Engaging digital artworks through emotion: interface design case study

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Abstract
Artworks are often created to solicit emotional responses, yet the emotional elements are largely missing from artworks' description and access options. In an effort to advance the design of emotion-based image retrieval systems, our study developed several research proposals for incorporating emotion into the description and access features of a digital artwork collection. Most of the proposed solutions for developing emotion metadata for artworks were informed by the current practices in information organization, including crowdsourcing and expert classifications. Being grounded in various emotion theories, the proposals offer a variety of ways to integrate emotion descriptors and navigation features into the interface design of a museum website. While the proposed solutions for integrating emotion features into online collections are not exhaustive, they highlight some of the design choices for developing emotion metadata, coding schemas and navigation features, and offer innovative ways to engage virtual visitors with museum digital collection.
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1   Introduction and Relevant work

Emotion is one of the defining elements of artistic expression. An art object expresses an artist's thoughts, perspectives, and emotions, and is frequently meant to generate an emotional response from the viewer (Gaut, 2000, 2007; Merriam-Webster, 2014). Yet, emotion is largely absent from artworks' description and access options.

At the same time, museums are striving to increase access to their physical and virtual collections and to explore new ways to engage visitors with the artworks. Examples of museum innovations include the use of multi-media exhibits (Ciolfi & McLoughlin, 2012) and interactive displays (van Dijk, Lingnau & Kockelkorn, 2012) in physical spaces, the use of 3-D or virtual reality technology (Paraizo & Kós, 2011), personalization (Marty, Sayre, & Fantoni, 2011), and Web 2.0-style features in virtual spaces (Arends et al., 2011).

One of the ways to increase engagement with digital art collections is to integrate emotion into the art objects' metadata and access. Art is perceived and accessed by viewers emotionally (Chupchik & Gignac, 2007; Eskine et al., 2012; Henrik et al., 2008), and adding this dimension to the artwork metadata could increase access to art collections and improve user engagement with them (Ciocca et al., 2011; Tschacher et al., 2012).

Previous work in the area of affective metadata development focused on user-generated, textually-based, and visually-based methods for deriving emotional meaning from art. The concept of user-generated taxonomy for artworks have been explored in theory (Trant, 2006) and in practice, and many art museums already incorporate crowdsourcing and folksonomies into their digital collections

(Philadelphia Museum of Art, 2014). Authors express different opinions on how to integrate user-generated taxonomies into collections. For example, Hollink et al.'s (2004) research advocates reliance on user-generated tags for creating emotion metadata. The authors propose relying on the twelve classes of descriptors previously proposed by Jorgenson (1998), including literal objects, people, people-related attributes, art historical information, color, visual elements, location, description, abstract concepts, content/story, external relationships, and viewer response. Choi and Hseih-Lee (2010) also emphasize the benefits of user-generated tags after finding a disconnect between expert-generated image metadata and the search terms used by non-expert searchers. The methods for the emotional tags development are also explored by Li et al. (2009), Neal (2010) and Chen et al. (2010). The authors analyzed users' search behavior in order to recommend effective ways of developing artworks' textual metadata. Other studies have attempted to solve the problem of accessing digital images with visual methods. Nguyen and Worring (2008) propose using a visualization schema to represent the collection. The authors' method combined a high-level overview of the collection, an image-specific view and visual representation of selected image relationship to the other images in the collection.

This article extends previous work by presenting several ideas for developing emotion-based metadata and navigation features for digital collections. Though the described proposals were developed for a particular museum client, presented ideas can be used in a broader context of developing innovative image retrieval interfaces that emphasize emotional elements of artifacts and art viewing experiences (Leder et al., 2012).

2   Study Design

The study was designed as a course exercise for ten Information Science graduate students. The students were tasked with developing a proposal for the emotion-based artwork description and access features for the Dallas Museum of Art (DMA). The DMA, known for its innovative "DMA Friends" program (Tozzi, 2014) is redesigning its website and is actively exploring new ways to engage its virtual visitors. Since the DMA is considering introduction of emotion-based features to its new website, the museum was interested in soliciting design ideas for developing emotion metadata and navigation features for its online collection.

In the process of developing the proposals, students had to familiarize themselves with a) the DMA online collection and interface, b) general standards in museum website design, and c) the use of emotion features in any existing information retrieval interfaces. In order to build a theoretical context for their work, the students were introduced to several emotion theories described below.

2.1   Emotion Theories

Emotion research generally follows two main approaches: cognitive and somatic (Lopatovska & Arapakis, 2011). The cognitive approach emphasizes a person's conscious or unconscious appraisal of stimuli as a required component of an emotional experience and treats emotion as a subjective experience since "in any situation different people will respond with different emotions" (Silvia, 2005),

While "the central assumption of all appraisal theories is that evaluation of events, not the events themselves are the cause of emotional experience" (Silvia, 2005), the somatic approach to understanding emotion claims that appraisal of a situation is secondary to the physiological reaction to stimuli and is manifested in changes in heartbeat, elevated levels of adrenalin, or other bodily responses (McIntosh et al., 1997). The Tschacher et al. (2011) research on emotional reactions to art objects offers an example of a study that employed both cognitive and somatic approaches. Researchers monitored participants' movements, heart rate, and skin conductance as they viewed works of art (somatic approach), and at the same time collected questionnaire data about participants' accounts of their emotional experiences (cognitive approach). The study found that participants' physiological responses significantly related to their self-reported emotional experiences. However, researchers concluded that they "have no empirical grounds to claim that aesthetic experiencing could or should be reduced to its physiological embodiment" (Tschacher et al., 2011).

In describing the structure of emotions, the two dominant perspectives are continuous and discrete. With a continuous approach, emotions are described in terms of their position within two or more dimensional spaces, where dimensions can include pleasure/displeasure, arousal/non-arousal, dominance/submissiveness (Russell, 1994), positive/negative, active/passive (Scherer, 2002), and others. In the framework of a continuous approach, emotions are described in terms of where they fall on a continuum of a specified dimension, whereas a discrete approach follows the theory that posits the existence of six or more discrete, basic emotions that are universally recognized and expressed by humans and most primates (Ekman, 1992). Although there is no agreement on what constitutes basic

emotions, the list generally includes fear, anger, disgust, happiness, sadness, and surprise. Other emotions are treated as combinations or variations on these basic emotions (Lopatovska & Arapakis, 2011).

3   Design Ideas for Integrating Emotion into Museum Interface

As a result of the design exercise, each student developed an individual proposal for the client. This section describes and critiques the main ideas expressed in student proposals for creating emotion description and access features for the DMA website.

3.1   Theoretical approach/grounding

For developing emotion description and corresponding access features to the artworks, seven of the ten proposals chose to follow cognitive and discrete approaches, and relied on a visitor's or curator's ability to assign specific labels to emotional experiences associated with an artwork. Four proposals suggested using the labels of the seven basic emotions (neutral, anger, disgust, fear, happiness, sadness, and surprise) for classifying artworks and corresponding navigation features (Figure 1). In one of the proposals, virtual visitors were given an option to expand the basic emotion classification and choose a more fine-grained description for the emotional state they associated with an image (Figure 2).
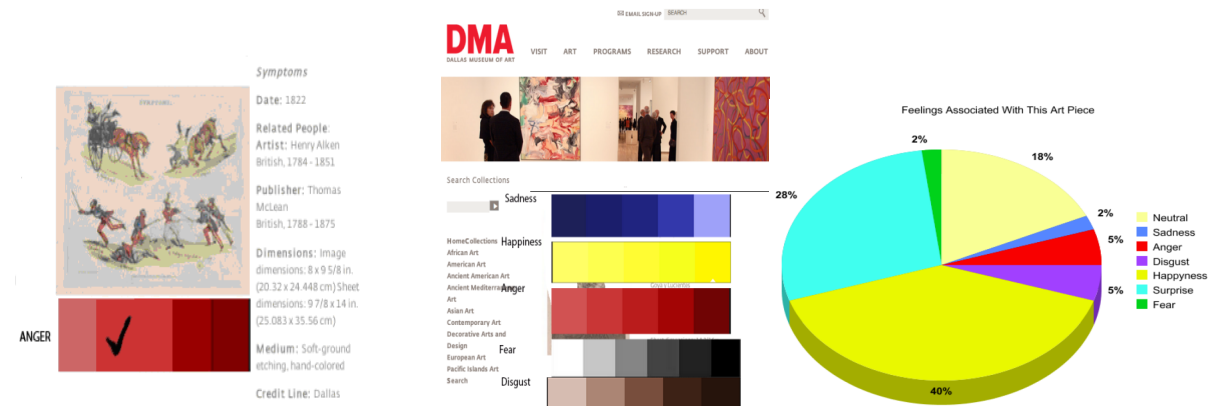
Figure 1. Example of the use of basic emotion labels for artwork description and collection navigation
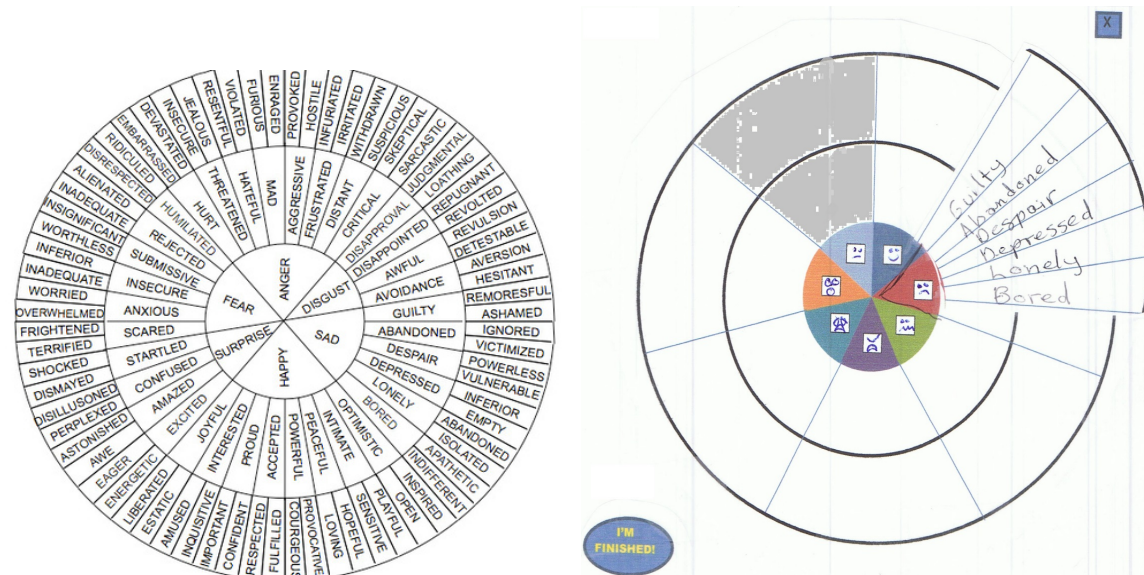
Figure 2. Expandable basic emotion wheel for artwork description and collection navigation

One of the proposals that was grounded in the basic emotion theory (Ekman, 1992) suggested harvesting emotion metadata by asking viewers to upload photographs ("selfies") of their facial expressions associated with the artwork. The collected selfies could then be automatically classified into the seven basic universal emotions (Nadlus FaceReader is one of the examples of an emotion classifying

software). The classification data can then provide artwork description and support collection navigation features (Figure 3).

Figure 3. Application of user-generated photographs in artwork description and collection navigation

One student chose to follow a cognitive/discrete approach by using a list of the All Music Guide (AMG) mood categories to classify artworks (Darwin, 2005). AMG is a "large database of music classified by genre, style, mood, and theme. Each artist, album, or song is assigned several moods, which, when averaged, convey a general mood for the given item" (Meyers, 2007). The 89 mood categories used to classify music in the AMG database were developed by music experts (Bischoff et al., 2009), and could inform a development of a similar classification for artworks in an online collection (Figure 4).

Figure 4. Example of the AMG mood categories for artwork description and collection navigation

In most of cases, students proposed using short emotion labels to classify the artwork. Only one proposal suggested soliciting a narrative that would explain the use of a particular emotion label to describe artwork (Figure 5).

Two proposals were grounded in a continuous emotion approach and suggested harvesting emotion tags by allowing visitors to select a point that best describes his/her state on a two or multi-dimensional emotion plot (Figures 5). In the proposal to use a two-dimensional space (inspired by Scherer, 2005), users would rate images along an x-axis continuum of negative-positive, charted against a y-axis representing the active-passive response, with the center signifying a completely neutral response. This would then allow for aggregate data to be collected, and average responses calculated and displayed. These averages would be dynamic, as each new response would be calculated into the totals. Website visitors could then search for artworks generally thought to elicit a particular emotional response by selecting a specific quadrant of the emotional axes as a search parameter (Figure 5).

Figure 5. Example of a two- and multi-dimensional emotion plots for artwork description and collection navigation

In the multi-dimensional plot proposal (also inspired by Scherer, 2005), the visitors would select one of the 100 emotion terms mapped within an eight-dimensional circle and later use the same "circle" to view item-level description and browse the collection (Figure 5).

One proposal suggested collecting emotion metadata from the virtual visitors in a free-text form, without forcing them to use any classification scheme to describe the artwork. This proposal is grounded in a cognitive approach where emotion descriptors can be both continuous and discrete. The pros and cons of free-form tagging will be discussed in the next section.

All ideas expressed in the proposals for developing artwork emotion descriptions and corresponding collection navigation features have their strengths and weaknesses. For example, the use of the discrete approach, and specifically, classification by basic emotions, offers a clear and simple framework for describing artworks. It also has a potential for translating into "clean" and intuitive navigation features (Figures 1, 4, 7). However, within this framework, the limited number or quality of emotion labels may be too general or inadequate for describing complex emotional states associated with artworks, and may not provide sufficient variability to distinguish between artworks. The continuous approach addresses these limitations and offers richer options for describing complex emotional experiences. However, the use of this approach might be confusing or overwhelming for the average museum visitor.

3.2   Emotion Metadata Development and Display

The dominant idea in all ten proposals was the use of crowdsourcing, or eliciting descriptive tags from the users, for developing emotion metadata for the DMA image collection (Oomen & Aroyo, 2011). While most of the proposals focused exclusively on crowdsourcing, one student recommended initial emotion classification of artworks by curators who would use basic universal emotions classification schema. However, after presenting this initial classification on the website, tagging artwork would be open to "challenges" from the visitors, who would be able to re-classify the work and provide a supporting narrative for the proposed change (Figure 6).

Nine out of ten proposals were based on controlled crowdsourcing, an idea of providing visitors with classification schema and asking them to select the option that best describes his/her feelings associated with the artwork (Dron, 2007). Only one proposal suggested uncontrolled crowdsourcing i.e., allowing users to tag artworks with any natural language word or a phrase (Noruzi, 2007).

The option of crowdsourcing emotion metadata has two major advantages: it is inexpensive for an institution and engaging for visitors. The main disadvantage of an uncontrolled crowdsourcing is rendering potentially low-quality metadata (Guy & Tonkin, 2006)[1]. While controlled crowdsourcing or staff-generated descriptions ensures data quality and standardization, it limits metadata diversity, creativity,

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[1] In one of the proposals, this limitation was partially addressed by enabling unstructured crowdsourcing only to the DMA Friends who already have accounts to access the museum's collection and care about their reputation within the Friends program community.

engagement for visitors (McElfresh, 2008; Jensen, 2010), and presents increasing challenges for institutions with large collections. Considering the pros and cons of various approaches for creating emotion descriptions for artworks, we would advise choosing a solution that advances the institution's strategic objectives: be it the quality of metadata and ease of retrieval, or the engagement of visitors with online content.
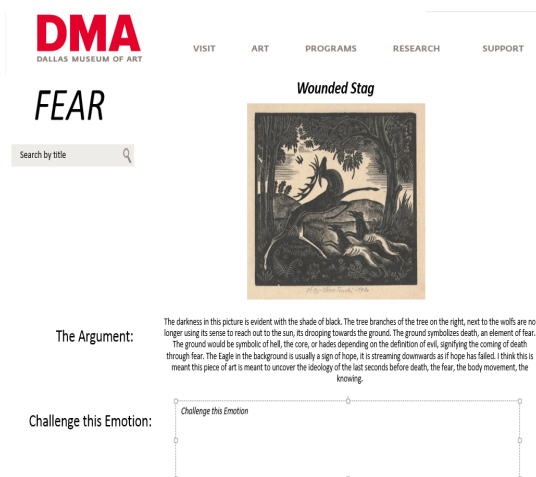

Figure 6. Example of a curator-generated artwork classification with an option of user-generated alternative description and rationale

All proposals suggested displaying emotion metadata as part of the item-level description. The proposals varied on particular designs for displaying emotion descriptors for individual artworks, including:

- a list (Figures 4)
- a pie chart (Figure 1)
- a wheel (Figure 1) (Woodward, 2014)
- a heat map (Figure 3)
- a tag cloud (Figure 5).

3.3   Navigation Functionality and Aesthetics

Student proposals outlined a diversity of options for developing collection access and navigation options based on emotion metadata. For example, emotion filters can be integrated with other filter options, including artist, medium, and date (Figure 7). Figure 8 illustrates how an "Explore" option can bring visitors to the artworks pre-sorted into emotion collections (e.g., a user would have an option to explore a collection of artworks expressing and/or eliciting fear). Figure 9 shows how a visitor upon entering the site can have an option of indicating his/her current emotional state and browse a sub-set of the collection that corresponds to that state.

In many instances, functionality and design of emotion navigation would replicate the design of an artwork tagging option. For example, if a drop down menu is available to tag the artwork using basic emotion labels, the same drop down menu would be available for browsing the collection or filtering the results (Figure 7).

Some of the themes in presenting emotion navigation features included simple drop down lists (Figure 7), expandable drop down list (Figure 4), colorful and monochrome emotion wheels with possible expandable options (Figure 2, inspired by Plutchik, 2001), heat maps and multi-dimensional spaces (Figure 5), tag clouds (Figure 3), and images of emotional expressions (Figure 3).

An analysis of the proposals for emotion-based navigation features emphasized several design considerations, including: 1) an importance of emotion navigation features to be consistent with the overall design and aesthetics of a website; 2) careful use of colors in presenting browsing options as these colors may detract from the artwork, conflict with the colors of the artworks, or be misinterpreted by visitors as the color represented in an artwork (Figure 1 represents emotion tags in color that can be confused with the color analysis of an artwork used by some museums (Cooper Hewitt Labs, 2013)); and

3) an importance of avoiding information overload in presenting possible emotion browsing features to the visitors.
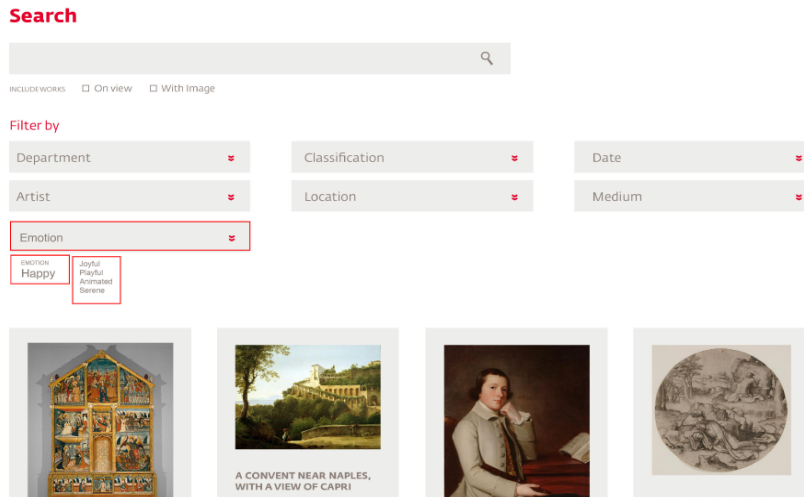

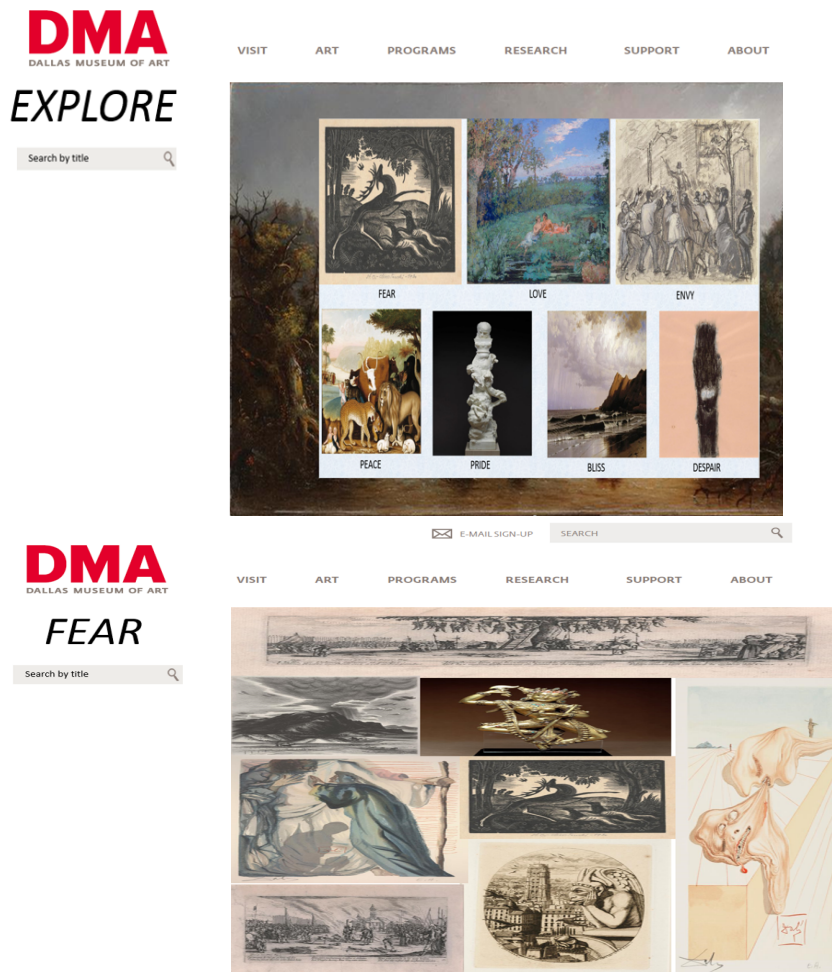Figure 7. Example of emotion filter integrated with other search options

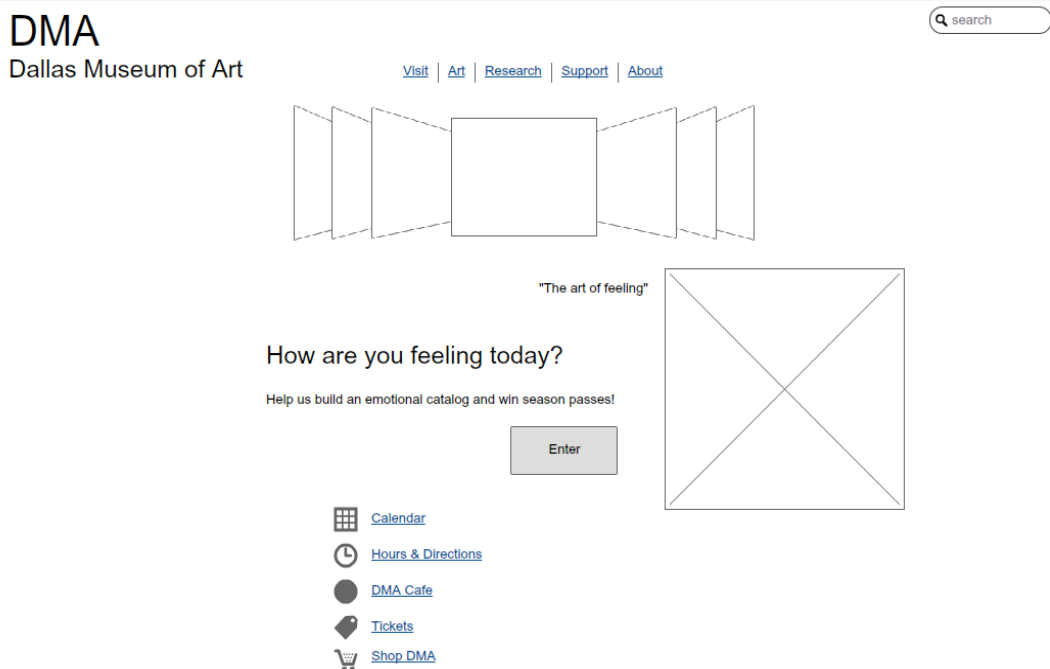Figure 8. Example of Explore collection browsing option

Figure 9. Example of an interface that collects information on a user's emotion and offers corresponding collection browsing options.

4   Conclusion

As far as we know, there is currently only one online art collection that provides emotion metadata and access points to its collection – Tate Gallery (2014). There is a scarcity of working solutions for developing and using emotion metadata for images; this study attempted to generate ideas and propose solutions for developing emotion descriptors and navigation options for digital art collections. Most of the proposed solutions were informed by the current practices in information retrieval (e.g., crowdsourcing metadata, tagging, sharing selfies) and interdisciplinary methods for collecting emotion data (Plutchik, 2001; Morris et al., 2010). Though the proposed solutions for integrating emotion features into online collections are not exhaustive, they follow the solutions proposed in previous research (Hollink et al., 2004; Choi & Hseih-Lee, 2010; Neal, 2010; Chen et al., 2010) and highlight some of the design choices for developing user-generated or authoritative metadata, and simple or complex emotion coding schemas and navigation features. Future work will explore additional methods for developing emotion metadata, including subcontracting description services to companies like Tagasauris (http://www.tagasauris.com) or generating it from analysis of artwork properties, such as colors and subject matter (Erdos, 2001; Gombrich, 1982; Kemp & Cupchik, 2007). Future work will also focus on development and testing of the several working prototypes based on the ideas expressed in the reviewed proposals and prior research.

We feel that experimentation with innovative emotion retrieval features offers multiple benefits for various communities. For the museum community, the use of emotion features in digital collections could attract new patrons and engage existing museum patrons at a new level. For a broader information retrieval community, emotion can offer a richer object description, access and user experience.

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