

Cross-sensory Photographs for Accessible Art Experiences

by

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Abstract

In an era where digital technologies can transform traditional art experiences to create accessible interactions, art institutions remain ocularcentric in nature. This preferred, established approach to the visual sense creates a barrier for those who are blind or visually impaired, preventing access to social inclusion, cultural participation and learning, emotional regulation, well-being, as well as many other intrinsic and extrinsic benefits that art can provide. In the last decade, the trend of cross-sensory art has been implemented into galleries to answer the call for more accessible cultural art interactions and accessibility. Incorporating more than one sensory modality to convey information, cross-sensory art produces other equivalent sensory responses, allowing visitors to connect with the art not just through vision but also through touch, sound, or scent. While this cross-sensory art approach has been applied to many forms of traditional art such as sculpture and paintings, it has been applied only rarely to the photographic medium. This MRP's investigation covered photographic discourse, cross-sensory technology, participatory practices, and the neuroscience behind cross-sensory perception to explore the possibilities for an expanded sensorium in photography. The aim of this research is to provide photographers, artists, and cultural institutions with the knowledge to create and include multi-sensory and accessible photographic experiences into their works and exhibitions.

I am dedicating this work to my smallest cheerleaders, Charlotte and Max. May you use your talents to make a difference in this world, believe in yourself, and know that you can achieve and conquer any challenges along the way. For my family, friends, and colleagues who have been a constant source of support along the way, and through the process of completing this degree. Thank you to my advisors Jim Drobnick and Michelle-Wyndham West (OCAD University) for their incredible encouragement and support in my vision for cross-sensory photographic experiences and their purpose. Much gratitude is extended to Peter Coppin, who assisted with the initial development and exploration of this MRP. Finally, I dedicate this to those who are not included or are left unrecognized in Canada's cultural art spaces due to disability: may this work be a small contribution in achieving equal inclusion and access!

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Introduction

Current approaches to photographic displays in art institutions limit access and create barriers for marginalized audiences. These barriers stem from the prioritization of ocularcentric art experiences, a bias of ranking vision over the other human senses. The issue of the ocularcentric barrier holds a relevant connection in disability and visual culture conversations. Those who live with blindness or visual impairment are excluded, affecting their ability to access culturally relevant, social experiences in art galleries and exhibitions. Currently there are an estimated 500,000 Canadians identified across a wide spectrum of visual disability (CNIB, 2021), where predictable and inaccessible experiences await those living with visual challenges or those who may have other sensory, mobility, or other cognitive abilities.

Art experiences should remove barriers for those with disabilities and who also wish to access the intrinsic and extrinsic affordances that art and cultural participation provide, positively influencing emotional well-being, physical health and immune systems, as well as learning and memory (Bazalgette, 2014). These intrinsic values enrich individual lives, however they also have a public ‘spillover component’ (McCarthy, Ondaatjem, Zakaras, & Brooks, 2005) in which social bonds are created among individuals extrinsically. The sharing of extrinsic art experiences through reflection and discourse reveals common values and develop community identity through artworks, creating significance for a nation or in an individual’s experience (p.14). As a vessel to facilitate critical reflection, art engagements have the ability to facilitate an empowerment of voice within a socio-political art community. However, when these engagements remain ocularcentric, the ability for visually impaired individuals to participate and develop these values are blocked.

In the last decade, a small number of galleries have discovered how to create accessible experiences through the adoption of cross-sensory art translations and design practices. Cross-sensory (or multisensory) art utilizes more than one sensory modality to convey information, where the cross-sensory signals produce responses in the receiver *equivalent* to the response in each uni-sensory component (Howes, 2015, p.1). These exhibits focus on the materiality of a single object and help visitors connect with the sensory properties of historic artifacts, their context, and the stories behind them (Levant & Pascual-Leone, 2014). Rather than limit the interaction between the visitor and the artwork through visual bias, the cross-sensory translations activate other senses through the visual, auditory, olfactory, tactile and spatial characteristics of a visitor's experience. These developments in cross-sensory art representation have inspired cultural institutions to begin to recognize the need to make collections accessible to a variety of visitors. If barriers can be broken down through cross-sensory translations, it will include, rather than exclude, current under-represented populations (Levant & Pascual-Leone, 2014).

The methods, materials, and tools used in creating cross-sensory translations are unique to the art that is to be translated, as well as the designer's experience and preferences. For example, at the Modern Museum of Art in New York City, Braille gallery maps are available along with audio tours and descriptions, as well as touch tours that can be catered to a wide variety of abilities and group needs. At the Art Gallery of Ontario in Toronto, Canada, multisensory tours are offered to individuals with low or impaired vision (2020). Visitors are invited to explore, touch, hear and smell their way through the art space and to interact with popular paintings. In my initial environmental scan, I noticed there was a wide range of artistic mediums and materials used to create cross-sensory art, from technology to clay. For example, artist Thomas Evans connects music and fine arts through traditional methods and technology, and the

tools utilized to develop the work are not limited to any one medium (Evans, 2017). Using electric paint, sensors, and programming code, he creates works to change the way traditional art is experienced: users can touch a traditional painted canvas, while an associated sound is played with the touch. Another artist, Ezgi Ucar of the Metropolitan Museum of Art created a small, touch-sensitive replica of a small statue within the Arts of Africa, Oceania, and the Americas exhibit. The replica incorporated similar materials to the original statue, as well as essential oil to simulate the original scent of the object (Ucar, 2015). The sculpture was wired using Arduino tools in order to play a sound file upon touch, and to express and emphasize the power of the figure, to aid to the overall interaction and experience of the visitor. Other works discovered included tactile raised-relief paintings of historical war ships, and more recently a tactile and interactive replica of an 18th century painting that utilizes touch-to-audio interactivity (Bowring, 2013).

Up until now, the only cross-sensory *photographic* translations that have been found incorporate only the visual and auditory senses. The Anthropocene Project (Baichwal, De Pencier, & Burtynsky, 2018) combined cinematic art and photography with cutting edge technology. From an accessible, cross-sensory point-of-view, with the exception of the inclusion of audio, the interactive exhibit was primarily visual. Similarly, photographer Kirsty Mitchell's Wonderland exhibit combines photography enhanced with soundscapes in order to heighten the experience and reactions of the visitors to the work (Mitchell, 2019). While these exhibits are phrased as "immersive" and "multi-sensory", in order to experience the artwork, the exhibits primarily rely on the participant's visual sense, and only incorporates a secondary sense of sound to support the overall experience of the translation, failing to provide a sensory equivalent of the information. "True" cross-sensory photographic experiences have not been found, however an

extensive list of accessible cross-sensory translations of paintings, sculpture, and other historical artifacts. There are various reasons as to why the medium of photography holds limited representation as a cross-sensory feature within art institutions.

The senses have been dominated by vision for centuries, with the eye symbolizing knowledge and enlightenment (Lupton & Lipps, 2018). As previously noted, this ocularcentric attitude remains in Western culture art institutions, with visual observation of art forms taking precedence over other sensory stimulation. While some attempts are made at providing an experience to incorporate other senses, ocularcentricism is supported as the societal norm. This mindset contributes to the view that disability and access have become an after-thought in curatorial art spaces, with programs offered as a supplementary service or treatment for those living with blindness, rather than integrated as part of the everyday art experience. One could consider how the latest technologies would open an array of opportunity for sensorial combinations, however even these technologies still contribute to the ocularcentric nature of art. These technologies remain focused on providing an endless selection of visual stimulation, contributing to the preferred ocularcentric form.

Implementing cross-sensory photographs into cultural spaces is largely a matter of budget, with cultural funding from private and public institutions remaining discriminating and lucrative. In the past decade, billions have been spent worldwide on new cultural institutions (Weisen, 2012), however, financially overstretched accessibility agencies and smaller cultural organizations cannot fill financial gaps on their own. Government commitment towards funding creating a national perspective, vision and strategy for change is required (p. 5). Despite funding organizations such as the Trillium Foundation and the Ontario Arts Council, accessing funding to support cultural accessibility initiatives are incredibly competitive, especially for suburban

galleries. An interview with Kerri King, CEO of Station Gallery in Whitby, Ontario, vocalized some of these challenges, as a “small community-based gallery going up against other major players” (King & Thaler, 2019) for funding of accessible programs, staff, and even mobility access to the building just to meet the Accessibility for Ontarians with Disabilities Act. For more modest galleries, accessibility tours and the associated artifacts are not considered based on the operating budget, while larger, more prominent galleries may provide specific “touch tours” (Museum of Modern Art, 2018) due to a larger access of supporting funds.

The availability of education in neuroscience and knowledge of how to create the photographic cross-sensory translations is another challenge in providing availability. Multimedia artists, photographers, curators and educators need to be provided with open education in the process of creation and have access to a wide-variety of both technological and traditional materials in order to deliver ethically deliver accessible art.

There are also costs to access accessible photographic art; with some visits requiring a minimum of three weeks’ booking notice (Art Gallery of Ontario, 2018), and can be expensive for a group visiting – upwards to \$200 for a maximum group of twenty visitors (pp. 4). Not only is accessibility to the artworks themselves a barrier, but financial costs added into the already inaccessible tours can impact social inclusion.

The development of research objectives will assist in providing evidence of the necessity for the creation of cross-sensory photographs, as well as provide insight into the processes involved with their creation to support the call for accessible photographs within art spaces. Research objectives describe concisely what the research is trying to achieve (Editage Insights, 2019). They summarize the accomplishments a researcher wishes to achieve through the study. Therefore, I identified the objectives of this study to address the following research questions:

1. Why is the medium of photography generally missing as part of the cross-sensory art trend?
2. What possibilities exist for photographic objects to be cross-sensory?
3. What significance can cross-sensory photographs have for artists, audiences, and galleries?

This research aims to explore the background, possibilities, and benefits of creating cross-sensory representations, as well as determine the ability of cross-sensory photography in increasing social equity for individuals within art communities.

Literature Review

The photographic medium has experienced many trends since the genesis of the first heliographic image captured by Joseph Niépce in 1826. Niepce's original heliographic image set in motion a worldwide excitement for photography by artists, scientists, and enthusiasts for over 200 years. As scientific and technological processes for capturing an image were improved, the photographic image was manipulated into new forms. Some of these forms became worldwide trends in photography, pushing the image into new representations while supporting social equity for its audiences.

Louis Daguerre expanded upon Niepce's work to develop the daguerreotype image, a process that used a polished sheet of silver-plated copper, treated with iodine to make it light-sensitive, which was exposed (for several minutes or more) under a lens, then "fixed" using mercury vapor. Daguerre's discovery, purchased by the French government, was revealed to the public on August 19, 1839 (Lerner, 2014, p. 8), making the photograph an accessible and affordable artistic medium for Victorians, leading to the trends of the "family album" and classic

portraiture. Verplank (2017) identifies that sitters of portraits were captivated by the novelty of daguerreotypes, the possibility of having their portraits taken accurately, quickly, and most importantly, at a modest cost. Photographs were commissioned by those who could not afford other portraits (p.18), ultimately providing access and bringing a form of social equity to the rising middle classes as well as other marginalized groups.

Samantha Hill (2021) examines how daguerreotype images were a pivotal tool for self-empowerment and social equity for Black Americans. It served as a way to counteract racist caricatures that distorted facial features and mocked Black society (pp. 4). American abolitionist and social reformer Frederick Douglass once stated “What was once the special and exclusive luxury of the rich and great is now the privilege of all. The humblest servant girl may now possess a picture of herself such as the wealth of kings could not purchase fifty years ago” (pp. 3).

Photography as a tool for social empowerment continued to evolve with invention of the calotype process, invented by Henry Fox Talbot in 1840. The process provided the ability to reproduce images using paper instead of a copper plate, resulting in the reproduction of long lasting, photographic images. With new technology, comes new trends: the calotype process made way for photomontage, a collage constructed from paper photographs (Tate, n.d.).

Developed by Raoul Hausmann, photomontage is often used as a means of expressing political dissent, first used as a technique by the Dadaists in 1915 in their protests against the First World War (pp. 1). Arslan (2018) discusses in his study how Dadaist artist John Heartfield used photomontage as a political weapon against political oppositions, such as the Hitler regime in Germany (p. 2). Photomontage ignited “artist-activism” and artistic political voice at a time when the world was reeling from the brutality and loss of World War I and II.

Image variations and manipulations of the photograph continued to evolve along with the science and technology for creating images, with the first digital image created in 1957. Once the first digital commercial cameras became available and affordable, it set the scene for new forms and trends of the medium to emerge.

Most notably is the integration of a digital camera with a mobile phone, or, now more widely known as the “smartphone”. Alongside the internet and rise of social media platforms, the photography of “ordinary people” achieved visibility and popularity, challenging the way in which photography was framed and consumed (Rubinstein & Sluis, 2008, p.10). Rubinstein and Sluis’ study discusses how the smartphone provides a means of reporting from the perspective of the participant in an event, allowing for easy inclusion of the photographer not just in the image (p. 11) but in social participation as well. Photo-sharing and social networking sites, such as Instagram, now provide a platform for photographers to deliver their images to locations where millions can view them simultaneously (p.10). In a similar fashion to how the montage created the affordance of creating a voice for political issues, the photography of social media is an avenue for the “paradigm shifters” – a term coined in Allsop’s (2016) study, those who believe that social media is fundamentally changing political behaviour and challenging existing power structures in society (p. 2). Smartphone technology, such as the iPhone, also provides for social inclusion within the realm of photography for individuals of all abilities, due to the abundance of accessibility features and supporting applications. Visually impaired photographer Luis Pérez identifies how the accessibility features of Apple’s iPhone allows him to participate as a photographer, including the sharing of his work on the social media platform Flickr (Pérez, 2013, pp.5). Another visually impaired photographer notes how, like anyone else, blind and visually

impaired people want pictures to enjoy and share with family (*How Do Blind People Take Pictures of Things?*, 2016).

Other modern trends of the photographic medium include photogrammetry. Photogrammetry utilizes images to create 3D renderings, and has been applied in museum settings to create touchable, tactile versions of original museum objects for guests on museum tours (Sebar et al., 2020). Additionally, haptic technology also permits the 3D rendering of images, and has been applied within the fields of healthcare, the arts as well as within the sciences to represent scientific visual data (Fritz, Way & Barner, 1996). Each of these modern photographic technologies incorporate more than just the sense of vision in the photographic experience in order to create further understanding and participation in the photograph itself. Knowledge on the neuroscience behind cross-sensory interactions within the human system allows us to gain a better understanding of creating equivalency in sensory responses.

In order to prioritize and create an understanding of the world around us, our human senses expose elements through cross-sensory perception. Sensory information is relayed through certain structures of the central nervous system before it enters the cortex of the brain (Teichert & Bolz, 2018). Cross-sensory perception is the tendency for our brains to preferentially associate certain features or dimensions of stimuli across the senses (Spence & Deroy, 2012). Traditionally, the five classic senses of vision, hearing, touch, smell, and taste have been studied in isolation by psychological and neuroscientific researchers (Spence, 2018). However, in the last decade, numerous studies in cross-sensory interactions have been documented to show that even early sensory processing within a single sense is modulated by information in, and attention towards, the other senses (pp. 2). When taken in isolation, each modality signals stimulus location with respect to its own receptor surface only, for example, on the eye for vision

or on the skin for touch (Driver & Spence, 1998). In processing spatial depth, a single modality alone cannot provide a reliable representation of external space, but instead requires the composition of information from multiple sensory modalities, so that current posture is taken into consideration, as well as the location of stimuli on receptor surfaces (p. 1).

This knowledge of cross-sensory perception has been applied to a variety of domains, including art galleries. Cross-sensory art is a small but steadily growing trend within the arts, providing artists and their participants with opportunities to consider the different ways in which viewers can interact with and experience art, while establishing social and cultural inclusion for a wide variety of individuals, especially those with disabilities.

In 2001, UNESCO recognized that cultural rights are an essential component of human development, representing a source of identity, innovation and creativity for the individual and the community, and is an important factor in social inclusion. Artist Olafur Eliasson (2016) frames the relation of art, social inclusion, and global connection by explaining that engaging with a good work of art can connect you to your senses, body, and mind (pp. 5). Artwork has the ability to be represented through the combined interactions of the visual, auditory, olfactory, tactile and spatial characteristics of a visitor's experience. For example, the role of touch within exhibits points to the social, cognitive, and even therapeutic value of handling objects (Pye, 2008). Additionally, the sense of touch connects a visitor to the object and its story (Candlin, 2017) while research on olfactory art experiences have revealed that scent can enhance the sense of the presence, but also stimulates the imagination of the future (Chu et. al, 2016).

Additional research has revealed that cross-sensory exhibits provide an exciting platform for visitors to learn more about the artwork being represented, benefitting not only young children but school-age and adult learners of all abilities (Levant & Pascual-Leone, 2014).

Developments in cross-sensory art representation have inspired art galleries to begin to recognize the need to embrace the trend and make collections accessible to a variety of visitors. If barriers can be broken down through cross-sensory exhibits, it will include, rather than exclude current under-represented populations (Levant & Pascual-Leone, 2014) while promoting creativity, expression, communication and sociality in the individual.

Since the creation of the original heliographic image, photographic trends have all explored and evoked new ideas, understanding, or perceptions of captured reality, with the image at the base of its construct. However, while some photographic trends such as photogrammetry and haptic photographs incorporate vision and tactile representations of images, current cross-sensory photographic experiences have not been found. Rather, literature for accessible, cross-sensory translations of paintings, sculpture, and other historical artifacts are extensive. Why has the photographic medium not been included in the trend of cross-sensory art translations? It is evident that there is scope and opportunity for further research and pursuit to advocate the trend of cross-sensory photography within art galleries in order to create social equity and inclusion for those with disabilities.

Methodology

By engaging the senses in cross-sensory photography, can artists and galleries increase social equity for individuals of all abilities? This research adopts both a transformative and pragmatic framework. As the overarching purpose of the study was to focus on the construction of knowledge to aid people and improve society, it corresponds to the narrative of a transformative framework. The transformative paradigm is one that allows researchers to consciously situate their work as a response to the inequities in society with a goal of enhancing social justice

(Mertens, 2010). As no one discipline covers aesthetics, disability, and the social inclusion of creating cross-sensory photography, incorporating both a transformative and pragmatic framework was necessary in order to answer the research questions. A pragmatic framework permitted the study to focus on the goals of achieving the outcomes of the research (Creswell, 2013, p. 28) and guide multiple methods of case study data collection to best answer the research questions. This is consistent with a pragmatic framework, as I required freedom to choose the best approaches for the methods, techniques, and procedures to best answer the research questions and meet the needs and purpose of the study.

The pragmatic paradigm influenced the adoption of both descriptive and multiple-case study methods in the approach. Descriptive case studies allow data to be collected from as many sources as are considered appropriate to provide in-depth information (Woods & Catanzaro, 1988). Case studies can stand alone or multiple case studies can be analyzed for similarities and differences (Yin, 1994). As there was limited literature available on cross-sensory photographic experiences, the case study data collection utilized a combination of unique case-study comparisons in order to capture a wide array of data within art gallery exhibitions and site visits, participatory design projects with the visually impaired community, as well as primary and secondary literature identified as relevant. Yin (1994) identifies that by using versatile, empirical material gathered in several different ways, it is possible to examine a specific event or action in a bounded environment. This combination of multiple sources of empirical material in a case study method is best understood as a strategy to add rigor, breadth, complexity, richness, and depth to the study (Flick, Kardorff, & Steinke, 2004).

Case studies were chosen as they related to exploring and answering the research questions. The case studies included looking to existing primary research in cross-sensory

representations and neuroscience, as well as my own work conducted with the visually impaired community. The goal was to capture information that would identify the significance and impact cross-sensory art held for visually impaired participants along with creation protocols and considerations. To guide my observations for the case studies, I developed an observational protocol which included the original research questions along with sub-questions to maintain a focus for the study (see below).

A protocol is a formal document that captures the set of procedures involved in the collection of empirical material. (Yin, 2009). In designing the protocol, the main objective of the study was to understand if social equity can be created through cross-sensory photography in art communities. Therefore, the overarching research questions were displayed first to guide the sub-questions. Sub-questions were developed for each category of case study in order to maintain data validity and comparison of relatable data. Figure 1, below identifies the case study category, the research questions associated with the category, and the sub-questions developed in each category to capture reliable and consistent data within each case study category.

Case Study Protocol

Research Questions
Q1 Why is the medium of photography generally missing as part of the cross-sensory art movement?
Q2 What possibilities exist for photographic objects to be cross-sensory?
Q3 What significance can cross-sensory photographs have for artists, audiences, and galleries?

Case Study Category	Guiding Research Questions	Case Study Sub-questions
Exhibitions & Site Visits	Q1, Q2	<ol style="list-style-type: none"> 1. Are cross-sensory art experiences offered? <ol style="list-style-type: none"> a. What days and times are they offered? b. Do they need to be booked? c. Are they led by a guide? d. Are they only for marginalized individuals? e. Is there a cost (if so, what?) 2. What medium is displayed in a cross-sensory format? 3. What technologies are used in the cross-sensory art experience? 4. Does the cross-sensory display meet AODA requirements and/or expectations in the RGD guide? 5. How many artifacts are available?
Projects	Q2, Q3	<ol style="list-style-type: none"> 1. What is the goal and purpose of the project? 2. What participants were involved? 3. Were the projects covered by REB? 4. What materials and technologies were used?

		<ol style="list-style-type: none"> 5. What feedback was provided by the participants? 6. What needed to be explored further in the project? Limitations? 7. What senses are touched upon in the project?
Primary and secondary literature	Q1, Q2, Q3	<ol style="list-style-type: none"> 1. What medium(s) are discussed in the literature? 2. What senses are addressed? 3. What materials and technologies were used? 4. What context is the cross-sensory discussed/offered? 5. Does the literature discuss/consider accessibility? 6. What feedback was provided by the participants? 7. What needed to be explored further in the project? Limitations?

Case Studies

The case studies in this research were used to explore the challenges, procedures, and impact of creating cross-sensory photographs, as well as an effort to further identify why photographs are missing from the trend of cross-sensory representations. Information was gathered from case studies in academic literature, as well as my own prototyping explorations in my courses,

approved by the OCAD University Research Ethics Board.¹ These multiple-case study sources were used to gather a wide variety of information related to the interests of this research.

Understanding how the human system processes and perceives the senses through cross-modal interactions, as well as the benefits of cross-sensory interactions, were of particular interest to explore. Specifically, can one sense perceive the same information as another sense? Can one sense assist another sense in the perception of the information or provide a comparable understanding? How might this be accomplished? Gaining insights first into cross-modal correspondences of the human body was hoped to be applied in the various prototypes.

Understanding Cross-sensory Correspondences and Perception

In order to prioritize and create an understanding of the world around us, our human senses expose elements through cross-sensory perception. Cross-modal correspondences have been defined as a tendency for a sensory feature, or attribute, in one modality, either physically present or merely imagined, to be matched (or associated) with a sensory feature in another sensory modality (Parise & Spence, 2012). Traditionally, the five classic senses of vision, hearing, touch, smell, and taste have been studied on their own in psychology and neuroscience. However, in the last decade, numerous studies in cross-modal interactions have been documented to show that even early sensory processing within a single sense is modulated by information in, and attention towards, the other senses (Driver & Noesselt, 2008, pp. 2).

Parise & Spence's (2012) work discusses previous findings on cross-sensory research with a focus on audio visual correlations, such as one of the first studies conducted that identified

¹ Work with human participants was covered by a class REB through OCAD University's Research Ethics Board, in Lab 2:Prototype Generation INCD-6012 and Inclusive Art, Design and Communication INCD-6007.

a direct mapping between the sound of a visual shape. Kohler (1929) provided participants with two nonsense words, *takete* and *baluna* and two outline drawings; a spiky and a rounded one. Participants were asked to match the words and drawings in the most natural way. Surprisingly, most observers matched the word *takete* with the spiky figure and the word *baluna* with the rounded shape. This exercise has been replicated with the same results over the years, regardless of culture. Following this original research in cross-modal correspondences, other studies have identified that the auditory pitch and the size of object presented visually or haptically are associated. Smaller objects are typically matched with higher pitched sounds and larger objects with lower pitched sounds (p. 2).

The work continues to discuss experimental techniques to measure congruency across cross-sensory correlations based on time. The most common technique is listed, which is based on measuring the reaction times (RT) of participants responding to stimuli on one sensory modality, while attempting to ignore other distractor stimuli presented in a different sensory modality. Any identified interference and responses with stimulus combinations leading to fast RTs are considered to be compatible, while those leading to longer RTs are considered to be incompatible. While this technique in measuring RTs of combined sensorial stimuli have provided important insights, Parise & Spence (2012) identify that there are limitations that comprise these results, namely, the results depend on the participants ability to report on their personal observations and are guided by their own selective attention (p. 3).

In order to rule out personal bias and selective attention in cross-sensory correspondences, the researchers attempted to measure the compatibility of senses using the implicit association test (IAT). In this test, participants respond as rapidly as possible to a series of stimuli – two auditory words, *mil* and *mal* and two visual cues, a small and large circle.

Participants used only two response keys, with two stimuli - one auditory and one visual over a block of trials. The participants were instructed to maintain their fixation on the shapes in the center of the screen and to respond to the stimuli as rapidly and accurately as possible, by pressing one of the two auditory keys on a computer keyboard, representing *mil* or *mal*. Other rounds of trials in the study involved changing the audio that was played by using auditory keys and the words *takete* and *maluma*; using two different frequencies instead of the words, or using a square wave vs. a sine wave (Parise & Spence, 2012, p. 5).

One particular block of trials demonstrated that congruent (compatible) correspondences were found between high pitch sounds and small circles and low pitch sounds with large circles, while incongruent (incompatible) correspondences were found between low pitch sounds and small circles and high pitch sounds and high circles (p. 9). Additionally, the reaction times of the incongruent correspondences were exceptionally slower than the congruent sensory correspondences.

These findings are of particular importance when applied to this research in creating cross-sensory photographs. For example, considering the creation of a photographic translation of the visual objects, items that look farther away in a photograph would therefore be smaller, and a cross-sensory representation would then require a high-pitched sound to be applied to the smaller photographic object in a cross-sensory representation. Limitations of Parise & Spence's (2012) discussed here include that the results do not consider multiple sounds being played at the same time matched to multiple visual cues. Also, when auditory and visual stimuli are jointly presented in time and location, any offset in their position may interfere with the congruency effects, such as an object presented off-screen while the corresponding audio is being played (p. 13). This suggests that time is an important factor in delivering sensorial cues to purposely relate

to one another and make an equivalent cross-sensory connection – another key aspect to consider when creating cross-sensory photographic translations.

Designing for People Living with Visual Impairment

Parise & Spence's (2012) research in cross-sensory correspondences provided an understanding on the cognitive processes and connections that occur between the senses. Their work revealed that time was shown to play a part in synthesizing sensorial information, and I was interested as to how this knowledge would relate to designing cross-sensory photographic translations for those who live with limited or no sight. Also, the research conducted by Metatla, Stockman, Ryan-Kinns, and Martin (2016) was also incredibly influential in exploring this inquiry. Their work focused on the creation of interactive tools that support collaboration between individuals in design, using different sets of modalities to interact with one another, specifically those who are visually impaired (p.5).

At the core of the study was incorporating a participatory design process for those who were blind or visually impaired. Participatory design, also falling under names such as “co-creation” or “co-design”, encompasses techniques useful to both initial discovery and subsequent ideation phases of a project, where the end-users of a product, service, or experience take an active role in co-designing solutions for themselves (Elizarova, O., Briselli, J., & Dowd, K., 2017, pp. 2). Individuals living with visual impairment should be included through the design process as they represent one of the main groups that would benefit from the final product. However, one of the main challenges when conducting a participatory design process for those with no or little sight is that tools are typically ocularcentric in nature. The researchers noted that sorting cards and paper prototypes are visual tools, cannot accommodate the needs of this

population of users, and therefore other more accessible tools should be adopted. Previous approaches to non-visual design tools are identified, including braille paper, pins and rubber bands, wikki-stix, lego models, cardboard mock-ups and plastic shapes (p. 3). Additionally, including appropriate levels of description verbally and the correct use of vocabulary that match the experience of visually-impaired people was noted to be of importance.

A few challenges exist even with such accessible prototyping materials listed above, including that Braille technology may exclude visually-impaired users who are not literate in Braille. Tactile models, such as cardboard mockups and plastic models, are their static in nature: once created, it is hard to change them in real-time, and physical mockups are only suitable to prototype haptic interaction and do not necessarily include auditory interaction (p. 3).

The research followed a series of workshops conducted (Metala, Bryan-Kinns, Stockman & Martin, 2015) with visually impaired participants working in the audio production industry. The workshops aimed to explore how to design accessible audio and haptic interfaces, translating the visual representations used to manipulate sound, namely waveforms (p. 4). Those in industry rely on screen-reader technology to access digital audio workstations (DAWs), which are industry standard for sound editing. However, modern DAWs interfaces are highly visual and incorporate a number of graphical representations of sound to support editing and mastering, such as waveform representations, which are entirely inaccessible to screen-readers (p.4). In order to understand how to make the DAW technology more accessible, Metala et. al (2016) attempted to incorporate an accessible means for designing auditory and haptic interactions by combining audio-haptic physical mock-ups with participatory prototyping and audio diaries (p. 3). Regarding the DAW software, participants explained that screen-reader scripts were by far

the most used accessible solutions, yet they remain inadequate when accessing waveform representations, applying sound effects, or navigating a large set of parameters space.

Foam paper, audio recorders, label tags and tag readers were used to create low-level auditory/haptic mock-ups, and two digital haptic devices were incorporated to explore what possibilities could exist in using the technology as a means of representing interface waveform data from the DAW (p. 5). Foam paper was available to be cut into various forms and shapes, and a sighted group member provided assistance in building any haptic structures. Self-adhesive tags were attached to pieces of foam paper, which could then be associated with an audio description that can be both recorded and read using electronic tag readers. Additionally, basic audio recorders were available to record up to 20 seconds of audio, and were provided to allow participants to record additional audio descriptions of their own physical mock-ups. Together, these mockups established physical low-semi-interactive audio-haptic translations of an interface display or a flow of interaction (p. 5). In another session, participants used sonification mapping that represented the peaks of a waveform to locate areas of interest within an audio track, allowing manipulation programmatically in real time to respond to the participants' feedback through the use of the haptic technology.

Multiple design iterations were approached through a participatory design format, with all participants engaging in the design process. The outcomes of the workshops included the ability for visually impaired users to construct digital prototype solutions that incorporated the ideas of all participants. The use of highly malleable non-visual digital prototypes in provided an effective medium for shared design activities and ideas (p. 11). An audio-haptic diagram editing tool was created in further stages, and basic prototypes for scanning and editing sound

waveforms were suggested for the DAW interface moving forward using the haptic technology to close the gap and provide real-time data.

A few insights from this study were considered for application within my own prototypes. The first was the understanding that incorporating a variety of cross-sensory interactions lead to create comparable interactive experiences, and the second was the approach of creating accessible tools to build a shared vocabulary for expressing non-visual design ideas. Additionally, incorporating technology to close the gap between cross-sensory correspondences and provide real-time sensory experiences between the visual and auditory information was deemed essential for my own future work.

Cross-Sensory Photographic Prototypes

Given the initial findings at the site visits discussed in the introduction, and the literature on cross-sensory perception and designing for those with visual impairment, my research explored the creation of two prototypes to answer the research questions. Can photographs be created a cross-sensory translations, and would they be accepted within formal art spaces? How would these cross-sensory photographs be received in a social setting? The first prototype aimed to look at the development of a cross-sensory photographic translation, and the second prototype looked at creating a cross-sensory photographic translation presented within an accessible art gallery presentation. Both prototypes were conducted in my course work at OCAD University, and were approved by the OCAD Research Ethics Board. The goal of the first prototype was to develop a cross-sensory photographic translation following participatory design methodology, influenced by the work of Metala et. al (2016). Participatory design is an approach where instead of designing *for* the end users of a product, we design *with* them. For the prototype, understanding

how a visually impaired user would solve the challenge of creating and using a cross-sensory photograph may lead to new insights about their experiences and how to ensure the final photographic translation is accessible for this group.

One visually impaired participant was invited for an afternoon to participate in the prototype creation of a photograph. The photograph chosen to be translated was Edward Burtynsky's (2016) "Elephant Tusk Burn". A variety of prototyping materials were sourced for the participant, including clay, a Penfriend with RFID stickers from the CNIB, and an ST-Board (space-time board).

The Pen Friend is a voice labelling system for blind and visually impaired users. Using RFID stickers, a user can create an audio recording in their own voice and connect that recording to a specific RFID sticker. When the Pen Friend is touched to the RFID sticker, the sound recording plays.

I developed the ST-Board to create a flexible method of communication and design between myself and the visually impaired participant, and to provide flexibility and adaptability in prototyping for the photographic translation. The ST-board was created to provide a blank canvas of being able to map objects based on the physical space of photographic objects as well as where the items exist in time or location to the main subject. Using a wooden canvas and dowels, dowels were placed on the board to represent a tactile representation of both location and time. The center of the board was reserved as space to create other physical objects of the main subject of the photograph. Other photographic objects are mapped around the center.

A background story with the context of the photograph was read to the participant. The participant asked many questions along the way to understand the context of the photograph as well as what physical properties existed in the photograph. I aimed to answer the participant's

questions in as much detail as possible – for example, describing what type of mud was on the ground. From there, the participant set out to create the physical properties of the main subject of the photograph on the ST-Board using clay. For other non-tactile materials that could not be created with clay, the Penfriend and RFID stickers were used to record an auditory description of an item in the photographic translation. For example, at the location where smoke is present in the photograph, the participant felt it was important to include the auditory description “smell of smoke”. Other descriptive words were also recorded and added to the translation in auditory format, such as “squelch of mud”. Each RFID sticker was placed on a 1-inch wooden cube, to promote tactile consistency and signal to visually impaired users that an auditory object exists at that particular location and in time.

Discussions with the participant in improving the prototype including the participant suggesting a more polished, art gallery display. Another suggestion was to investigate types of scents and how people relate to them – along with the auditory description of “smell of smoke”, the participant felt that using a smoky-smelling oil at that identified location would add to the experience. Additionally, the participant felt that a more structurally sound and polished look and feel – accomplished by 3D printing – should be applied to the stacked elephant tusks, in the same manner as the participant had placed them with clay. The participant noted how important it was hearing a verbally descriptive background story of the photograph. She suggested that the story could be provided as a separate auditory RFID touch point to assist the user in understanding the context of the translation. Finally, improvement in how the participatory design sessions are conducted will assist in planning further iterations and capturing of data. For example, having more participants will assist in capturing a wider range of perceptions and possibilities for the cross-sensory translation. I felt that the use of the ST-board in creating a photographic translation

was a successful communication and physical tool, will continue to be used in future participatory design sessions.

This prototype provided a greater overview of the participant's perception of the photographic content and the ways in which the participant believed different senses could be incorporated to tell the photographic story. Throughout the prototyping session, it was important to the participant to ensure the photographic translation was created as realistically close to the photograph as possible – the participant noted that they felt it was important to maintain the integrity of the photographic content, ensuring this by asking details about the type of mud, where and how high the smoke was rising, or the way the elephant tusks were stacked. I felt of particular importance was the emotional connection the participant had to the story and prototype creation, noting how she “had no idea” that the event burning of the elephant tusks had occurred in the news and was emotional. Towards the end of the prototyping session, she shared how much she enjoyed being a part of the session, working with her hands, participating, and expressed how she hoped to do it again and invite other visually impaired colleagues who would also find value in the process.

The goal of the second prototype was to also develop a cross-sensory photographic translation, however, the second prototype iteration involved considering the entire experience as an accessible art gallery display. The photograph chosen to be translated for the second prototype was my own personal photograph, one depicting the creep of urban sprawl towards protected conservation forest spaces in the endangered Carolinian environment.

Due to time constraints in completing the prototype, it was not possible to follow a participatory design process and recruit participants as in the first prototype. The prototype for this exhibit was developed in both a 2D and 3D format to provide multiple planes, depths, and

textures similar to the photo. A variety of prototyping materials were used, including the previously used Pen Friend and RFID stickers for auditory labels, wooden cubes for the RFID audio recordings, and as recommended by the participant in the first prototype, a background story was incorporated and accessible through the Pen Friend technology. New materials included this prototype included a focus on textures: wood for modelled houses, leaves for trees, spray concrete for building bases, as well as sand and rocks to represent gravel on a building site to represent textures.

For the gallery exhibit, both extended and interpretive panels were printed to provide the purpose, background, and contextual information about the translation. This was printed in black and white to provide high contrast for visually impaired visitors. The same information was also provided in braille and recorded audio to cater to multiple learning intelligences and abilities. All items were placed on the wall at a lower height in order to provide easy access for those of all abilities and encourage touch in exploration and participation.

Observational notes were taken while users experienced the prototype and the accessible display. Both sighted and visually impaired users interacted with the translation and were eager to provide feedback. There was confusion as to where to start first: for visually impaired visitors, it was noted and suggested that visitors start at the panels first that provide the context and background and include a description of how to explore the artwork – for example, explain there is permission to touch the display, how and how to use the Penfriend. Essentially, a brief how-to guide and wayfinding within the exhibit itself. One visually impaired participant recommended to increase depth between the planes to make more of a distinction, while another visually impaired individual suggested including ground, something for the planes to sit on, instead of just the feeling of the 3D items hovering. Finally, another blind visitor suggested shorter audio

clips as well as a smaller scale of the translation, making it easier to explore. Overall, the feedback from both sighted and non-sighted visitors well received, such as acknowledgment for the creativity placed into the work, and commentary on how the cross-sensory photographic art experience is a welcome and necessary addition with art galleries.

Conclusion

This MRP has explored what possibilities exist for cross-sensory photographs in both their creation and social contribution to accessibility in the arts community. Throughout the initial environmental scan and literature search for this study, it was discovered that the medium of photography held limited representation in cross-sensory displays within art institutions and installations. Research for past and current exhibits featuring accessible, cross-sensory photographic experiences were not found, despite there being an extensive list of accessible cross-sensory translations of paintings, sculpture, and other historical artifacts existed. This research discovered that cross-sensory photography can create a significant impact in social inclusion for artists, audiences, and galleries, and the possibilities of creating and establishing cross-sensory photographs as normative features in public art experiences would be widely received.

Findings: Emergent Themes

Influenced by the case studies, the prototypes revealed that cross-sensory photographic objects are possible, as long as the “rules” of time and space are followed in order to create the cross-sensory correspondence. Utilizing an understanding from literature and my own prototypes of how cross-sensory interactions occur answers the possibility of developing cross-sensory

photographic objects. Throughout the case studies, the emergent themes of *time and spatial location* were revealed as major factors to consider in creating a comparable cross-sensory experience of objects. For example, based on the work of Parise & Spence (2012) it is suggested that when considering the creation of a photographic translation of the visual objects, items that look farther away in a photograph should be created smaller in both vision and touch and also require a high-pitched sound be applied to the smaller object. Also, when auditory and visual stimuli are jointly presented in time and location, any offset in their position may interfere with the congruency effects, such as an object presented off-screen while the corresponding audio is being played of (Parise & Spence, 2012, p. 13). These same themes were also noted in the case study of Metatla, Stockman, Ryan-Kinns, and Martin (2016), where haptic technology replaced the highly malleable tactile prototypes to provide real-time congruency of sensorial information when mapping audio waveforms and other data.

In the first prototype, while I created an ST-Board to enable a flexible method of communication between myself and the visually impaired participant, it was revealed as a useful tool for the participant to indicate where (space) and when (time) she felt the photographic objects should be placed. For example, the auditory RFID sticker “squelch of mud” was placed at the *bottom* and *further away* from the main photographic object, meaning this object happened before and/or after the main subject of the elephant tusks, and not at the same time. The second prototype revealed the same themes: the suggestion of one visually impaired participant recommended to increase depth between the planes to make more of a distinction in the photographic objects of “what comes first”, while another visually impaired individual suggested including “ground” between the planes, something for the photographic objects to “sit on”, instead of just the feeling of the 3D items hovering. This suggests the hovering planes created

confusion for the participants about the spatial location and the order the photographic objects were presented in time.

Findings: The Importance of Participatory Design

Participatory design sessions should be at the core in creating cross-sensory photographs for marginalized groups. In my personal work, developing the second prototype without following the participatory design process was equivalent to “designing blindly” – the prototype would have avoided some of the issues identified by the participants had they been involved in the design process. This was also identified as key in work by Metala et. al (2016). As found in the first prototype, working with those who the research ultimately aims to serve provides value and integrity to the photographic translations. Going forward, I intend to only use the participatory design method during the creation of cross-sensory photographic translations.

Implications for Accessibility

Traditionally, art museums have been a place where the majority of works provide visual content for visitors to consume (Levant & Pascual-Leone, 2014). The issue with this approach is that the visitor experience is pre-determined through visual encounter only, establishing predictable and inaccessible experiences for those who visit, while also under-representing a segment of the population with mobility, cognitive, or sensory abilities. Rather, art museums should be a place for exploration and discovery for all who visit, regardless of ability. The institution should provide accessible opportunities to enable visitors to create meaning through the cultural artwork and artifacts presented, develop community and engage in meaningful discussion, inspire

personal imagination (Metivier, 2016), and increase awareness on global issues and current and historical events.

In the last decade, some museums have discovered how to create these engaging and accessible experiences through cross-sensory art translations in exhibits. Rather than limit the interaction between the visitor and the artwork, institutions have started rethinking the multiple restrictions on the use of the senses in the museum and begun actively soliciting the senses instead (Levant & Pascual-Leone, 2014). Artwork has the ability to be represented through the combined interactions of the visual, auditory, olfactory, tactile and spatial characteristics of a visitor's experience. For example, the role of touch in museum exhibits points to the social, cognitive, and even therapeutic value of handling objects (HJ Chatterjee, Hannan, L., & Thomson, L., 2016). Candlin (2017) also identified that the sense of touch connects a visitor to the object and its story.

Additional research has revealed that cross-sensory exhibits provide an exciting platform for visitors to learn more about the artwork being represented, benefitting not only young children but school-age and adult learners as well of all abilities (Levant & Pascual-Leone, 2014). These developments in cross-sensory art representation have inspired art galleries and museums to begin to recognize the need to make collections accessible to a variety of visitors. If barriers can be broken down through cross-sensory exhibits, it will include, rather than exclude current under-represented populations (Levant & Pascual-Leone, 2014) while promoting creativity, expression, communication and sociality in the individual.

In 2005, the Ontario Government passed the Accessibility for Ontarians with Disabilities Act (AODA) in 2005. The goal of AODA is to make Ontario accessible for people with disabilities by 2025. With the act is a province-wide mandatory accessibility standard that all

businesses and organizations in Ontario will have to follow to identify, remove and prevent barriers to accessibility in all areas of daily life (Ontario Arts Council, 2014), including those barriers in arts and culture. The Ontario Arts Council (OAC) committed to goals to achieve accessibility according to any standard that is implemented under AODA. These goals promote accessibility in a variety of formats including large print, recorded audio and electronic formats; braille, accommodations for inclusive participation, communication supports including captioning and sign language, electronic or digital format that facilitates conversion into an accessible format; and includes data, facts and knowledge that exists in any format, including text, audio, digital or images, and that convey meaning (Ontario Arts Council, 2014, p. 4). These goals are in line with the goals of this research and have been met through the initial prototypes, and answers the research question on the social significance of cross-sensory photographs in arts culture.

Implications for the Arts & Social Equity

The Canadian government held a roundtable discussion in October 2020, to document key takeaways surrounding accessibility and the participation of people with disabilities in arts, culture and sport. An issue addressed was that cultural institutions and sport facilities are not consistently physically accessible, limiting the ability of artists and athletes with disabilities to use and access them, in turn exacerbating mental health issues associated with severe isolation for artists with disabilities (Heritage Canada, 2020). Measures are currently being taken to sustainably fund and universally design facilities to remove these barriers and prevent social isolation.

The value of social inclusion and global connection was seen in the first prototype. The participant was eager and connected in completing the work surrounding a global environmental issue, and through the photograph learned about an unknown topic. Both myself and the participant were both able to share together and connect in the experience of creating a cross-sensory photograph.

Implications for Artist Training and Education

Accessibility has not been adopted by Ontario's photography industry as an essential criterion in practice for commercial or artistic photographers, nor is it part of the curriculum requirements in post-secondary programs. Current legislation is not enough to ensure the creation of accessible photographs is taught or practiced in these programs. The Harvard Law Review identified this as a major issue long ago, in 1984: "No longer can we "hide behind empty legal formulas that only defer the commitments that honesty compels us to make" (p.12). As the Ontario government enforces formal standards of accessibility in information and communications, there is an urgent need to provide Ontario's creative sector with the information, guidelines, education and tools required to make accessibility a key measure of success for every project (RGD, 2010). In order to create positive, lasting, rooted changes, educating future photographers to design for a wide range of accessibility should be accomplished at the outset – making it the norm, part of the process, rather than the exception. This includes addressing the content that is taught at the post-secondary education level in Ontario for photography programs.

Education on creating cross-sensory photographs for photographers, both new or established, currently does not formally exist. Post-secondary education in Ontario focuses on developing sound technical skills as well as creative skills as an essential aspect to producing

professional images. What is missing from the photography curriculum is education on how professionalism for new graduates also means meeting Ontario's AODA standards for businesses, and how to go about meeting accessibility guidelines. Post-secondary graduates entering a career in photography may be requested to create for accessibility at some point, whether for their own client base or for an art institution. Are graduates prepared to meet legislation for accessibility through in their photographic work? Are students educated on creating an accessible gallery space to showcase their photography? Photography is a technology-based career, from the build of DSLR cameras to the online presence of an artist or commercial photographic business. Without disability awareness and accessibility skills in their professional toolkit, students entering the technology industry are not prepared to produce quality products and services that everyone can use (Teach Access, 2019). This research can provide an initial guide for all photographers on how to create accessible photographs using the propositions for cross-sensory photographic objects offered in this work.

Missing Medium of Cross-sensory Photographs

A cumulating rationale exists for the reason why photographs have been missing in representation, spreading across the study from the initial environmental scan, literature, and my own personal prototypes. A few of these are:

- Further research on cross-modal correspondences is needed in an easy-to-understand language for a variety of readers;
- Cultural institutions often do not have the budget or personnel to implement cross-sensory translations and experiences;

- Education in post-secondary photography programs for new photographers, as well access to cross-sensory education and AODA for existing photographers;
- Advocacy for accessible art experiences from a wide range of groups within the arts community to provide a voice for those under-represented.

It is with hope this research and future work in cross-sensory photography fills the gap of information missing from the academic world on accessible photographic art experiences.

Conclusion

In the initial environmental scan and literature review, it was identified that cross-sensory photographs were missing in representation in literature and as a gallery experience. This study contributes to the literature on cross-sensory art by focusing on the possibility of creating cross-sensory photographs as well as their contribution to arts communities. This research has explored the possibility and significance of creating cross-sensory photographs. Various forms of literature and my own prototypes addressed the challenges associated with creating these cross-sensory photographs, as well as identified some of the reasons why photographs have been missing from the cross-sensory art trend. Through the prototypes, it was identified that photographs possess the ability for creation when the rules of space and time cross-modal correspondences are taken into consideration, and through participatory design methods can increase social equity within art communities for individuals of all abilities. Regardless of AODA legislation mandating accessible avenues and experiences in arts and culture, as a society it is time to approach the medium of photography in new ways. While there is still much to learn, this MRP suggests that cross-sensory photographs can hold representation in art institutions by utilizing technology, seeking out further understanding of the neuroscience behind cross-sensory

correspondences, educating and encouraging both new and existing photographers, and above all, advocating for those who are marginalized within our cultural institutions.

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