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Exploring Children's 'Indexical Encounter' with Real and Digitised Archive Photographs Using Tablet and Large Flat Screen Technologies

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ABSTRACT

Archive photographs are used widely in heritage education, but the photographic experience and our understanding of it, is poorer than it could be. This is primarily because the learning often fails to harness a photograph's tangible indexical link with the past, but also because the instability of photographic meaning requires that we assign explicit labels for historic purposes, without always being fully cognisant of the impact. Research has shown that manipulating defined realness does affect adults emotional and cognitive responses to photographs, but no similar studies have been undertaken to date with children. Pragmatics of re-creating the experience of looking at actual archive photographs remains a significant barrier, but the uptake of small, mobile tablet devices offers new opportunities to investigate what we have described here as children's indexical encounter with photographs. In this study children were shown matched pairs of natural and staged archive images, across three viewing conditions, (i) as real archive photographs and as (ii) digitised images on tablet and (iii) large flat screen devices. Children's emotional responses to natural archive images was significantly stronger when these were viewed as real archive photographs, but cognitive responses to natural photographs were significantly greater when these were viewed on tablets. Results are discussed with reference to the indexical experience and how an understanding of photographic properties can help tailor better visual learning experiences for children both in a heritage education context and in other disciplines.

Categories and Subject Descriptors

H.5.2 [User Interfaces]: user-centred design;

I.4.0 [General] image displays.

General Terms

Design, Human Factors.

Keywords

Heritage, digital archive, emotion, cognition, photograph, indexicality, tablet technology, touch-screen.

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1. INTRODUCTION

A key aim in heritage education is to enable children to appreciate and empathise with people who lived in the past. Yet all too often history classrooms can be "very sterile" because the learning experiences are a poor match for, "...talking to, doing, touching, [and] participating in the past" [1]. The singular ability of an archive photograph to re-present the past in the classroom experience is well recognised. The use of historic photographs as primary sources, both reflect events and experiences, but also help learners engage with the more intangible aspects of history, like rights and duties [2]. Further, giving learners primary sources, including personal photographs, encourages them to "...act like historians" and "...promote civic engagement in the process of examination" [3].

Choices of these *affective* artefacts that can move and motivate, such as authentic archive photographs, help touch learners emotionally as well as cognitively [4]. However, the actual photographs given to children are often presented within poor quality print based reproductions and all too often photographs are used more like a welcoming break, than an opportunity to develop skills in reading pictures [5]. Technology innovations, particularly across mobile platforms are enabling more interactive exploration of cultural heritage [6] and opening up vast stores of archive images [7]. However, unless we recognise the singular qualities of archive photographs, any selection or deployment will be largely intuitive and mere volume and accessibility is unlikely to yield the true potential of the photographic archive. From the outset it is important to recognise that an appreciation of photographs and photography is a rapidly expanding academic discipline in its own right, driven inevitably by new digital photographic practices. Critical photographic theory uses its own particular methods and constructs to explore how we use and attribute meaning to the photographic image in social contexts. A key aim of this study has been to explore how some of this theory could be used to shed new light on the visual aspects of interaction design in learning contexts.

2. THE INDEXICAL ENCOUNTER

In critical photographic theory, the 'index' or indexicality, denotes the physical relationship between the actual subject and their representation in the image [8]. It is this indexical relationship which accounts for much of our reverence of old photographs. In her essay Sontag [9], the cultural theorist who has written extensively about photography, argues that photographs, "...do

not seem to be statements about the world so much as pieces of it, miniatures of reality that any can make or acquire". In the photograph, the object is made "present" to the addressee [10] because of a physical contiguity, the light rays reflected from the object *touch*ed the film, and it is this that created the image, not resemblance or iconicity.

An actual photograph is a flat, fragile, perishable and physically insubstantial object; this is easy to rationalise. However when we hold and view a photograph of a person, it can have an effect that is at odds with its physicality which has been attributed to our "...double consciousness" towards images, manifest in our emotional and rational response to them [11]. Understanding the fundamental impact of the photographic index, it is argued here, is central to recognising the value of the archive photograph and its deployment. Yet this special quality of the photograph is given scant attention, both in theory and practice in the design of heritage education learning interventions for children. Not least because the photograph is a technological innovation in itself which is changing over time and is, "...situated in the specific historic circumstances of [...] being made, used, reproduced and circulated [12], recognising the impact of digital technology on the photographic image. Attempts have and are being made to account theoretically for the sometimes irrational ways in which we respond to the photographic image [13,14][15]. However, the photograph and its indexical quality, or the visualisation of representations of reality and our response to it, is dynamic, evolving and adapting through new digital practices, and although this is hotly debated in critical photographic theory, it goes largely unheeded in interaction design disciplines.

One of the most important changes to how we access, view and respond to photographs has been the emergence of both mobile phones and tablet computers. These hand held technologies, with their tactile design and touch-screen properties have not only heralded new photographic practices because of the ways in which they make cameras readily accessible, but have also created new ways of viewing and touching photographs, the impact of which we are only just beginning to explore. Not surprisingly, these technologies have rapidly made inroads into heritage learning contexts because of their ability to bridge the gap between the classroom and the museum, but also because they open up the potential of the photographic archive.

3. TOUCH-SCREEN TECHNOLOGY

The assimilation of out of school curricular activities, including visits to heritage sites and museums with classroom learning can have a significant impact beyond the ability to improve learner content understanding and the development of cognitive skills [16]; new mobile technologies including the tablet device support this integration and foster this more blended alliance.

An important feature of this technology is how quickly children are able to engage with it, with children as young as 3 learning how to use tablet devices extremely quickly [17],[18]. For older children tablet technologies are increasingly being used to potentiate the impact of the museum visit to reinforce and extend learning, for example by coupling mini-game delivery with social networking [19]. Children's interaction with archival material through mobile phones and tablets enriches the learning experience by enabling them to manipulate information, to engage through a dialectic process and to take part in a social activity where children can, "...play with, think with and have fun in a purposeful manner" [20].

Furthermore, tablet technology and its ability to break down the barrier between physical and digital systems, for example between paper and a tablet computer, mean that children can engage in activities which bridge both, including the creation of their own digital content. For example tagging objects in the real world, and scanning them to create a corresponding digital artifact on a tablet computer [21].

As the use of tablet computers becomes more widespread, work is ongoing to investigate the impact of touch screen size and performance in the mobile environment. Preliminary data from a between-subjects experiment has shown that smaller screen-size elicited greater perceived mobility while larger screen size was a key to greater enjoyment [22]. Intuitively, the size of a tablet is one its most commendable design features. Unlike laptops, tablets are small and portable enough to be held like a clipboard and paper printout, are able to connect wirelessly to the Internet and have a multi-touch screen which significantly improves the interface interaction, "...promoting almost sub-conscious behaviour via 'lightweight' gestured techniques" [23]

The rapid uptake of tablet technology in schools and the phenomenal growth in apps that support learning are testament to its design prowess, but as yet there is not a well understood set of terminologies that accurately convey the new and unfamiliar touch-screen gestures required for interaction [24], or explain adequately how these support the learning process in complex multi-modal user experiences. Further, there are large gaps in our understanding of how children respond and interact with photographs delivered on these platforms, particularly with respect to differences between analogue and digital, which makes a further understanding of children's appreciation of photographs especially pertinent.

4. CHILDREN'S APPRECIATION OF PHOTOGRAPHS

In order to conduct studies which help us to investigate children's responses to photographs it is important first to consider how children acquire visual ability recognising that any investigation of visual ability or behaviour is operating across a continuum, but also to appreciate the ethical and practical constraints inherent in experimental studies involving children in this domain.

4.1 Progressive Development of Visual Ability

Studies into the development of visual object recognition in school-age children using a array of neurophysiological tests confirms progressive age dependent visual ability development for children of school age 6-11 [25]. Children's ability to interpret, appreciate and respond to photographs is likewise incremental. It has been demonstrated that there is a continuum across which children develop the ability to distinguish between photographs and their referents, where young children's tendency is to focus on object properties and older children's and adults attention progressively develop the ability to assimilate relational information as well [26]. Recognising that any individual approaches any given stimulus, such as a photograph, with a complex assortment of characteristics and personal history, Liben [27] highlights three particular domains of "viewer qualities" that appear to be relevant to interpreting photographs and that have been shown to undergo normative age-linked changes, namely representational development, spatial development and "other-mindedness" which included theory of mind.

4.2 Authenticity and Representation

Unlike photographs that children look at in the contemporary setting, the authenticity of an archive photograph is an adjunct to its indexical qualities. Studies looking at the development of an understanding of authenticity and how children, adolescents and young adults respond to authentic and non-authentic objects, suggested that both children and adults recognise the special nature of authentic objects by reporting that they belong in museums. Further, results demonstrated that for preschool as well as older children, history as a non-visible property adds meaning beyond the material or functional worth of an object [28]. Further, even with very young children, experiments show that there is a significant influence by the representational medium on fidelity judgements with six year old treating photographs as having greater fidelity to the reality they depict than is true for drawings, although both forms of representation are in general less compelling than real materials themselves [29].

4.3 Instability of Photographic Meaning

As photographic technology was invented and developed, its unprecedented ability to capture and represent reality meant that its uptake and influence on the social, political and cultural context was unprecedented. Indeed, towards the end of the nineteenth century photography became the, "...defining representational medium of its age" [30]. However, since its inception, the photograph has always been stalked by questions surrounding the truthfulness of photographic representation. This means that the nature of what a photograph represents or means is never a straightforward interpretation. Although a photograph may have been taken for a particular purpose, whether this is to highlight particular social conditions, or to record a child's school days, when photographs are used for historical purposes, in effect looking back – how the photograph is interpreted is inevitably different to that intended by those who created or commissioned it as Hudgins et al. point out, "...photographic meaning is always unstable, ever shifting as its physical and ideological agenda changes" [31]. In the context of the archive and historical interpretation, the recognition of the ambiguous nature of the photograph is inherent in practices associated with their use, but this instability of meaning means that the use of photographs in heritage education has to be undertaken with great care and sensitivity. This is because the same photography may be interpreted by different people in different ways, invoking quite different kinds of responses depending upon how a particular photograph is contextualised and or presented.

4.3.1 Reality versus Fiction

Just how people respond to the same photograph when it is given a different label has been the subject of investigations by Mendelson and Papacharissi [32]. In a large study that looked at the impact of defined realness upon viewers emotional and cognitive responses to photographs, groups of adult subjects (students) were given the same photograph but were told that the photograph was either taken in a real context or was fictional, that is, set up for a film shoot. Results demonstrated that when participants were told a photograph was real, their emotional response was stronger than that of subjects who were told that the photograph was fictional; but that when subjects were told the same photograph was fictional, their cognitive responses were greater, in other words they thought more about the photograph. Mendelson and Papacharissi attributed this difference in response to interpretative strategies called *attribution* and *communication*

inference respectively. They propose that their findings suggest that when subjects look at a real photograph, there is a strong emphatic response because they believe the image to be real – identifying naturally with the subjects in the image, but they take in the content of the representation and move on, thinking very little about what they've seen. They conclude that this is because the image is not communicative to subjects of any deeper significance. However, when subjects look at a photograph that has been labeled fictional, their emotional response is less because they think that the representation isn't of something real, but they believe that because the photograph content has been created, that there is a perceived and inherent intention to communicate. Subjects consequently try to infer meaning, seeking to determine what the communicator was trying to say.

These results demonstrate that giving different labels to the same photographs lead to different kinds of responses emotionally and cognitively. This raises some important research questions. Firstly, would similar experiments demonstrate similar effects with children, recognising the continuum of visual ability discussed above, and secondly does this artificial distinction between photographs for experimental purposes have anything to tell us about different kinds of photographs in the historic archive and their deployment in the context of innovative and technological approaches to heritage education.

4.3.2 Experimental Design and Children

Conducting similar experiments with children, within the context of heritage education, that is giving the same photograph to different groups of children and telling one group that a photograph is real, and the other that it is not, is fraught with ethical and pragmatic difficulties. First a heritage education experience for a class of children, is not the same as a psychology experiment, either in terms of numbers involved or the creation of a photographic manipulation that can be defended. Further, manipulating children's experiences with photographs has been shown to lead to the creation of false memories [33], [34], which is not acceptable in this context.

In terms of the reproducibility of effects between similar pairs of photographs, research has been undertaken which made comparisons between for example between natural and man-made photographs looking specifically at the aesthetic judgement of photographs, for contrast, sharpness and grain. Tinio et al. [35] conducted an experiment where subjects looked at 200 photographs of each type. They demonstrated among other things, that degradations in contrast affect judgements of photographs of human-made scenes more than those of natural scenes which contradicted previous findings that the effects of image degradations are similar across various image types [36], [37]. In this case, the explanation given was that natural scenes are more robust or tolerant to contrast degradations than human-made scenes because humans evolved in and are well adapted to natural environments [38].

In summary, the photographic experience in heritage education can be very poor. This is because photographs are often low quality reproductions but mainly because educators aren't fully aware of the indexical properties of photographic images, making intuitive choices and deploying them in ways that offer a much weak substitute than looking at real photographs. It is argued here that much more thought needs to be given to the '*indexical encounter*' and that the use of small, hand held tablet devices increasingly used successfully with small children and in heritage contexts, could provide both an interesting way forward and a mechanism for exploring children's acuity for the photographic

image. The tablet device, both ergonomically and in terms of user interaction, has handling and tactile qualities; can these be used to tap into and simulate aspects of the indexical encounter with an actual photograph? We know that visual abilities are incremental, so are children likely to respond to real and fictional photographs in the manner reported by Mendelson and Papacharissi [32] and what impact, if any, will technology have on these kinds of response?

5. RATIONALE AND HYPOTHESIS

The notion of the index and indexicality has to date been absent from discourse in HCI research on the user experience, yet the ability of a photograph to exert emotional and cognitive effects in particular is acknowledged and well documented, particularly in media and journalism contexts.

5.1 Rationale

This study adapts the protocol of the Mendelson and Papacharissi study [32] which manipulated a series of identical photographs to measure participants (adults) emotional and cognitive responses when the same images were labelled as either real or fictional. Here, a similar experimental condition has been achieved by removing the need experimentally to use one photograph labelled differently with different subject groups.

In this study the dimension of the real or fictional are operationalised into two distinct real world categories of the 'natural' or 'staged' photograph. This image categorisation is used to explore the indexical dimension. It looks at how children respond to real photographs, tangible objects with photographic surfaces that can be held between two fingers and touched, and their corresponding responses to digitised photographs on a tablet device and large flat screen computer. This study set out to investigate if differences existed between how children respond to natural and staged photographs when viewed in three separate viewing conditions namely (i) as real archive photographs and as (ii) digitised images on tablet and (iii) large flat screen devices.

5.2 Hypothesis

Based upon the findings of Mendelson and Papacharissi [32] into patterns of response to real and fictional photographs, the similarities both ergonomically and in terms of holding size and touch screen capability of tablet devices, and children's apparent ease of uptake of this technology, the following hypotheses will be tested in this study:

5.2.1 Emotional Effect

That children's emotional reactions to photographs taken in natural settings will be stronger than those to photographs which were staged.

5.2.2 Cognitive Effect

That photographs that were staged will encourage children to think more than photographs taken in natural settings.

5.2.3 Medium Effect

That children's emotional and cognitive reactions to natural and staged digitised photographs viewed on tablet technology, will be similar to the indexical experience of viewing real archive photographs, whether natural or staged. In addition that children's emotional and cognitive reactions to natural and staged photographs viewed on large flat screen technology will not

emulate the indexical experience of viewing real archive photographs, whether natural or staged.

6. METHODS

The study was undertaken in the context of a Victorian classroom at the Donnison School Museum. The Donnison School is a well preserved 18th Century school originally established to provide educational opportunities for the 'poor girls' of Sunderland (UK), Figure 1.



Figure 1. The Donnison School

The school is situated within the Sunderland Heritage Quarter, a regeneration project in the East End of the City of Sunderland and provides children across the city with an authentic experience of school in Victorian times. Thirty children aged 9-10yrs at Key Stage 2 took part in the study. All thirty children came from one local school, also situated within the regeneration area, and a short walking distance from the museum. The Donnison School also operates as the Regional Oral History Centre for Living History North East (LHNE) and has a large archive of over 25,000 historic photographs documenting the social and economic history of Sunderland and the North East region Figure 2.



Figure 2. Archive Photograph
©Living History North East

LHNE provides a wide range of community based activities to help make this archive accessible to people across the city; all the photographs used in this study were drawn from this collection.

6.1 History Detective Role Play Activity

In order to provide children with an appropriate learning context, the study was loosely embedded within a 'History Detective' role play activity and thirty children in total took part. To accommodate children and technology comfortably in the small Victorian classroom at Donnison, they were divided equally into two groups of fifteen and the study was conducted over two sessions, each lasting approximately two and half hours.

Each session commenced with a short visualisation activity to help children appreciate what life was like for school children in Victorian times and they were given a short introduction to the role play activity and the data recording instruments, full details of which are outlined below (Section 6.1.6).

Children worked in small groups of five to look at three different pairs of photographs across the three different viewing conditions; (i) as real archive photographs and as (ii) digitised images on tablet and (iii) large flat screen devices. Comfort breaks were specifically built into each session to ensure that children's viewing experience of photographs was staggered. During these comfort breaks children went out of the classroom into the Victorian kitchen garden at Donnison where they could play with authentic Victorian toys, giving them a complete change of activity during the different phases of the experimental study.

At the end of the study, and just before children returned to school, they were given a creative task which involved them developing a persona for one of the children they had seen depicted in the photographs they had examined.

The history detective role play thus provided a mixture of classroom based activities within which the experimental study could be embedded, staggering the study protocol between other classroom activities, with in-role comfort breaks to help children clear their thoughts between different phases and built-in opportunities to relax and have fun.

6.2 Natural and Staged Photographs

To undertake the study, three pairs of natural and staged archive photographs originally shot between 1900 and 1928 were selected from the LHNE digital archive. Natural photographs had been taken in a local context with subjects involved in everyday activities, often unaware that they were being photographed.

Staged photographs involved subjects posing for the camera in a formal studio or performance setting, aware that they were posing for a formal photograph. Each natural/staged pair were matched for the number of subjects in the image and all photographs had the patina of old black and white photographs, Figures 3a and 3b.

Matched pairs of photographs were examined by children across three viewing conditions, (i) as real archive photographs that could be handled (these were digital images sourced from the archive and printed to look and feel like old photographs); (ii) digitised images accessed via a tablet using touch-screen interaction; (iii) digitised images accessed via a large flat screen computer using a mouse.



Figure 3a and 3b. Natural and Staged Photo Pair
©Living History North East

6.3 Study Protocol

Children examined three pairs of archive images in turn across the three viewing conditions. Each matched pair was presented at three separate workstations designated A, B & C respectively, see Figure 4. Simulated real photographs were stored in white acid free paper in an archive box.

Children were instructed to retrieve the photographs from the archive box and wore white cotton gloves throughout. They were also each given a small magnifying glass and encouraged to look at the fine detail of the photograph. The digitised images on the tablet and large flat screen computer were stored in the Photos app and Desktop respectively and as they progressed from one workstation to the next, children were given a short demonstration of how to use each technology to view the pairs of photographs.

During the study, groups rotated from one table to the next, so that they saw consecutively the three pairs of photographs across the three formats being studied. In addition the order of viewing of natural and staged photographs was switched as children progressed from one workstation to the next, see Figure 4.

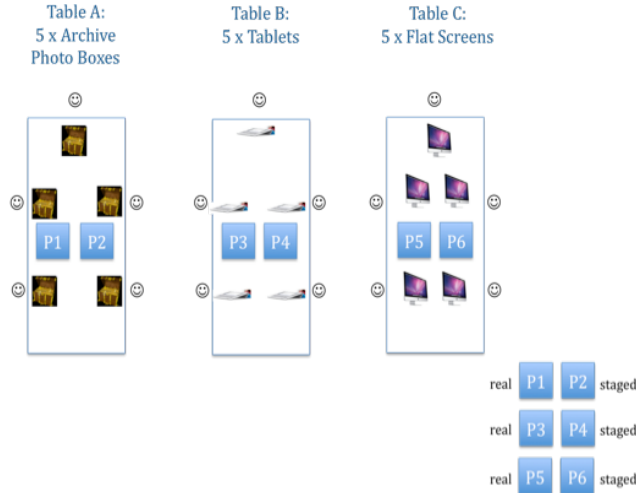


Figure 4. Classroom Organisation

6.3.1 Instruments

Two main instruments were used in the study, the first to measure children's emotional reactions to photographs and the second so that children could record what they were thinking about each image.

6.3.1.1 Emotional Effects

Children's emotional reactions to photographs were measured using a rating instrument called the self-assessment manikin (SAM), [39]. Here SAM, a series of graphic figures that range from smiling and happy to frowning and unhappy was adapted to record the hedonic valence dimension.

6.3.1.2 Cognitive Effects

To measure children's cognitive reactions to photographs a thought-listing technique was used [40], [41]. After looking at each photograph children were told to write down everything that they could think of about the photograph on an Ideas Record Sheet (IRS). Participants were instructed to write one idea on each line. The total number of words written and total items listed were used to measure and cross validate children's cognitive responses to photographs.

6.3.2 Instrument Completion

Children viewed each photograph of the pair in turn. They were encouraged to look at the first photograph for 2-3 min before completing the adapted SAM questionnaire (*Instrument 1*) followed by the IRS (*Instrument 2*). Children then repeated the process with the second photograph. Children were given time to exhaust their ideas in writing before they moved onto the next photograph. Viewing and completing *Instruments 1 & 2* took approximately 20 min.

Before children moved on to the next workstation and next set of photographs, they were given a short comfort break. For a full review of the research protocol, see Figure 5.

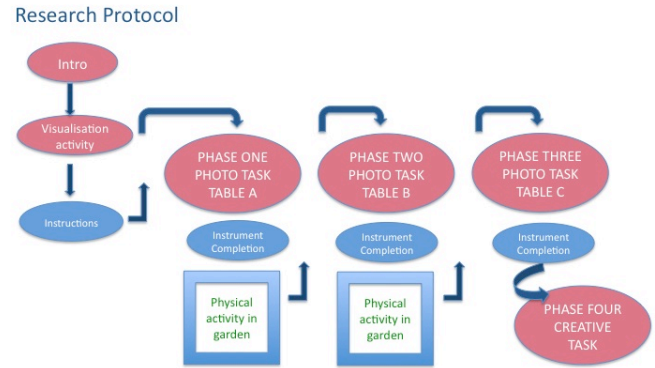


Figure 5. Research Protocol

7. RESULTS

Children's emotional and cognitive responses to natural and staged photographs using the adapted SAM and IRS are presented below.

7.1 Emotional Reactions

The adapted SAM was used to detect both the intensity and polarity of children's emotional reactions to natural and staged photographs.

7.1.1 Intensity of Emotional Response

The adapted SAM was used to detect the intensity of children's emotional reactions, whether positive or negative, to natural or staged photographs and concatenated results are presented in Tables 1 and 2 as the number of children exhibiting a response to the viewing condition.

Table 1. Intensity of Emotional Reactions to Natural and Staged Photographs Across Three Viewing Conditions

	Real Archive		Tablet		Flat Screen	
	1 Staged	2 Natural	3 Staged	4 Natural	5 Staged	6 Natural
0	15	5	13	5	10	6
1	10	13	10	11	10	15
2	5	12	7	14	10	9

To test children's emotional reactions across the three separate viewing conditions – real archive, tablet and flat screen, for differences in reaction to photograph type – natural or staged, the Chi Squared test was used. For the real archive viewing condition, natural photographs produced stronger emotional reactions than staged ($p=0.016$). With the tablet, natural photographs produced stronger emotions than staged but the result was borderline significant ($p=0.051$). With the large flat screen there was no significant difference in emotional response to the natural or staged photographs. Across the three separate viewing conditions, children's emotional reactions to natural and staged photographs were compared using the Wilcoxon Signed Rank

test, the non-parametric equivalent of the matched paired t-test where $p < 0.05$ is significant. The comparison of emotional response across the three viewing conditions for both natural and staged photographs was not significant.

7.1.2 Polarity of Emotional Response

The adapted SAM was also used to detect the polarity of children's emotional reactions, positive or negative, to natural or staged photographs and concatenated results are presented in Table 2 as the number of children exhibiting a response to the viewing condition.

Table 2. Positive or Negative Emotional Reactions to Natural and Staged Photographs Across Three Viewing Conditions

	Real Archive		Tablet		Flat Screen	
	1 Staged	2 Natural	3 Staged	4 Natural	5 Staged	6 Natural
+	5	8	7	19	8	14
0	15	5	13	5	10	6
-	10	17	10	6	12	10

Taking into account the polarity of children's emotional responses, positive or negative, for the archive viewing condition, natural photographs produced a significantly more positive response than staged ($p = 0.023$). Similarly with the tablet, natural photographs produced significantly more positive response than staged ($p = 0.0064$). However, for the large flat screen there was no significant difference between children's responses to natural or staged photographs.

Across the three separate viewing conditions, children's emotional reactions to natural and staged photographs were compared using the Wilcoxon Signed Rank test, the non-parametric equivalent of the matched paired t-test where $p < 0.05$ is significant. The comparison of emotional response across the three viewing conditions for both natural and staged photographs was not significant. Across the three separate viewing conditions, and taking into account the polarity of children's responses, children's emotional reactions to natural and staged photographs were compared using the Wilcoxon Signed Rank test. The comparison of emotional response across the three viewing conditions for natural photographs was significant ($p = 0.037$), but for staged photographs was not.

7.2 Cognitive Reactions

Children's cognitive reactions were recorded using *Instrument 2*, the Ideas Recording Sheet (IRS) which functioned as a thought recording technique. As children frequently recorded thoughts that ranged from single words to complete sentences, results are analysed here through both the total words recorded and individual thoughts recorded on each line of the instrument.

7.2.1 Thought Listing Technique – Words Recorded

Across the three separate viewing conditions – real archive, tablet and flat screen and photograph type – natural or staged, the most words were generated when children examined natural photographs either as real archive photographs or digitised images on a tablet and the least words were generated when children viewed the staged photograph on the tablet device; results are presented in Table 3 as the mean number of words generated and standard deviation.

Table 3. Words Generated to Natural and Staged Photographs Across The Three Viewing Conditions

Real Archive		Tablet		Flat Screen	
1 Staged	2 Natural	3 Staged	4 Natural	5 Staged	6 Natural
30.75	34.2	24.70	33.33	30.10	28.97
±	±	±	±	±	±
17.755	20.855	14.220	14.233	12.149	19.111

Across the three separate viewing conditions, children's cognitive reactions to natural and staged photographs was compared using the Wilcoxon Signed Rank test. With real archive photographs, the difference in response between natural and staged just fails to achieve significance ($p = 0.058$). With digitised photographs on a tablet however, the difference in response between natural and staged was significant ($p = 0.003$). With digitised photographs on a large flat screen, the difference in responses to natural and staged photographs was not significant.

A Friedman Test was used to compare first natural, then staged photographs across the three viewing conditions and there was no significant difference to children's cognitive reactions to natural photographs but this was significant for staged photographs ($p = 0.024$). For the staged photographs, post-hoc tests were carried out using the Wilcoxon Signed Rank test with the Bonferroni Correction. The comparisons for staged photographs viewed as real archive vs tablet and real archive vs large flat screen was not significant, however differences in cognitive responses to staged photographs viewed on the tablet and flat screen was borderline significant ($p = 0.017$). Given that the Bonferroni Correction is a strict test requiring significance at $0.05/3$, this result is an interesting one nonetheless.

7.2.2 Thought Listing Technique – Ideas Recorded

Examining the ideas count across the three separate viewing conditions – real archive, tablet and flat screen and photograph type – natural or staged, the most ideas were generated when children examined natural photographs either as real archive photographs or digitised images on a tablet although the differences were less marked than with the word count. Again the least words were generated when children viewed the staged photograph on the tablet device. However, more ideas were generated for the staged than the natural photograph when viewed on the large flat screen; results are presented in Table 4 as the mean number of ideas recorded and the standard deviation.

Table 4. Ideas Generated to Natural and Staged Photographs Across The Three Viewing Conditions

Real Archive		Tablet		Flat Screen	
1 Staged	2 Natural	3 Staged	4 Natural	5 Staged	6 Natural
7.00	7.07	5.53	6.83	7.43	6.97
±	±	±	±	±	±
3.216	3.759	3.104	3.354	3.779	3.146

Across the three separate viewing conditions, children's cognitive reactions to natural and staged photographs was compared using the Wilcoxon Signed Rank test. With real archive photographs, the difference in response between natural and staged was not significant. However, again with digitised photographs on a tablet, the difference in response between natural and staged

photograph was significant ($p=0.008$). With digitised photographs on a large flat screen, the difference in ideas generated to natural and staged photographs was not significant.

The Friedman Test was used to compare first natural, then staged photographs across the three viewing conditions and there was no significant difference to children's ideas generation to natural photographs but again this was significant for staged photographs ($p=0.028$). For the staged photographs, post-hoc tests were carried out using the Wilcoxon Signed Rank test with the Bonferroni Correction. The comparisons for staged photographs viewed as real archive vs tablet and real archive vs large flat screen was not significant, however differences in thought generation to staged photographs viewed on the tablet and flat screen was significant ($p=0.004$).

In summary results generated from cognitive data collected from the IRS [Ideas Recording Sheet] yielded similar results when analysed either through a word count or as individual ideas recorded.

8. DISCUSSION

This study adapted an experiment undertaken by Mendelson and Papacharissi [32] who reported that adults' emotional reactions to photographs were stronger when they thought they were real but thought more about photographs that they thought were fictional. As this research study was conducted in the context of an authentic Victorian classroom experience involving 30 children at a city museum based in a regional heritage quarter, it was neither appropriate nor feasible to use the same pairs of photographs across all three viewing conditions, or to repeat experiments with multiple instances of natural or staged photographs; in this respect the results have to be considered with a degree of caution.

8.1 Experimental Design

Even with the great care taken with the selection of natural and staged image pairs, and taking into account genre, spatial content, spatial vantage point, format and aesthetic quality, photographic material is highly complex and difficult to control. That said, the results of this study offer interesting differences to those of Mendelson and Papacharissi [32] that open up further avenues of investigation, encourage debate on the nature of children's indexical experience and encourage a more considered approach to the use of photographic material, real or digitised, across a range of viewing conditions. This study has particular pertinence because increasingly innovative mobile learning opportunities are being developed which attempt to break down geographical and contextual barriers which attempt to shift children seamlessly between technology based and real world interactions [21].

8.2 Indexical Encounter

In this study there were consistent similarities between children's emotional reactions to photographs when viewed as either real archive photographs or digitised archive images on a tablet. Much attention was given to making the experience of viewing real archive images as '*indexical*' an encounter as possible, which as discussed above has strong emotional features. Although the photographs used were simulated as real, rather than actual historical artefacts, children seemed to readily accept that they were valuable, unique artefacts, handling them wearing white cotton gloves and viewing them with a magnifying glass as would a real photographic archivist. Naturally children took to the tablet technology with great enthusiasm and in the classroom they were

clearly enjoying using the tablet devices, in this case iPads – as evidenced by both researcher observation and video footage.

However, the patterns of emotional reaction to natural and staged photographs viewed either as real archive artefacts or digital images viewed on a tablet were strikingly similar, with the arguably inevitable technology effect counterbalanced by the children's engagement with real photographs. In fact, the strongest difference in emotional reaction between natural and staged photographs was achieved when these were presented as real archive photographs.

8.3 Natural or Staged Photographs

Natural and staged photographs are compositionally and aesthetically very different kinds of images and in the sense that children's emotional reactions to natural photographs are stronger than to staged when viewed as real archive images and as digitised images on a tablet, the results here corroborate the findings of Mendelson and Papacharissi [32] with respect to participants emotional responses to real photographs. However, where Mendelson and Papacharissi found participant adults to *think* more about photographs they believed to be fictional or staged [for a theatrical/media context], here results indicated that children recorded more ideas after they had viewed natural photographs both in the real archive and tablet viewing conditions. This finding needs further investigation to see if similar results are achieved using multiple images across the two photographic genres and across these two viewing conditions, nevertheless the preliminary findings here do point to different patterns of cognitive response.

This in itself can readily explained by children's incremental ability to process and interpret visual information which becomes more discriminating with age [25-27]. One explanation for this is that the reduction in visual cues afforded by staged photographs may make it more difficult for children to latch onto specific representations that they can think about. The staged photographs chosen from the archive for the study were all taken under studio conditions, with plain backdrops and while compositionally less complex than the natural photographs akin to street photography, they do deploy props. However, even though these are effectively portrait shots, the staged photograph that children had most difficulty thinking about – that is were the least able to generate ideas/words about was the staged photograph viewed on the tablet that contained no props at all. Clearly, the nuances of particular photographs in a more critical photographic context could generate endless debate, particularly where comparisons are being made. However, these broad differences between archive images are pertinent where photographic choices are being made for innovative interventions in heritage education for children, be they with, or without the use of technology.

8.4 Tablet versus Flat Screen Technology

Across all three separate viewing conditions in which natural and staged photographs were presented, the large flat screen computers, were the only context that yielded no results of any significance. The only significant result of note was the comparison for cognitive reaction to staged images between the tablet and large flat screen computer which was significant ($p=0.004$). However, this comparison included the staged photograph viewed on the tablet that yielded the least ideas from children across all the photographs used in the study.

The most obvious differences in user interaction relate to the size of the viewing field and the more limited interaction that can be

achieved with the mouse. Nevertheless, it was valid to include the large flat screen in the study because of the potential ability to zoom in and out of the images and consequently comprehend more detail. However, both results and observations corroborate that the scale of real photographs and the ability of small screen tablet technology with touch screen capability to emulate some aspects of the photographic handling experience, seem more readily manageable for children. Further, from direct observation and video footage, children using large flat screens were more socially isolated in the classroom. Where children were viewing real archive images or digital images on the tablet, there was no barrier to seeing, talking to or listening to other children and adults in the vicinity and this connectedness inevitably encouraged a more lively classroom. While the facilitator working with children on the flat screen computer table remained standing and continually walked around the participants, nevertheless other children were sitting below the height of the screen and social interaction with other children was reduced.

8.5 Further Work

This study has demonstrated some significant differences with respect to how children respond emotionally and cognitively to natural and staged photographs either as real or digital images and the analysis to date has focused on the quantitative aspects of the study. A more detailed qualitative analysis is now required which will include closer consideration of children's written responses to the three pairs of photographs across the three viewing conditions to explore what this can tell us about the 'quality' of the cognitive response, including an examination of children's concrete and abstract thinking. The study also raised interesting new observations on the opening up of the learning space where children are using tablet technologies and the impact that this concurrent social interaction with peers while using technology has on their visual experience and learning.

Looking more specifically at the value of photographic content and the archive in the heritage experience for children, the categorisation of images and the specific choices of photographic pairs only scratches the surface in terms of opportunities to explore what visual experience works best for children. The photographs used in this study were drawn from a collection of archive images of Sunderland and the North East of England, closely linked with the children's own social, cultural and economic context. Opportunities to explore children's responses to heritage and culture outside their immediate experience are enormous. Lastly, recognising the methodological challenges of this research domain, future studies will aim to strengthen the methods used by giving children much more access to archive images to explore what their own 'choices' of images in a design context can further tell us about the nature of the indexical experience.

9. CONCLUSIONS

Although archive photographs are used extensively in heritage education, insufficient recognition is given to their inherent indexical properties both in pragmatic and theoretical terms. The indexical dimension of the user experience does not feature significantly in HCI research either, being more confined to critical studies in visual culture. However, new small tablet technology with highly intuitive touch screen properties offer new, innovative ways for deploying archive photographs that make a connection with these ways of thinking about how users react to visual artefacts highly pertinent.

Further research is now needed to understand and further appreciate the nature of the indexical encounter and how this can be used to evaluate new technology platforms for children in the context of heritage education.

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