Family touch practices and learning experiences in the museum

Carey Jewitt and Sara Price

The Senses and Society Journal 2019

Affiliation:
UCL Knowledge Lab, Institute of Education, University College London

Abstract
This paper investigates how family museum visitors crafted learning through interaction with one another and the touch objects of an exhibition. Through a case study of seven families' interaction, we show how families used touch to bring their interests and resources into dialogue with museum expectations and resources. Using a multimodal approach to analyse observational data, we generate a fine-grained account of differently configured family touch practices and ways of experiencing and knowing objects through their material, sensory tactile and affective qualities. We conclude by highlighting how our findings can inform the design of touch exhibits to support family learning, with attention to engagement, narrative creation, and embodied learning, and point to the paper's methodological contribution to the analysis of visitor situated real-time interaction and learning in museums.

Key words: Touch, Museum, Learning, Family visitors, Case study, Interaction, Multimodal

Introduction
This paper investigates how family museum visitors craft their learning experiences through multimodal interaction with the exhibits and one another, with an emphasis on the place of touch. We focus on how touch features in the family learning experiences to explore its significance for exhibition design and family interaction. A recent study of visitor experiences to the gallery reported nearly all visitors who glanced at an exhibit touched the objects and most visitors rated them highly as adding appeal to the exhibits. Nevertheless, 'feeling objects as channels of engagement and learning are not yet fully understood' (Fisher and Mann, 2013, 40). Drawing on a case study of seven families visiting the Treasures Exhibition at the Cadogan gallery of the London Natural History Museum (NHM), we examine interaction with the four Touch Objects in the exhibition, to contribute empirically-based understanding of the use of touch.

Using a multimodal approach, we provide a fine-grained observational account of the families' interaction to illustrate the significance of touch as a resource used to generate ways of experiencing and knowing. We show how touch is enacted in the re-positioning of museums as contemporary centres of learning. We illustrate ways in which families create narratives, and actively create meanings through touch to craft their learning

experiences together. Drawing on these findings we highlight their potential to inform the design of touch exhibits to support family museum learning.

Exhibitionary complexes and the visitor

Museums bring together an ensemble of disciplines, discursive formations, and techniques of display (e.g. dioramas and panoramas) to form 'exhibitionary complexes'. These complexes simultaneously order and organize objects, technologies of representation, and particular exhibition narratives for public inspection and in doing construct social realities (Bennet, 1995, 59). They articulate knowledge (and power) in particular ways and point to the pivotal role of the museum as 'a set of educative and civilizing agencies' in relation to the formation of the modern state (ibid, 79). The 'exhibitionary complex' enacts the museum curator's expectations of visitors, with respect to learning and their use of the 'senses to make meaning of an exhibit' (Fors, 2013, 273).

Growing recognition and interest in how exhibition design features influence visitor attention has led to a multidisciplinary field of visitor studies, contributing to better understanding of visitor experience, behaviours, interests, attitudes, and motivations as well as best-practice strategies for how to attract, educate and serve them (Bitgood and Shettle, 1996). Bennet has argued that "It is through movement, bodily acts, walking and touch that museum visitors create meaning" (1995, 37). Research has shown how visitors actively constitute the sense and significance of objects and artefacts through their interaction with exhibits and each other in the museum (e.g. Heath et al, 2002).

Hooper-Greenhill (2007, 374) argues that 'one of the strongest claims made by museum educators is that of the value of learning through the senses' and the need for multiple and embodied pathways to knowing and embodied approaches to learning. Museums have sought to enhance visitor participation with dynamic multisensory and multimodal exhibits that move beyond language-based models of knowledge transmission and engender new ways of seeing and experiencing objects. This has served to generate new cultural norms, 'competences' and relationships to knowledge in the museum (Rees-Leahy, 2012). Extending and newly emphasising visitor interaction and agency in this way, has placed new expectations on visitors to actively craft their own learning experiences within the museum (Fors, 2014). The reframing of the museum visitor as an active meaning maker, combined with renewed attention to the sensory and multimodal techniques of display and the potentials of digital technologies, has led to a contemporary re-appraisal of the place of touch in the museum.

The place of touch in the museum

Touch in the contemporary museum is situated within a long and significant history of tactile encounters in the museum (Grosvenor and Macnab, 2013). With attention to visually impaired children's museum encounters in the early 1900s, they trace the development of ideas around 'seeing through touch' from embossed books and maps, Braille printing machines, to tactile experiments and handling sessions. Sensory historians (Classen, 2005, 2017; Candlin, 2010) have mapped the significance of touch to museum visitors in the seventeenth century and its place in the present museum, where touch has received new attention as a significant sense for engaging with artefacts (e.g. Chatterjee 2013; Pye, 2008; Howes and Classen, 2013). It is beyond the scope of this

paper to provide a full historical narrative on the place of touch in the museum, however, this history underpins contemporary multisensory exhibitions and programs for visually and hearing-impaired visitors (e.g. tactile and auditory tours) and is a factor in the re-evaluation of touch for *all* visitors.

While touch based programs have certainly not shattered the 'ocular-centric tendencies' of museums (Clintberg, 2014) they contribute to the 'dismantling' of the visual scripts and 'controlling center' that dominate museum practice (Bennet, 2006, 63). However, 'feeling objects as channels of engagement and learning are not yet fully understood' (Fisher and Mann, 2013, 40), and not always available. The museum shop remains the main place where touch is permitted (Levent and McRainey, 2014). Museum based research suggests that touch can establish essential connections leading to social, cognitive and therapeutic value (Chatterjee, 2013) and visitors report touching artefacts provides a 'strong sense of their body meeting that of another person over an immense time and space' (Candlin 2010, 65). Candlin (2008, 288) points to the imaginative affectual engagement of the visitor's touch to 'animate the past, the object and, by implication, the visitor'. Object handling in the museum is associated with a range of social and learning benefits, engagement and aesthetic tactile pleasure, enhanced information retention and recall and understanding through the tactile acquisition of knowledge (Levent and Pascual-Leone, 2014).

There is little research on the use of touch by family visitors and its place in their learning experiences, this paper contributes to a deeper understanding of *how* families use touch in the museum for learning experiences.

Methodology

Site

Treasures in the Cadogan Gallery, NHM (London) is popular with family visitors, and the combination of touch screen technology (digital object 'labels'), touch objects, and original artefacts in viewing cases is considered to be an innovative design. The exhibition is designed around the development of natural history as a science (Fisher and Mann, 2013). A sign at the entrance to the gallery notes that 'Each exhibit tells an extraordinary story, telling us something about our planet and the remarkable people who have helped explore and understand it'.

The rectangular gallery has 22 objects displayed around a central island. The exhibition includes 'touch objects' alongside four of the 22 exhibits (each have the texture, scale and shape of the original, but cannot be picked up or moved):

Hans Sloane's Nautilus Shell: A large convolute shell, around 12 inches high, smooth, with compressed whorl sections, with a floral motive carved on the surface. The Touch Object is a smooth Shell of the same size without carvings.

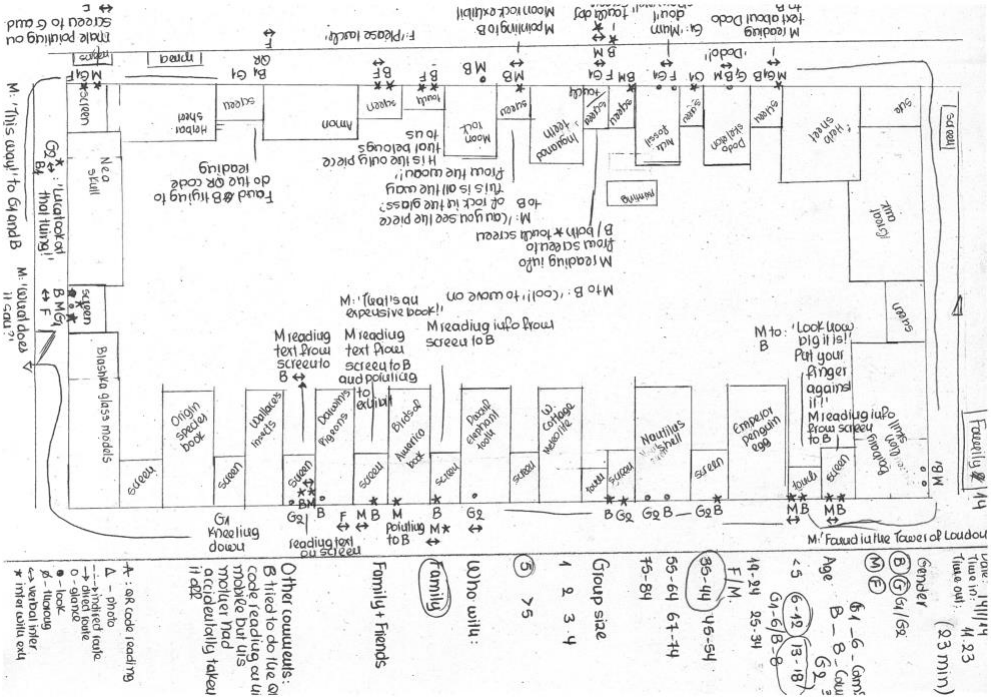
The Barbary Lion: is the oldest lion found in the UK after the extinction of native wild lions. A reproduction with the jaw fixed slightly open forms the touch object.

Iguanodon Teeth: The first ever found, sparking the discovery of dinosaurs, 141 to 137 million years old. A relief cast of three teeth in rock is available to touch.

William Smith's ammonites: a display of 4 ammonites in a slab of rock: fossils used to signify the new science of geology. A replica plaster cast of ammonite fossils is available to touch.

The intended gallery route is clockwise and presents the visitor with a touch object (if available), an interactive digital screen (the size of a tablet) which contains a range of information, and the original artefact, in that order (see figure 1, in the form of a museum tracking sheet).

Figure 1: Visitor Tracking Sheet –layout of the Treasures exhibition, Cadogan Gallery, Natural History Museum



Participants

Families were recruited by the researcher over two days as they neared the gallery entrance. They were given information on the study's interest in family experiences of the gallery (funders and research team, and data-storage). Seven family groups consented to participate: 10 adults and 9 children, aged from five to sixteen years.

Family	Composition		Time in gallery
	Adult	Child/ren (age)	
1.	Mother	1 x girl 5 years	12 minutes
2.	Mother	1 x boy 8 years	15 minutes
3.	Father	1 x girl 5 years	10 minutes
4.	Father, mother	1 x boy 8 years	23 minutes

		2 x girls 6 years & 16 years	
5.	Father	1 x boy 6 years	6 minutes
6.	Mother, father	2 girls 6 years & 5 years	14 minutes
7.	Mother, father	1 x boy 6 years 1 x girl 5 years	11 minutes

Table 1: Overview of family composition and time in the gallery

Data collection

Qualitative data comprised a combination of 1) *Video recordings* - providing a detailed real-time recording of the multimodal interaction of family members with one another and the exhibit. The researcher recorded them throughout the visit. 2) *Tracking sheets* giving a static overview of each family's visit, using a map of the gallery exhibits, marked up with observational notes mapping the family's movement in the gallery, their visit time, indications where they glanced, looked, dwelled, and talked (e.g. Figure 1). The analysis draws on the video data as its primary data source, supported by the tracking sheet data.

Analytical framework

Multimodality, with origins in social interaction and linguistic studies, is concerned with communicative 'modes' rather than the senses (Jewitt, Bezemer and O'Halloran, 2016). What counts as a mode is a set of semiotic resources (shaped from material, sensory and social resources in a community), with a regularity of use (principles and rules of use) that fulfils the communication purposes (meaning functions) of that community. All modes are understood as being shaped through their social, cultural, and historical usage to realize communicative work in distinct ways: making the choice of mode a central aspect of interaction and meaning. What counts as touch, and how sensory aspects of touch are socially worked into semiotic resources or modes for use in the gallery varies, is culturally specific, and historically fluid. We explore touch against this backdrop.

A multimodal approach (Jewitt, Bezemer and O'Halloran, 2016) is typically used to generate a fine-grained account of interaction-in-context looking beyond what people say to study all communicative forms (e.g. movement, gaze, gesture). While our analytical emphasis is on the place of touch, we acknowledge that touch is situated in a broader multimodal ensemble. What kinds of meanings does the use of touch, as an apt resource available to them as visitors to a museum, help them to realize? We employ multimodal concepts of 'sign maker' and 'motivated sign' to theorize the family visitors as actively (purposefully) crafting their experience in dialogue with the museum collection. From this perspective, learning is embodied and situated, shaped by both the interests of the visitor, and the social and material resources of the museum environment. Our analytical focus on their situated use of touch attends to the types of touch practices they engage in, and how they use touch along with other modes to share, explain, narrate, and extend their experiences as a family in the exhibition seeks to understand the implications of touch and modal choices for their learning experience.

Data analysis involved a sequence of established steps in multimodal video-based research (Jewitt, 2012). The video data for each family was repeatedly viewed to generate

a preliminary descriptive account. The interactional modes and resources available to the visitor were mapped: visitor direction of movement, sequential interaction with the exhibits, the use of mediating technologies – related to modes of interaction, and the touch afforded by exhibits, the family touch practice, and the experiences that the families reference and deploy within the exhibition, as well as how they orchestrate their interaction with the exhibits and one another. We selected excerpts of touch-based interaction in each family trajectory for closer analysis to infer patterns of touch practice within the families. We assembled these excerpts to explore, develop and refine analytical themes related to touch interaction across the families, enabling us to describe and explore variation across the families use of the sensory and semiotic resources of touch for learning.

The place of touch: findings and discussion

Our analysis focused on the four exhibits with touch objects. It is important to note that the related touch objects are *reproductions* (i.e. casts or replicas) and do not have the same material qualities as the original objects on display, for example, in terms of their weight or temperature. Observations show that families touched the replicas in relation to the original: sometimes touching the reproduction whilst looking at the original. This offers opportunities for making links between tactile and visual features of exhibits through creating a relationship between the touch object and the original artefact through their multimodal interactions.

Overview of the families touch interaction

Analysis of the families' interaction with the exhibits shows that the touch objects support meaning making in different ways (summarised in Table 2).

Table 2: Overview of family interaction with the four touch exhibits in the gallery (T: Touch Object; IP: IPad; O: Original artefact)

Sequence	**Shell**	**Lion**	**Teeth**	**Ammonites**
Museum	T IP O	T IP O	T IP O	T IP O
Family				
1.	T	T	T	T
2.		O	O IP	T O IP
3.	T IP O	T IP O	T IP	T IP
4.	O T	O T IP	IP T	IP T
5.	T	T	T	

		IP O		
6.	T	T IP O	T IP O	T
7.	O IP T	O IP T		

All of the families interacted with one or more touch object in the exhibition, and most (5/7) interacted with three or more. As noted earlier, the gallery is designed such that visitors move through the space in a particular direction (Table 2). Two families (F4, F7) moved through the gallery in the 'reverse direction' (indicated by a shaded row); most family members (21 in total) did not engage with all of the exhibits in this 'expected' sequence (19/21); and under a half (9/21) used the full range of exhibit elements (i.e. touch object, iPad or original artefact).

The four touch objects attracted different levels of interaction, and touch practices (Table 3), suggesting different levels of attention and interest.

Table 3: Comparison of touch practices with the different touch objects

Touch object	Touch practices	Focus
Nautilus shell	Stroking, point	Materiality & affect
Barbary Lion	Stroking, pointing, grasping or holding an object, inserting their fingers into the gaps and crevices of an object, kissing, patting and	Materiality & affect Explore physical Animate Narrate

	'petting' an object, tapping, and wiping an object, and using their fingers to measure an object.	
Igunado teeth	Pointing, pinching, holding	Materiality & affect Explore physical Narrate
Ammonites	Tracing a shape with a finger, holding, cupping the shape, pointing, wiping, and using their fingers to measure an object.	Materiality & affect Explore physical Narrate

Most of the families (6/7) interacted with the Nautilus shell and Iguanodon teeth cast. However, their interaction was quantitatively and qualitatively more limited than with the other touch exhibits. Touch interaction was fleeting, families touched while still walking and only 3 families stopped at these exhibits. Family F4's interaction with the Nautilus shell, described below, is typical for both exhibits:

> 'The boy continues to walk, he glances at the original carved shell in the display cabinet, as he walks past the touch object, he slows his pace, he reaches out and touches it with his finger, and walks on to the next exhibit; his father walks alongside him matching his pace, they do not exchange gaze or comment.

These two exhibits were mainly touched by the children rather than adults (1/10). The Iguanadon Teeth were stroked, and the teeth were pointed at, pinched, and held. At the Nautilus shell children between 3 to 5 years of age employed their prior experience to interpret it, placing their ear next to the object's hole to hear if there were any sounds, and it triggered different kinds of touching among family visitors including smooth touch and tapping. However, these exhibits generated a more limited range of touch, and the nautilus shell generated limited dialogue compared to other touch exhibits. Interaction here was focused on material and sensory qualities, and generally the families did not use the iPads to contextualize, interpret or explain the objects.

The families dwelled longer at the Barbary lion skull and the Ammonite fossil exhibits, where the touch objects became a focus of family interaction, generating a wider range of touch practices and for a longer time. The majority of the families (5/7) interacted with the ammonite cast, which promoted mutual simultaneous touch between adults and children. The Barbary lion skull touch object was also a focus of interaction for most families (6/7), and was touched by adults (5/10) and children (8/11). It generated the widest range of types of touch, including mimicking the shape of the jaw, and imagining the action of the Lion through gesture and facial expression. The Barbary Lion also generated the most talk: adults guided or instructed the child's touch, saying, for example, 'feel its teeth', 'what does it feel like?'. At times during their interaction the family touched the Lion skull together. As we describe below, these moments of mutual touch created a shared experience and generated dialogue.

The families use of touch for learning

The families used touch in four main ways that were significant for crafting their learning experiences: engaging with materiality and affect; exploring the physical features of an

exhibit; narrating objects; and animating an exhibit. These categories are not intended as an exhaustive account of family touch in the museum, rather they make an empirical contribution toward better understanding how family visitors use touch and touch objects, and their potential for supporting meaning making.

Engaging with materiality and affect

The families, notably the young children, used touch to engage with an object. This gave them access to the materiality and sensory affective experience of the object and through that experience a potential relationship to representations of social, cultural and historical meanings. Priem (2014, 55) has argued that 'things are closely interwoven with sensual perception and stimulation, cultural practices, techniques for gaining knowledge, and the creation of meaning'. The visitors related their engagement with the materiality of the objects with emotion.

> The child (F1, age 5) approaches the Nautilus Shell. [This is the first time she initiates the interaction with an exhibit.] She places her hands open palmed on either side of the shell and she gently and slowly moves her open palms up and down the shell stroking it six times. She moves her face closer to the shell and still stroking she starts to describe its texture to her father who is standing behind her: '*It's sooo soft and its soooo slippery! It is a bit shiny isn't it. It's sooooo LOVELY'*. Her parent looks at the iPad beside the touch object and says, '*It's called a nautilus shell'* but she does not read the text. She then returns to the shell touch object, she puts both her hands on either side of it and very lightly caresses it up and down.

Where the focus of touch was on materiality, the families did not work to interpret or situate the object in the wider discourse of the gallery. While touch provides both information about the size, shape, texture and temperature of the objects its primary meaning appears to be interpersonal – creating a connection between the visitor and the object, often through silent mutual touching of objects. The visitors used touch to elicit information about an object's material properties, but touch also enabled curiosity, investigation and a sense of desire (Candlin, 2008).

Exploring the physical features of an exhibit

The families all used touch to explore, measure and compare, the physical features of the exhibits, with attention to their shape, features, and size. A typical example is family (F 4) interacting with the Barbary Lion Skull:

> The Father points to the skull in the display cabinet and says '*that's good'*. The child looks at the skull in cabinet and clenches his teeth, pulling his head backwards. The Father starts to touch the object, he feels the teeth and says '*feel those teeth!*' The child touches them and laughs. Father instructs further, '*Feel at the top'*. The child puts his hand in the mouth of the skull and feels around, then says '*Oh weird'*. The Father says '*Look how big it is, put your finger against it'*. He demonstrates using his finger how to measure the tooth and the child touches the tooth. Then the Father: says, '*put your finger against the length of that bottom tooth*'. The child touches it and the Father encourages him saying, '*go on hold your finger up against it*'. [The child is finding it difficult to do this]. The father holds the child's finger and manoeuvres it into position, '*that's – points at tooth-*

is as long the length of your finger'. The child holds his finger in place and says '*That's big!*'The Father moves to the IPad, he swipes the screens and then says, '*It was found in the tower of London*' [The father is paraphrasing rather than reading aloud the text. The child asks '*are they extinct?*'. The Father says '*no*', but then reads the full iPad text and says '*oh yes it says'*..and then he reads the excerpt on extinction.

The father leads the child's touch interaction, demonstrating to his son how and where to touch the skull, giving him verbal queues. He made size the salient feature of the skull. By helping the child to use his finger to measure the lion tooth he helps the child to compare the lion to his body as an embodied way of understanding scale – the lion tooth in relation to boy's finger. The mutual touch experience created shared focus that appeared to promote questions and dialogue. Several adults supported their children to use their bodies to map the size and shape of the exhibits and children used touch to recognise similarities and make connections between the touch objects and original artefacts. Through the experience of touching the children identified criterial aspects of the object (e.g. its' shape and size, or patterned shape and texture) and to map these to their understanding of the original object in the display cabinet. Touch appeared to provide a connection between the child and an exhibit: made visible through their animation of an object – discussed later in this section.

Narrating objects

Several of the families (F2, F3, F6) used the objects to tell stories, create narratives, or connect narratives, each of which positioned the exhibits differently and contributed to different kinds of learning experiences. For instance, the family (F 2) used each of the objects that they stopped to look at to tell stories of natural history exploration. The mother drew on her own general knowledge, as well as the labels and information on the iPads to weave stories around the exhibits. She asked the child to imagine themselves into the story, asking '*could you have carried that Penguin egg all the way back from Antarctica?*' for example, and '*what would it be like to find the first ever dinosaur tooth?*' of the Iguanodon teeth exhibit. However, she did not touch them, and in this way, the teeth remained an imagined object. Family 2 only used touch to engage with the ammonites, the mother using the exhibit to evoke and link to the child's experience of the natural world and exploration.

The boy runs to the ammonite exhibit and says, '*We know about these!*'. He points at the ammonite casts, and with his pointed finger he touches the casts, and traces the spiral shape of one of the ammonites, and then another. His Mother says, '*We know about these - What are these*?' . The child continues to trace the spiral shape with his finger, and says, '*Sea shells*'. His Mother answers, '*They aren't shells'* and points at label and moves her finger along the written name as she says, '*They are AM – MON- ITES, they are found on beaches*.' She then traces the shape of the ammonite with her pointed finger and asks '*Is this what you found when you went to Dorset?*' The child says, '*I think so. Yeah!*' The Mother asks, '*Did you find ammonites like that?*' The child says '*Yeah*' as she asks '*are you sure?*' Now both are stroking and pointing the Ammonite casts, the boy says, '*Yeah I found them like that'* – he points at the original ammonites in the display case. He places his pointed finger on the glass of the display case and slowly traces the spiral shape of the ammonites below the glass. '*They were swirly*

> *just like that!*' He continues to trace the spiral, through his touch he links his '*beach find*' with the cast, and the cast with the original. His Mother then asks '*And did you know you'd found a fossil or did you just think it was cool?*' The boy says '*I knew I'd found a fossil'*

Through touching the object, the child made the shape criterial and by tracing over the original artefact he generated a touch and action-based abstraction of the ammonite.

A second example, shows how the use of everyday narratives by a family (F 6) can disrupt the museum narrative. The family do not engage with the written information on the iPads, the mum says 'I'm not reading all that!'. They look at the images on the iPad, the touch objects and the original artefacts. The adults use of 'small' everyday narratives - snails, brushing teeth, watching films, and having lunch, does not serve to connect the family's experience of the objects with the exhibition narrative. This example raises the question of how the character of touch can signify and reveal different kinds of 'engagement, interests and knowledge' (Bezemer and Kress, 2016, 49). Comparison of the touch features of the child's flat stroking of the Ammonite cast as a slab (F 6) with another child's pointed tracing of the shape of the Ammonites (F 2), for example, serves to reveal different interests based on different knowledge: The child (F6) knows what an Ammonite is, and that there are 3 on the slab, and uses his finger to trace what for him is criterial – their 'swirly' shape. The other child feels the whole slab and links the texture she feels to a creature in her everyday experience, a creature that has similar features, in being 'shell-like' and 'swirly' in shape.

Animating an exhibit

The use of touch and kinaesthetic resources by some children suggested an interpersonal connection between them and an exhibit. For example, some children patted and petted the Lion skull, looked into its eyes, and kissed it as if it were a living lion. Touch enabled them to imagine the lion and its features, as a child (F1) said in interview, 'Then I put my hand for the holes and I've put my hands under the tooth and I saw. It felt smooth and it had big eyes.' This links to Candlin's (2008, 288) argument that objects are 'brought alive' through imaginative affectual engagement in ways that 'animate the past, the object and, by implication, the visitor'.

The following example illustrates how a child of one family (F 5) animated and embodied the lion skull exhibit through touch, gaze, gesture, body posture, movement, and facial expression.

> The child approaches and touches the lion skull. The father says '*This is a lion's skull*'. The child strokes the top of the skull and repeats '*A lion's skull'*. The boy puts his right hand on its jaw, and says, '*Oh its strong jaws'* and feels inside the jaw. He pats the skull on the head with his left hand and pats the mouth of the lion – as if patting a dog

Figure 2a: The child ‘holds the lions mouth closed’

Figure 2b: The child positions his hand into a jaw shape to mimic the lion’s open jaw

Figure 2c: The child reverses his 'jaw' hand and opens up his palm as if opening the 'jaw' towards himself

> He holds onto the skull with his left hand and swipes the iPad screen with his other hand (his father stands beside him). The boy stops swiping the screens to look at a drawing of a lion with its mouth open. His father looks at the picture and touches the lion's jaw [this serves to direct the child's attention back to the touch object and connects the iPad image with the touch object]. The father touches the jaw – '*There's its' mouth look and its' teeth'*. The child looks and holds onto the lions 'mouth' with his hand – as if to hold the jaw closed (Figure 2.a). He holds the jaw while he looks at another picture on iPad of a lion eating another animal and says to his father, '*look it's a lion eating'*. He lets go of the skull and wipes his hands down the front of his shirt [as if to clean them] as he says '*Its got blood all over its mouth'*. The child stands in front of the original skull in the display case and says '*This is lion's skull'* and touches the glass cabinet. The father reads the label verbatim, '*It is, it's the oldest lion found in the UK since the extinction of native wild lions*'. His phone rings, he answers it, starts to talk and walks off. The child stares at the skull, he says '*This is a wild lion'*. He opens his mouth and clenches his jaw. He puts his hand into a jaw like shape that mimics the lion's open jaw (Figure 2.b.). He taps his 'jaw-hand' at the skull on the glass cabinet eight times. He reverses his 'jaw-hand' and opens up his palm as if opening the lion's 'jaw' towards himself (Figure 2.c).

The child, through his touch, the imagery of the iPad and the pose of the original skull, realises an emotional interpersonal relationship with the lion. He pets the lion and controls it in the action of holding its jaw 'shut' (note: the replica jaw does not move or open). The ability to touch the lion skull brings the child's hand into the interaction. The child positions himself *as* the lion by imagining and wiping off the 'blood' on his top; he mimics the lion's jaw's opening and interacts 'as a lion' by tapping on the display cabinet. He enacts violence and attack as criterial 'lion-ness'. Finally, the child embodies

and animates the lion by reversing his hand to 'be the lion jaw' coming toward him as if 'the lion' were about to attack him – creating a connection between himself and the lion.

Conclusion: touch and family learning experiences

This paper contributes to an interrogation of touch-based displays in the museum. The use of touch objects from cultural heritage is a strategy used by museums as a valuable prerequisite for remembering and sharing stories and knowledge. Through an exploration of family visitor embodied tactile encounters with touch objects, we illustrated some ways in which families develop narratives, and actively create meanings to craft their learning experiences through touch. We have shown how families' interactions exploited the potential of touch as a pathway to generate new ways of experiencing, and knowing objects through their material, sensory tactile and affective qualities. The findings and discussion are significant for museum practitioners, particularly as few studies have attended to the multimodal touch experiences of family visitors. Three key contributions can inform the design and use of touch-based exhibits to create family learning experiences.

Engagement: Being able to touch objects has the potential to increase the family's engagement (dwell time, talk, and types of interaction), and aesthetic tactile pleasure. Touch objects supported and generated family dialogue, prompting children to ask questions, describe textures, make comparisons and recall stories, and adults to name, classify and situate objects in their own knowledge or that provided by the museum in the form of written and digital labels.

Narrative creation: Families can use touch experiences as a basis for creating narratives around their own interests, knowledge and experience, and specifically narratives that link their current visitor experience to museum narratives. Touch can open up spaces for the visitor to remake or subvert museum narratives (Binter, 2014). This potential provides routes through which the museum can encourage and harness visitor imaginations, re-telling, and the generation of personalised narratives that can make learning more relevant to families.

Embodiment: A large body of work highlights the role of the body in underpinning learning (Piaget, 1972; Vygostsky, 1978), and as a potential catalyst for personal relevance in learning (Cook, Mitchell, and Goldin-Meadow, 2008). The personal tactile dialogues that touch enabled, together with the sensation of intimacy this instilled, may help families to recall objects and their museum experiences (e.g. Ward, 2014). Beyond 'rational' engagement with the touch objects (size, measurement etc.), and as an embodied instantiation of narrative creation, child visitors made use of touch to generate interpersonal connections with the objects.

This sensori-motor engagement with key features, supports the embodying of ideas, where action and touch experiences can form the foundation for abstraction and later communication potential (Cook, Mitchell, and Goldin-Meadow, 2008). Just like touch experiences provide different kinds of knowledge about an object, so can the actions implicit in the touch experience provide the basis for abstracted gestural forms of communication. Gesture has been shown to illustrate children's understanding of phenomena (Sauter et al., 2012), and can extend verbal communication through

representational means, and providing important action repertoires for conveying different aspects of an idea or concept. For children and families touch-based experiences, therefore, offer important modes of interaction for learning.

The paper makes a methodological contribution to research on museum visitor interaction by demonstrating the potential of a multimodal analytical approach of family visitor situated real-time interaction, which theorises the interaction between the interests and actions of the visitor and those of the museum. This study demonstrates that touching in the museum is a culturally shaped practice, and shows how different types of touch interaction provided families with different routes to different knowledge. Just as "knowing how to look in the museum also involves knowing how and where to stand, where and how fast to walk, what to say and what not to say" (Rees-Leahy, 2012, 5), touch needs to be framed for learning.

While the study did not reveal how touch supported families' engagement with scientific, historical and cultural importance of the objects, it does highlight ways in which touch supported young visitors to gain other important sensory based experiences and types of valuable knowledge. Such designs are critical in developing focused curiosity in young children, and provide an important first step toward larger educational goals. An exhibitionary regime that creates opportunities for families to touch exhibits provides such potential routes to other ways of knowing, and for imaginative, speculative and emotional ways of knowing material objects, as well as enabling sensory experiences that form the foundation for extending communicative potential in remembering, re-enacting and explanation.

Acknowledgements
This paper has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 681489), and a UCL/IOE collaboration -'The Digital Museum'. Thanks to Dr Eleni Vomvyla who collected the data that we analyse in this paper, and Dr Theano Moussouri who was a collaborator on the project.

References

Bennett, T. 1995. *The Birth of the Museum: History, Theory, Politics*. London: Routledge.
Bennet, T. 1998. "The Exhibitionary Complex." *new formations* (4): 73-102.
Bennett, T. 2006. "Exhibition, Difference and the Logic of Culture." In Ivan Karp, Museum Frictions: Public Cultures/Global Transformations

Bitgood, Stephen, and Harris H. Shettel. (1996) An Overview of Visitor Studies, *The Journal of Museum Education*, 21(3):6–10.
Cook, S. W., Mitchell, Z., and Goldin-Meadow, S. (2008) Gesturing makes learning last. *Cognition, 106* (2):1047-1058.
Kratz, C. and Szwaja, L. (2008) (eds), *Museum Frictions: Public Cultures/Global Transformations*, Durham, NC: Duke University Press.
Binter, J. (2014) Unruly Voices in the Museum Multisensory Engagement with Disquieting Histories, *The Senses & Society* 9(3): 342–360.

Candlin, F. (2008) Touch, and the Limits of the Rational Museum or Can Matter Think?, *The Senses and Society*, 3 (3): 277-292.
Candlin, F. (2010) *Art, Museums and Touch*, Manchester: Manchester University Press.
Chatterjee, H. J. and Noble, G. (2013) *Museums, Health and Wellbeing*. Ashgate Publishing Ltd: Farnham, UK; Burlington USA.
Classen, C. (2005) *The book of Touch*, Oxford: Berg Publishers.
Clintberg, M. (2014) Where Publics May Touch Stimulating Sensory Access at the National Gallery of Canada, *The Senses & Society* 9(3): 310–322.
Department for Culture, Media and Sport (2015) *Sponsored Museum Performance indicators 2014-15* http://ow.ly/Ipbe30aPpmj
Fisher, S and Mann, C. (2013) *Evaluating the effectiveness of the Treasures Exhibition*. Natural History Museum.
Fors, V. (2013) Teenagers' Multisensory Routes for Learning in the Museum, *The Senses and Society*, 8 (3): 268-289.
Gadoua, M. (2008) Making Sense through Touch: Handling Collections with Inuit Elders at the McCord Museum, *The Senses & Society*. 3 (3): 323-341.
Grosvenor, I and Macnab, N. (2013), Seeing through Touch: The Material World of the Visually Impaired Child, Educar em Revista, 49, 39-57.
Heath, C., Luff, P., vom Lehn, D., and Hindmarsh, J. (2002) Crafting participation: designing ecologies, configuring experience, *Visual Communication* 1(1): 9-33.
Hooper-Greenhill, E. (2007) Education, postmodernity and the museum, in Simon J. Knell, Suzanne MacLeod and Sheila Watson (eds.) *Museum Revolutions: how museums change and are changed*. Routledge: London: 367-377
Howes, D. and Classen, C. (2013) *Ways of Sensing: Understanding the Senses in Society*, London: Routledge.
Howes, D. (2014) Introduction to Sensory Museology, *The Senses & Society*, 9 (3): 259-267.
Jewitt, C., Bezemer, J. and O'Halloran, K. (2016) *Multimodal Research*, London: Routledge.
Jewitt, C. (2012*). An Introduction to Using Video for Research* (NCRM Working Paper Series).
Levent, N and Pascual-Leone, A. (2014) *The Multisensory Museum*. Rowman and Littlefield: Plymouth UK.
Priem, K. (2014) Visual, Literary and Numerical Perspectives on Education: Materiality, Presence and Interpretation, P. Smeyers and M. Depaepe (eds.) *Educational Research: Material Culture and Its Representation*, London: Springer: 53-69.
Piaget, J. (1972) *The Principles of Genetic Epistemology*. Basic Books, New York, USA.
Pye, E. (ed) (2008) *The power of touch: handling objects in museum and heritage contexts*. Walnut Creek: California, USA.
Rees-Leahy, H. (2012) *Museum Bodies: The Politics and Practices of Visiting and Viewing*, London: Routledge.
Sauter M, Uttal DH, Alman AS, Goldin-Meadow S, Levine SC. (2012) Learning what children know about space from looking at their hands: the added value of gesture in spatial communication. *Journal of Experimental Child Psychology*,111(4):587-606.
A.Shelton (2006) Museums and Museum Displays, Chapter 30 in C. Tilley, K. Webb, S. Kuchler, M.Rowlands and P. Spyer (Eds) *Handbook of Material Culture*, Sage: London.
Vygotsky, L. S. (1978). *Mind and Society*. Harvard University Press: Cambridge, USA.