

## **In situ, 3D printed heritage souvenirs: Challenging conventional spaces and culture**

### **Introduction**

This paper outlines an Arts and Humanities Research Council (AHRC) funded Design Innovation Development Award project titled 'Enhancing the Authenticity and Sustainability of the Visitor Heritage Experience through 3D Printing Technology', undertaken in collaboration with the heritage organisation Historic Scotland at Stirling Castle, between academics in the Schools of Tourism and Design at Edinburgh Napier University. In this study, the research team produced a collection of 3D printed souvenirs in a variety of materials and scales on an Ultimaker 2 3D printer. It was set up within the castle next to one of the halls that formed part of a tour as a small, 'pop up' maker space and gift shop.

The researchers invited visitors to take part in a short survey and then offered them a 3D printed item at the end (a small unicorn from Thingiverse to reflect the castle's branding). This study took place in situ to demonstrate the technology and processes involved with 3D printing and to engage the public and staff with the design process of 3D printing a souvenir from start to finish using these technologies and to experience, fleetingly, certain characteristics of a shared maker space.

The project started with the idea that traditionally produced souvenirs can often be thought of as inauthentic, mass produced, cheap, meaningless objects that are not worthy of serious consideration. (Swanson, 2004) However, souvenirs may be viewed as texts that reveal meanings and events behind their production. They can, therefore, act as tangible evidence of a visit that enables a reliving of an experience and retains the memory of a special occasion and location. (Morgan and Pritchard, 2005) Additionally, souvenirs are expressions of highly personal individuality, sense of self, creativity and aesthetic taste. (Swanson and Timothy, 2012)

Many contemporary museums and galleries have extended souvenirs' use as 'memory triggers', not only by expanding gift shop variety, but also by experimenting with digital technologies, such as 'apps', that allow the visitor to take home physical experiences and absorb them in their everyday lives, mediating place and enveloping the past with the present. (Tung and Ritchie, 2011) There are also instances of maker spaces being set up within the museum locus as educational tools to engage visitors with particular exhibitions or themes in interactive and creative ways.

This study, in particular, concentrated on unlocking the potential of the established heritage attraction 'gift shop' and the personal significance of the souvenir object itself, employing many of the intrinsic qualities of an unregulated maker space, while exploring the dichotomies of this juxtaposed with commercial retail.

Heritage environments and an understanding of the history, societal inclusivity and public ownership of the buildings and artefacts can be lost in the institutionalised approach that heritage is often presented and funded. This can be because of the conventional dissemination of exhibited information, charging entrance fees or commercial gift shop provision, potentially excluding and disengaging segments of the population and even the local community. It can also be that children and young people do not fully engage with traditional heritage educational materials. This study, through the use of in situ 3D printing and experiential souvenirs, challenges these concepts by adding digital making, customisation, peer production and interaction to this encounter. The ability to potentially customise and interact with the making of souvenirs that 3D printing heralds may create opportunities to escape the serial reproduction of culture and engage the visitor in the creation of personal meaning. (Richards and Wilson, 2006)

This research also evaluates the outcomes of disrupting, through the introduction of several traits of a peer based maker space, a heritage retail environment, in this case frequented by a relatively affluent demographic with, arguably, 'cultural capital' (Bourdieu, 1984 : 43). This is defined as 'the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition' and 'a taste for fine art because they have been exposed to and trained to appreciate it since a very early age, while working-class individuals have generally not had access to 'high art' and thus have not cultivated the 'habitus' appropriate to fine art [understanding]'. The paper will also discuss how aspects of the maker movement, including the use of desktop tools, sharing and collaboration and the use of common design standards to facilitate fast iteration can be beneficially assimilated into a seemingly dissimilar heritage retail culture and public and what the societal benefits of this may be.

## **Literature Review**

### **Souvenirs as meaningful 'things'**

Bjorgvinsson, Ehn and Hillgren (2010: 41), describe a 'thing' as something that 'challenges when entering the public sphere and the field of innovation research. A major challenge has to do with what is being designed – a 'thing' (object or service) or a 'Thing' (socio-material assembly that deals with 'matters of concern'). In this study, the researchers have treated the public interaction with the digitally made souvenir objects and their relationship with the deconstructed use of the heritage space as meaningful.

Souvenirs and the 'gift shop' are often overlooked as having any significance in how the public interact with their heritage environment. However, according to Norman (2004: 48), for example, 'we become attached to things if they have a significant personal association. If they bring to mind pleasant, comforting moments. Perhaps more significant, however, is our attachment to places. Our attachment is really not to the thing, it is the relationship to the meanings and feelings the thing represents.' In this way, the souvenir may, in some cases, eclipse the actual exhibit in the way that it is remembered or personally, authentically engaged with. Through digitally made souvenirs, this study moves the institutionalised heritage experience out of the prescribed space, into the gift shop then into a domestic environment and considers the implications of this.

Gordon's research (2004: 135) claimed that, 'the universality of the souvenir can be understood in light of its underlying role or function. As an actual object, it concretizes or makes tangible what was otherwise only an intangible state. Its physical presence helps locate, define and freeze in time a fleeting, transitory experience and bring back into ordinary experience something of the quality of an extraordinary experience.' Souvenirs have the ability to be 'tangible, magical, sentimental, cherished objects of memorable experience, intangible reminders and golden memories' (McKercher and du Cros, 2002: 80). By providing a material point of reference for a specific memory, souvenirs create, recreate and mediate a multi-sense tourist experience (Morgan and Pritchard, 2005) and are a means of mediating or transferring messages from one reality to another (Collins-Kreiner and Zins, 2011: 19).

### **Digitally making collaborative 'authentic' souvenirs**

In this project, albeit a short pilot study where the publics' interaction with the actual 3D printer and designing process was relatively limited, aspects of the tourist and design co-creation processes were applied and the feedback was appraised. According to Binkhorst and Dekker (2009: 320) 'modern consumers want context related, authentic experience concepts and seek a balance between control by the experience stager and self determined

activity with its spontaneity, freedom and self-expression.' Sanders and Stappers (2008: 6) define co-creation as 'the creativity of designers and people not trained in design working together in the design development process'. The ability of the visitor to simply interact with the making process of 3D printing, through colour choices, scales and inclusion of inscription, in addition to the occasional flaws and imperfections in the printing process, can lead to the additional experience of serendipity, often experienced by skilled makers.

The in-situ 3D printing experience that the research team facilitated for the heritage public seemed to elevate their souvenirs from being throwaway plastic unicorns into co-created experiential objects, embedded with 'authenticity'. Traditional 'craft' produces souvenir objects that are often perceived as more 'authentic' by visitors. (Littrell, Anderson and Brown, 1993) Elements of authenticity are thought to be implicit in craft production processes, materials, workmanship, exclusivity and authorship of the souvenir objects. (Paraskevaidis and Andriotis, 2015) This has been a long held belief, reflected in Redgrave's report of the Great Exhibition in 1851 which argued, 'wherever ornament is wholly effected by machinery, it is certainly the most degraded in style and execution; and the best workmanship and the best taste are to be found in those manufactures and fabrics wherein the handicraft is entirely or partially the means of producing the ornament' (Auerbach, 1999: 136). Handicraft and human touch can therefore equate to extended engagement with the object and a more intimate experience of ownership (Kettley, 2010).

The processes, outputs and experience of 3D printing technologies seem to be in contrast to this. Digital making, particularly 3D printing, engage the maker in a number of ways that differ from 'pure' handcraft or that which has been uniformly 'manufactured' by machine (Rotman, 2012). Pye (1968: 4) defines 'the workmanship of risk' as 'workmanship using any kind of technique or apparatus, in which the quality of the result is not predetermined'. The 'workmanship of certainty' is that 'always to be found in quantity production. The quality of the result is always predetermined before a single saleable thing is made.' It could be argued that 3D printing combines the best attributes of risk and certainty. Through the particular traits of 3D printed making in a shared, informal setting, the public applies 'communicative self steering' (Cornelius, 1988) and personal value to their relationship with the heritage environment and the exhibit.

### **Maker spaces and the concept of 'leisure'**

This project brought aspects of an open, accommodating maker space to the institutionalised setting of the commercial heritage environment. However, the tourist public had entered the heritage environment with a mind to it being a 'leisure' activity, where any engagement or learning would be informal.

Binkhorst (2009: 320) stated that 'during free time people express their quest for ever more unique experiences reflecting their own personal stories.' 'There is also a 'shift towards active rather than passive forms of consumption and an emphasis on living or intangible culture rather than static, tangible cultural heritage in tourism. (Gonzalez, 2008) The fundamental nature of creative tourism seems to lie in activities and experiences related to self realisation and self expression whereby tourists become co-performers and co-creators as they develop their creative skills' (Richards, 2011: 1237). In creative tourist experiences, the host and the tourist mediate authenticity in situ, each playing a role as the originator of the experience. Escapist experiences involve a greater immersion than entertainment or educational experiences. (Tung and Ritchie, 2011) According to Gretzel and Jamal (2007: 7-8) 'play, aesthetics and empathy strongly characterise new creative experiences. Further, stories woven around experiences support meaning creation, which is central to creative experiences'.

Peppler and Bender (2013) state that the maker movement and maker spaces are a diverse movement united by a 'shared commitment to open exploration, intrinsic interest and creative ideas.' Objects made in maker spaces can be, therefore, often social activities, and the learning that takes place is unstructured and has a particular relationship to leisure. (Cunningham, 2017) Maker spaces are related to production, leisure, entrepreneurship and 'creative commons' but the attitude within the spaces does not appear to be motivated by profit. Maker spaces connect the 'do-it-yourself' maker movement, the creative economy and the social reproductive work that makes the spaces feel alternative, 'anti-establishment' and 'radicalised' (Cunningham, 2017: 14). The maker space creates incentives for collective work. Evaluations of the concepts around 'leisure' are therefore important as maker spaces are supposed to be a 'fun' environment for do-it-yourself activities as a form of escape from everyday work. This, in many ways, aligns the maker space to the communal, 'free time' experience of holidays, cultural events and the type of 'creative tourism' intended through this study.

In this study, the heritage public were given a trial of the enabling, active role that being a digital maker allows, in a setting where they were sociable, informal leisure consumers rather than structured, institutionalised learners. Extensive follow on research as to the affect of this experiment may have had on the publics' engagement with the heritage environment was not possible in this project. However, the collected observations seemed to point to changes in the heritage publics' attitudes to their personal empowerment. Firstly, this may have been attributed to their relationship with the 'experienced stagers' of the 3D printing event. Secondly, the public felt that they may have a more creative self expression and a democratic 'say' in the way that the exhibits and environments were seen, mediated and 'owned' and that this might simply be reflected in a 'meaningful' heritage souvenir.

### **The 'pop up' retail ethos and the maker movement**

In this study, the researchers attempted to set up a 'pop up' temporary, simple, maker and retail space, drawing upon aspects of both the maker movement's democratic, enabling environment and principles of 'experiential' retail and concepts of emotional attachment to the souvenir. Through this it was found that many of the traits of the relatively new phenomenon of pop up events and spaces align themselves to the maker culture well and are worthy of further exploration.

Toffler (1981) coined the terms 'prosumer' and 'prosumption' to describe how the transition from the Industrial Age Society (second wave), to the Information Age society (third wave) was giving rise to processes that were blurring the boundaries between producers and consumers. Researchers have used other terms such as co-creation, co-production and collaborative consumption to describe situations where consumers collaborate with companies or with other consumers to produce things of value (Gayson and Humphrys, 2008). Fox (2014: 18) commented that 'third wave DIY draws upon the read/write functionality of the internet, and digitally driven design/manufacture to enable ordinary people to invent, design, make and/or sell goods they think of themselves'. Ritzer and Jurgenson (2010: 13) point out that '[economic development's] early years were dominated by production, especially in the factory. Recently, the focus shifted to consumption (with the shopping mall coming to rival, or even supplant, the factory as the centre of the economy)'. Pine and Gilmore (1999), Richards (2001), and Postrel (2003) all assert that there is a change in consumer behaviour where many consumers do not want to simply buy goods and services, they also look for engaging experiences. According to Gordon (2004), to be successful, pop up retail must create an environment that is highly authentic and experiential, focuses on promoting new product or brand attributes and enables a more face-to-face dialogue with 'brand representatives'. Consumers want more choice, personalisation, and participation in the actual retail experience. This engaged consumer also wants products, communication, entertainment, and marketing ploys that appeal to their senses,

emotions, and stimulate their thinking. They want the process of purchasing to be fun. (Karolefski, 2003). These 'fun' interactions can include 'pop-up retail,' which involves 'sensation-rich and unique experiences that appeal to the growing desire for innovativeness and open-mindedness towards diverse, unique experiences, measured by consumer innovativeness' (Engelland et al., 2001; Midgely and Dowling, 1978; Steenkamp et al., 1999).

With pop up retail, selling products is often coupled with creating theatrical experiences where 'spectacle comes first' (Trendwatching, 2003). It can appear to offer something that is 'limited, discovery-driven and of the moment'. (Marchinaik and Budnarowska, 2014) 'Pop up stores tap into the current zeitgeist, evidenced through flashmobs where retail brands are keen to align themselves with aspects of youth culture.' (Baker 2008). Pop up offers 'massclusivity' (Trendwatching 2003), wherein exclusive no longer means being expensive. Collins (2004) says that 'pop up marketing through pop up retail benefits the customer offers excitement from the novel experience, offers customers exclusive products or experiences, offers discovery or a surprise factor, offers a good way for consumers to learn about and test products, provides desired free samples and services to consumers, helps consumers spend money wisely, engages the consumer on a personal level, and provides entertainment desired by the consumer'.

While buying and selling seem at odds with the ethos of the maker movement, pop up appears to mirror the nonconformist, collective, emotionally authentic attributes of the maker movement, whether this is fortuitous or a cynical, commercial strategy. (Niehm et al, 2015) The temporary, highly personal nature of the event, where the public could interact with digital craft and speak directly to the 'experienced makers', in an unusual environment, added to the publics' experience, memory and value of their heritage visit, reflected in the team's observations and potentially challenging the established traditions of the heritage organisation.

## **Research Design**

The initial study took place in collaboration with Historic Scotland, in Stirling Castle in Scotland, producing 3D printed souvenirs of their visit to the Castle in July and August 2014. A research protocol was agreed with Historic Scotland regarding the collection of data and the use of photography within the Castle, which also adhered to Edinburgh Napier University's Research Integrity procedures. The researchers excluded visitors under the age of eighteen from the interviews and only took a few photos, as there were many families with young children visiting on the days of data collection. The researchers were aware of the research integrity issues surrounding photography of children in public spaces and had adapted their research design and methods accordingly prior to the data collection process. All the interviewees signed a consent form, which detailed the purpose of the project and the use of the information they provided. The souvenirs were produced in a variety of materials and scales and were formed on an Ultimaker 2 portable 3D printer that was set up within the castle next to one of the halls that formed part of a tour.

The researchers invited visitors to take part and then offered them a 3D printed item at the end of the short survey (a unicorn to reflect the Castle's branding). The survey took place in situ to demonstrate the technology and processes involved with 3D printing and to engage the public and staff with the design process of manufacturing a souvenir from start to finish using these technologies.

Closed answer questions were produced which were then slightly modified to reflect feedback from the visitors after the initial pilot study. The questions were informed by the literature review and sought to identify the respondents' previous knowledge and exposure to 3D printers; their impressions of the printed souvenirs, and their willingness to pay and

interest in souvenir personalisation. At the time of the study, and the nature of the collaboration with Historic Scotland and their gift shop, the questions in the survey reflected this, rather than a fuller exploration of the peer process or how the public's perception of the prescribed, conventional characteristics of the heritage environment were challenged.

Questions asked in the survey included:

- Have you heard of 3D printing before?
- In what context?
- What do you think of the printed items as souvenirs?
- If you had the opportunity to personalise your souvenir, is this something you would be interested in? (Anything you saw today when you visited the castle?)
- How much would you be prepared to pay for a 3D printed souvenir?

In total, 139 short surveys were completed on location over the course of four days and responses were also audio recorded to check for accuracy. The printer was set up so that participants could see and hear the items being printed whilst they were being interviewed. After the completion of the data collection process, the researchers also noted their observations of the visitors' engagement with the objects and their interactions with the printer in situ. The participant sample achieved consisted of 75 females and 64 males. 90% of the participants had heard of 3D printing before through public media (The Big Bang Theory sitcom and a news story item of a 3D printed gun were the most frequent associations/references made). Several participants had seen or used 3D printers in their work environment (as designers, engineers, information technology and scientific researchers); others also mentioned the use of 3D printers for a medicine/prosthetics purpose or the construction of aeronautical parts. Some respondents had used 3D printers in their school or had a museum/festival science experience with the printers. Only two respondents owned a 3D printer and one was a prospective 3D printer buyer. A number of participants stressed that although they had heard of 3D printing, this was the first time they were seeing a 3D printer in action. The findings were synthesized including respondents' comments and the researchers' personal reflections and observations of the visitor engagement with 3D printing in situ.

## Findings

In the context of this piece, survey answers and observations relating to the 'value' of the souvenir and the 3D printing experience within the heritage environment, will be concentrated on for their relevance to the challenge to conventional heritage culture. Value will be defined as 'a reflection of the owner(s)/ buyer(s)' desire to retain or obtain a product, introducing subjective aspects to the value of a product.' (Neap and Celik, 199: 181) Appadurai (1988: 70), says, 'economic exchange creates value. Value is embodied in commodities that are exchanged. Focusing on the things that are exchanged, rather than simply on the forms or functions of exchange, makes it possible to argue that what creates the link between exchange and value is politics, construed broadly. This argument justifies the conceit that commodities, like persons, have social lives.' Lin and Wang (2011) suggest that souvenir value lies in its authentic and hedonic characteristics. A selection of responses related to the concept of the experience and souvenir's 'value', from the survey and the observations include:

*It is insane; it is awesome, absolutely incredible. I can feel the ridges, I guess it's how it's done. Being able to create something sounds cool.*

*Pay more for personalisation. Have a hand in the making. Seeing it produced at source is important. It's less tacky, more a souvenir as it's made there and not made in China.*

*I think it would work for people like me who are a bit geeky. The process as well I'm interested in. I would say definitely for me it's important to see it in action.*

3D printing offers the satisfaction of visitors 'crafting' their own souvenir without requiring a full crafting experience that would be more demanding in terms of skill and time commitment. While part of the appeal of this particular study may have been the novelty and 'gimmick' of 3D printing, the combination of potential interaction, machine controllability and serendipitous flaws in process and outcomes appears to make 3D printing an appropriate, innovative tool for creative tourist experiences.

Although the pilot study did not involve visitors personalising their objects apart from choosing from a range of colours, their reaction to the prospect of further interaction, including adding their name or other inscription, choosing different materials, instantly seeing, scanning and printing objects in their immediate vicinity and adding visual elements of authentication of the time of their visit was gauged through the questions and observations. Most participants responded positively to these descriptions of achieving these characteristics through 3D printed souvenirs.

*I'm not really a souvenir guy, but personalised gives you an extra option. If you could insert the personalised into the souvenir then that would be good.*

*The experience itself is not as important. The personalisation would be much more interesting.*

*More value, linking experience to the visit and the personalisation. It's educational.*

*See it happening makes it more significant, personalise it would be great, [the] interactive process makes it more interesting, like a pressed coin.*

*There's as many options as there are ideas. What you see when you go into a gift shop, you've seen before. This is 3D it gives it more realism, it is tangible and I like the fact you can personalise it.*

The visitors' interest in having their souvenirs further individualised through inscription or certification appears to add to their association with the place and date of their experience, engaging them more emotionally with the souvenir object. Dating and inscribing souvenir objects appears to transform objects, in this case made from coloured plastic that may be mass produced, into highly individual, sentimental objects with personal meaning, whose intrinsic value is increased and may fluctuate over time. In addition to this, the potential of using a scanned in version of an object related to the visit, where other people have the same object, can become a 'bespoke' item, bringing notions of individuality and uniqueness. These objects may also be consumed and kept as precious, treasured possessions rather than disposable ephemera.

One of the most interesting observations was the interviewees and onlookers' engagement with the process. One researcher observed, '*people were very interested to watch the printer while it printed and some stood and watched for five minutes or longer without speaking at all. Many people pointed and tried to grab who they were with to also have a look. The general feel was positive and engaged*'. Having the 3D printer present and running appeared to add to the overall experience and added value to what was otherwise described at times as 'just a piece of plastic'.

*A good idea, I like the idea of scanning items and making what you like.*

*Seeing it being printed - watching it in action with the software expert, and a demonstration of what's happening becomes part of the experience.*

*Difference is it is made in front of you - not made in China.*

*I think that kids would love it, because it's modern. Adults would like it but from a novelty factor. Kids will see it as of their time.*

*It's one of the marketing ways. Ivory Tower to common world. Great to introduce technology to the public.*

A few respondents suggested that 3D printed, customisable souvenirs would appeal more to children. Some respondents also highlighted the educational potential of the technology. A few respondents commented on how popularising 3D technologies in a heritage environment was a good way to offer access to novel technology by different audiences.

Bringing the 3D printer and team into the castle space and gauging the audience's reactions to the processes and souvenir outcome appeared to point to additional 'value', of the experience and to the object. The way that the souvenir was valued by the public – engaged with in relation to the castle environment and tourist experience – seemed to point to a divergence in their established ways of thinking about heritage and retail. In situ, pop up digital making, within a historical castle space, and the possibilities offered (albeit hypothetically), of seeing them immediately 'owning' a part of the formalized heritage environment seemed like a popular concept with the audience. The experience and souvenir would appear to be 'valuable' to the public without this personal value directly affecting what is considered valuable to the heritage organization; what is displayed, given prominence or turned into souvenirs to be sold in the gift shop.

## **Analysis**

In this study, the research team experimented with setting up a 3D printer within a heritage environment and gauging the reaction to the potential of visitors creating their own souvenirs of that place (through choice of pre-defined imagery, materials and scale). Even at this time, as with maker spaces, it is feasible that when a simple 3D printer such as the Ultimaker used in this project, is set up within a retail environment, a customer could print out their own design or 'make (almost) anything' (Gershenfeld, 2005). Adding and changing materials are relatively simple as is adding one's own 3D printable file. The more difficult process is the CAD modelling of the design, but in doing this in advance, customers could choose from a range of predetermined designs while still feeling that their 'prosumer' experience of making was personal, participative and authentic.

Through the theoretical and empirical research undertaken on this project, several themes emerged where the motivations and, debatably, the ideologies of the maker movement and 'alternative' maker spaces coincided with that of innovations in the dichotomous institutions of heritage retail and creative tourism. These cluster around ideas of emotional engagement with the objects made, creative and 'magical' experiences, connections between learning and leisure, enhanced opportunities for collective sharing and face to face interaction and new commercial models for prosumption and mass customisation.

Tourist souvenirs largely consist of mass produced merchandise that others have designed and produced for them. The literature on souvenir value has developed because in its current form, souvenir consumption is a passive process. Notions of souvenir 'authenticity' have focused on how close to the 'real' artefact the souvenir item or the significance of the item for the construction of self-identity (Belk, 1992) and associated meaning(s) (Baker et al, 2006). The opportunity to 'craft' your own souvenir alters our notions of identity construction



and associated meanings attached to them. 3D printed souvenirs lead to self-extension through immediate, creative means - they offer further opportunity for self-expression and singularisation. Tourists may 'sacralise' these objects as they hold extraordinary power and carry stronger emotional and affective meanings. (Belk et al, 1991) 3D printing symbolically revises the standard souvenirs.

Visitor interaction with 3D printed souvenirs and their subsequent experience of their heritage environment has been considered in this study. Visitors' ability to choose, add to and change their own souvenir adds their individualism and 'self' to the object. In addition to this, the visitors incorporated individualised emotional investment in the object, which visually signifies a particular artefact, location and time, further bound them to their visit. The souvenirs, therefore, have a positive effect on the visitor's relationship with the heritage site at the time of their visit and their memory of their experience through the souvenir once it is taken off site, as they are personally 'embedded' within the object. In this case, as with pop up retail that is not necessarily in a heritage environment, the experience was further enriched by the public's interaction with the research team and other interested members of the public at the site of the demonstration. This added to the unique, personal nature of their experience.

Through this study, the role of souvenirs have been reappraised as non-static mediators of individuality, memory, sentiment and experience. Despite this study's use of plastic and devices of mass production, the traditional role of the souvenir as a tool of mass consumption is questioned and repositioned as a multi-faceted, controllable, yet serendipitous, personal but co-produced, inexpensive and, at the same time precious artefact.

The way that 3D printing allows for individual, on the spot production of souvenirs also gave a special quality to the memento, meaning that each souvenir was completely unique. It had been made for each visitor at that moment in time, witnessed by them which seemed to give the small talisman even more meaning. Unlike previous research that suggested that the mass production of souvenirs led to a detachment of the visitor from the heritage experience, 3d printing allows for a mass produced but personalised experience that increases the subjective authenticity of the produced souvenir.

The unique nature of the 3D printer, which combines machine with an element of personal interaction, adds meaning to the making and souvenir experience. The 3D printing medium records both hand and machine tool movements as memory traces, further engaging the visitor with the artefact and site. Each product's meaning comes from a specific context that, to the creator, act as a further means of discovery. It can then be that digital making becomes a catalyst for creative expression and experience instead of just a means of production and that digital production with added digital complexities, such as mistakes, ridges and uneven textures, inspired by traditional craft and design processes and historical artefacts lead to interesting souvenirs.

It was found that participants involved in the study valued their souvenir more because of their in situ interaction with the making process and their ability to personalise, adding something of their 'self' to the object and site specific visit. This embedded 'instant individuality' differentiates the 3D printed objects and processes from traditional souvenir consumption and craft tourism. In addition to this, the imperfect nature of 3D printing, including the break downs in technology, glitches and ridges, while 'unromantic', appear to add the realism, interest and authenticity of the object and visitor experience. The meaning of the souvenirs is, therefore, mediated and can change over time, between individuals between objects that have been printed out using the same file. Mass produced becomes highly personal and bespoke with implications for manufacturing methods, engagement and profitability.

As the 3D printer technology, through this study, has shown to have the potential to facilitate changes in society and social organisation, further research will focus on whether it demands a cultural response, whether it has an 'ideology' built in and what affect this technology could have on culture. 3D printing allows for a means of expression in an age when mass media is able to instantly introduce images and cultures, past and present, from all over the globe.

## **Conclusion**

It could be argued that making anything commercial and concentrating a study on a western, relatively affluent heritage audience is relatively limited, as argued by Braybrooke and Jordan (2017: 43) that 'making practices only make sense within the dominant form of early 21<sup>st</sup> century capitalism'. It could also be said that while the 3D printed souvenirs and pop up nature of the 'digital making space' in a castle was unexpected and contradictory to what the tourist audience expected to see, the experiment was designed. In contemporary tourism theory, authentic experiences are highly personal and reflective of the visitors own creative inclinations. (Richards and Raymond, 2000) This project could be described as 'experience delivered in a neat package to make us feel we have discovered it.' (Perlis, 2011) However the use of digital making and shared practices brought to the institutionalised heritage environment, looked at through the lens of a collaboratively made souvenir object, affects ownership of the heritage environment itself. The souvenirs produced, and the interactive way that the public were allowed to participate in the digital making and express their sentiments as to the value of the experience, the object qualities, the object content, the surroundings and the formalised heritage offering gave meaning and profundity to their visit and relationship with the heritage organisation.

Aspects of unregulated 'ad hoc' maker space, that describe a maker identity, such as 'the development of a tool and material sensibility that relies on an extensive engagement and practice with tools and materials to learn how to use them well, how to judge which tools are appropriate for which situations, and to understand how to use available materials appropriately; the cultivation of an adhocist attitude, which involves learning to trust one's intuitions and judgments through a maker process and adopting practical approach to project building and learning; and developing a sense of community engagement with other makers' (Toombs, Bardzell and Bardzell, 2014) were lightly introduced to the heritage environment. While the public were participating in the leisure activity of visiting a historical site, they further experienced the leisure activity of impromptu, personalised, interactive making, as they may have experienced within a hobby led maker space. From the results of this project, it seemed to add to public engagement with the heritage environment and a new dimension to their attitudes on ownership and the value and meaning of their souvenir object.

Digital making and the creation of souvenirs, within 'unlikely' heritage environments and reflecting the visitors immediate aesthetic interests – in this case a historic castle but in further research from this team, within the 'not yet loved' heritage of Brutalist buildings and domestic housing schemes, certainly disrupts the publics' preconceived ideas on tradition and conventions. These include ideas on what the heritage environment is, what souvenirs are, how different aspects of a hobby experience may interact, how digital craft may be considered, peer relationships between 'expert stagers' and non-experts and, most importantly, how the public may have a say in the possession of their experience and surroundings.

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