Measuring Awe and Critical Thinking in a Science Museum

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Abstract: Museums and informal science learning centers often use awe to entice, inspire and educate. Recent studies have suggested that awe can also impact critical thinking skills. We gave surveys to 1,057 guests at a science and an art museum to look for how aspects of awe differ among spaces and activities. Critical thinking was also measured utilizing a framework established in the art museum field.

Introduction

Science museums and many other informal learning spaces use awe to entice, inspire and educate. Foundational work in the field of psychology has suggested that awe can also be a key step in supporting science learning (Valdesolo, Shtulman, & Baron, 2017) and impact critical thinking (Griskevicius, Shiota, & Neufeld, 2010). We report on results of the first phase of a planned mixed method study to answer the question: How do science museums inspire awe in guests and how does that impact critical thinking?

Awe has recently been proposed as a catalyst for science learning (Valdesolo, Shtulman, & Baron, 2017). When students are curious or experience interest they persist longer at learning tasks and get better grades (Silvia, 2008). Awe has also been shown to promote critical thinking via a lower likelihood of being persuaded by weak arguments (Griskevicius, Shiota, & Neufeld, 2010) and promoting ethical decision-making (Piff, Dietze, Feinberg, Stancato, & Keltner, 2015). Critical thinking has been measured in art museums using a framework developed for the Visual Thinking Strategies (VTS) curriculum, a method utilized to promote critical thinking through aesthetic development. VTS is based on eliciting feedback from guests about what they see in an object and connecting it with specific evidence (Housen, 2002; Greene, Kisida, & Bowen, 2014).

Methods

Surveys were given to guests at locations in a large science museum that were *a priori* expected to reflect differing levels of awe. They include the museum's parking garage (as a baseline condition), the Rotunda (a large, dramatic central domed area with exhibit entrances on all sides), a submarine exhibit (centered on an indoor, authentic German U-boat) and in front of the ground floor entrances of the Museum (surrounded by classical, Beaux Arts style architecture in large, open park land). We also collected data in front of the entrance of a local art museum, which is situated in a substantially different community environment (dense urban) and has a very different architectural design (modernist).

The survey consists of three main sections: awe, critical thinking, and demographic information. The awe section was centered on the Situational Awe Scale (SAS) - a 19-item Likert measure designed to assess respondents' momentary experiences of awe (Quinn & Krenzer, 2017). It has four factors: (1) awe as liberating (the self) and connecting (to the world); (2) awe as oppressing and isolating; (3) physiological correlates (e.g., chills, goosebumps), and (4) the self as small within a vast world. For analysis, Likert survey data was converted into an ascending numerical scale from -3 (strongly disagree) to 3 (strongly agree). Mean scores were computed for each of the SAS factors.

To measure critical thinking, we developed constructed-response items based on VTS. Each guest was randomly shown 2 of 3 science themed images or art work. They were asked to answer three VTS questions about each image. Each response was coded by a researcher using a rubric with 8 categories adopted from Adams, et al. (2006). In each category, the first 135 responses were coded by two researchers who reached an IRR of 86%-96% across categories. We conducted exploratory analyses linking critical thinking and awe using separate hierarchical logistic regression models. 0 codes were removed and the remaining categories were recoded as 0 and 1. Subject was the random effect for all regression models. Separate models were run using each SAS factor to predict each VTS code.

Preliminary results and discussion

Guests reported significantly different levels of awe for each SAS factor across all measured spaces, according to ANOVAs with each of the individual SAS factor means as a DV and the locations as the IV and p value set to .05 (Table 1). Overall, we found positive aspects of awe were more likely to be experienced in the internal spaces than the outdoor spaces. In contrast, these differences are not evident for negative awe.

Table 1: Mean scores on the SAS scale.

Location		SAS Factor							
		Liberating & Connecting*		Oppressing & Isolated**		Physiological Characteristics**		Small Self in Relation to Vast World**	
		N	M (SD)	N	M (SD)	N	M (SD)	N	M (SD)
Indoor	Parking Garage	302	.81 (1.2)	301	-1.2 (1.3)	302	-.91(1.5)	301	.16 (1.2)
	Rotunda	256	.63 (.99)	256	-1.6 (1.1)	256	-.12 (1.3)	256	.73 (1.1)
	Submarine	94	.62 (1.2)	94	-.98 (1.2)	94	.11 (1.3)	94	.64 (1.2)
Outdoor	Science Museum	171	.96 (1.1)	171	-1.8 (1.2)	171	-1.63 (1.4)	171	-.28 (1.4)
	Art Museum	122	.91 (1.1)	122	-1.1 (1.3)	122	-1.5 (1.5)	122	-.14 (1.4)

We conducted exploratory analyses linking critical thinking and awe using separate hierarchical logistic regression models. Subject was the random effect for all regression models. Separate models were run using each SAS factor to predict each VTS code. Most of the VTS codes were not related to reported awe emotions. However, we did find strong, *negative* relationships between VTS scores related to "comparing elements within an image" and awe. We also found a negative relationship between the Physiological aspects of awe and some of the VTS codes suggesting that as guests feel more awe, they show less evidence of critical thinking. Maybe awe decreases critical thinking immediately because the awe experience is positive and people are motivated to stay in the moment rather than do anything (like thinking critically) that would pull them out of the moment. Perhaps awe's effect on critical thinking can only be seen over time, in terms of later motivation to learn. To answer our research questions: Different spaces in the Museum instill different aspects of awe. These aspects also seem to impact some critical thinking experiences. However, the impact seems to be mostly negative using this specific measure of critical thinking using aesthetic analysis and observation. We are currently analyzing interviews to look for explanations for that relationship. Our results suggest that high levels of awe may not be conducive to critical thinking in-the-moment. Planned follow up studies include using other measures of critical thinking and also looking for differences between in situ and recalled feelings of awe.

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