

DOES AWARENESS-MAKING ELICIT MEANING-MAKING IN BELL MUSEUM
VISITORS? A MIXED-METHODS STUDY OF A NATURAL HISTORY MOOSE
EXHIBIT

A THESIS
SUBMITTED TO THE FACULTY OF THE
UNIVERSITY OF MINNESOTA
BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE

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MAY 2019

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May 2019

Acknowledgements

There are many people who I would like to acknowledge and thank for their support in completing this thesis. First, I want to thank my advisor, Kristen Nelson, and the rest of her research lab. Kristen has been a strong guiding force in my thesis journey and her lab has wonderful individuals who each have assisted in the completion of my thesis. In particular, I want to thank Jesse Engebretson for sharing invaluable statistical resources. I am also grateful to my committee for their statistical guidance and editorial assistance: Amit Pradhananga and John LaVelle. I would also like to thank my friends, family, and fellow graduate students in the Natural Resource Science and Management program for their community and support. Finally, I would like to thank my partner, Michael Lloyd, for his patience, encouragement, and support.

Abstract

Awareness-making (AM) describes a process by which visitors bring with them past experiences, knowledge, and ideas, all of which help them make sense of museum exhibits. Meaning-making (MM) is when museum visitors' memories and experiences transform their museum experience into new knowledge and meaning. This article explores how AM elicits MM in museum visitors. I offer findings from a research study of a natural history museum exhibition called Minnesota Journeys, based on a moose natural habitat display and accompanying interactive touchscreen. The exhibition was developed in Minnesota by The Bell Museum for all ages. I report findings from a mixed-methods study incorporating surveys (n=243) and interviews (n=30) with adult museum visitors. I found that moose biology and ecology were not well-known subjects for this audience. However, after visiting both the habitat display and touchscreen, most visitors learned to identify specific moose biology and ecology characteristics, such as behavior and habitat. Also, the exhibit was more likely to elicit MM for visitors who answered AM questions correctly or agreed to AM belief statements. This study demonstrates how in a natural history museum setting visitor awareness-making can facilitate visitor meaning-making.

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Preface

In the field of museum education, awareness-making (AM) and meaning-making (MM) are discussed as two independent theories and, in the literature, little is mentioned on how AM and MM may be interconnected. This paper explores the hypothesized relationship and explains how AM and MM fits within one of museum education's foundational theoretical frameworks.

This thesis has two components: (1) a mixed-method study exploring the interconnection between two major theories in the museum education literature and (2) an initial report with descriptive findings given to the Bell Museum.

The mixed-methods study builds on prior research and discusses how AM and MM are important factors to museum visitor learning. Falk & Dierking's (2000) Contextual Model of Learning, a significant theoretical framework in museum education literature, acknowledges that cognitive and affective processes influence the making of both awareness and meaning, but the model does not explicitly mention AM or MM. This thesis argues that there is a connection between AM and MM in a natural history museum setting and how AM and MM fit within the Contextual Model of Learning.

The Initial Report was a document provided to The Bell Museum as a thank you for letting the researcher use the moose exhibit as the researcher's study site. This document includes an executive summary, introduction, methods, descriptive findings, future products, works cited, and appendices.

As a graduate student of the Natural Resource Science & Management program (NRSM), this research relates to my scholarly work because its foundation began upon environmental education. I chose NRSM's recreation resources, tourism, and environmental education track and many of the classes I have taken throughout my graduate journey have helped build my skills as an environmental educator. Not only does this research build upon my professional-development, it also serves my own scholarship as a means to learn how to design, implement, and write scholarly work.

This thesis is thanks to the support of my advisor, my committee, and select Bell Museum staff and, for that, I am grateful.

Does awareness-making elicit meaning-making in Bell Museum visitors? A mixed-methods study of a natural history moose exhibit

INTRODUCTION

Awareness-making (AM) and meaning-making (MM) both play crucial roles in shaping the museum visitor experience. AM is when museum visitors bring with them past experiences, knowledge, and ideas, all of which help them make sense of museum exhibits (Graburn, 1997; Linderman, 1964). For example, in a natural history museum setting, AM may be a visitor learning a new concept about Sandhill crane mating behaviors from reading an exhibit's interpretive material. Or, evidence of AM may be two visitors discussing their previous knowledge about beaver dams and then sharing ideas and incorporating new facts they learned from a beaver habitat display. Heightened awareness from exposure to exhibits is often one of the desired outcomes for museum evaluators and has been measured and documented in the literature (Falk et al., 1998; Giusti, 2012; Megonigal et al, 2010; & Ogden et al., 1993). Falk & Dierking's (2000) Contextual Model of Learning (Figure 1) is an example for how AM occurs in a museum setting. This framework describes three different contexts that shape the visitor museum experience: (1) a personal context (2) a socio-cultural context, and (3) a physical context.

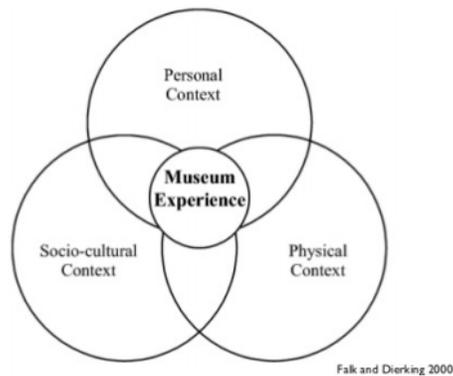


Figure 1: Contextual Model of Learning (Falk & Dierking, 2000), image modified by Stuedahl (2013)

Within these three contexts, Falk & Storksdieck (2005) identified a total of twelve specific independent variables that each contributed to museum visitors learning. The five that fall under the model's personal context are: (1) visitor motivation and expectation; (2) prior knowledge, (3) prior experience, (4) prior interests, and (5) choice and control. For this study, AM falls within this model's personal context and it is this context that this paper prioritizes. It is

important to note that the physical context is briefly explored in this study. Research has shown that the design of interpretive spaces, such as lighting, color and sound can subtly affect visitor learning (Coe, 1985; Hedge, 1995; Ogden, 1993). Though measuring awareness is an essential step to better understanding the museum visitor experience, AM only accounts for the cognitive aspect of how much visitors are learning and retaining knowledge. To better understand the Bell Museum visitor experience, it is essential to acknowledge the different types of meanings experienced by its visitors.

MM is when museum visitors' memories and experiences transform their museum experience into new knowledge and meaning (Ansbacher, 2002; Silverman, 1995; Benton, 2010). For example, MM may be a visitor viewing a habitat display, remembering a place or a time in his or her life that is meaningful, and then using that memory to make meaning of the information learned at the habitat display. Natural history museums often have ecological places portrayed in habitat dioramas and research suggests that place is an important factor when considering affective variables (e.g., emotions, attitudes, feelings, beliefs) (Garibay & Gyllenhaal, 2014). Garibay & Gyllenhaal (2014) explain further that when visitors connect with the dioramas, either by evoking memories or creating connections to other places they have visited, this can affect museum visitors' feelings and emotions. This example from the literature showcases place-based learning, which is an educational approach that many museums use to incorporate local knowledges and environments as the central content for their programs and exhibitions. This type of approach, especially in a museum setting, can be a powerful tool to promote MM in its visitors (Villeneuve & Martin-Hamon, 2007).

In museum education literature, AM and MM are discussed as two independent theories and little is discussed about how AM and MM may be interconnected. Other fields of literature acknowledge that cognitive and affective processes influence the making of both awareness and meaning (Paavola & Hakkarainen, 2009), but the connection itself has not been fully explored within a museum setting. Falk & Dierking (1992) reference the connection between cognitive and affective variable in museum settings within their Contextual Model of Learning, but the terms AM and MM are not explicitly used. Using this framework, this study reinforces and expands one of the model's key components, the personal context.

Research Questions & Hypotheses

This paper argues that there is a connection between AM and MM and that this connection resides within the Contextual Model of Learning's personal context (Figure 2). To build on these theories and to address this gap in the literature, this study aims to explore two primary research

questions. The first question is: (1) To what extent does the moose exhibit evoke AM in Bell Museum visitors? The aim of this question is to measure how much AM is being evoked by the Bell Museum’s moose exhibit. The researcher hypothesized that: (H1) increased interactions with moose exhibit interpretive materials would positively influence visitor AM and (H2) increased recognition of room design elements would subtly increase visitor AM.

The second question is: (2) To what extent does AM elicit MM in Bell Museum visitors? The aim of this question is to explore how AM may influence MM within a museum setting by measuring how much MM was being elicited by what visitors learned cognitively from the moose exhibit. The researcher hypothesized that: (H3) sociodemographic factors, such as education, age, and race would influence visitor MM and (H4) increased AM would positively influence MM.

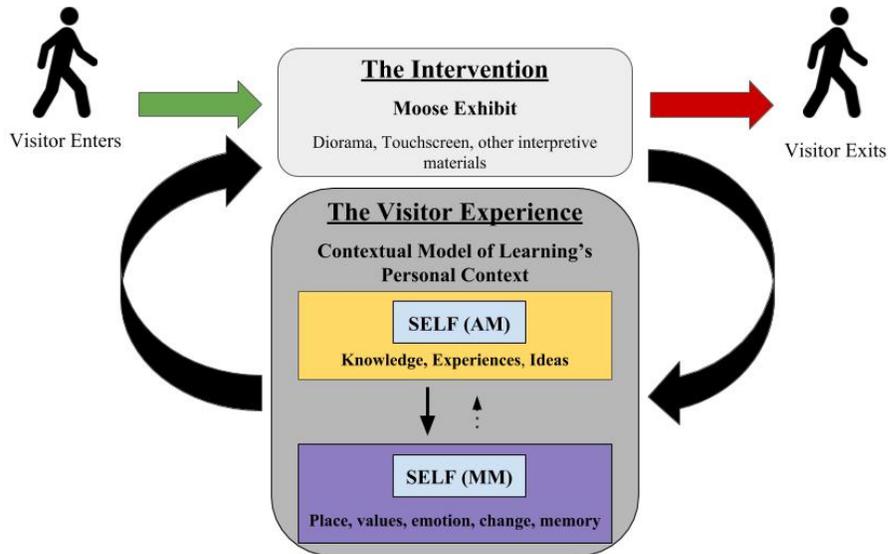


Figure 2: Conceptual Framework of how AM and MM fit within the Contextual Model of Learning’s personal context

The Exhibition: A Journey Through Space and Time

Minnesota Journeys was the first permanent exhibit developed by the recently renovated Bell Museum. The Bell Museum is a natural history museum located in Falcon Heights, Minnesota. The idea of this exhibit was to interpret Minnesota’s natural history ranging from the beginning of the universe to present day. The exhibit is meant to attract visitors of all ages and to create a fully immersive space for interactive learning and entertainment. One section of the museum highlights Minnesota’s coniferous forest biome (North Woods). The first room of the exhibit showcases dioramas of a moose community, a wolf pack, a raven, and a loon family. The room’s interpretive materials highlight the North Woods as a fragile ecosystem in which plants and

animals must adapt to extreme climatic conditions. The interpretive materials used as the study site for this research were the moose habitat display's diorama, written interpretive materials, and accompanying touchscreen.

The moose exhibit is highly interactive and has several components all with varied learning outcomes. The moose diorama's foreground includes a bull wading through a bog, and a small window highlights a perch living underneath the water surface. The diorama background depicts a lake landscape with a cow and its calf walking onto the nearby lakeshore. The scene is designed to represent what rutting season may look like for a moose community (Figure 3). The written interpretive materials adjacent to the moose diorama touch on topics such as moose diet, predator-prey relationships, habitat biodiversity, and reproductive energy allocation. The adjacent touchscreen is designed to breathe life into the moose diorama and its interpretive materials. The touchscreen has five interactive components: (1) Bring it to Life, (2) Search It, (3) Field Guide, (4) Meet an Expert, and (5) Species Checklist. "Bring it to Life" is a visual elucidation and representation of the diorama. "Search It" is a game visitors can play to search for animals and plants in the habitat display. "Field Guide" shows a simplified phylogenetic representation of the diorama's animals and plants. "Meet an Expert" plays a short video of a moose biologist sharing about their research on moose population decline. And "Species Checklist" shows a full list of flora and fauna found within the habitat display and offers visitors the opportunity to learn more about those particular species.



Figure 3: An image of The Bell Museum's moose diorama

METHODS

Methodology

This is a study using a mixed-methods explanatory sequential design (Cresswell & Clark, 2010), which intends to explore the connection between AM and MM by utilizing social science theory as its foundation. Conducted in two phases, the first phase was quantitative (survey) and the second phase was qualitative (semi-structured interview). A mixed-methods design was chosen so the researcher could: (1) obtain a quantitative evaluation of the predictors of AM and MM in Bell Museum visitors; (2) use the quantitative results to fine-tune the interview protocol; (3) analyze the rich, anecdotal qualitative data from the interviews to further explore and better understand participant views on AM and MM topics; and (4) use the qualitative data to assist with interpretation of the quantitative results.

Data Collection

Quantitative data were gathered by a survey, available in both electronic and paper formats. Qualitative data were collected by subsequent interview. The first phase, survey data collection, was administered on-site at The Bell Museum. To participate in the study, participants must have visited the moose exhibit, be 18 years or older, and be proficient in English. For the survey, visitors were approached by the researcher as they left the Minnesota Journey's permanent exhibit and verbally invited to complete the survey. The researcher administered data collection outside the exhibition area to reduce potential negative impacts on other visitors' museum experiences. On average, respondents completed the survey within 8 to 10 minutes. Participants were offered a free magnet with natural history content for completion of their survey.

Using convenience sampling with purposeful parameters, survey data collection occurred for four weeks between November and December of 2018. To maximize variation in the types of museum visitors that the researcher would encounter, the researcher varied the time and the day of the week of sampling (Appendix A. Sampling occurred every day of the week, except for Wednesdays due to a time conflict by the researcher. Data collection occurred within two-hour shifts during The Bell Museum's open hours. The shifts were: (1) 10:30 am to 12:30 pm, (2) 12:30 pm to 2:30 pm, and (3) 2:30 pm to 4:30 pm. Using random sampling, one shift was assigned per day within the four weeks of data collection.

Interview participants were recruited via the survey which had a final question assessing the level of interest of participating in a brief phone interview. From the initial number of survey respondents (n=263), 70 participants indicated interest in participating in follow-up interview. Given the limited time and resources of this study, the researcher used randomized sampling to

reduce the sample size to 30 individuals. 30 phone interviews were conducted between December 2019 and January 2019. On average, interviews lasted about ten minutes. Each interview was transcribed as a complete transcript, which allowed the researcher to identify and categorize themes during analysis.

Survey

The survey was comprised of fourteen multiple choice questions and ten short answer questions. The survey also included a color photograph of the moose diorama as a reference for respondents (Figure 3, see Appendix B for complete survey).

Awareness-making. Four statements were used to measure respondents' beliefs and knowledge on moose biology and moose ecology topics on a 4-point Likert-scale of "strongly disagree" to "strongly agree." AM question design was based from a summative evaluation conducted at Yale Peabody Museum of Natural History (Giusti, 2012) and then reworded to fit within the realm of the Bell Museum's moose exhibit. Respondents were asked to respond to the following statements: (1) The moose exhibit made me realize how many different plants and animals live in the North Woods region; (2) The moose exhibit made me realized how moose have adapted to live in the North Woods region; (3) Moose themselves can't digest most of what they eat. It is with the help of microbes in their belly that helps digest their food; and (4) During the fall season, moose are rutting (i.e., in mating season). Two open-ended questions were also used to assess cognitive dimensions by asking respondents to explain what they thought the moose exhibit was about and what was one thing they learned from the moose exhibit that they didn't know or were unsure of before (Appendix B).

Meaning-making. Four statements were used to measure respondents' beliefs on four place-based questions. MM question design was based from previously developed sense-of-place studies and instruments (Garibay & Gyllenhall, 2015). Respondents were asked to respond to the following statements: (1) This diorama brought back memories of my own outdoor experiences; (2) I enjoy visiting wild places (i.e., wilderness areas); (3) My favorite outdoor places have broad lawns, formal gardens, and trimmed shrubs; and (4) This diorama sparked my curiosity to visit a place like the moose diorama in real life. The first, second, and third questions were verbatim from Garibay & Gyllenhall's (2015) sense-of-place survey instrument. Using similar design elements as the first three questions, the fourth question was based from The Bell Museum's mission statement. These questions were based on a 4-point Likert-scale of "strongly disagree" to "strongly agree" (Appendix B).

Demographics. Age was included in analysis. Age was a fill-in-the-blank question. For analysis, age was separated into categories (e.g., 18-27). Other demographic variables were collected and analyzed but were not included in the results because either the sample sizes were too small, or the results were not statistically significant (Appendix C).

Interview

The interview guide consisted of four semi-structured open-ended questions (Appendix D). The questions were tailored to further explore the participants' experiences, AM, and MM when visiting the moose exhibit. The researcher did not directly ask about how learning and thinking about the moose interpretive materials may have promoted MM. The researcher also avoided using the terms "awareness-making" and "meaning-making." Participants' descriptions of memories elicited by the moose exhibit allowed for better understanding of how individuals express ideas and feelings of MM through the language used to tell and describe their stories.

Awareness-making. Two open-ended questions were asked to further explore AM factors. Interviewees were asked: (1) when thinking back on the moose exhibit, what feature of the exhibit comes to mind first? And (2) what were your take-home messages of the moose exhibit? These questions tried to engage the cognitive realm and were meant to help the participants remember the physical and interpretive elements of the exhibit.

Meaning-making. Based on participant survey answers, two open-ended questions and subsequent prompts were asked to further explore potential MM factors. These questions implicated place-based meaning and encouraged participants to share stories of places or times in their life that the moose exhibit brought to mind. In the survey, many respondents indicated that the moose exhibit reminded them of a place or time in their life, and in the interview, participants were asked to describe those places or to elaborate on their lived experiences. The researcher asked probing questions when participants shared stories, explicitly asking the participants to describe how they felt at the time of their story.

Analysis

Using a mixed-methods explanatory design, the first phase was a quantitative analysis (Appendix E). For hypothesis one and two, differences among respondent groups (i.e., multiple versus single uses of interpretation materials) were examined using T-tests. Effect size indicators (e.g., V) were reported when appropriate. For hypothesis three, One-way ANOVA (F) tests determined what factors and demographic variables (i.e., independent variables) significantly influenced overall AM and MM (i.e., dependent variables). Lastly, for hypothesis four, correlation analyses were

used to determine if there was a relationship between AM and MM factors. A matrix of four Likert-scale questions were used to measure each factor. The responses for each factor matrix were aggregated and then the aggregated results were analyzed by correlation analysis.

The subsequent qualitative phase used thematic analysis to explore AM and MM from the point of view of individuals who experienced the moose exhibit. This rich, anecdotal data helped describe the types of factors behind the hypothesized relationship between AM and MM. Significant statements were first categorized into themes and then were reassessed again into subsequent categories. The themes were compared to the raw data to ensure that they are an accurate compilation of participants' belief and experiences. Direct quotes from the participants were used to back research claims and to reduce the potential for researcher bias. All responses were assessed holistically as a complete narrative to gain a better understanding of the moose exhibit experience across all 243 open-ended survey questions and 30 interviews.

RESULTS

Participant response rate and demographics

Approximately 600 visitors were approached and a total of 263 surveys were completed by eligible museum visitors (estimated response rate of 44%). After discarding incomplete surveys, a total of 243 survey responses were used for data analysis. Participant demographics were mostly homogenous. As compared to the Minneapolis-St. Paul metropolitan area, participants who completed the survey, on average, had higher levels of education, were slightly younger, and predominantly racially identified as white (Appendix C). Regarding group dynamics, 89% (n=217) of respondents visited the museum in a group and 47% (n=102) of those groups included children (Appendix C). Lastly, limited funding prohibited a non-response bias check for this study.

To what extent does the moose exhibit evoke awareness-making?

Respondents were asked the extent to which they disagreed or agreed with four belief statements about The Bell Museum moose exhibit. On average, respondents who visited multiple interpretive materials were significantly more likely to agree that the moose exhibit made them realize how many different plants and animals live in the North Woods region, $t(241) = 2.3, p = .02$ (Table 1). Effect sizes ($r_{pb} = .15$) suggested that differences between those who visited one or multiple interpretive materials were small to medium (Cohen, 1998) or minimal to typical (Vaske et al., 2002). Compared to respondents who only visited one interpretive material, those who interacted with multiple interpretive materials were also more likely to agree that the moose exhibit made them realize how moose have adapted to live in the North Woods region and that moose are rutting (i.e., in mating season) during the fall season, but these differences were not statistically significant, $t(241) = .03$ to $.05, p = .42$ to $.66$. Lastly, among respondents who visited one interpretive material or multiple interpretive materials, there was no difference between the likelihood of agreement or disagreement when asked about moose digestion and microbes, $t(241) = .01, p = .99$.

Table 1. Differences in beliefs between visitors who visited^a multiple interpretive materials or visited only one interpretive material

	<i># of Interactions</i>		<i>t-value</i>	<i>df</i>	<i>p-value</i>	<i>Effect size (r_{pb})</i>
	1 ^b (50%)	2 ^c (50%)				
Perception belief statements^d						
The moose exhibit made me realize how many different plants and animals live in the North Woods region	3.08	3.31	2.3	241	.02*	.15
The moose exhibit made me realize how moose have adapted to live in the North Woods region.	3.12	3.20	.81	241	.42	.05
Knowledge belief statements						
Moose themselves can't digest most of what they eat. It is with the help of microbes in their belly that helps digest their food.	3.18	3.18	.01	241	.99	0
During the fall season, moose are rutting (i.e., in mating season).	3.06	3.11	.44	241	.66	.03

a. A visit was defined by if the visitor self-identified as interacting with the interpretive material (e.g., touching, listening, etc.)

b. Single interaction (diorama or touchscreen only)

c. Multiple interactions (diorama and/or touchscreen)

d. Based on a 4-point scale of 1 "strongly disagree" to 4 "strongly agree"

*Significant $p < .05$

In open-ended questions about what participants' thought the moose exhibit was designed to convey and one thing participants learned, respondents who interacted with multiple and single interpretative materials considered a variety of topics as they assessed their personal interpretation of the moose exhibit. On average, respondents who only visited one interpretive material were more likely to mention moose habitat and general information (Table 2, Appendix F):

"It shows the size of the animal and its habitat"

"Moose walking through wetland"

"For me, it was cool to see an animal in its natural habitat yet not worry about affecting the habitat in any way"

Table 2. Frequency of the eight most-commonly mentioned themes from survey question, “What do you think the moose exhibit is about?”

Themes ^a	# of Interactions	
	1 (n=107)	2 (n=113)
Habitat & Environment	55	47
General Information About Moose	30	20
Ecosystem	6	18
Population	5	12
Moose Behavior	15	24
Education	5	12
Conservation	5	10
Culture & Natural History	0	10

a. Themes are non-exclusive.

In comparison, respondents who visited multiple interpretive materials were more likely to mention a variety of topics, such as moose ecosystems, population, behavior, education, conservation, and natural history (Table 2):

“Moose and how they fit into the ecosystem”

“I think my biggest takeaway is that obviously moose used to be in a lot more of Minnesota and now they are in a lot less of Minnesota”

"How the moose behaves in the wild. What it naturally eats and where it typically roams"

"Educating the public on moose and the current habitat - how we impact their habitat"

"They need space. They need wild areas. ...The space needs to be protected so that the animals can be protected"

“Natural history of moose in Minnesota”

When asked if respondents learned anything new, on average, respondents who only visited one interpretive material were more likely to answer “nothing” or “unsure” (Table 3, Appendix F):

"I'm sure if I would have used the touchscreen I would [have] learned something. I should probably go back"

Table 3. Frequency of the five most-commonly mentioned themes from survey question, “What is one thing you found out from the moose exhibit that you didn't know or were unsure of before?”

Themes ^a	# of Interactions	
	1 (n=87)	2 (n=97)
Moose Characteristics	31	35
Unsure or Nothing	23	13
Moose Diet	12	21
Population & Disease	10	13
Reproductive Energy Allocation	1	6

a. Themes are non-exclusive.

Respondents who visited multiple interpretive materials were more likely to answer about topics, such as moose characteristics, diet, population & disease, and reproductive energy allocation (Table 3, Appendix F):

"The hoof is really big"

"Their fur was soft, and their noses are very round"

"How much of the moose diet is aquatic vegetation"

"The thing that struck me the most about moose...are that they have much more specific eating requirements than I realized"

"There has been a dramatic drop in the moose population in northern Minnesota but there is a healthier population elsewhere"

"Issue on diseases"

"That a male moose will expend as much energy growing antlers as a nursing cow expends nursing a calf. I learned that a moose cannot digest everything eats"

A confounding variable, group dynamics, emerged when analyzing the qualitative data.

"Doing dioramas with 3 kids under 7 means you don't get to look for deeper meanings. It means you just get to look for poop."

“Honestly I was keeping my nephews entertained”

Group dynamics, especially a group with children, often influenced visitor AM. For this study, there wasn’t enough data to further explore this confounding variable.

Influence of social factors on awareness-making

On average, older respondents (generally over the age of 48) were more likely to agree that moose are rutting during the fall season, $f(237) = 2.05, p = .01$, while respondents who were younger (between the ages of 18 and 47) were less likely to agree that moose are rutting during the fall season (Table 4).

Table 4. Mean differences in belief statement agreement across varying visitor age categories

	Age						F-value	df	p-value	Eta (η)
	18-27 (21%)	28-37 (25%)	38-47 (19%)	48-57 (11%)	58-67 (14%)	68+ (11%)				
Perception belief statements^a										
The moose exhibit made me realize how many different plants and animals live in the North Woods region	3.32	3.07	3.09	3.38	3.24	3.22	1.1	237	0.35	0.15
The moose exhibit made me realize how moose have adapted to live in the North Woods region.	3.22	3.03	3.04	3.35	3.24	3.22	1	237	0.42	0.14
Knowledge belief statements^a										
Moose themselves can't digest most of what they eat. It is with the help of microbes in their belly that helps digest their food.	3.08	3.28	3.13	3.31	3.21	3.07	0.54	237	0.75	0.12
During the fall season, moose are rutting (i.e., in mating season).	3.02	2.93	2.87	3.5	3.3	3.2	2.05	237	0.01**	0.24

a. Based on a 4-point scale of 1 "strongly disagree" to 4 "strongly agree"

** Significant $p < .01$

Due to the homogenous sample size, there was not enough variation in the data to statistically explore the other socio-demographic variables (race/ethnicity and highest level of education). As a result, these socio-demographic factors came out as statistically not significant.

To what extent does awareness-making elicit meaning-making?

There is a significant positive correlation between AM and MM, $r = .436$, $p < .001$. Respondents who were identified as having higher AM were more likely to have meaning-making elicited, whereas respondents who were identified as having less AM were less likely to have meaning-making elicited. After analyzing the interviews, three themes emerged in regard to AM eliciting MM: (1) conservation, (2) childhood, and (3) encountering the other (Appendix G).

Conservation. First, a majority of interview respondents shared that the moose exhibit elicited a feeling of wanting to protect the planet and its natural landscapes. One interview respondent said: *“to protect our planet, to save our planet. And...you know, to change our practices in ways that will contribute to that effort.”* While another interview respondent shared how the moose exhibit elicited a feeling of protecting natural environments, but with an educational lens:

“I just think the whole process of...connecting and educating people about the environment is super important. Especially [when] we look at our environment right now, like, how climate change and how warm it is getting in Minnesota...I think that would be an element to tie into.... I thought a lot about...how the last white rhino went extinct. Like, I don't want that to happen to moose and their only natural habitat is, like... they now don't have that because we've ruined that for them.... I think that would be an interesting piece to tie into the moose exhibit... the way we farm like we do and taking their habitat or it's doing all these things that affect them.”

Second, when seeing the moose exhibit, respondents felt that moose are important because they signify a healthy ecosystem. For example, an interviewee, who self-identified as a hunter, said:

“Um, kind of a sense of seeing an animal in a habitat that is healthy. You know, moose are certainly a reflection of high-quality habitat. Um... you know, a healthy habitat, a healthy ecosystem. As opposed to a deer. Deer can do really well in really fragmented, poor habitat. Developed areas obviously, like the deer in the city here. Or farmland, that kind of thing. Whereas, moose need that kind of older growth, more stable habitat that is, um... more indicative of a healthy ecosystem, I would say. So, that is the kind of feelings that... that seeing a moose brings up for me. Um, besides the “shock and awe” factor too...”

Childhood. The second emergent theme was childhood, which focused mainly on interviewees' reminiscence of past experiences. One interviewee shared how seeing the moose exhibit reminded them of childhood vacations to the North Shore:

"When I was a kid, my parents and I used to go up to Duluth...quite a few [times] out of the year and part of what we would do is go up to the Gunflint Trail and look for moose. And that's what it kind of reminded me of and made me think of."

Similarly, another interviewee shared that the moose exhibit reminded them of their experience as a child at the New York City's American Museum of Natural History: *"I grew up in New York City. So, you know, I would go to the American Museum of Natural History. And so they are echoes for me of... my childhood experiences."* Even an interviewee, who self-identified as a "not outdoorsy person," shared that the moose exhibit reminded them of a school field trip from when they were a child:

"In grade school, when we would go on different kinds of fields trip to... parks—not, like, a playground park, but more like a wildlife kind of park. Where you're like... just kind of...out in wooded areas. Things like that.... That's the thing that came to mind because it feels kind of, like, reminiscent on the exhibit."

Lastly, in a similar vein as the first emergent theme, another interviewee shared how the moose exhibit made them reflect on how important it is to have children learn at a young age how to appreciate nature:

"It's nice to... grow [up] having that connection to all, like, wildlife around. Like, how I take care of my pets or... watering my plants, to just, like, thinking about how we keep that environment, you know? Like, having that... good connection when I was younger, I think sustain that. Keeping the value of having... big nature and, like, having... actual wildlife and seeing, you know, different species and different environments living in a different way than we do. Like, I think it's very important to see, especially as a little kid, cause then if that was... is a core value in you, I think it really changes how you develop and how... you interact with others. Whether that be people, animals... wildlife, plants, you know? And I think that's important."

Encountering the Other. The third emergent theme relates to how seeing the moose exhibit elicited feelings and memories of animal and moose encounters. A majority of

interviewees shared their personal stories about witnessing moose in their natural habitat, as well as in urban areas.

“Well, you know, to see anything in their natural habitat in the wild is pretty wonderful. And, um, you know, not... to have any telephone wires or planes overhead. Anything like that in the way I think just makes it more special.... We saw lots of moose prints in the muddy portages. And they’re huge! I mean, it kind of takes you back when you realize just how big they are. So, I think you have to respect that. You have to respect that these aren’t cuddly little toys or stuffed animals and it just seemed like that is where they should be. I know zoos are important because we’ve lost so many animals, but much more fun to see them in the wild.”

Another interviewee shared that the moose exhibit reminded them of significant times in their life, such as seeing a deer in the wild:

"I was thinking about Afton State Park because we saw a lot of not moose, we saw a lot of deer there. And somehow that is the only park... that you can see a lot of deer. I don't know what the reason is, but for some reason... and we live in the city, so seeing a deer is kind of a big deal for us."

DISCUSSION

This research project extends the consideration of how visitor awareness-making (AM) can have an effect on visitor meaning-making (MM). Falk & Dierking (2013) discussed this concept during a presentation: “learning is not just about facts and concepts, especially intrinsic learning often is a very emotional experience... True learning is both cognitive and emotional” (slide 17), but the explicit relationship between AM and MM has not been explored in detail within Falk and Dierking’s (2000) Contextual Model of Learning, as well as in the museum studies literature. This study has thus provided two main insights: (1) the extent to which the moose exhibit evokes AM in Bell Museum visitors and (2) the extent to which visitor AM influences visitor MM.

First, the study suggests that the moose exhibit did evoke AM in its visitors. The moose exhibit’s highly interactive interpretive materials offered museum visitors several opportunities for AM. Interactive exhibits have been regarded as an effective teaching tool in informal education settings (Falk & Dierking, 1992). Most museum exhibits employ multiple interpretive materials, such as touchscreens, associated to individual exhibits which often have a central theme that the exhibit intends to convey to its audience (Mulholland et al., 2014). Bell Museum visitors who interacted with multiple interpretive materials (i.e., both the diorama and touchscreen) often gained a deeper understanding of moose biological concepts as compared to visitors who only visited a single interpretive material (Table 1, Table 2). Overall, when interacting with multiple interpretive materials, visitors were more likely to gain awareness about that exhibit’s desired learning outcomes, which reinforces how interacting with multiple interpretive materials is a key component to museum visitor AM within a natural history museum context.

Surprisingly, regarding the cognitive variables analyzed in this paper, age was a somewhat significant factor for visitor AM. Survey participants over the age of 48 were more likely to be aware that moose are rutting (i.e., mating) during the fall season. The explicit factors behind these findings are outside the scope of this study, though arguably, participants who are older have had more time to gain knowledge of moose by informal education or personal experience. For example, there were several respondents who self-identified as hunters and each of these participants were older than 48 years old. These participants had a deeper understanding of moose mating behavior for multiple reasons, one in particular is that deer hunting season is when deer are also rutting. Moose and deer are both ungulates (i.e., in the family Cervidae) and they rut at the same time of year. Hunting as a recreational activity has declined in popularity in the last 30 years (U.S. Census Bureau, 2011), which leads to the possibility that participants over

the age of 48 are more likely to have hunting experiences over participants younger than 48. It is important to note that age is thoroughly discussed within the museum studies literature (Koran & Koran; 1983; Falk & Dierking, 2013), but there is little conversation about the relationship between age and AM in a natural history museum setting. Future research is needed to further explore this subject.

Second, this study indicates that AM is indeed an avenue for MM in Bell Museum visitors. After visiting the moose exhibit, most visitors, no matter the age, were able to identify moose biology topics and concepts by describing information they learned from the exhibit's interpretive materials. These findings were then compared to affective variables, which showed there was a positive correlation between AM and MM. The possible factors behind this relationship were further explored by interview. When asked if the moose exhibit reminded participants of a place or a time in their life, a majority (n=225) said it reminded them of a place and over half (n=162) said it reminded them of a time in their life. Each of which often prompted meaningful memories, which were shared by storytelling. These memories gave further insight into how respondents personally connected to the moose exhibit both cognitively and emotionally and how these variables may be connected. Three themes emerged from the stories told by interview participants: (1) Conservation, (2) Childhood, and (3) Encounter with the other.

It is not surprising that the moose exhibit prompted visitors to elicit thoughts and feelings about land and moose conservation. Moose are charismatic animals of the Northwoods and when participants become aware that moose populations are declining because of a variety of factors, including human impact, it is no wonder that participants want to protect moose habitat. In a natural history museum setting, Garibay & Gyllenhaal (2014) explore how habitat dioramas help visitors connect with places, especially familiar places, and how this connection can develop into a sense of place. Adams (2013) defines a sense of place as "the lens through which people experience and make meaning of their experiences in and with place." Scholars in the field acknowledge that a sense of place can lead to environmentally responsible behavior (Ardoin, 2006; Kudryavstev et al, 2012), even in a museum setting (Utt & Olson, 2007). Though this study's focus was not on sense of place, these findings reinforce the idea that place is a significant factor for promoting MM in museum visitors and how developing meaning can be the initial steps towards a sense of place and, subsequently, environmentally responsible behavior.

Regarding visitors' reminiscences of childhood, this is also not a surprise. If the visitor is from the upper-Midwest, which many were, the moose exhibit showed a relatable scene of a swampy, coniferous forest. Many visitors saw the exhibit and were reminded of childhood family vacations or excursions up north to Duluth or Michigan. Often these memories were meaningful

and were directly elicited by the visitors' interactions with the moose exhibit. Through interpretation of museum exhibits, Benton (2010) discusses how visitors create meaning in a Native American Museum setting and one major factor was personally significant family members. This echoes what my findings say because often visitors' childhood stories were centered on a significant family member that brought them to a place and gave them a meaningful experience. It is these memories that were elicited by the moose exhibit

Lastly, "encountering the other" refers to the fact that visitors had personal experience with moose or other animals either in the wild or at the zoo. This theme was often brought up with interview participants who had seen a moose before and then were saddened to learn that moose may disappear from Minnesota as a result of climate change and human intervention. Lima & Green (2017) discuss the intricacies of wildlife encounters and conservation through the lens of tourism. They discuss how effective tourism management can utilize environmental education practices to make their clients more aware about the environmental challenges wildlife face as a result of human impact, which can promote feelings and potential action of environmentally responsible behavior. This finding reinforces the fact that wildlife encounters can lead to significant and memorable experiences, but it also expands the idea of how encountering the other can occur within a natural history museum setting. Further research is needed to study this phenomenon in a museum context.

Certainly, limitations are present in all studies, and this study is no exception as it is a short study exploring multiple complex variables. At the same time, limitations open avenues for future research. First, due to limited time and resources, many voices were not heard in this study. Also, since this study was based out of The Bell Museum, which has an entry fee, low-income individuals may not have been able to visit due to the price for entry. This means there is a lack of representation from different cultures, genders/identities, income levels, age categories, etc. Overall, bounded by the homogenous group of participants, the demographics collected were not enough to see if the data had a bias towards a particular group or category of people. As a means to combat this, future studies should attempt a non-response bias check. Second, the survey and interview instruments used for this study were initial drafts. It is important to continue fine-tuning these instruments by continued study and peer-review to improve upon its effectiveness. Of course, this is not an exhaustive list. Longer term studies should attempt to further ascertain the factors behind the connection between AM and MM, as well as further explore the relationship between AM, MM, and age.

CONCLUSION

This study provides a preliminary picture of how AM influences MM, as well as a better understanding of the potential factors behind this connection. This study's initial insights highlight how AM and MM fit within the Contextual Model of Learning. It also demonstrates that interacting with multiple interpretive materials at a single exhibit can have a significant influence on visitor AM. Certainly, more research is needed to further clarify the factors influencing the connection between AM and MM, but this study introduces an important theoretical construct within the Contextual Model of Learning that the museum education field has not explored sufficiently.

Future visitor research should consider exploring the influence AM has on MM in different museum settings and facilitate discussions with visitors to further dissect what factors are behind this connection. Several studies have demonstrated that both visitors AM and MM can serve as rationales for different museum management practices that in turn impact the overall visitor experience (Benton, 2010; Giusti, 2012). For many years, researchers have provided a wealth of knowledge regarding best management practices for professionals in the museum industry (e.g., Ahmad et al., 2013; Nelson & Cohn, 2015). Recent management practices often involve evaluation of visitor AM and MM, with a focus on finding ways to enhance visitors' museum experiences and to fulfill the museum's mission (Storksdieck et al., 2006). Given this study, we have a better understanding of the role visitor AM plays in visitor MM. In practice, this new theoretical knowledge can be incorporated in future museum evaluations, allowing museum professionals to have a deeper understanding of their evaluative results.

As museum professionals, our future work can build upon research in the field in order to help visitors achieve deeper awareness and meaning stimulated by museum exhibits. In a natural history museum setting, this deeper understanding of biological concepts and place can influence visitor MM, which can be the beginning steps towards environmentally responsible beliefs and behaviors (Ardoin, 2006; Krudryavstev et al, 2012; Semken & Freeman, 2008). To make this a reality, museum professionals must continue to build upon their own knowledge of the factors behind visitor AM and MM and implement what is learned in practice.

Epilogue

Findings and select results of this mixed-methods study were first disseminated to The Bell Museum executive team. It is the author's hope that these findings will spark conversations within The Bell Museum team regarding their habitat displays and their role in evoking awareness and eliciting meaning. The author intends to use these paper's findings to write a peer-reviewed article for the Journal of Museum Education.

On its own, this thesis provides a valuable theoretical exploration into the interconnection between awareness-making and meaning-making in a natural history museum setting. Better understanding this new concept, as well as how it fits within the museum visitor experience adds to museum education literature and advances our overall understanding of how even a short visit to a natural history museum can facilitate visitor learning, which can influence subsequent meaning-making.

WORKS CITED

- Adams, J.D. (2013). Theorizing a sense of place in transnational community. *Children, youth and environments*, 23(3): 43-65.
- Ahmad, A., Abbas, M. Y., Yusof, W. Z. M., Taib, M. Z. M. (2013). Museum learning: Using research as best practice in creating future museum exhibition. *Procedia – Social and Behavioral Sciences*, 105: 370-382
- Ansbacher, T. (2002). Misunderstandings of meaning making. *Exhibitionist*, 21(1): 1-4.
- Ardoin, N. M. (2006). Toward an interdisciplinary understanding of place: Lessons for environmental education. *Canadian Journal fo Environmental Education*, 11: 112-126.
- Benton, G. M. (2008) Visitor meaning-making at Grand Canyon’s Tusayan Museum and Ruin. *Curator*, 51(3): 295-309
- Coe, J. (1985). Design and perception: Making the zoo experience real. *Zoo Biology*, 4:197-208
- Cohen, j. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.
- Cresswell, J. W, & Clark, V. L. P. (2012) *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: SAGE Publications.
- Falk, J. H. & Dierking, L. D. (1992). *The Museum Experience*. Washington, DC: Whalesback Books
- Falk, J. H. & Dierking, L. D. (2000). *Learning from museums: Visitor experiences and the making of meaning*. Lanham, MD: Rowman & Littlefield.
- Falk, J. H. & Dierking, L. D. (2013). *The museum experience revisited*. Walnut Creek, CA: Left Coast Press, Inc.
- Falk, J. K. & Dierking, L. D. (2013) Museum experience model [27]. Retrieved from <https://www.slideshare.net/RubenSmit/museum-experience-as-defined-by-john-falk-lynn-dierking-2013>
- Falk, J. H., Mousouri, T. & Coulson, D. (1998). The effect of visitors’ agendas on museum learning. *Curator*, 41 (2): 107-120.
- Falk, J. & Storksdieck, M. (2005). In: Falk, J; Dierking L. (eds). Using the conceptual model of learning to understand visitor learning from a science center exhibition. *Science Education*, 89: 744-778. doi: 10.1002/sce.20078
- Garibay, C. & Gyllenhaal, E. (2014). Habitat dioramas and sense of place: Factors linked to visitors’ feelings about the natural places portrayed in dioramas. In: Tunnicliffe S., Scheerso A. (eds), *Natural History Dioramas*. Springer, Dordrecht.
- Giusti, E. (2012). Yale peabody Museum of Natural History’s “travels in the great tree of life:” Museum visitors learning about phylogenetic relationships. *Evolution Education Outreach*, 5: 68-75.
- Graburn, N. (1977). The museum and the visitor experience. *Roundtable Reports*, pp. 1-5.
- Hedge, A. (1995). Human-factor considerations in the design of museums to optimize their impact on learning. In J. Falk & L. Dierking (Eds.): *Public Institutions for Personal Learning*. Washington, DC: American Association of Museums.
- Koran, J. J. & Korana, M. L. (1983). Visitor behavior: Studies and strategies. The roles of attention and curiosity in museum learning. *Roundtable Reports*, 8(2): 14-17, 24.
- Krudryavstev, A., Krasny, M. E., & Stedman, R. C. (2012). The impact of environmental education on sense of place, among urban youth. *Ecosphere*, 3(4): 29.
- Lima, I. B., & Green, R. J. (2017). *Wildlife toursim, environmental learning and ethical encounters: Ecological and conservation aspects*. New York, NY: Springer.
- Linderman, E. W. (1964). Curriculum for awareness. *Art Education*, 17(6): 5-9.
- Megonigal, J. P, Starrs, B. S., Pekarik, A., Drohan, P., and Havlin, J. (2010). “Dig it!”: How an exhibit breathed life into soils education. *Soil Science Society of America Journal*, 74: 706-716.

- Mulholland, P., Wolff, A., Kilfeather, E., & McCarthy, E. (2014). Using event spaces, setting and theme to assist the interpretation and development of museum stories. In: Janowicz, K., Schlobach, S., Lambrix, P., Hyvönen, E. (Eds.), *EKAW 2014. LNCS*, 8876: 320–332. Springer, Heidelberg.
- Nelson, A. G. & Cohn, S. (2015). Data collection methods for evaluation museum programs and exhibitions. *Journal of Museum Education*, 40(1): 27-36.
- Ogden, J. L., Lindburg, D. G., & Maple, T. L. (1993). The effects of ecologically-relevant sounds on zoo visitors. *Curator*, 36(2): 147-156.
- Paavola, S. & Hakkarainen, K. (2009). From meaning to joint construction of knowledge practices and artefacts - a triological approach to CSCL. In C. O'Malley, D. Suthers, P. Reimann, & A. Dimitracopoulou (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 2009 conference*: 83-92. Rhodes, Creek: *International Society of the Learning Sciences (ISLS)*.
- Semken, S. and Freeman, C. B. (2008). Sense of place in the practice and assessment of place-based science teaching. *Science Education*, 92: 1042-1057. doi: 10.1002/sce.20279
- Silverman, L. H. (1995). Visitor meaning-making in museums for a new age. *Curator*, 38(3): 161-170.
- Storksdieck, M., Stein, J. K., & Dancu, T. (2006). Summative evaluation of public engagement in current health science at the Current Science & Technology Center, Museum of Science, Boston. Annapolis, MD: Institute for Learning Innovation.
- Stuedahl, D. (2013). Participatory approaches to museum design - departing from people's cultural practices [4]. Retrieved from <https://www.slideshare.net/dagnystuedahl/participatory-approaches-to-museum-design-departing-from-peoples-cultural-practices>
- U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce. (2011). National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. U.S. Census Bureau. Retrieved from <https://census.gov/library/publications/2018/demo/fhw-16-nat.html>
- Utt, E. and Olsen, S. L. (2007). A sense of place in museum public programming: Three case studies. *The Journal of Museum Education*, 32(3): 295-302.
- Vaske, J. J., Gliner, J. A., & Morgan, G. A. (2002). Communicating judgments about practical significance: Effect size, confidence intervals and odds ratios. *Human Dimensions of Wildlife*, 7, 287-300.
- Villeneuve, P. & Martin-Hamon, A. (2007). At the heart of it: Museums and place-based study in rural communities. *Journal of Museum Education*, 32(3): 253-262.

Appendix A

Data Collection Schedule and Frequencies

Appendix A1: Total number of data collection shifts by day and time-of-day

	Day Shifts^a		
	10:30 am – 12:30 pm	12:30 pm – 2:30 pm	2:30 pm – 4:30 pm
Monday	2	1	1
Tuesday	1	1	2
Thursday	1	2	1
Friday	1	1	2
Saturday	1	2	1
Sunday	2	1	1
Total	8	8	8

a. Shifts were randomly assigned by day and time-of-day. Wednesdays were not included in data collection due to a time conflict by the researcher.

Appendix A2: Frequency and total number of visitors surveyed from week-to-week and day-to-day

	Survey Weeks				Total (Days)	Frequency (%)
	11/19 – 11/25	11/26 – 12/2	12/3 – 12/9	12/10 – 12/16		
Monday	7	13	11	7	38	14
Tuesday	10	15	6	14	45	17
Thursday	0 ^a	8	14	6	28	11
Friday	18	9	12	6	45	17
Saturday	12	20	20	5	57	21
Sunday	13	18	9	10	50	19
Total (By Week)	60	83	72	48	263	
Frequency (%)	23	32	27	18		

a. Thanksgiving Day

Appendix B

Visitor Exit Survey

North Woods Moose Exhibit

Hello. My name is Molly O'Connor. I am with the University of Minnesota. I am working on a project to understand what museum visitors are taking from their experience at the Bell Museum's moose exhibit. We are asking visitors to complete a short survey and to answer a few questions about their experience. The results will be used for my master's research and to inform future visitor research at the Bell Museum. It should take about 5 to 10 minutes to complete. Participation in this study is voluntary. We are not gathering any personal information that reveals your identity. There is no penalty for refusing to participate, and you can withdraw at any time.

To start, I want to hear about your experience in the North Woods Exhibit, specifically about the Moose exhibit



1. How did you use the Moose exhibit area?
(Check all that apply)

- I observed the moose diorama
- I read the moose diorama panel
- I used the Field Guide
- I watched a video that brought the diorama to life (i.e., Bring It to Life)
- I listened to a moose expert talk about their research
- I touched the moose print
- None of the above
- Other (describe in the text box below)

2. Which interpretive materials did you look and/or interact with at the moose exhibit? (Check all that apply)

- Moose diorama
- Touchscreen
- None of the above
- Other

3. Briefly explain, what do you think the Moose exhibit is about?

4. What is one thing you learned from the moose exhibit that you didn't know or were unsure of before?

5. Please read the statements below and rate to what degree do you agree or disagree with the following statements (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree)

	Strongly Disagree	Somewhat disagree	Somewhat agree	Strongly Agree
5. The moose exhibit made me realize how many plants and animals live in the North Woods region.	1	2	3	4
6. The moose exhibit made me realize how moose have adapted to live in the North Woods region.	1	2	3	4
7. Moose themselves can't digest most of what they eat. It is with the help of microbes in their belly that helps digest their food.	1	2	3	4
8. During the fall season, moose are rutting (i.e., in mating season).	1	2	3	4

6. When visiting the museum today, did you come with previous knowledge about moose? (Check all that apply)

- Yes, I have knowledge from formal education (i.e. schooling, long-term training)
- Yes, I have knowledge from informal education (i.e. museums, talks, TV, personal experience, etc.)
- No, I have no knowledge of moose

Please read the statements below and rate to what degree do you agree or disagree with the following statements (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree)

	Strongly Disagree	Somewhat disagree	Somewhat agree	Strongly Agree
This diorama brought back memories of my own outdoor experiences.	1	2	3	4
I enjoy visiting wild places (i.e. wilderness areas, etc.)	1	2	3	4
My favorite outdoor places have broad lawns, formal gardens, and trimmed shrubs.	1	2	3	4
This diorama sparked my curiosity to visit a place like this in real life.	1	2	3	4

8a. Did the moose exhibit remind you of a place you've been?

- Yes
- No [Skip to question 11]

8b. If yes, please describe.

9a. Did the moose exhibit remind you of a time in your life?

- Yes
- No [Skip to question 9]

9b. If yes, please describe the time in your life the moose exhibit reminded you of.

Now I would like to get a sense of how you spend time at the Bell Museum.

10. What motivated you to come to the Bell Museum today? (Check all that apply)

- To learn something new
- To spend time with friends
- To spend time with family

- To see the new building
- To relax
- To pass time
- Other (describe in the text box below)

11a. Who visited the museum with you today?

- No one
- I was in a group
 - ___ Number of adults
 - ___ Number of children

11b. How many were family members?

- ___ Number of adults
- ___ Number of children

12. How often do you visit the Bell Museum?

- Daily
- Weekly
- Monthly
- Annually
- This is my first time

Now I would like to get a sense of who you are.

13. In what year were you born? _____

14. What race/ethnicity do you identify as?

15. What is the highest level of formal education you have completed?

- | | |
|--|--|
| <input type="checkbox"/> Did not finish high school | <input type="checkbox"/> College bachelor's degree |
| <input type="checkbox"/> Completed high school | <input type="checkbox"/> Some graduate work |
| <input type="checkbox"/> Some college but no degree | <input type="checkbox"/> Completed graduate degree (Master's or Ph.D.) |
| <input type="checkbox"/> Associate degree or vocational degree | |

Lastly, we'd like to know if you would be willing to answer a few questions

For this study, Molly, the graduate researcher, is conducting surveys and in-person/phone interviews. These interviews will last approximately 15 minutes. The purpose of these interviews is similar to this survey, except Molly will ask more in-depth questions in order to get a deeper understanding of your museum experience. Any information shared will be deleted after the completion of this study and what is discussed during the interview will be kept completely confidential.

16. Would you be willing to participate in a short phone interview about your museum experience?

- Yes
- No [Skip to question 17]

17. Please share your contact information below and the researcher will contact you in the next week.

Full name: _____

Phone: _____

Email: _____

Preferred time to be contacted: *Please circle the days and times that work best for you.*

Best days to contact you: Mon Tues Wed Thurs Fri Sat Sun

Best times to contact you: Morning Afternoon Early Evening

Thank you! Molly will place your information in a survey pool. Only 30 individuals will be called for this study. If you are randomly selected, the researcher will contact you sometime between mid-December to early January (excluding holidays).

18. Did we miss anything? Please provide additional comments or questions you may have about the Bell Museum and its moose diorama

You've completed the survey! Thank you for your participation.

Appendix C

Participant Demographics

Table C1: Sociodemographic characteristics among survey respondents

	Frequency (%)
<i>Race/Ethnicity</i>	(252)
American Indian/Alaska Native	<1
Asian	5
Black	4
Eastern/North African	<1
Mixed	5
Native Hawaiian	<1
White Hispanic	1
White non-Hispanic	83
Other	<1
Choose not to answer	<1
<i>Educational Attainment</i>	(252)
Completed high school	2
Some college but no degree	10
Association degree or vocational degree	8
College bachelor's degree	41
Some graduate work	9
Completed graduate degree (Master's or Ph.D.)	29
<i>Age</i>	(251)
18-27	19
28-37	22
38-47	21
48-57	12
58-67	14
68-77	11
78-87	2
88-97	<1
<i>Visited with a group?</i>	(255)
Yes	89
<i>Children in your group?</i>	(102)
Yes	47

Appendix D

Interview Protocol

Thank you for your willingness to answer a few questions.

First, I'd like to hear about your experience visiting the moose exhibit.

1. I am interested in how people make sense of habitat displays. Let's think back on the moose exhibit.

Saliency prompt: When thinking back on the moose exhibit, what feature of the exhibit comes to mind first?

Awareness Prompt: What were your take-home messages of the moose exhibit?

Now, I'd like to hear more about what you were thinking while visiting the moose exhibit.

2. Did the moose exhibit remind you of a **place** you've been?

You said at the time that the exhibit reminded you of <insert what they said>. Tell me more about this place, describe it to me.

Specific Time Prompt: What period of life were you in? What mattered to you then? What were you doing during that place? How were you feeling?

Anything else?

3. Is there anything else that is apart of what you shared with me today that we haven't talked about that you think is important to add?
4. Is there anything else you would like to share with me today?

Thank you for your time today. I really appreciate your participation!

Appendix E

Summary of On-Site Survey Questions, Including Definitions of Factors

Appendix E1: Summary of on-site survey questions, including research topics, survey items, and answer options

Theme	Survey item	Response option
Awareness-making	“The moose exhibit made me realize how many plants and animals live in the North Woods region.”	4-point Likert-scale: Strongly agree to Strongly disagree
	“The moose exhibit made me realize how moose have adapted to live in the North Woods region.”	4-point Likert-scale: Strongly agree to Strongly disagree
	“Moose themselves can’t digest most of what they eat. It is with the help of microbes in their belly that helps digest their food.”	4-point Likert-scale: Strongly agree to Strongly disagree
	“During the fall season, moose are rutting (i.e., in mating season).”	4-point Likert-scale: Strongly agree to Strongly disagree
	“Briefly explain, what do you think the moose exhibit is about?”	Open-ended
	“What is one thing you learned from the moose exhibit that you didn’t know or were unsure of before?”	Open-ended
Meaning-making	“This diorama brought back memories of my own outdoor experiences.”	4-point Likert-scale: Strongly agree to Strongly disagree
	“I enjoy visiting wild places (i.e., wilderness areas, etc.)	4-point Likert-scale: Strongly agree to Strongly disagree
	“My favorite outdoor places have broad lawns, formal gardens, and trimmed shrubs”	4-point Likert-scale: Strongly agree to Strongly disagree
	“This diorama sparked my curiosity to visit a place like this in real life”	4-point Likert-scale: Strongly agree to Strongly disagree
	“Did the moose exhibit remind you of a place you’ve been?”	Yes / No, Open-ended
	“Did the moose exhibit remind you of a time in your life?”	Yes / No, Open-ended
Exhibit use	Frequency of visits to the Bell Museum	Daily, Weekly, Monthly, Annually, Never
	Use of exhibit area	Interacted with Moose diorama, touchscreen, Other, None of the above
	Group dynamics	Open-ended numeric scale. No one, In a group, With family.

Socio-
demographic
characteristics

Year of birth

Open-ended

Race/ethnicity

Open-ended

Highest level of education

7 categories: Did not complete
high school to graduate school

Appendix F

Survey Theme Codebook

Table F1: Codebook for eight most-commonly mentioned themes from survey question, “What do you think the moose exhibit is about?”

Theme	Example quotes from survey respondents
Habitat & Environment	“The exhibit is about the natural habitat of moose in Minnesota”; “Habitat”; “About moose environment
General Information About Moose	“All about moose”; “Teaching people about moose and where they live”; “The exhibit explained about the moose’s life in general such as habitat, food, so on.”
Ecosystem	“It shows you the interconnection of the ecosystem”; “I like that the moose diorama featured a variety of other life forms and highlighted the relationship between aquatic vegetation and the animal”
Population	“The decline of moose due to climate change and other factors”; “Habitat and population”; “...Informing about how the moose population in Minnesota has decreased. And how we are tracking the moose and trying to find the cause for the decline”
Behavior	“Moose and what they eat, how they live”; “The behaviors and habitat of moose in Minnesota”; “It seemed to be about mating”; “The type of environment moose thrive in, the land it feeds off of and its migration patterns”
Education	“Educating the public on moose and the current habitat – how we impact their habitat”; “Inform our understanding of moose, be aware of the creature’s enemies and the potential declines of the moose population in Minnesota”
Conservation	“Moose, conservation, nature”; “The history of moose in MN and further conservation”; “Habitat of moose and preserving it”
Culture & Natural History	“Northern MN, represents cultural and natural history of MN”; “Natural history of moose in Minnesota”; “The history of moose in Minnesota and their importance in modern times”

Table F2: Codebook for five most-commonly mentioned themes from survey question, “What is one thing you found out from the moose exhibit that you didn’t know or were unsure of before?”

Theme	Example quotes from survey respondents
Moose characteristics	“How big a moose foot is!”; “I was surprised at their size. I’ve never seen one so close and was slightly awestruck”; “How the fur feels and their size was fun to see up close”
Nothing & unsure	“Nothing”; “I didn’t find anything new but I have a wildlife degree so I am a bad person to ask”; “Didn’t get to investigate fully”
Moose diet	“That there are bacteria in the moose stomach to help the moose digest their 72 pound of daily food intake”; “I didn’t know they could eat so much in one day”; “I didn’t know they ate underwater plants”
Population & disease	“There has been a dramatic drop in the moose population in northern Minnesota”; “Issues on diseases”; “I didn’t know about the location of moose in Minnesota”
Reproductive energy use	“That bull moose use as much energy growing horns as a cow raising a calf”; “Takes a lot of energy for male moose to grow antlers. Male moose lose a lot of weight when trying to mate”

Appendix G

Interview Theme Codebook

Table G1: Codebook for three emergent themes and subthemes from respondent interviews

Conservation	
Pro-Environmental Behaviors	<p><i>"I would say nature and... that these animals, yah know, they should be protected. Yeah, there are in... the part of the world we live in and... [when] they start disappearing... well, that's a loss, a serious loss."</i></p> <p><i>"Well I think that the overall feeling I had was of the need... to protect our planet, to save our planet. And... to change our practices in ways that will contribute to that effort."</i></p>
A Healthy Ecosystem	<p><i>"Kind of a sense of seeing an animal in a habitat that is healthy. Moose are certainly a reflection of high quality habitat. You know, a healthy habitat, a healthy ecosystem. As opposed to a deer. Deer can do really well in really fragmented, poor habitat... or farmland, that kind of thing. Whereas, moose need that kind of... older growth, more stable habitat that is... more indicative of a healthy ecosystem, I would say. So, that is the kind of feelings that... that seeing a moose brings up for me."</i></p>
Childhood	
Family	<p><i>"Yeah, so when I was a kid, my parents and I used to go up to Duluth, um, quite a few summers out of the year and part of what we would do is go up to the Gunflint Trail and look for moose. And that's what It kind of reminded me of and made me think of."</i></p>
School	<p><i>"Being in grade school when we would go on different kinds of field trips to, uh, parks. ...Not, like, a playground park, but more like a wildlife kind of park. Where you're like... out in wooded areas. Things like that. That's the thing that came to mind because it feels kind of, like, reminiscent on the exhibit."</i></p>
Museum Experiences	<p><i>"I grew up in New York City. So, you know, I would go to the American Museum of Natural History. And so they are echoes for me of... my childhood experiences."</i></p>
Valuing Nature From a Young Age	<p><i>"Having that, like, good connection [with nature] when I was younger. I think sustaining that, and... keeping the value of having, like, big nature and, like, having actual wildlife and seeing, you know, different species and different environments living in a different way than we do. Like, I think it's very important to see, especially as a little kid, cause then if that was... a core value in you, I think it really changes how you develop and how, like, you interact with others. Whether that be people, animals, um, wildlife, plants, you know? And I think that's important."</i></p>
Encountering the Other	
Moose Encounter	<p><i>"...To see [a moose] in their natural habitat in the wild is pretty wonderful. And, you know... not to have any telephone wires or planes overhead. Anything like that, in a way, I think just makes it more special"</i></p>
Deer Encounter	<p><i>"I was thinking about Afton State Park because we saw a lot of not moose, we saw a lot of deer there. And somehow that is the only park... that you can see a lot of deer."</i></p>

Appendix H

Consent Form

Bell Museum Visitors' Perceptions of Northwoods Moose Exhibit Consent Script

Purpose

The purpose of the project is to document and measure Bell museum visitor awareness-making and to determine if awareness-making transforms into meaning-making experiences. The study will help guide future decisions about the Bell Museum's exhibit design, content, and interpretive strategies.

Duration

We anticipate the survey will take 5 to 10 minutes to complete. If you volunteer to answer a few questions, we anticipate the interview will take approximately 15 minutes.

Procedures

For the survey, please select the answer option(s) that are the best fit for your answer. For interviews, please answer the questions to the best of your ability.

Participation

Your participation in this study is voluntary. You can skip any questions that you do not wish to answer, or stop participating at any time for any reason. We do not expect that your participation will result in any individual benefits or risks.

Anonymity

Your responses will not be connected to any identifying information. Results will only be reported in aggregate.

Contact Information

To reach a member of the research team with questions, concerns, or complaints about the research, please contact Molly O'Connor at oconn394@umn.edu (Or Kristen C. Nelson at nelso468@umn.edu or [612 624-1277](tel:6126241277)).

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), you are encouraged to contact the Research Participants' Advocate Line, (612) 625-1650 or go to <https://research.umn.edu/units/hrpp/research-participants/questions-concerns>.

Appendix I

Photo Consent Form

Photo Publication Release Form

IRB No.: 00004760

Title of Research: Studying Meaning-Making at the Bell Museum

Date of IRB Approval: 11/14/2018

All persons taking still photographs for University of Minnesota (UoM)-related research must obtain a signed release form from anyone who is visibly recognizable in the photograph. Crowd scenes where no single person is the dominant feature are exempt. This form is intended for use with UoM IRB approved research under the above-noted IRB protocol.



PARTICIPANT CONSENT

I am 18 years of age or older and hereby grant the researcher designated below from the University of Minnesota - Twin Cities has permission to photograph me for publication, use in presentations, and posters for the above titled IRB approved research only. My name will not be used in any publication. I will make no monetary or other claims against the University of Minnesota for the use of the photograph.

Print Name: _____

Signature: _____

Date: _____

UoM Researcher

Name: Molly O'Connor

Date: _____

Address: 320 Green Hall, 2005 Upper Buford Circle, St. Paul, MN 55108

Contact Information: (612) 868-0364

Signature: _____

Appendix J

Bell Museum Initial Report

Please turn to the next page to review Does Awareness-making Elicit Meaning-making in Bell Museum Visitors? An Initial Report.

Note: The original formatting changed slightly while transferring to this document. Also, note that the page numbers restart to page 1, page 2, etc.



Does Awareness-Making Elicit Meaning-Making in Bell Museum Visitors?

Initial Report

Written by:
Molly O'Connor¹

In Collaboration with:

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bell museum

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April 2019

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EXECUTIVE SUMMARY

In the field of museum education, awareness-making (AM) and meaning-making (MM) are discussed as two independent theories. AM is when museum visitors bring with them past experiences, knowledge, and ideas, all of which help them make sense of museum exhibits (Graburn, 1997; Linderman, 1964). MM is when museum visitors' past memories and experiences transform their museum experience into new knowledge and meaning (Ansbacher, 2002; Silverman, 1995; Benton, 2010). Little is mentioned on how AM and MM may be interconnected in a museum setting, though other fields of literature acknowledge that cognitive and affective processes impact the making of both awareness and meaning (Paavola & Hakkarainen, 2009). To build on these theories and to fill this gap in the literature, this initial report aimed to explore two questions: (1) To what extent does the moose exhibit evoke AM in Bell Museum visitors? and (2) To what extent does AM elicit MM in Bell Museum visitors?

From November 19th 2018 to December 16th 2018, O'Connor conducted on-site surveys at the Bell Museum of Natural History to explore visitor awareness-making and meaning-making related to the moose exhibit. From December 22th, 2018 to January 17th, 2019, she conducted phone interviews, which were a sub-sample of the survey participants.

In-person surveys were conducted just outside of the Minnesota Journeys permanent exhibition on the upper steps of Horizon Hall. The surveys were conducted over 2-hour periods during the Bell Museum's open hours. Each day of the week, except for Wednesday, was sampled. Due to research protocols, only visitors who were 18 years or older and were proficient in English were eligible to take the survey. Approximately 600 visitors were initially approached, and 263 visitors agreed to participate and were eligible (an estimated response rate of 44% among eligible participants). There was very little demographic variation in the sample across the different times of day and days of the week.

Since this is an initial report, it provides descriptive findings based on the research questions. Further analysis will be used for a peer-reviewed article, as part of O'Connor's Master's thesis.

Key items included in this report:

1. A brief literature review focusing on the two theories explored in this study
2. A summary of the study's methods and procedures
3. Descriptive findings and aggregated responses for each survey question
4. A short description of how these results will be used in the future
5. Copies of the survey and interview protocols

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INTRODUCTION

Awareness-making (AM) and meaning-making (MM) both play a crucial role in shaping the museum visitor experience. AM is when museum visitors bring with them past experiences, knowledge, and ideas, all of which help them make sense of museum exhibits (Graburn, 1997; Linderman, 1964). For example, in a natural history museum setting, AM may be a visitor learning a new concept about Sandhill crane mating behaviors from reading the exhibits interpretive material or evidence of AM may be two visitors talking about their previous knowledge about beaver dams and then bouncing off ideas about new facts they learned from a beaver habitat display. Falk & Dierking (1992) further explain that the museum experience is not only defined by the visitor's personal context, but also by their social (i.e. group dynamics, etc.) and physical contexts (i.e. architecture, exhibit design), all of which contributes to a highly interactive museum experience. Heightened awareness from exposure to exhibits is often one of the desired outcomes for museum evaluators and has been measured and documented in the literature (Falk et al., 1998; Falk & Storksdieck, 2005; Giusti, 2012; Megonigal et al, 2010; & Ogden et al., 1993). Though measuring awareness is an essential step to better understanding the museum visitor experience, AM only accounts for the cognitive aspect of how much visitors are learning and retaining knowledge. To better understand the Bell Museum experience, it is essential to acknowledge the different types of meanings made by its visitors.

MM is when museum visitors' memories and experiences transform their museum experience into new knowledge and meaning (Ansbacher, 2002; Silverman, 1995; Benton, 2010). For example, MM may look like a visitor viewing a habitat display, remembering a place or a time in their life that is meaningful to them, and then using their memory to make meaning of the information learned at the habitat display. Natural history museums often have ecological places portrayed in habitat dioramas and research suggests that place is an important factor when considering affective variables (e.g., emotions, attitudes, feelings, beliefs) (Garibay & Gyllenhaal, 2014). Garibay & Gyllenhaal (2014) explain further that when visitors connect with the dioramas, either by inspiring memories or creating connections to other places they have visited, this can affect museum visitors' feelings and emotions. This example showcases place-based learning, which is an educational approach that many museums use to incorporate local knowledges and environments as the central content for their programs and exhibitions. This type of approach, especially in a museum setting, can be a powerful tool to promote MM in its visitors (Villeneuve & Martin-Hamon, 2007).

There is little research on how AM and MM are interconnected (Cucchiara & Del Bimbo, 2014). Other scholarly fields acknowledge that cognitive and affective processes impact the making of both awareness and meaning (Paavola & Hakkarainen, 2009), but no one has explored the connection itself within a museum setting. This study fills this gap in museum studies research, especially in the natural history realm. The report findings will give Bell staff insight on what visitors are learning and finding meaningful from the moose exhibit and will provide information that can be used to inform future decisions.

METHODOLOGY

This is an inductive study using a mixed methods explanatory sequential design. Utilizing social science theory as its foundation, this study's intent was to explore two major theories: AM and MM. This study was conducted in two phases. The first phase was quantitative (survey) and the second phase was qualitative (semi-structured interview). The reasoning for mixing methods was so the researcher could: (1) obtain a general statistical picture of the predictors of AM and MM in Bell Museum visitors; (2) use the quantitative results to fine-tune the interview protocol; (3) analyze the rich, anecdotal qualitative data from the interviews to further explore and better understand participant views on AM and MM topics; and (4) use the qualitative data to explain the quantitative results.

SURVEY METHODS

For this mixed-methods study, research was conducted at the Bell Museum of Natural History using both survey and interview instruments. Surveys were administered on site, available in both electronic and paper formats. The researcher approached visitors as they left the Minnesota Journey's permanent exhibit and verbally invited them to complete the survey. The researcher administered data collection outside the exhibition area to reduce potential negative impacts on other visitors' museum experience. To participate in the study, participants must have visited the Bell Museum's moose exhibit, be 18 years or older, and proficient in English. On average, respondents completed the survey within 8 to 10 minutes. Participants were offered a free magnet with natural history content for completion of their survey.

Using convenience sampling with purposeful parameters, data collection occurred for four weeks between November and December of 2018. To maximize variation in the types of museum visitors encountered, the researcher varied the time and the day of the week sampled (Appendix A). In total, the researcher spent approximately 50 hours surveying museum visitors. Approximately 600 visitors were approached and a total of 263 surveys completed by eligible museum visitors (estimated response rate of 44%). After removing incomplete surveys, a total of 255 surveys were used for data analysis.

The survey instrument was designed in collaboration with Bell Museum staff and Dr. Kristen C. Nelson, the researcher's advisor. The survey was comprised of 14 multiple-choice questions and 10 short answer questions, including a color photograph of the moose diorama (Appendix B). Participants answered questions about their experience at the moose exhibit, their experience at the museum as a whole, as well as socio-demographics information. Most questions were tailored to investigate visitor awareness-making and meaning-making with the intent to further explore primary research areas.

INTERVIEW METHODS

Interview participants were recruited via survey, which had a final question assessing the level of interest of participating in a brief phone interview. **The interviews were administered off-site by phone.** From the initial number of survey respondents (n=263), 70 participants indicated interest in participating in follow-up interview. Given the limited time and resources of this study, the researcher used randomized sampling to reduce the sample size to 30 individuals. 30 phone interviews were conducted between December 2019 and January 2019. **The interview guide consisted of four open-ended questions, which were tailored to further explore the participants' meaning-making in their own words (Appendix C).** On average, interviews lasted about ten minutes. Each interview was transcribed as a complete transcript, which allowed the researcher to identify and categorize themes during analysis.

DESCRIPTIVE FINDINGS

Q1 - How did you use the moose exhibit area? (Check all that apply)

- I observed the moose diorama
- I read the moose diorama panel
- I used the Field Guide
- I watched a video that brought the diorama to life (i.e., Bring It to Life)
- I listened to a moose expert talk about their research
- I touched the moose print
- None of the above
- Other (describe in the text box below)

Table 1: Visitor use of the moose exhibit’s interpretive materials

Uses of the Moose Exhibit	Frequency (n=255)	Percent (%)
Diorama Only		
I observed the moose diorama (only)	46	18
I observed the diorama and read the moose diorama panel	42	16
I observed the moose diorama, read the moose diorama panel, and touched the moose print	22	9
I observed the diorama and touched the moose print	17	7
I observed the moose diorama (multiple - combined)	11	4
Subtotal	138	54
Diorama and Touchscreen		
I observed the moose diorama, read the moose panel, and watched the “Bring it to Life” video.	20	8
I observed the moose diorama, read the moose panel, watched the Bring it to Life video, and touched the moose print	14	5
I observed the moose diorama and watched the Bring it to Life video	11	4
I observed the moose diorama, read the moose panel, used the Field Guide, and touched the moose print	7	3
I observed the moose diorama, watched the Bring it to Life video, and touched the moose print	7	3
I observed the moose diorama, I read the moose panel, I watched the Bring it to Life video, I listened to a moose expert, and I touched the moose print	5	2
I observed the moose diorama (multiple - combined)	50	20
Subtotal	114	45
Touchscreen Only		
I watched the Bring it to Life video	2	1
I used the Field Guide	1	<1
Subtotal	3	1
Total	255	100
Other responses (verbatim): "Took a photo" ; "Took pictures of the diorama and caption because we visited Gunflint lakes a few years ago but did not see any moose." ; "Compared hands to moose hoof" ; "Touched fur" ; "I touched the fur. I don't like touching public items usually." ; "Search it" ; "Species checklist" ; "Looked in window under water" ; "Have loved the moose since childhood at the old Bell." ; "I sketched the antler wall" ; "I was drawn to the actual exhibit and life like presentation"		

Q2 - Which interpretive materials did you look and/or interact with at the moose exhibit? (Check all that apply)

- Moose diorama
- Touchscreen
- None of the above
- Other

Table 2: Which interpretive materials (diorama and/or touchscreen) did visitors interact with?

Interpretive Materials Used	Frequency (n=255)	Percent (%)
Moose Diorama and Touchscreen	123	48
Moose Diorama (only)	108	42
Touchscreen (only)	11	4
Moose diorama, Touchscreen, and Other	4	2
None of the Above	6	2
Total	255	100
Other responses (verbatim): "Moose fur" ; "Hoof and fur touch" ; "Caption" ; "Read everything and concentrated on display specifics - foot prints in mud; flora; N. MN. Landscape" ; "Antler Wall"		

Q3 - Briefly explain, what do you think the Moose exhibit is about?

Table 3: Examples of themes from responses to Q3

Theme	Frequency (n=230)	Example quotes from survey respondents
Habitat & environment	97	"The exhibit is about the natural habitat of moose in Minnesota"; "Habitat"; "About moose environment"
Behavior	40	"Moose and what they eat, how they live"; "The behaviors and habitat of moose in Minnesota"; "It seemed to be about mating"; "The type of environment moose strive in, the land it feeds off of and its migration patterns"
General info about moose	38	"All about moose"; "Teaching people about moose and where they live"; "The exhibit explained about the moose's life in general such as habitat, food, so on."
Ecosystem & Ecology	26	"It shows you the interconnection of the ecosystem"; "Moose in a natural setting and interactions with their habitat"; "I like that the moose diorama featured a variety of other life forms and highlighted the relationship between aquatic vegetation and the animal"; "Moose ecology"
Moose characteristics	25	"...we also got to admire the size, characteristics and features that may not be picked up in pictures, videos, etc."; "demonstrations of moose habitat, size, scat, hoofs, fur"
Education & awareness	23	"Educating the public on moose and the current habitat – how we impact their habitat"; "Inform our understanding of moose, be aware of the creature's enemies and the potential declines of the moose population in Minnesota"

Table 3b: Continued

Moose population	16	"The decline of moose due to climate change and other factors"; "Habitat and population"; "...Informing about how the moose population in Minnesota has decreased. And how we are tracking the moose and trying to find the cause for the decline"
Conservation	15	"Moose, conservation, nature"; "The history of moose in MN and further conservation"; "Habitat of moose and preserving it"
Survival	11	"What moose's do, how they survive..."; "It describes their habitat and resources needed for their continued survival"; "How it has adapted to life in northern MN"
Culture & natural history	10	"Northern MN, represents cultural and natural history of MN"; "Natural history of moose in Minnesota"; "The history of moose in Minnesota and their importance in modern times"
Moose family	6	"Family life of moose..."; "...Family structure"; "A moose family in its natural habitat doing what moose do"; "Bringing to life a scene in the north woods depicting a moose family"

Q4 - What is one thing you learned from the moose exhibit that you didn't know or were unsure of before?

Table 4: Seven most-commonly mentioned things learned from the moose exhibit

Theme	Frequency (n=190)	Example quotes from survey respondents
Moose characteristics	69	"How big a moose foot is!"; "I was surprised at their size. I've never seen one so close and was slightly awestruck"; "How the fur feels and their size was fun to see up close"
Nothing & unsure	37	"Nothing"; "I didn't find anything new but I have a wildlife degree so I am a bad person to ask"; "Didn't get to investigate fully"
Moose diet	34	"That there are bacteria in the moose stomach to help the moose digest their 72 pound of daily food intake"; "I didn't know they could eat so much in one day"; "I didn't know they ate underwater plants"
Population & disease	23	"There has been a dramatic drop in the moose population in northern Minnesota"; "Issues on diseases"; "I didn't know about the location of moose in Minnesota"
Behavior	10	"They have an interesting nose. And have strong faces for fighting during mating season"; "I enjoyed seeing the moose family interact"
Habitat	10	"Moose seem to spend more time in water than I had realized"; "They like wetlands"; "They walked in swampy areas"
Reproductive energy use	7	"That bull moose use as much energy growing horns as a cow raising a calf"; "Takes a lot of energy for male moose to grow antlers. Male moose lose a lot of weight when trying to mate"

Q5 - Please read the statements below and rate to what degree do you agree or disagree with the following statements (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree).

Table 5a: Visitor level of agreement or disagreement to the statement “the moose exhibit made me realize how many different plants and animals live in the North Woods region”

The moose exhibit made me realize how many different plants and animals live in the North Woods region	Frequency (n=252)	Percent (%)
Strongly agree	97	39
Somewhat agree	120	48
Somewhat disagree	24	9
Strongly disagree	11	4
Total	252	100

Table 5b: Visitor level of agreement or disagreement to the statement “The moose exhibit made me realize how moose have adapted to live in the North Woods region”

The moose exhibit made me realize how moose have adapted to live in the North Woods region	Frequency (n=252)	Percent (%)
Strongly agree	92	36
Somewhat agree	121	48
Somewhat disagree	30	12
Strongly disagree	9	4
Total	252	100

Table 5c: Visitor level of agreement or disagreement to the statement “Moose themselves can’t digest moose of what they eat. It is with the help of microbes in their belly that helps digest their food”

Moose themselves can’t digest moose of what they eat. It is with the help of microbes in their belly that helps digest their food.	Frequency (n=249)	Percent (%)
Strongly agree	102	41
Somewhat agree	102	41
Somewhat disagree	31	12
Strongly disagree	14	6
Total	249	100

Table 5d: Visitor level of agreement or disagreement to the statement “during the fall season, moose are rutting (i.e., in mating season)”

During the fall season, moose are rutting (i.e., in mating season)	Frequency (n=249)	Percent (%)
Strongly agree	87	35
Somewhat agree	112	45
Somewhat disagree	35	14
Strongly disagree	15	6
Total	249	100

*Q6. When visiting the museum today, did you come with previous knowledge about moose?
(Check all that apply)*

- Yes, I have knowledge from formal education (i.e. schooling, long-term training)
- Yes, I have knowledge from informal education (i.e. museums, talks, TV, personal experience, etc.)
- No, I have no knowledge of moose

Table 6: Visitor previous knowledge about moose

Visitor previous knowledge about moose	Frequency (n=255)	Percent (%)
Yes, I have knowledge from informal education (i.e., museums, talks, TV, personal experience, etc.)	154	60
Yes, I have knowledge from both formal and informal education	20	8
Yes, I have knowledge from formal education (i.e., schooling, long-term training)	18	7
No, I have no previous knowledge of moose	63	25
Total	255	100

Q7. Please read the statements below and rate to what degree do you agree or disagree with the following statements (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree).

Table 7a: Visitor level of agreement or disagreement to the statement “the diorama brought back memories of my own outdoor experiences”

The diorama brought back memories of my own outdoor experiences	Frequency (n=255)	Percent (%)
Strongly agree	116	45
Somewhat agree	100	39
Somewhat disagree	20	8
Strongly disagree	19	8
Total	255	100

Table 7b: Visitor level of agreement or disagreement to the statement “I enjoy visiting wild places (i.e., wilderness areas)”

I enjoy visiting wild places (i.e., wilderness areas)	Frequency (n=255)	Percent (%)
Strongly agree	200	78
Somewhat agree	40	16
Somewhat disagree	9	4
Strongly disagree	6	2
Total	255	100

Table 7c: Visitor level of agreement or disagreement to the statement “my favorite outdoor places have broad lawns, formal gardens, and trimmed shrubs”

My favorite outdoor places have broad lawns, formal gardens, and trimmed shrubs	Frequency (n=254)	Percent (%)
Strongly agree	21	8
Somewhat agree	36	14
Somewhat disagree	97	38
Strongly disagree	100	39
Total	254	100

Table 7d: Visitor level of agreement or disagreement to the statement “the exhibit sparked my curiosity to visit a place like this in real life”

The exhibit sparked my curiosity to visit a place like this in real life	Frequency (n=254)	Percent (%)
Strongly agree	151	60
Somewhat agree	86	34
Somewhat disagree	9	3
Strongly disagree	8	3
Total	254	100

Q8a. Did the moose exhibit remind you of a place you’ve been?

- Yes
- No [Skip to question 9]

Table 8a: Frequency and percentage of visitors who were reminded of a place they had been when visiting the moose exhibit

Did the moose exhibit remind you of a place you’ve been?	Frequency (n=255)	Percent (%)
Yes	225	88
No	30	12
Total	255	100

Q8b. If yes, please describe the place the exhibit reminded you of.

Table 8b: Four most commonly-mentioned categories and themes of places the moose exhibit reminded visitors of

Country Category	Frequency (n=217)	Percent (%)	State Category	Frequency (n=217)	Percent (%)	Experience Category	Frequency (n=217)	Percent (%)
USA	170	78.3	Minnesota	122	56.2	Outdoor Activities ^c	29	13.4
Canada	14	6.4	Alaska	12	5.5	Moose encounter	15	6.9
Europe ^a	5	2.3	Michigan	11	5.1	Family	12	5.5
Not mentioned	28	12.9	Wisconsin	8	3.7	Childhood	10	4.6
Total	217	100	Montana	6	2.8	Not mentioned	151	69.6
Landscape Category	Frequency (n=217)	Percent (%)	Wyoming	6	2.8	Total	217	100
Water	88	40.5	"Out West"	5	2.3	a. Norway, Sweden, Ireland b. NE, ND, OR, WA, CA, CO, MA, NY c. Hiking, camping, going to camp, canoeing, geocaching, hunting, dog sledding		
Forest	76	35	Maine	4	1.8			
Mountains	4	1.9	Other States ^b	11	5.1			
Not mentioned	50	23	Not mentioned	32	14.7			
Total	217	100	Total	217	100			

For the full list of places, please see Appendix C.

Table 8c: Examples of themes from survey responses for Question 8b

Themes	Examples
Water	"BWCA"; "Bog and woods areas in Massachusetts"; "Rivers along the north shore with cedar forests"; "Up by Tower MN. By swamps and a small lake we saw them."
Forest	"A forest from a hiking trip"; "The Hoh rainforest in Washington"; "The north woods of Minnesota"; "My family hunting land with its large trees"
Mountains	"Bighorn mountains, and northern MN"; "Mountains in Montana"
Moose encounter	"Hiking above Jenny Lake in the Grand Tetons. We spotted a large moose off the trail, munching on trees."; "Being in the boundary waters in a boat, at night, and heard a noise and discovered a moose was just 10 feet from my boat knee deep standing in the water."
Outdoor Activities	"This exhibit diorama reminded me of the north shore when I went hiking "; "Places I've been camping"; "Camping out West"; "My Quetico cabin & a life time of canoe trips there and in the BWCA."; "I thought a lot about going on nature walks and geocaching with my family when I was younger."; " The scene reminded me of the area I hunt and the BWCAW."; "While dog sledding in northern Minnesota"
Family	"My family's experiences"; "Last spring my family went to dog sledding in Ely MN and it reminded me of that area."; "I live in Alaska and it also reminds me of times at the lake with my grandpa."
Childhood	"Growing up in Wisconsin."; "Camping as a child in various Minnesota state parks"; "The forest around my childhood home in NW Wisconsin."

Q9a. Did the moose exhibit remind you of a time in your life?

- Yes
- No [Skip to question 9]

Table 9a: Frequency and percentage of visitors who were reminded of a time in their life when visiting the moose exhibit

Did the moose exhibit remind you of a time in your life?	Frequency (n=254)	Percent (%)
Yes	162	64
No	92	36
Total	254	100

Q9b. If yes, please describe the time in your life the moose exhibit reminded you of.

Table 9b: Eight most commonly-mentioned visitor memories or experiences that were elicited when visiting the moose exhibit

8 Most Common Themes	Frequency (n=154)	Percent (%)	Examples
Childhood, youth, or past	61	39.6	"It reminded me of my childhood"; "When I was much younger and active in scouting; "As a child walking through the woods just walking and looking"; "A younger more rigorous age."
Outdoor activity	61	39.6	"I went camping in northern Minnesota several times and the moose is such an iconic species of that area that, despite rarely seeing them, even just the thought of them is enough to bring back those memories."; "When I fell in the mud"; "Snow shoeing near Gooseberry Falls."
Time spent in parks or nature	59	38.3	"Camping in the BWCA"; "Time at the state park"; "When we were younger and able to tramp about in the woods"; "Hiking in a woody and muddy area"
Road trip, vacation, or travels	34	22.1	"A vacation"; "When I visited Colorado"; "Hike/road trip"; "Road trip w my sisters and the moose who ran into our school bus"
Moose, elk, or another animal encounter	27	17.5	"Many times but especially seeing deer out my kitchen window this summer"; "I was obsessed with moose as a kid. Loved seeing them at the Minnesota zoo"; "I saw a moose outside Grand Marais"; "Seeing moose wading out of the water while fishing in Ontario and encounters from canoes in the BWCAW."
Spending time with family	17	11	"Canoeing with my family every year in the BWCA."; "Practicing shooting at my uncle's land with him and my grandpa."; "When traveled and camped with our children."
School or college	9	6	"Studying environmental science in Minnesota in the field"; "College!"; "High school and college when I spent time in the BWCA"; "About 30 years ago when I was in college. Out for a Sunday drive in northern MN. North of Tower MN"
Visiting the old Bell and other museums	3	2	"As a child at the old Bell Museum "; "Used to go to the New York Museum of Natural History as a child"

Q10. What motivated you to come to the Bell Museum today? (Check all that apply)

- To learn something new
- To spend time with friends
- To spend time with family
- To see the new building
- To relax
- To pass time
- Other (describe in the text box below)

Table 10: Eight most common reasons why respondents visited the Bell Museum

Top 8 Motivations for Coming to the Bell Museum	Frequency (n=254)	Percent (%)
To spend time with family (only)	26	10.2
To spend time with family and to learn something new	22	8.8
To spend time with family, to learn something new, and to see the new building	22	8.8
Other (only)	12	4.7
To learn something new (only)	10	3.9
To spend time with friends (only)	9	3.5
To learn something new and to spend time with friends	9	3.5
To see the new building (only)	8	3.1
Other - Multiple	136	53.5
Total	254	100
Other responses (verbatim): "To plan an event, and for a meeting for work."; "Event planning for AIS"; "To play with my four year old"; "Planetarium"; "Planetarium, Revisit the dioramas"; "Because my grandma brought me"; "We are a member of another science center, so admission was free."; "Encouraged to by a friend"; "Had an assignment"; "To find material for a class"; "To see a wooly mammoth."; "To meet the skynet research group and planetarium"; "Getting married here"; "It was close by"; "Dioramas"; "Son had visited and invited me to join him."; "To learn more about the museum because of the artist residency program"; "Expose our 18 month old grandson to animals"; "Lecture after the museum [closes]."; "Attend a meeting"; "Inquisitiveness"; "To bring friends of my grandkids"; "To have fun"; "Meet tracking experts for today's special event"; "To see the new Bell and reminisce about all the past experiences at the old Bell. Dream of next trip up North."; "Look at exhibit creation"; "To visit a relevant museum."; "Dragged here by my wife. All because our daughter hates stuffed animals."		

Q11a. Who visited the museum with you today?

- No one
- I was in a group
 - ___ Number of adults
 - ___ Number of children

Table 11a: Frequency and percent of respondents visiting the museum in a group or alone

Who visited the museum with you today?	Frequency (n=255)	Percent (%)
I was in a group	227	89
No one	28	11
Total	255	100

Table 11ai: Frequency and percent of adults and children who were present in respondent groups during their visit to the museum

How many were adults (18 or older?)	Frequency (n=227)	Percent (%)	How many were children (17 or younger)?	Frequency (n=227)	Percent (%)
1	56	25	0	122	54
2	89	39	1	47	21
3	32	14	2	39	17
4	24	10	3	12	5
5	9	4	4	2	1
6	5	2	5	1	<1
7	6	3	6+	5	2
8+	6	3			
Total	227	100	Total	227	100

Q11b. How many were family members?

- ___ Number of adults
- ___ Number of children

Table 11b: Frequency and percent of adult and children family members who were present in respondent groups during their visit to the museum

How many were family (18 or older)?	Frequency (n=227)	Percent (%)	How many were family (17 or younger)?	Frequency (n=227)	Percent (%)
0	68	30	0	123	54.2
1	68	30	1	48	21.1
2	47	21	2	41	18.1
3	18	8	3	11	4.8
4	11	5	4	2	0.9
5	7	3	5	1	0.4
6+	8	3	6+	1	0.4
Total	227	100	Total	227	100

Q12. How often do you visit the Bell Museum?

- Daily
- Weekly
- Monthly
- Annually
- This is my first time

Table 12: Frequency and percent of respondent visitation to the Bell Museum

How often do you visit the Bell Museum?	Frequency (n=253)	Percent (%)
Weekly	5	2
Monthly	31	12.2
Annually ^a	28	11.1
This is my first time ^b	189	74.1
Total	253	100

a. The wording of the question caused confusion in respondents. Respondents who interpreted the question as "how often do you visit the new and old Bell Museum locations," often answered with "annually."

b. Respondents who interpreted the question as "how often do you visit the new Bell Museum location," often answered with "This is my first time."

Q13. *In what year were you born?*

Table 13: Respondent age categories

Age Categories	Frequency (n=251)	Percent (%)
18 to 27	47	19
28 to 37	54	22
38 to 47	52	21
48 to 57	30	12
58 to 67	35	14
68 to 77	28	11
78 to 87	4	2
88 to 97	1	<1
Total	251	100

Q14. *What race/ethnicity do you identify as?*

Table 14: Respondent race and ethnicity categories

Race Categories	Frequency (n=252)	Percent (%)	Example Quotes from Respondents
White non-Hispanic	210	83	"Northern European"; "White"; "Scandinavian American"; "Caucasian"; "White Jewish Canadian"; "White Ashkenazi"
Mixed	12	5	"African & White"; "Caucasian Mixed European decent: people are not white and black"; "Native American/White"; "Asian and African American"; "White, African American"; "A fun mix"; "Hispanic, Asian"; "African American – Asian"
Asian	11	5	"Asian"; "Filipino"; "Asian Indian"
Black	9	4	"Black"; "African American"; "Black non-Hispanic"; "African American non-Hispanic"
White Hispanic	3	1	"White Hispanic"

Table 14: Continued

Native Hawaiian	1	<1	“Native Hawaiian”
Eastern/North African	1	<1	“Pakistani”
Native American/Indigenous	1	<1	“Native American, Indigenous”
Other	1	<1	“European American”; “None/American”
Chose not to Answer	2	<1	“Choose not to Answer”; “N/a”

Q15. What is the highest level of formal education you have completed?

- Did not finish high school
- Completed high school
- Some college but no degree
- Associate degree or vocational degree
- College bachelor’s degree
- Some graduate work
- Completed graduate degree (Master’s or Ph.D.)

Table 15: Respondent highest level of education completed

What is the highest level of formal education you have completed?	Frequency (n=252)	Percent (%)
Completed high school	5	2
Some college but no degree	26	10
Association degree or vocational degree	21	8
College bachelor’s degree	103	41
Some graduate work	23	9
Completed graduate school (Master’s or Ph.D)	74	29
Total	252	100

Q16. Would you be willing to participate in a short phone interview about your museum experience?

- Yes
- No [Skip to question 17]

Table 16: Respondent willingness to participant in a subsequent phone interview

Would you be willing to participate in a short phone interview about your museum experience?	Frequency (n=253)	Percent (%)
Yes	73	23
No	180	71
Total	253	100

Q17. Did we miss anything? Please provide additional comments or questions you may have about the Bell Museum and its moose exhibit.

Table 17: Additional comments and questions

Category	Did we miss anything? Please provide additional comments or questions you may have about the Bell Museum and its moos exhibit. <i>Comments are verbatim</i>
Compliments	<p>“Very well done”; “Perfect” ; “This was a really great experience and I enjoyed my time and what I learned”; “Great dioramas, very lifelike”; “Thank you!!”; “We love it” ; “Loved the room”; “Having the moose species featured so prominently in the museum says something of the values, narratives, and expectations that do and do not feature prominently in our culture”; “No. Loved the museum”; “Love the bird dioramas. It’s nice to see the screen to identify birds”; “Love all the details in the habitat from birds to plants to reptiles”; “Great exhibits!”; “Great spot!”; “Great exhibit, very detailed, informative, and well built”; “So impressed with realism, down to detail of making soil appear damp”; “We love birds and being able to look around in the moose exhibit and seeing birds in there as well. Plus the sounds were AMAZING”; “I am impressed by the life like exhibit. The artistry is beautiful</p>
Research-Related	<p>“This is special. Thank you for visiting with my family while I took the survey”; “Email only but happy to participate”; “I would participate in the in-depth questions, but I just don’t think I would be super helpful since most of the visit was telling the kids that we’d be going to the touch room when we were done looking at the exhibits. It’s fairly distracting/distracted way to visit a museum”; “Good luck with your research!”; “I don’t always answer my phone if I don’t recognize the number. Leave a message and I could call back”; “Question was answered”; “Good luck”; “Nice interview and data collection”</p>
Recommendations	<p>“I’m curious if the Bell Museum is interested in doing a more investigative info panel about the harmful effects of chemicals/mines on areas along the Gunflint/BWCA. Super important for our natural species’ future and sustainability”; “A giant head of a megaloceras would be a nice experience”</p>
Exhibit-Related	<p>“Fish in the pond, maybe I missed them”; “I will look at it more closely next time I come”</p>
Nothing	<p>“No” ; “NA” ; “None that I can think of” ; “Don’t think so</p>

FUTURE PRODUCTS

Using the results from this study, O’Connor will write a peer-reviewed article with the intent to send the article to the editors at the Journal of Museum Education for publication. This peer-reviewed article will also be used as O’Connor’s Master’s thesis.

WORKS CITED

- Ansbacher, T. (2002). Misunderstandings of meaning making. *Exhibitionist*, 21(1): 1-4.
- Cucchiara, R. & Del Bimbo, A. (2014). Visions for augmented cultural heritage experience. *IEEE MultiMedia*, 21(1): 74-82.
- Falk, J. H. & Dierking, L. D. (1992). *The Museum Experience*. Washington, DC: Whalesback Books
- Falk, J. H., Moussouri, T. & Coulson, D. (1998). The effect of visitors' agendas on museum learning. *Curator*, 41 (2): 107-120.
- Falk, J. & Storksdieck, M. (2005). In: Falk, J; Dierking L. (eds). Using the conceptual model of learning to understand visitor learning from a science center exhibition. *Science Education*, 89: 744-778. doi: 10.1002/sce.20078
- Garibay, C. & Gyllenhaal, E. (2014). Habitat dioramas and sense of place: Factors linked to visitors' feelings about the natural places portrayed in dioramas. In: Tunnicliffe S., Scheerso A. (eds), *Natural History Dioramas*. Springer, Dordrecht.
- Giusti, E. (2012). Yale Peabody Museum of Natural History's "travels in the great tree of life:" Museum visitors learning about phylogenetic relationships. *Evolution Education Outreach*, 5: 68-75.
- Graburn, N. (1977). The museum and the visitor experience. *Roundtable Reports*, pp. 1-5.
- Linderman, E. W. (1964). Curriculum for awareness. *Art Education*, 17(6): 5-9.
- Megonigal, J. P, Starrs, B. S., Pekarik, A., Drohan, P., and Havlin, J. (2010). "Dig it!": How an exhibit breathed life into soils education. *Soil Science Society of America Journal*, 74: 706-716.
- Ogden, J. L., Lindburg, D. G., & Maple, T. L. (1993). The effects of ecologically-relevant sounds on zoo visitors. *Curator*, 36(2), 147– 156.
- Paavola, S. & Hakkarainen, K. (2009). From meaning to joint construction of knowledge practices and artefacts - a triological approach to CSCL. In C. O'Malley, D. Suthers, P. Reimann, & A. Dimitracopoulou (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 2009 conference* (pp. 83-92). Rhodes, Creek: *International Society of the Learning Sciences (ISLS)*.
- Silverman, L. H. (1995). Visitor meaning-making in museums for a new age. *Curator*, 38(3): 161-170.
- University of Minnesota (2018). The bell museum mission. Retrieved from <https://www.bellmuseum.umn.edu/mission/>

Appendix A

Additional Tables

Table 18: Frequency and total number of visitors surveyed from week-to-week and day-to-day

Day of the week	11/19 – 11/25	11/26 – 12/2	12/3 – 12/9	12/10 – 12/16	Total
Monday	7	13	11	7	38
Tuesday	10	15	6	14	45
Thursday	0 ^a	8	14	6	28
Friday	18	9	12	6	45
Saturday	12	20	20	5	57
Sunday	13	18	9	10	50
Total	60	83	72	48	263
a. Thanksgiving Day					

Appendix B

Visitor Exit Survey North Woods Moose Exhibit

Hello. My name is Molly O'Connor. I am with the University of Minnesota. I am working on a project to understand what museum visitors are taking from their experience at the Bell Museum's moose exhibit. We are asking visitors to complete a short survey and to answer a few questions about their experience. The results will be used for my master's research and to inform future visitor research at the Bell Museum. It should take about 5 to 10 minutes to complete. Participation in this study is voluntary. We are not gathering any personal information that reveals your identity. There is no penalty for refusing to participate, and you can withdraw at any time.

To start, I want to hear about your experience in the North Woods Exhibit, specifically about the Moose exhibit



1. How did you use the Moose exhibit area?

(Check all that apply)

- I observed the moose diorama
- I read the moose diorama panel
- I used the Field Guide
- I watched a video that brought the diorama to life (i.e., Bring It to Life)
- I listened to a moose expert talk about their research
- I touched the moose print
- None of the above
- Other (describe in the text box below)

2. Which interpretive materials did you look and/or interact with at the moose exhibit? (Check all that apply)

- Moose diorama
- Touchscreen
- None of the above
- Other

3. Briefly explain, what do you think the Moose exhibit is about?

4. What is one thing you learned from the moose exhibit that you didn't know or were unsure of before?

5. Please read the statements below and rate to what degree do you agree or disagree with the following statements (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree)

	Strongly Disagree	Somewhat disagree	Somewhat agree	Strongly Agree
5. The moose exhibit made me realize how many plants and animals live in the North Woods region.	1	2	3	4
6. The moose exhibit made me realize how moose have adapted to live in the North Woods region.	1	2	3	4
7. Moose themselves can't digest most of what they eat. It is with the help of microbes in their belly that helps digest their food.	1	2	3	4
8. During the fall season, moose are rutting (i.e., in mating season).	1	2	3	4

6. When visiting the museum today, did you come with previous knowledge about moose? (Check all that apply)

- Yes, I have knowledge from formal education (i.e. schooling, long-term training)
- Yes, I have knowledge from informal education (i.e. museums, talks, TV, personal experience, etc.)
- No, I have no knowledge of moose

Please read the statements below and rate to what degree do you agree or disagree with the following statements (1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree)

	Strongly Disagree	Somewhat disagree	Somewhat agree	Strongly Agree
This diorama brought back memories of my own outdoor experiences.	1	2	3	4
I enjoy visiting wild places (i.e. wilderness areas, etc.)	1	2	3	4
My favorite outdoor places have broad lawns, formal gardens, and trimmed shrubs.	1	2	3	4
This diorama sparked my curiosity to visit a place like this in real life.	1	2	3	4

8a. Did the moose exhibit remind you of a place you've been?

- Yes
- No [Skip to question 11]

8b. If yes, please describe.

9a. Did the moose exhibit remind you of a time in your life?

- Yes
- No [Skip to question 9]

9b. If yes, please describe the time in your life the moose exhibit reminded you of.

Now I would like to get a sense of how you spend time at the Bell Museum.

10. What motivated you to come to the Bell Museum today? (Check all that apply)

- To learn something new
- To spend time with friends

- To spend time with family
- To see the new building
- To relax
- To pass time
- Other (describe in the text box below)

11a. Who visited the museum with you today?

- No one
- I was in a group
 - ___ Number of adults
 - ___ Number of children

11b. How many were family members?

- ___ Number of adults
- ___ Number of children

12. How often do you visit the Bell Museum?

- Daily
- Weekly
- Monthly
- Annually
- This is my first time

Now I would like to get a sense of who you are.

13. In what year were you born? _____

14. What race/ethnicity do you identify as? _____

15. What is the highest level of formal education you have completed?

- | | |
|--|--|
| <input type="checkbox"/> Did not finish high school | <input type="checkbox"/> College bachelor's degree |
| <input type="checkbox"/> Completed high school | <input type="checkbox"/> Some graduate work |
| <input type="checkbox"/> Some college but no degree | <input type="checkbox"/> Completed graduate degree (Master's or Ph.D.) |
| <input type="checkbox"/> Associate degree or vocational degree | |

Lastly, we'd like to know if you would be willing to answer a few questions

For this study, Molly, the graduate researcher, is conducting surveys and in-person/phone interviews. These interviews will last approximately 15 minutes. The purpose of these interviews is similar to this survey, except Molly will ask more in-depth questions in order to get a deeper understanding of your museum experience. Any information shared will be deleted after the completion of this study and what is discussed during the interview will be kept completely confidential.

16. Would you be willing to participate in a short phone interview about your museum experience?

- Yes
- No [Skip to question 17]

17. Please share your contact information below and the researcher will contact you in the next week.

Full name: _____

Phone: _____

Email: _____

Preferred time to be contacted: *Please circle the days and times that work best for you.*

Best days to contact you: Mon Tues Wed Thurs Fri Sat Sun

Best times to contact you: Morning Afternoon Early Evening

Thank you! Molly will place your information in a survey pool. Only 30 individuals will be called for this study. If you are randomly selected, the researcher will contact you sometime between mid-December to early January (excluding holidays).

18. Did we miss anything? Please provide additional comments or questions you may have about the Bell Museum and its moose diorama

You've completed the survey! Thank you for your participation.

Appendix C

Interview Protocol

Thank you for your willingness to answer a few questions.

First, I'd like to hear about your experience visiting the moose exhibit.

1. I am interested in how people make sense of habitat displays. Let's think back on the moose exhibit.

Saliency prompt: When thinking back on the moose exhibit, what feature of the exhibit comes to mind first?

Awareness Prompt: What were your take-home messages of the moose exhibit?

Now, I'd like to hear more about what you were thinking while visiting the moose exhibit.

2. Did the moose exhibit remind you of a **place** you've been?

You said at the time that the exhibit reminded you of <insert what they said>. Tell me more about this place, describe it to me.

Specific Time Prompt: What period of life were you in? What mattered to you then? What were you doing during that place? How were you feeling?

Anything else?

3. Is there anything else that is apart of what you shared with me today that we haven't talked about that you think is important to add?

4. Is there anything else you would like to share with me today?

Thank you for your time today. I really appreciate your participation!

Appendix D

Full list of states, cities, and/or regions that the moose exhibit reminded people of

USA	Canada	Europe	
<p>Minnesota</p> <ul style="list-style-type: none"> Twin Cities Minnesota Zoo North Shore North Woods Lake Superior St. Croix River John's Landing Iron Range Arrowhead Region BWCA Knife Lake Nina Moose Lake Gunflint Lake The Gunflint Trail Superior Hiking Trail Aitkin County Duluth Two Harbors Baptism River Grand Marais Grand Portage Grand Rapids area Ely Bear Head Lake Babbit Nisswa Orr Tower Remer Spirit Lake Itasca State Park Voyager NP <p>Michigan</p> <ul style="list-style-type: none"> North Woods Isle Royale Upper Peninsula <p>Oregon</p>	<p>Alaska</p> <ul style="list-style-type: none"> Anchorage Denali NP Fairbanks <p>Montana</p> <ul style="list-style-type: none"> Glacier NP <p>Wyoming</p> <ul style="list-style-type: none"> Bighorn Mountains Yellowstone Grand Tetons Jenny Lake <p>Wisconsin</p> <ul style="list-style-type: none"> North Woods Coulee Region Chequamegon Lake Namekagen <p>Maine</p> <ul style="list-style-type: none"> Lake Sebago <p>New York</p> <ul style="list-style-type: none"> NYSS Finger Lakes Museum of Natural History <p>North Dakota</p> <ul style="list-style-type: none"> Sheyenne <p>Massachusetts</p> <p>California</p> <p>Nebraska</p> <p>Colorado</p> <p>Washington</p>	<p>Alberta</p> <ul style="list-style-type: none"> Jasper NP <p>Ontario</p> <ul style="list-style-type: none"> Quetico Provincial Park <p>Nova Scotia</p> <ul style="list-style-type: none"> Cape Breton Island <p>Newfoundland</p> <p>Manitoba</p>	<p>Sweden</p> <ul style="list-style-type: none"> Stockholm <p>Norway</p>