specific videos shown would likely be unfamiliar to participants, meaning it may be more cognitively challenging, but it may also be more engaging. The awe videos were 2-3 minutes in length which may have been more time consuming than the written task, although we have no way of knowing this. What participants chose to write about would have likely been more personally meaningful to them then the awe video shown which may have made this task more engaging or moving on the other hand. However, those asked to write about an experience of negative awe may have been less motivated to rehash such an experience, although judging from the written responses, many participants did divulge quite unpleasant experiences of negative awe in detail. Further, generalizing all the felt positive (or negative) awe from the videos includes seven different elicitors or videos. Although analyzing ratings of awe from each video reduces variability, each condition had around 30 or 40 participants making generalizability from each video ill advised.

This study included seven different videos to elicit awe, however almost all of them utilized physical elicitors (e.g., nature), neglecting social elicitors (e.g., inspiring leaders) and cognitive elicitors (e.g., "mind blowing" facts or insights). The Ibex goat video while showing a vast dam is arguably not best classified as a physical elicitor as it is the amazing feat of the ibex that evokes a sense of awe which could be considered a social elicitor (e.g., admiring the tenacity

of the goats) or a cognitive elicitor (e.g., amazement that such a feat is possible). This lack of diversity amongst the awe elicitors may be problematic given that various domains of humility may differ in their ability to predict experiences of awe depending on the source of awe (e.g., prosocial domains of humility may predict awe from social elicitors better than cognitive domains of humility). It also remains unclear how expectancy effects (participants reporting feelings of awe to align with what they think the researchers are expecting) and social desirability may have influenced participants responses to awe ratings. There was no control video to see if participants would feel pressured to rate highly on positive or negative awe for a mundane video that would presumably not elicit any awe. Further, passing the manipulation check for the videos (see Appendix E) does not ensure that participants were engaged with the video or that they watched the video in full.

Lastly, a possible theoretical weakness of the current study is the assumption that analyzing the relationship between awe and various domains of humility can help determine if awe should be categorized as a prosocial or epistemic emotion. Past research does suggest that awe and humility are linked, therefore uncovering which domain(s) of humility awe is most often associated with may be informative. Although there is good reason to believe that intellectual humility captures more of a cognitive function than ethical humility for example, it is at least possible that intellectual (and epistemic or cosmic) humility are not the most ideal proxies of a person's tendency to engage in cognitive or information processing functions. Put differently, prosocial domains of humility may reflect a tendency to be prosocial better than cognitive domains of humility reflect a tendency to engage in cognitively demanding tasks. Despite this potential asymmetry, cognitive domains of humility are relatively more cognitive than prosocial domains of humility which may still be useful for unraveling the function of awe.

Future Directions and Recommendations

Although recent awe research is utilizing more vast elicitors of awe (e.g., virtual reality), it may be useful to consider the necessity of cognitive accommodation or schema violation for the conception of awe. As mentioned, the AWE-S (Awe Experience Scale) includes four other components of awe and does not privilege vastness and cognitive accommodation over the other components, meaning one can have an experience of awe without schema violation or cognitive accommodation. Reports from lay persons also suggest that perceived vastness and cognitive accommodation represent a more extreme variant of awe (Preston & Shin, 2017; Weger & Wagemann, 2018) suggesting that the psychological definition of awe may be neglecting other valid experiences of awe. Indeed, the psychological conception of awe was derived in part from lay reports of awe (Keltner & Haidt, 2003), therefore these two conceptions should not be too disparate from each other, yet they need not be identical as folk notions of awe may not capture the essence or the main features of awe experiences.

Following from some of the limitations previously broached, future work should either broaden the definition of awe such that a need for cognitive accommodation or schema violation is not necessary for all accounts of awe, or the definition of awe provided to participants during studies should explicitly include perceived vastness and schema violation. Given that much research on awe has relied on a milder version of awe that is not contingent on a need for cognitive accommodation, it may be best to broaden the definition of awe from the original conception proposed by Keltner and Haidt (2003). If the conception of awe is broadened to encompass bottom-up processing from vast stimuli, then depictions of awe presented to participants could include a feeling of absorption or immersion with the awe inducing stimulus as well as a decrease in self-absorption or mind wandering (this may be a good proxy for reduced

DMN activity, more so than asking if participants felt small). Including these additional questions would have been informative for the present study, to gain insight into the phenomenology of awe experiences the videos were evoking. Asking about ratings of oppression from negative awe elicitors may also be useful, as feeling oppressed may represent a distinct source of negative affect than fear or a discomfort of uncertainty during experiences of negative awe. Including such a measure may have been useful for understanding the link between self-abasing humility and negative awe- perhaps the tendency to feel small and submissive, captured by self-abasing humility, leads to heightened feelings of oppression during experiences of negative awe, whereas a discomfort of intellectual limitations would better predict negative awe experiences driven by schema violation and a difficulty of achieving cognitive accommodation.

The awe literature may also benefit from an amended or a more comprehensive dispositional (positive) awe scale. The current dispositional awe scale narrowly focuses on physical elicitors of awe (e.g., nature) and neglects social and cognitive elicitors. This study found that appreciative forms of humility (valuing humility and environmental humility in particular) best predicted dispositional positive awe, however cosmic or epistemic humility may have been more relevant if cognitive elicitors were included, for example. The dispositional awe scale could also be improved by including other elements of awe more explicitly (e.g., self-diminishment, perceived vastness, connectedness). Perhaps those with a low self-focus- a marker of many domains of humility- are more susceptible to feeling a small self from common awe elicitors.

Intellectual humility was most associated with agreeableness of the six HEXACO dimensions, which was unexpected. In particular, the limitations owning facet was highly correlated with the flexibility facet of agreeableness ($r = .41$). Those who can admit their

intellectual shortcomings when others point them out may be doing so because they are more agreeable. To ensure that measures of intellectual humility are not also measuring a proclivity to be polite and avoid disagreements, items asking about one's ability to acknowledge intellectual limitations should not include the presence of others. For example, one item from the limitations owning facet reads, "When someone points out a mistake in my thinking, I am quick to admit that I was wrong" (Haggard et al., 2018). Although a disagreeable person who can admit their intellectual limitations would agree with that item, an agreeable person may as well, irrespective of their intellectual humility simply to avoid interpersonal conflict. If one can admit their intellectual shortcomings or maintain flexible opinions in private, this would be indicative of a more genuine version of intellectual humility.

Lastly, these results suggest that there is a distinction between meek and worthless self-abasing humility. Meek self-abasing humility may indicate more of an emotional response to perceived threat whereas worthless self-abasing humility is more akin to low social self-esteem, which is how one tends to think of themselves and may therefore be less context dependent than the former. Both versions of self-abasing humility include the proclivity to feel small and shameful, suggesting that this is the core of self-abasing humility, at least amongst the six items used by Werz (2017). Future work should assess if these results replicate while also exploring self-abasing humility in greater detail as more socially desirable and appreciative forms of humility receive the bulk of attention in humility research.

Conclusions

Taken together, the present investigation is an important step for gaining a better understanding of the relationship between awe and humility, and perhaps even the function of

awe. Past research has shown a link between awe and humility, but it was unclear what specific modalities of humility are more closely related to awe and which ones are not. Research in this area has often neglected negative awe (dispositional and elicited) as well as various domains of humility such as self-abasing humility, Einsteinian humility, and intellectual humility. This study sought to address those gaps while verifying the assumption that there are distinct domains of humility, at the construct and item level. Domains of humility that predicted feeling awe were epistemic humility (positive awe from awe videos and the non-social factor of dispositional negative awe), appropriate discomfort of limitations (positive awe from awe videos and dispositional negative awe), religious humility (positive awe from the recall task and negative awe from awe videos), modesty (negative awe from the recall task), and valuing and environmental humility (dispositional awe). Proneness to positive and negative awe were not captured by the same domain of humility, nor was positive or negative awe from different elicitors predicted by the same domain of humility. These findings also offer hints as to whether awe is better classified as a prosocial or an epistemic emotion, which will be useful for unearthing awe's evolutionary function and the nature of one of our most uniquely human emotions.

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Appendix A- Information Letter

Dear interested participant,

Welcome to the Awe study! This study is investigating normal psychological functioning and we are recruiting members of the general population to take part. Below is some information that will briefly describe what this study is about and what would be expected from you should you decide to participate. Please note that participating in this study is *optional.* After reading the following information, you may decide to agree to participate in the study, or you may wish to decline.

PURPOSE

The purpose of this study is to explore how the emotion awe relates to features of one's personality. The researchers conducting this study are David Racioppa- a graduate student at Lakehead University under the supervision of Dr. Laurence Fiddick- a psychology professor at Lakehead University.

WHAT INFORMATION WILL BE COLLECTED?

First, we will ask you some information about your background (age, gender, cultural background, and country of residence). The bulk of the questions in the study are about various traits, attitudes, and experiences of awe. You will also be asked to recall an awe experience you have had in the past.

WHAT IS REQUESTED OF ME AS A PARTICIPANT?

It is expected that completing the study will require 35-75 minutes. The study will be entirely online on the SurveyMonkey website. You are encouraged to complete the study in a comfortable and private place, if possible. You will be asked to answer 170 questions truthfully to the best of your ability and to read all instructions before responding to any questions. There will be a short video that you are expected to watch in full, with as few distractions as possible.

As mentioned above there will also be a short writing task based on your memory of an awe experience. Both the video and the writing task will be followed by a few short questions about those experiences. You are also expected to complete the study individually without communicating with anyone else either in person or electronically.

WHAT ARE MY RIGHTS AS A PARTICIPANT?

You are under no obligation to participate and should you choose to participate, you are free to exit the study at any point. You will be able to have your data withdrawn up until the point of

submitting your responses at the end of the study. The study consists of various parts with a brief introduction to each so that you can decide whether you would like to continue.

WHAT ARE THE RISKS AND BENEFITS?

You will acquire firsthand experience about the nature of experiments that you may find interesting and relevant to your studies. In addition, you will be granted course credit for participating in the study. This research could contribute to our basic understanding of emotions and how they relate to personality and cognition. This study addresses a gap in our current understanding in this area. The debrief form at the end of the study will also inform participants of the different measurements used and include a reference for further reading for interested students.

In some versions of the experiment, you may experience a small amount of discomfort from one of the videos and writing tasks.

HOW WILL MY CONFIDENTIALITY BE MAINTAINED?

All responses will be held confidentially by the researchers and will not be shared with anyone else. Given that the study will be conducted on Survey Monkey, which is run on American servers, all responses will potentially be viewable by security agencies in the United States. The US Patriot Act permits U.S. law enforcement officials, for the purpose of anti-terrorism investigation, to seek a court order that allows access to the personal records of any person without the person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. Although efforts will be made to publish the study, data will be presented as anonymized statistics.

WHAT WILL MY DATA BE USED FOR?

Data will be combined and used in statistical analyses to test research questions for David's Masters
thesis. The results of this study may be published in a peer review journal presenting the data as anonymized statistics that cannot be traced back to any participant. Only the researchers, David Racioppa and Laurence Fiddick will have access to the data.

WHERE WILL MY DATA BE STORED?

The data will be stored on an account on David Racioppa's password-protected SurveyMonkey account and the researchers' personal computers all of which are also password-protected. All data will be stored in Dr. Fiddick's office on Lakehead University's campus for a minimum of 5 years following completion of the study.

HOW CAN I RECEIVE A COPY OF THE RESEARCH RESULTS?

If you are interested in viewing the results of the study after it is completed, you can email either of the two researchers- David Racioppa or Laurence Fiddick. If the results are accepted for publication, you can also request to see a copy of the publication from the researchers. Their contact information is listed below and will be shown again at the end of the study.

WHAT IF I WANT TO WITHDRAW FROM THE STUDY?

Due to the anonymous nature of the survey, you will be unable to withdraw your data once you have submitted as we cannot link your data back to you. You can however withdraw at any time during the survey by simply closing your browser.

RESEARCHER CONTACT INFORMATION:

Principal Investigator- Dr. Laurence Fiddick. Email: lfiddick@lakeheadu.ca

Secondary Researcher- David Racioppa. Email: racioppad@lakeheadu.ca

Co-investigator- Dr. Beth Visser. Email: beth.visser@lakeheadu.ca

RESEARCH ETHICS BOARD REVIEW AND APPROVAL:

This research study has been reviewed and approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team, please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

Appendix B- Consent Form

MY CONSENT FOR THE AWE EXPERIENCES AND INDIVIDUAL DIFFERENCES STUDY:

As described above, this study will examine the emotion awe and individual differences. There will be 170 questions, a writing task, and a short video which should take approximately 35-75 minutes in total to complete. Participating in the study means that you agree to the following:

- ✓ I have read and understand the information contained in the Information page.
- ✓ I agree to participate.
- ✓ I understand the risks and benefits to the study.
- ✓ That I can withdraw from the study at any time and may choose not to answer any question
- ✓ That the data will be securely stored on the researchers' password protected computers for a minimum period of 5 years following completion of the research project.
- ✓ I understand that the research findings will be made available to me upon request.
- ✓ I understand that my participation will remain confidential.
- ✓ All of my questions have been answered.

Please note that the online survey tool used in the study, Surveymonkey, is hosted by a server located in the USA. The US Patriot Act permits U.S. law enforcement officials, for the purpose of anti-terrorism investigation, to seek a court order that allows access to the personal records of any person without the person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. With your consent to participate in this study, you acknowledge this.

By consenting to participate, I have not waived any rights to legal recourse in the event of research-related harm.

☐ *By checking this box, I indicate that I have read and agree to the above information and consent to proceed to the online survey.*

[Note: the only way to proceed to the questionnaire is to check the box to indicate consent]

Appendix C- Demographic Questions

Thank you for taking part in the Awe Experiences and Individual Differences study! First, we will begin with some brief demographic information.

1. What is your age?

(drop down list from <17 -50+)

2. What is your gender?

-Male

-Female

-I do not identify as either male or female

3. What country do you reside in?

(written response)

4. What is your nationality?

(written response)

5. Would you like to receive bonus marks for completing this study?

-No

-Yes

Appendix D- Questionnaires

Please rate your agreement with each of the following statements from 1 (strongly disagree) to 7 (strongly agree).

Dispositional Awe Scale (Shiota et al., 2006)

1. I often feel awe.

2. I see beauty all around me.

3. I feel wonder almost every day.

4. I often look for patterns in the objects around me.

5. I have many opportunities to see the beauty of nature.

6. I seek out experiences that challenge my understanding of the world.

Dispositional Negative Awe (Muto, 2016)

1. There are many people around me who are overwhelmingly more excellent than me.

2. I often feel that people and the nature around me have large presences that make me realize my own limitations.

3. I often feel that things like myself are tiny compared to the vastness of space and nature.

4. When I talk with someone who is outstanding in some way, I often feel intimidated, with feelings of fear and respect.

5. When I meet people who have some overwhelming ability or talent, I often feel weak with fear or intimidation.

6. I feel small whenever I meet some great person.

HEXACO-100 (Lee & Ashton, 2018)

1. I would be quite bored by a visit to an art gallery. (r)

2. I clean my office or home quite frequently.

3. I rarely hold a grudge, even against people who have badly wronged me.

4. I feel reasonably satisfied with myself overall.

5. I would feel afraid to travel in bad weather conditions.

6. If I want something from a person I dislike, I will act very nicely toward that person in order to get it. (r)

7. I'm interested in learning about the history and politics of other countries.

8. When working, I often set ambitious goals for myself.

9. People sometimes tell me that I am too critical of others. (r)

10. I rarely express my opinions in group meetings. (r)

11. I sometimes can't help worrying about little things.

12. If I knew that I could never get caught, I would be willing to steal a million dollars. (r)

13. I would like a job that requires following a routine rather than being creative. (r)

14, I often check my work over repeatedly to find any mistakes.

15. People sometimes tell me that I'm too stubborn. (r)

16. I avoid making "small talk" with people. (r)

17. When I suffer from a painful experience, I need someone to make me feel comfortable.

18. Having a lot of money is not especially important to me.

19. I think that paying attention to radical ideas is a waste of time.

20. I make decisions based on the feeling of the moment rather than on careful thought.

21. People think of me as someone who has a quicker temper.

22. I am energetic nearly all the time.

23. I feel like crying when I see other people crying.

24. I am an ordinary person who is no better than others.

25. I wouldn't spend my time reading a book of poetry. (r)

26. I plan ahead and organize things, to avoid scrambling at the last minute.

27. My attitude toward people who have treated me badly is "forgive and forget".

28. I think that most people like some aspects of my personality.

29. I don't mind doing jobs that involve dangerous work. (r)

30. I wouldn't use flattery to get a raise or promotion at work, even if I thought it would succeed.

31. I enjoy looking at maps of different places.

32. I often push myself very hard when trying to achieve a goal.

33. I generally accept people's faults without complaining about them.

34. In social situations, I'm usually the one who makes the first move.

35. I worry a lot less than most people do. (r)

36. I would be tempted to buy stolen property if I were financially tight. (r)

37. I would enjoy creating a work of art, such as a novel, a song, or a painting.

38. When working on something, I don't pay much attention to small details. (r)

39. I am usually quite flexible in my opinions when people disagree with me.

40. I enjoy having lots of people around to talk with.

41. I can handle difficult situations without needing emotional support from anyone else. (r)

42. I would like to live in a very expensive, high-class neighborhood. (r)

43. I like people who have unconventional views.

44. I make a lot of mistakes because I don't think before I act. (r)

45. I rarely feel anger, even when people treat me quite badly.

46. On most days, I feel cheerful and optimistic.

47. When someone I know well is unhappy, I can almost feel that person's pain myself.

48. I wouldn't want people to treat me as though I were superior to them.

49. If I had the opportunity, I would like to attend a classical music concert.

50. People often joke with me about the messiness of my room or desk. (r)

51. If someone has cheated me once, I will always feel suspicious of that person. (r)

52. I feel that I am an unpopular person. (r)

53. When it comes to physical danger, I am very fearful.

54. If I want something from someone, I will laugh at that person's worst jokes. (r)

55. I would be very bored by a book about the history of science and technology.

56. Often when I set a goal, I end up quitting without having reached it. (r)

57. I tend to be lenient in judging other people.

58. When I'm in a group of people, I'm often the one who speaks on behalf of the group.

59. I rarely, if ever, have trouble sleeping due to stress or anxiety. (r)

60. I would never accept a bribe, even if it were very large.

61. People have often told me that I have a good imagination.

62. I always try to be accurate in my work, even at the expense of time.

63. When people tell me that I'm wrong, my first reaction is to argue with them. (r)

64. I prefer jobs that involve active social interaction to those that involve working alone.

65. Whenever I feel worried about something, I want to share my concern with another person.

66. I would like to be seen driving around in a very expensive car. (r)

67. I think of myself as a somewhat eccentric person.

68. I don't allow my impulses to govern my behavior.

69. Most people tend to get angry more quickly than I do.

70. People often tell me that I should try to cheer up. (r)

71. I feel strong emotions when someone close to me is going away for a long time.

72. I think that I am entitled to more respect than the average person is. (r)

73. Sometimes I like to just watch the wind as it blows through the trees.

74. When working, I sometimes have difficulties due to being disorganized. (r)

75. I find it hard to fully forgive someone who has done something mean to me. (r)

76. I sometimes feel that I am a worthless person. (r)

77. Even in an emergency I wouldn't feel like panicking. (r)

78. I wouldn't pretend to like someone just to get that person to do favors for me.

79. I've never really enjoyed looking through an encyclopedia. (r)

80. I do only the minimum amount of work needed to get by. (r)

81. Even when people make a lot of mistakes, I rarely say anything negative.

82. I tend to feel quite self-conscious when speaking in front of a group of people. (r)

83. I get very anxious when waiting to hear about an important decision.

84. I'd be tempted to use counterfeit money, if I were sure I could get away with it. (r)

85. I don't think of myself as the artistic or creative type. (r)

86. People often call me a perfectionist.

87. I find it hard to compromise with people when I really think I'm right. (r)

88. The first thing that I always do in a new place is to make friends.

89. I rarely discuss my problems with other people. (r)

90. I would get a lot of pleasure from owning expensive luxury goods. (r)

91. I find it boring to discuss philosophy. (r)

92. I prefer to do whatever comes to mind, rather than stick to a plan. (r)

93. I find it hard to keep my temper when people insult me. (r)

94. Most people are more upbeat and dynamic than I generally am. (r)

95. I remain unemotional even in situations where most people get very sentimental. (r)

96. I want people to know that I am an important person of high status. (r)

97. I have sympathy for people who are less fortunate than I am.

98. I try to give generously to those in need.

99. It wouldn't bother me to harm someone I didn't like. (r)

100. People see me as a hard-hearted person. (r)

*Items 1, 7, 13, 19, 25, 31, 37, 43, 49, 55, 61, 67, 73, 79, 85, 91 measure Openness to Experience (items 1, 25, 49, 73 measure aesthetic appreciation; items 7, 31, 55, 79 measure inquisitiveness; items 13, 37, 61, 85 measure creativity; items 19, 43, 67, 91 measure unconventionality).

Items 2, 8, 14, 20, 26, 32, 38, 44, 50, 56, 62, 68, 74, 80, 86, 92 measure Conscientiousness (items 2, 26, 50, 74 measure organization; items 8, 32, 56, 80 measure diligence; items 14, 38, 62, 86 measure perfectionism; items 20, 44, 68, 92 measure prudence).

Items 3, 9, 15, 21, 27, 33, 39, 45, 51, 57, 63, 69, 75, 81, 87, 93 measure Agreeableness (items 3, 27, 51, 75 measure forgivingness; items 9, 33, 57, 81 measure gentleness; items 15, 39, 63, 87 measure flexibility; items 21, 45, 69, 93 measure patience).

Items 4, 10, 16, 22, 28, 34, 50, 46, 53, 58, 64, 70, 76, 82, 88, 94 measure Extraversion (items 4, 28, 52, 76 measure social self-esteem; items 10, 34, 58, 82 measure social boldness; items 16, 40, 64, 88 measure sociability; items 22, 46, 70, 94 measure liveliness).

Items 5, 11, 17, 23, 29, 35, 41, 47, 53, 59, 65, 71, 77, 83, 89, 95 measure Emotionality (items 5, 29, 53, 77 measure fearfulness; items 11, 35, 59, 83 measure anxiety; items 17, 41, 65, 89 measure dependence; items 23, 47, 71, 95 measure sentimentality).

Items 6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84, 90, 96 measure Honesty-Humility (items 6, 30, 54, 78 measure sincerity; items 12, 36, 60, 84 measure fairness; items 18, 42, 66, 90 measure greed avoidance; items 24, 48, 72, 96 measure modesty).

Items 97-100 measure altruism.

Intellectual Humility (Haggard et al., 2018)

1. When I don't understand something, I try hard to figure it out.

2. I love learning.

3. If I don't understand something, I try to get clear about what exactly is confusing me.

4. I care about truth.

5. When I think about the limitations of what I know, I feel uncomfortable. (r)

6. I focus on my intellectual limitations and weaknesses. (r)

7. I tend to get defensive about my intellectual limitations and weaknesses. (r)

8. When I know that I have an intellectual weakness in one area, I tend to doubt my intellectual abilities in other areas as well. (r)

9. When someone points out a mistake in my thinking I am quick to admit that I was wrong.

10. I am quick to acknowledge my intellectual limitations.

11. I have a hard time admitting when one of my beliefs is mistaken. (r)

12. I feel comfortable admitting my intellectual limitations.

*Items 1-4 measure love of learning, 5-8 measure appropriate discomfort of limitations, 9-12 measure limitations owning

Dual Dimension Humility Scale (Wright et al., 2018)

Religious Humility

1. I often feel humble when I think of a Higher Power.

2. God requires us to be humble.

3. Ultimately, there is a Supreme Being who gets all of the credit and glory for our individual

accomplishments.

4. My Creator works through me in all my good actions.

5. I accept my total dependence upon the grace of God.

Epistemic Humility/ Cosmic Low Self-Focus

6. I often find myself pondering my smallness in the face of the vastness of the universe.

7. I often think about the fragility of existence.

8. I frequently think about how much bigger the universe is than our power to comprehend.

9. When I look out at the stars at night, I am often deeply humbled.

10. I feel awe towards the mysteries and complexities of life.

Environmental Humility/ Low Self-Focus

11. Humans have to learn to share the Earth with other species.

12. We should always try to be in harmony with Mother Nature.

13. I often feel in touch with Mother Nature.

14. It's important from time to time to commune with nature.

15. Caring for humanity requires us to care about the environment.

Ethical Humility/ High Other-Focus

16. I often place the interests of others over my own interests.

17. My friends would say I focus more on others than I do myself.

18. I always find myself making sacrifices for others.

19. My actions are often aimed towards the wellbeing of others.

20. I care about the welfare others, at times more than my own welfare.

Valuing Humility

21. Humility is a virtue.

22. I find humble people to be very admirable.

23. A good dose of humble pie is often necessary.

24. Teaching kids the value of humility is very important to their development.

25. It's important to always keep one's accomplishments in perspective.

Einsteinian Humility (Earp et al., 2018)

Now we would like to ask you to call to mind whatever you consider to be your three biggest successes or achievements. You don't need to rank order them. With these three big accomplishments in mind, please rate how personally responsible you feel for each of them from 1 (not at all responsible) to 7 (completely responsible).

Briefly describe one of your top accomplishments

-written response-

Personal responsibility rating for accomplishment #1

Briefly describe another accomplishment

-written response-

Personal responsibility rating for accomplishment #2

46. Briefly describe a third accomplishment

-written response-

Personal responsibility rating for accomplishment #3

<div align="center">**Appendix E- Awe Manipulations**</div>

Video Instructions

[for positive awe videos]

Now we would like to ask you to watch a short video about nature. Try to be as free from distraction as possible.

[for negative awe videos]

Now we would like to ask you to watch a short video of a natural disaster. Try to be as free from distraction as possible.

Video Follow-up Questions

What was the video about? [manipulation check for positive awe videos]

A: Wild goats (Ibex) climbing a dam to lick salt

B: Wild goats (Ibex) falling from a dam

C: A compilation of natural landscapes

D: A compilation of the world's highest waterfalls

E: None of the above

What was the video about? [manipulation check for negative awe videos]

A: Water mains breaking from an earthquake, causing city streets to flood

B: Water flowing over barriers, causing city streets to flood

C: Tornadoes and lightning storms

D: Tornadoes and hail stones shattering a car windshield

E: None of the above

Is there anything else you'd like us to know (any technical issues or thoughts on the video)?

-written response-

On a scale from 1 (*none*) to 7 (*an extreme amount*) please indicate how much of each emotion you currently feel after watching the video.

-Positive Awe (a strong positive feeling of admiration or wonder)

-Negative Awe (a strong feeling of fear and wonder)

-Surprise

-Joy

-Sadness

-Fear

-Calmness

-Compassion

Videos

Ibex goat video: https://www.youtube.com/watch?v=RG9TMn1FJzc

Planet Earth trailer: https://www.youtube.com/embed/fRBFSkc4oyw?rel=0&showinfo=0

Planet Earth trailer (without music): https://vimeo.com/617116986

Tsunami video: https://www.youtube.com/watch?v=QVeY39q4BGg

Birth of a tornado: https://www.youtube.com/watch?v=b4ihrxg9wXE

Birth of a tornado (without music): https://vimeo.com/617149139

Space video: https://www.youtube.com/watch?v=5UnzLGFIKK0

Written task instructions (adapted from Graziosi & Yaden, 2021; Negami, 2020)

Positive awe:

Now we would like you to recall an experience of awe you have had in the past. Awe is our emotional response to things perceived to be vast and astonishing that alters the way we understand the world. Please describe a recent experience of awe where you felt this way. Try to tell the story exactly as you experienced it, from your point of view, in as much detail as possible. Feel free to write as much as you'd like.

On a scale from 1 (*none*) to 7 (*an extreme amount*) please rate how much awe you experienced *in that past event* that you wrote about?

On a scale from 1 (*none*) to 7 (*an extreme amount*) please rate how much awe you are *currently experiencing* after writing about that past event?

Negative awe:

Now we would like you to recall an experience of negative awe you have had in the past. Negative awe is an emotional response of fear and wonder at things perceived to be vast and astonishing that challenges the way we understand the world. Please describe an experience of negative awe where you felt this way. Try to tell the story exactly as you experienced it, from your point of view, in as much detail as possible. Feel free to write as much as you'd like.

On a scale from 1 (*none*) to 7 (*an extreme amount*) please rate how much awe you experienced *in that past event* that you wrote about?

On a scale from 1 (*none*) to 7 (*an extreme amount*) please rate how much awe you are *currently experiencing* after writing about that past event?