Chapter 6

Universal Design for — Emotion in — Learning: A Practice for the Creation of Emotionally Accessible Digital Learning Experiences

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Introduction

Affective neuroscientist Mary Helen Immordino-Yang once stated that, “without emotion, all decisions and outcomes are equal — people would have no preferences, no interests, no motivation, no morality, and no sense of creativity, beauty, or purpose … Emotions are, in essence, the rudder that steers thinking” (Immordino-Yang, 2015). And, in fact, the modern neuro and learning sciences explicitly tie the process of learning to meaning-making within the context of emotional experience. Reflecting this view, there is widespread agreement within the museum field that engagement, identity and motivation — three emotionally-laden constructs — are critical to informal learning experiences (CAISE, 2019).

Yet, our understanding of emotion in the design of museum spaces is impoverished and lacking attention to the full complexity of human experience (Christenson, Reschly, & Wylie, 2012; Fredricks, Blumenfeld, & Paris, 2004; Rappolt-Schlichtmann & Daley, 2013). Our prior research shows that whether or not we actively attend to emotion in design, visitors are experiencing many varied emotions in museums, ranging from happiness, wonder, and empathy to anxiety, confusion, and even fear. These emotional experiences are quite varied, informed by visitors' background knowledge, ethnic and cultural heritage, other aspects of identity, and experiences of the designed interactives in the moment, as well as their capacity for self-awareness, emotion understanding, expressiveness and emotion regulation (Salovey & Mayer, 1990; Brackett, Rivers, Bertoli & Salovey, 2016). The rich emotional life of visitors within museums includes people with disabilities, who stand to benefit substantially from deep and engaged learning experiences in museum settings, when supported to do so. Indeed, research literature has long described the important role informal learning environments play in sparking and cultivating long-term interest in topics of personal relevance — an experience of critical importance to the success of people with disabilities (Fink,1998; Rappolt-Schlichtmann & Daley, 2013).

However, without attention to emotion in all of its rich complexity, our designs can be rendered emotionally inaccessible, leaving many people out of deep

learning experiences that could otherwise enrich and support them to thrive in learning and life. What if we thought about emotion specifically, and for its own sake? What does it mean to set emotional goals in museum design? How are people diverse in their emotional capacity and intelligence in ways that affect their experiences in museum settings? If feeling is, in fact, critical to learning and relating in life, how can we support emotion right alongside cognition in ways that reflect the integrated nature of thinking? In this chapter, we explore the concept of emotional design for informal digital learning experiences and address how Universal Design for Learning (UDL) can be leveraged to create experiences that foster emotional accessibility and support the development of emotional intelligence for all visitors.

What is Emotional Accessibility?

Following the passage of the Americans with Disabilities Act (ADA) in 1990, many museums improved the accessibility of their facilities to significantly expand the reach of their programming and exhibit spaces to people with disabilities. Typical solutions provide for the increased physical presence or accommodation of people with disabilities including, for example, text labels presented in both audio and Braille (Tokar, 2004).

Digital interfaces further extended the potential of these solutions to provide for more dynamic accommodations including just-in-time feedback, visuals with alt text, closed captioning and even device-specific responsive content. While such accommodations have had a substantial and positive impact on individuals with disabilities being able to physically or cognitively access museums, full participation as evidenced through deep engagement and intrinsic motivation for learning still lags (Rappolt-Schlichtmann & Daley, 2013).

Physical and/or cognitive accessibility does not, on its own, provide for engagement — learning does not occur as a consequence of the presence of the accessible label, per se. Rather, the design of supportive emotional conditions promotes the approach and interaction of diverse people with physically accessible exhibits, shaping the emergence of engaged visitor experiences (Falk & Dierking, 2013). To be effective, design for emotional accessibility must, like

design for physical, sensory or cognitive diversity, consider the range of human variability in emotional experience. Just as variability in vision can be addressed through specific affordances built into the learning environment, variability in emotional experience can be proactively addressed through design. But how should we think about human emotional experience — what do we need to attend to — so as to create emotionally accessible designs?

To be sure, the experience of emotion is content-rich and more complex than our everyday experience would imply. Affective scientists describe two related but distinct aspects of emotional experience that can be attended to in exhibit design:

Core affect constitutes your general bodily state such as feeling pleasant or unpleasant, energetic or lethargic, and

Subjective feeling constitutes your understanding of your overall experience which we label with familiar terms like happiness, sadness, rage, pride, relief, etc.

In addition to these two aspects of emotional experience it is important to recognize, as designers, that human beings have intelligence and skills based on emotion that vary from person to person.

Emotional intelligence is your capacity to govern and leverage your emotion.

Emotional intelligence includes skills important to museum experiences like self-awareness, self-management (e.g., controlling impulses and motivating oneself), social awareness, relationship skills (e.g., cooperating with others and active listening), and responsible decision making (e.g., evaluating the realistic consequences of various actions so as to support your own well-being as well as that of others). As with physical, sensory and cognitive capabilities, people vary substantially in their emotional experiences of museum spaces and, as such, emotionally accessible exhibits will consider and address each of these three components of emotional experience — core affect, subjective feeling, and emotional intelligence.

UDL: A Framework for Thinking About Emotional Accessibility

The UDL framework can be extended to think about issues of emotional accessibility and, while not perfectly aligned, the approach provides a good and concrete starting point that may be familiar to many museum professionals.

UDL was conceived in the late 1980s by neuropsychologists David Rose and Anne Meyer who were working to respond to the "problem" of people who learn differently — those with learning, cognitive, or sensory disabilities or those who are otherwise neuroatypical. Rose and Meyer noted that the "problem" wasn't the people at all but rather the "one-size-fits-all" learning environments that are too narrowly conceived, defined and constructed to meet the needs of the rich diversity of learners in the general population (Meyer, Rose, & Gordon 2014; Rose & Gravel, 2010; Rose, Meyer, & Hitchcock, 2005). Rather than describing people as disabled, Rose, Meyer and their colleagues at CAST began to describe learning environments as designed to be disabled or disabling. They conceived of the UDL guidelines as a means to provide opportunities for deep learning through the design of highly flexible methods, materials and learning experiences (Rose & Meyer, 2002; Rose, Meyer, & Hitchcock, 2005).

As neuropsychologists, Rose and Meyer anchored the UDL framework and guidelines to a careful synthesis of relevant research from across the learning sciences. They intended for UDL to represent our best and most current understanding from the research literature for practitioners, educational designers and learning scientists. For example, the framework and guidelines stem from the realization that three broad divisions are often made when describing learning, which are how people:

1. engage and are motivated,
2. perceive information and comprehend, and
3. navigate the environment and express what they know (Bloom, 1984; Luria, 1973; Vygotsky, 1978).

What differentiates UDL from previous and current reform efforts is its orientation to continuous improvement both in the design of learning environments as anchored to the guidelines and in the evolution of the framework itself. Indeed, as the learning sciences shift and develop, so do the UDL framework and guidelines (Rose & Gravel, 2012).

As discussed above, perhaps the most notable shift in the learning sciences over the last few decades (and since the conception of UDL) is our understanding of and attention to the role of emotion in learning. Historically, learning scientists conceived of rational thought as a kind of holy grail in learning design — emotion was something to be controlled, eliminated or trained-up, wholly independent of cognition in learning (Fischer & Bidell, 2006). But the last few decades have seen a kind of renaissance in thinking about the nature of emotion in learning. Research now counters the common conception that cognition and emotion operate in opposition, advancing the understanding that they operate together as two sides of the same coin and providing the basis for engagement, perception and comprehension, as well as action and expression in learning (Frijda, 1986; Lazarus, 1991; Russell & Barrett, 1999).

Affective scientist Mary Helen Immordino-Yang notes that:

> Quite literally, it is neurobiologically impossible to think deeply about or remember information about which one has had no emotion because the healthy brain does not waste energy processing information that does not matter to the individual (Immordino-Yang, 2015). Emotions help learners set goals during learning. They tell the individual experiencing them when to keep working and when to stop, when she is on the right path to solve a problem and when she needs to change course, and what she should remember and what is not important. (National Academies of Sciences, Engineering and Medicine, 2018)

So where is emotion in the UDL guidelines? Most obviously emotion is explicitly represented within the *Engagement* principle (the “why” of learning). The guidelines highlighted therein can help practitioners think about: the multiple ways in which people engage and are motivated to learn; lowering barriers to

interest; effortful engagement; and self-regulation in designed experiences. In recognizing the shift in the learning sciences described above, CAST adjusted the graphic representation of the UDL guidelines in its second iteration and moved the *Engagement* principle into the first position so as to keep emotion front of mind in design (CAST, 2018).

However, deep engagement is only one goal practitioners might hold for visitors. UDL also provides guidelines for the creation of designed learning experiences that support the many varied ways in which people perceive and comprehend information, as well as the ways that they navigate the learning environment and express what they know. These are the two other UDL principles: *Provide Multiple Means of Representation* (the "what of learning"), and *Provide Multiple Means of Action and Expression* (the "how" of learning).

Emotion is, of course, also represented in these guidelines because emotion and cognition are always at play in every aspect of human life — engaging, comprehending, acting and expressing are all, at once, both cognitive and emotional. Thus, if you frame goals such as, "visitors will explore the perspectives of Native American people," or "visitors will analyze engineering design solutions," or "visitors will discuss scenarios for the mitigation of climate change," for various learning experiences, the UDL guidelines can help you think about how to support and scaffold visitors' diverse cognitive and emotional needs through design.

For example, when you provide background information (the UDL Guidelines: *Provide multiple means of representation — Activate or supply background knowledge)* you are supporting cognition in that you provide context to inform understanding of the current scenario. You are also supporting emotion regulation by lowering the demands of the task and helping visitors be more resourceful. Likewise, providing alternative representations of text labels will support the emotion and cognition of visitors who have difficulty with text (e.g., those who are blind, dyslexic or second language learners) by improving perception and comprehension, as well as by providing for a more positive core affective experience: "I believe I can do this," "I feel like I belong here." These strategies, in conjunction with supporting approach behavior, improve emotional accessibility.

Universal Design for Emotion in Learning (UDEL): Two Case Studies

Though the formal extension of the UDL framework to support emotional inclusion is a relatively new concept, we have developed several models of the approach through our work at the Museum of Science in Boston (MOS) that illustrate what it means to design digital interactives for emotional accessibility. These are by no means meant to be exhaustive — they are a set of examples to provide fodder for practitioners who we hope will be expansive in adopting this frame to develop emotionally accessible and inclusive experiences for visitors.

Our first example draws on prior work leveraging UDL in two scenarios: the design of the *Hall of Human Life* exhibition at the MOS, and a new project we are currently engaged in called APPRAISE (Exhibit Appraisal and Diverse Populations: Pilot Research about Intersectional and Science Identities in Science Exhibits; DRL-1906688). The APPRAISE project is funded by The National Science Foundation (NSF) and is focused on exploring and describing strategies for emotionally inclusive design that reduce barriers to deep learning and facilitate pathways to engagement for a wide range of diverse audiences.

The second example is focused on strategies for supporting, applying and developing emotional intelligence. We draw from work completed under our NSF-funded project, “Developing Guidelines for Designing Challenging and Rewarding Interactive Science Exhibits” (DRL-1612577), where we developed exhibits that strategically leverage emotions to improve performance on specific tasks, support learners’ regulation of negative emotions, and promote emotional awareness.

Exploring and Supporting Core Affect and Subjective Feeling in the Hall of Human Life

Within museums, learners select which exhibits they will visit. From our perspective, this decision point is the first moment at which design can be rendered emotionally accessible. The UDL guidelines describe “recruitment of

interest" as vital to engagement because, "information that is not attended to, that does not engage learners' cognition [and emotion] is in fact inaccessible" (CAST, 2018). Museum professionals have long studied behavioral patterns in exhibit use through methods like observation and timing and tracking (Serrell, 1997, 2010; Yalowitz & Bronnenkant, 2009). The APPRAISE project pushes beyond this to explore *why* people choose to approach or bypass an exhibit. It studies the ways in which museum professionals can use emotional experience as an information-rich indicator of barriers to visitor engagement or learning, and thereby facilitate pathways to engagement. The project measures visitors' conscious and subconscious bodily responses to designed learning experiences to tease out the emotional mechanisms of the approach and avoidance behaviors that shape museum experiences.

The APPRAISE research study is set in the *Hall of Human Life* exhibition at the MOS. This 9,700 square foot exhibition hosts over 70 exhibits — including many digital interactives — about human biology and human health (Barth, et al., 2018). Below, we explore the emotional consequences of design strategies in the *Hall of Human Life*, focusing on the three UDL strategies for recruiting interest:

1. Optimizing individual choice and autonomy;
2. Optimizing relevance, value, and authenticity; and
3. Minimizing threats and distractions.

Although this project is just beginning, the following sections illustrate the ways in which developers of digital interactives can apply the UDL guidelines in emotionally accessible design, inviting a wide range of learners to feel comfortable initiating a learning experience.

UDEL Strategy: Provide meaningful choice for visitors to create positive and energized emotional experiences.

Offering visitors meaningful choices can lead to emotional experiences that support them to approach exhibits and engage deeply. Reflecting the UDL guidelines for engagement (the UDL Guidelines: *Provide multiple means of engagement — Provide options for recruiting interest; Optimize individual choice and autonomy),* the *Hall of Human Life* provides visitors with a wide range of

choices that can bolster feelings of autonomy in the learning experience. Visitors can choose between different types of engagement: at one exhibit, learners navigate through screen-based prompts using a button box similar to a simple keyboard; another exhibit involves taking off your shoes and walking across a platform that measures the arch of your foot; one asks learners to hold their hand still on a metal plate as it reads temperature and provides an interactive data visualization. Additionally, visitors can navigate through the exhibition in any order, allowing learners the choice to drive the agenda of their learning experiences.

Research suggests that these kinds of meaningful choices will have direct affective consequences; feeling like you have control over a learning situation and are able to define your experience on your own terms supports a sense of belonging and comfort. This can result in positive and energized core affect and subjective feelings like happiness, calm and excitement (Barrett, Mesquita, Ochsner, & Gross, 2007; Clore & Ortony, 2000; Scherer, 2001). In turn, the feeling that they are in control of a situation, as well as feeling energized and positive, increases the likelihood that visitors will approach an exhibit, and can lead to their investing more effort into the activity at hand and therefore developing higher levels of mastery (Immordino-Yang & Singh, 2011).

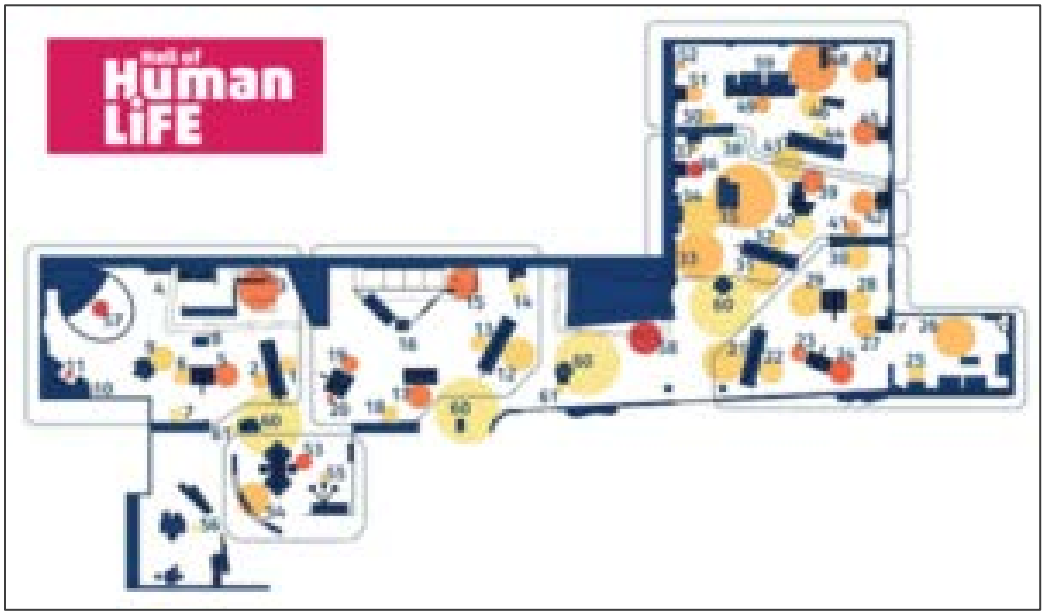

Figure 1: With over 60 exhibit components, the *Hall of Human Life* offers visitors with many choices about how to navigate its non-linear layout.

UDEL Strategy: Provide opportunities for visitors to personally connect, to boost feelings of relevance.

Helping visitors learn about themselves can boost feelings of relevance, contributing to deeper learning. One of the most prominent strategies to optimize relevance, value, and authenticity in the *Hall of Human Life* is a series of Link Station activities at which learners gather data about themselves and compare it with other visitors' data (the UDL Guidelines: *Provide multiple means of engagement — Provide options for recruiting interest; Optimize relevance, value, and authenticity).* This provides a personalized learning context and the opportunity to reflect on oneself within a larger context. The summative evaluation report for the *Hall of Human Life* demonstrates that the Link Stations enhanced relevance for many visitors. For example, "Maddison," a 13-year-old student who visited the exhibition on a field trip, described one of the stations as the most interesting part of her visit. She described the exhibition as "a place where you can interact with many things and learn more about your body and mind, and compare it with other people," and added that the Link Stations helped her "think about what I eat and how much my calorie intake is…[I] learned what my data was compared to other [people]" (Barth, et al., 2018).

As is the case with choice, feelings of relevance strongly relate to emotional experience. From an emotional perspective our bodies are constantly reviewing information about our environments. There is too much environmental data for us to attend to all of it, and doing so would be maladaptive, as much of it does not demand our attention. Instead, our bodies direct resources and attention based on our judgements about what is relevant to us; we attend to, and devote processing power to, what we judge as relevant (Scherer, 2001). This has clear implications for learning, especially within an exhibition with so many choices for interactives. Given limited time, people are more likely to feel positively, energized about, and ultimately choose the interactives that seem immediately relevant to them.

UDEL Strategy: Provide consistency in design and opportunities for visitors to reflect, to boost feelings comfort, safety and calm.

The *Hall of Human Life* provides quiet places for reflection and offers predictability through consistent design across the gallery (the UDL Guidelines: *Provide multiple means of engagement — Provide options for*

recruiting interest; Minimize threats and distractions). Benches offer a space to relax amid the hectic exhibition environment, and The Human Body Theater is a quiet, enclosed spot to watch film clips in a more passive learning mode than the surrounding interactive activities. Emotionally, spaces for reflection may provide a different kind of learning than the rest of the gallery. Providing benches in the theater is a design that intends to support visitors to feel less energized than in other spaces in the gallery. Emotions that are less energized like feeling thoughtful, peaceful, hopeful and focused may be particularly powerful for learning goals such as building empathy and consensus with others (Brackett, 2019), which can be a particular challenge for digital learning experiences (Immordino-Yang & Singh, 2011).

Figure 2: Benches and quiet spaces in the gallery provide opportunities for reflection. Here, visitors can quietly observe cottontop tamarins and compare them to humans.

With regard to consistency, the *Hall of Human Life* is designed with five main themes — physical forces, food, communities, organisms, and time. Each theme is located in its own physical area in the exhibition, and within that area each

theme has the same key elements, including an Introductory Wall, a DNA Wall, a Health Condition Wall, Link Stations, and additional interactives. This consistency helps learners know what to expect after they have visited the first area. The emotional consequences of consistent design elements can help learners devote full attention to the designed learning experiences. Each of us has a limited physiological capacity for deep learning, and we often see that our biological resources are most engaged at the beginning of an activity (Cruz-Garza et al., 2017; Dilenschneider, 2018). Consistent design means learners spend less effort figuring out what to do, so they can dedicate more attention to deep engagement within the designed exhibit challenge.

Figure 3: To reduce the burden of orientation and allow learners to focus their attention on deeper learning, each section of the gallery includes the same elements: an Introductory Wall (pictured here), a DNA Wall, a Health Condition Wall, Link Stations, and additional interactives.

Designing with and for Emotional Intelligence in Skull Mystery

Our second example is focused on applying strategies that support and develop emotional intelligence through design. We present the work of one of our most recent projects which is focused on promoting emotional intelligence through the lens of "productive struggle." Productive struggle is an emotional experience that occurs when a learner engages with disequilibrium in order to navigate a challenging task and achieve a satisfying resolution. The team defines "disequilibrium" as a sense of imbalance (which can be experienced as confusion, frustration, surprise, or unease) brought on by a social, physical, or cognitive challenge. In this project, we developed an interactive, digitally-enhanced exhibit called *Skull Mystery,* which supports visitors to have emotionally accessible and rewarding experiences. We applied insights about emotional intelligence so as to support visitors to deepen their emotional skills. This exhibit invites learners to select one of multiple physical skulls which they can manipulate and investigate. A digital interface guides visitors through an exploration of different skull features — such as teeth and eye sockets — which provide clues about the animal's diet, habitat, and other characteristics. At the end, visitors piece together what they learned to identify which animal the skull is from.

UDEL Strategy: Define emotional goals to support the strategic design of exhibits that foster emotions which enhance visitor experience.
In designing this exhibit, the team worked to create a supportive environment that helped diverse visitors leverage emotions for the purpose of facilitating thought — a critical aspect of emotional intelligence. In defining emotional goals for the exhibit, developers applied insight from the emotion sciences to align the exhibit task with emotional states that enhance performance for deep problem solving. This strategic goal-setting sought to create a supportive environment that would allow learners to access deep and rich emotional experiences that might have otherwise been unattainable. In this case, the exhibit activity asks visitors to develop an argument about the skull they are investigating. They gather evidence about their skull and then make a claim about the animal's

identity. Research about emotional intelligences suggests that performance for tasks like this — where you need to engage in problem solving to develop and defend your position — can be enhanced when participants experience active and negative emotions such as confusion and frustration (Brackett, 2019).

To encourage visitors to experience these emotions, the team made the activity intentionally difficult. Visitors learn rules and then find out that there are exceptions to the rules. To heighten activation, visitors are asked to make a guess at the beginning of the activity so their investigation serves to confirm their initial idea or prove it wrong. Preliminary analysis of our summative data collection effort shows that our attempts to support the emergence of feelings of disequilibrium were successful; all 35 participants of the *Skull Mystery* activity indicated that they felt frustrated, challenged, surprised, disappointed, nervous, or confused at some point during the activity.

UDEL Strategy: Strategically support visitors and provide opportunities for them to practice regulating their emotions during exhibit experiences.
To ensure that "struggle" emotions are manageable and inclusive for a wide range of learners, we applied insight from another key aspect of emotional intelligence: emotion regulation. Emotional intelligence research shows that effective strategies for regulating disequilibrium emotions include taking breaks and offering positive encouragement (Brackett, 2019). At *Skull Mystery*, timely feedback encourages a sense of mastery over the task (the UDL Guidelines: *Provide options for sustaining effort and persistence; Increase mastery-oriented feedback)* and learners are empowered to pace themselves through the activity as they make choices about which tasks to do and in which order (the UDL Guidelines: *Provide multiple means of engagement — Provide options for self-regulation; Facilitate personal coping skills and strategies).* These strategies also support visitors to monitor their progress on the task which supports emotion regulation as visitors can better foresee a way through the difficulty (he UDL Guidelines: *Provide multiple means of action and expression — Provide options for executive functions; Enhance capacity for monitoring progress).* The design allows visitors to take on more difficult challenges when they are prepared to embrace disequilibrium, or to step back and work on simpler tasks when the levels of disequilibrium become too high (the UDL Guidelines: *Provide multiple means of engagement — Provide options for*

sustaining effort and persistence; Vary demands and resources to optimize challenge). To support persistence, learners can draw on a range of hints and scaffolds that highlight patterns and prompt attention to key features. In the language of UDL, this structure provides graduated levels of support that build fluency, modulate task demands, and facilitate comprehension (the UDL Guidelines: *Provide multiple means of action and expression — Build fluencies with graduated levels of support for practice and performance) (*Â the UDL Guidelines: *Provide multiple means of representation — Highlight patterns, critical features, big ideas, and relationships).*

In the *Hall of Human Life* example, we described how choice and autonomy can be leveraged in design across an exhibition space to support visitors' core affect and subjective feeling, and encourage approach and engagement with exhibit interactives. Here, we illustrate how autonomy within a designed experience can offer visitors a platform for practicing and performing emotional intelligence at a digital interactive. In this way we worked to leverage strategies that created a sense of autonomy so that visitors would feel safe and in control of their experience, thereby increasing the likelihood that they will feel comfortable persisting through new ideas in a difficult task. Although this was a new way of looking at exhibit design for the MOS, the results were encouraging. Of the 35 participants who used the *Skull Mystery* activity in our final study, all but two people reported that they had felt focused, determined, motivated, and persistent at the activity, and 64% indicated that the ability to make choices about how to use the activity contributed to these feelings.

UDEL Strategy: Provide opportunities for active reflection on emotional experience to support visitors' self and social-awareness.

Although significant thought about emotional intelligence informed the design of the *Skull Mystery* exhibit, most visitors are likely unaware of this intentionality. However, our research into visitors' experiences of the design invited learners to engage with another key aspect of emotional intelligence: as visitors described their experience with the exhibit, they were supported to practice the skill of emotional awareness. Data collectors exercised empathy and welcomed social connection as they interviewed youth participants. This research approach was an intervention in itself, applying UDL strategies to enhance value by inviting active participation in meaning-making about the exhibit and prompting deeper

exploration about the learning experience (the UDL Guidelines: *Provide multiple means of engagement — Develop self-assessment and reflection).* The following vignette shares such emotionally-aware reflections from a 17-year-old visitor whom we will call "Jared," who described himself as having high-functioning autism, attention-deficit/hyperactivity disorder (ADHD), sensory integration disorder, and anxiety disorder. Engaging with disequilibrium could have been threatening for Jared, but he described how the ability to choose his own path through the learning experience helped him ultimately reach a satisfying resolution.

Case Study

Jared sat down in front of the *Skull Mystery* exhibit with his service dog, Nemo. He began the activity at skull 1, where he learned about the eyes, teeth, and crest. Jared had been clicking through the exhibit questions quickly but as he proceeded to the next skull, he slowed down. Jared recalled, "I couldn't tell… if they were flatter teeth or pointier teeth." He reached out and ran his hands along the skulls' teeth. "I was a little bit concerned that I was going to get it wrong because I can't exactly tell which one it is."

This moment could have been critical for someone with Jared's disabilities. However, Jared noted that the ability to make choices about how to do the activity, and the ability to try multiple times contributed to his decision to keep going. He indicated that he was, "focused, determined, persistent, and motivated." Jared gathered all the information he could and then made a guess based on skull 3's teeth. He was correct. "I was a little bit relieved," he remembers.

Jared then re-engaged with disequilibrium as he explored the next skull's ridge. "That one was interesting because of the thing with the ridge," he recalled, "I got it wrong I think because I didn't notice it was a crest. I was just like, 'there's no ridge' and instantly selected that." When the exhibit suggested that there was a better answer, Jared looked back and forth, comparing the skulls and the images on the screen. Reflecting on the experience, Jared explained:

> I didn't understand what they meant by the crest at first. I found the crest, but at skull 3 the crest is a different shape [than skulls 1 and 2] …I was like, oh, wow, that's something that I didn't expect, that it would be a different shape. That's something I'm going to remember.

He revised his answer and tried again, this time selecting the correct response, and said, "I felt good that I got it right."

Summarizing his experience afterwards, Jared reported that he felt confused and surprised when he didn't know the answers to the questions, but that overall the activity was satisfying. He was motivated to learn about the different skulls, and he felt like he achieved that goal, making him feel "proud."

We have found that when you ask someone how they feel, an unprompted explanation almost always follows: "I feel_____ because…" And, when asked about their emotional experience, visitors are often open and excited to share rich details about their experience on the whole. This practice of reflection and social connection around exhibit experiences supports visitors' feelings of personal relevance, value and authenticity, and fosters a sense of community and connection around informal and museum learning experiences. Though we leveraged the strategy as a part of our approach to research, design strategies that support self-awareness and an understanding of self and others could be levied within the exhibit experience itself.

Conclusion

Core affect, subjective feelings and emotional intelligence are central to thriving in learning and life (Elbertson, Brackett & Weissberg, 2010; Durlak et al., 2011). They provide us with content-rich information about our assessment of the social, physical and intellectual environments. They are also critical to motivated behavior, as well as the overall well-being of visitors as they make decisions about their experiences, self-regulate in the face of meaningful challenges, and adapt and grow in response to museum experiences (Lopes & Salovey, 2004). From this point of view, visitors' emotional experience can and should be

supported and, perhaps even be the subject of scaffolding to support the further development of emotional concepts and skills critical to learning. Indeed, if we do not actively support core affect, subjective feelings and emotional intelligence in design, then we leave the overall well-being of our visitors to chance.

Within this context, digital technology is paving and will continue to pave new paths towards the creation of emotionally accessible and inclusive learning experiences. In the work we have described in this chapter, the use of digital interfaces allowed us to more nimbly implement UDEL-based solutions to support emotional experiences. Visitors can receive dynamic feedback based on their progress and choices. Interfaces can be implemented in more customizable ways so that we are better able to meet the needs of diverse audiences, and support positive judgements of the museum environment without having to make choices that remain static, thus, narrowing the range of needs and preferences we might otherwise be able to address by design. It is worth noting that we have also been experimenting with biosensors and affect-detection technologies to explore potential design strategies for affect-responsive support within exhibit experiences. Though not specific to the museum field, others are exploring the use of virtual avatars and robots to assess affective experience and support emotion regulation (e.g., Breazeal, 2002; Chang & Breazeal, 2011; Klein, Moon, & Picard, 2002; Picard & Klein, 2002; Ring, Barry, Totzke & Bickmore, 2013).

This kind of work, focused on affective responsivity via dynamic and digitally-designed experiences, is in its infancy but rapidly advancing, raising ethical concerns especially with regard to the limitations of technology to detect and analyze visitors' emotional experiences. The public's understanding of and trust in affective technology is still limited due to its relative absence in daily life. Concerns around the consequences of algorithmic bias built into affectively-intelligent systems are growing (Heger, Kampling, & Niehaves, 2016). Leaders in fields within and related to affective computing and the advancement of affect-responsive technologies have called for further research, evaluation and development of systems to address the limitations of current approaches. We are venturing towards a time when such systems could reliably detect a multiplicity of naturally occurring emotional states for people in real-world situations, and could do so in ways that are ethically sound and empowering for those involved (Calvo, D'Mello, Gratch, & Kappas, 2015; Picard, 2010).

Certainly, we need to proceed thoughtfully and with caution around the use of advanced affect-detection technologies, but the potential is thrilling. Consider the *Skull Mystery* exhibit described above: while enhanced digitally, our design approach was limited in that we could only assume visitors' emotional experiences and attempt to proactively provide support. We were, in a sense, placing burdens on visitors to access the support they needed, when they needed it, even when it was provided dynamically in response to performance and choices. What if designers had digital tools to implement that could empower more museum visitors to navigate confusion and frustration in ways that foster deeper learning and engagement? What if an exhibit could tune into visitors' affect, sharing the burden of identifying confusion awareness, and leveraging support to encourage persistence in the moment when a visitor needs it most?

Whether or not the integration of affect-responsive technology becomes a reality, UDEL can provide practitioners a framework to think systematically about the affective and emotional variability visitors bring to designed museum spaces. But, to render design emotionally accessible and create emotionally inclusive environments we need to leverage the framework in ways that may feel atypical to current use in the field.

First, we need to get comfortable with and consistent about setting emotional goals. Because emotions and cognition are always at play, setting a cognitive goal without an emotional goal will leave emotion to chance and may bias exhibits to the majority experience or view. Second, all emotions and emotion experiences have utility — there are no “good” or “bad” emotions. Museum designers often have a bias towards supporting happy, positive experiences. What we would suggest is that designers focus on well-being and thriving instead. Confusion feels like a negative, but keeping it out of our spaces actually creates barriers to deeper learning because it is a natural and useful consequence of effortful information processing in the face of new and surprising evidence. It’s good to feel confused as long as visitors are supported through problem solving to resolve those feelings. We have found on the "productive struggle" project that visitors have deeply satisfying experiences and even report feeling pride. By creating emotionally accessible exhibits and

inclusive museum experiences we aim to support the proliferation of outcomes that are cognitively, socially and emotionally more meaningful by design.

Finally, it is important to note that while we have found the UDL framework incredibly useful in thinking about design for emotion, in some ways, it is also emotionally wanting. This shouldn't be a surprise per se because the creators were learning scientists who had a cognitive focus; they were also focused on formal education settings which tend to prioritize cognition and achievement. Though the framework addresses engagement explicitly and can be used to maneuver emotional goals there are some aspects which could be enhanced if viewed through an emotion lens. For example, the UDL guidelines deal implicitly with support for emotional intelligence skills but attention to their explicit accessibility would improve the utility of the framework and support practitioners to be more mindful to issues of emotional inclusion.

At its core, Universal Design for Emotion in Learning is about a shift toward embracing the "whole visitor" — social, cognitive, corporeal *and* emotional. In supporting practitioners to start thinking more holistically and about emotional accessibility specifically, we have framed a kind of *emotion-as-information* approach where visitors' core affect and emotion confer value on their thoughts and experiences in museums (Clore, Gasper & Garvin, 2001; Schwartz & Clore, 2007). When design is rendered so as to support visitors' core affect, emotion and emotional intelligence, other aspects of visitor engagement, including approach/avoidance, attention, decision-making and overall well-being, are supported. When emotion is supported and museums are rendered to be emotionally accessible, visitors will be better able to engage in museum experiences with their whole selves in adaptive and constructive ways. Taking this approach will support designers to create more equitable, resourceful and meaningful museum experiences.

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