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Smartphone Guide Technology in Cultural Spaces: Measuring Visitor  
Experience with an iPhone Multimedia Guide in Shakespeare's Church

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## Abstract

Smartphone technologies are now used to deploy audio and multimedia guides in cultural spaces including historic churches. It is important to measure what effect the use of such technologies have on visitor experience of the cultural space and the usability and user experience of the guide. An “in the wild” study was conducted to investigate visitor experience in a historic church, with two versions of a multimedia iPhone Guide and with a traditional paper guide. The Church Experience Scale (CES) and the Multimedia Guide Scale (MMGS) were used to measure experience of 59 visitors to Holy Trinity Church, Stratford-upon-Avon, known as Shakespeare’s church. 40 visitors used an iPhone guide, 21 a free choice version and 19 a guided tour version and 19 visitors used a paper guide. Results showed that participants with a smartphone guide had a significantly more positive visitor experience and spent significantly longer on their visit to the church. There was a significant correlation between length of visit and the Enjoyment, Intellectual Stimulation and Curiosity factor of the CES, but further work is needed to understand the direction of causality in this relationship. The usability and user experience of the multimedia guide conditions did not differ from each other, but the results of the MMGS showed that both guides could be improved in terms of general usability and quality of interaction. Challenges of conducting a study “in the wild” of a smartphone app in a cultural space are discussed.

Keywords: multimedia guides, audio guides, cultural spaces, museums, historic churches, visitor experience, user experience, Church Experience Scale (CES), Multimedia Guide Scale (MMGS)

## Smartphone Guide Technology in Cultural Spaces: Measuring Visitor Experience with an iPhone Multimedia Guide in Shakespeare's Church

### Introduction

Interactive technologies are now part of all aspects of our lives, including our cultural lives. For many years, museums and other cultural spaces<sup>1</sup> have been using interactive technologies to engage with their visitors (Shyam Sundar, Go, Kim & Zhang, 2015). This includes using interactive exhibits, information kiosks, simulations related to exhibits and their contexts, and in particular audio and multimedia guides<sup>2</sup> to permanent collections and special exhibitions. Cultural spaces were early adopters of handheld mobile devices to use as guides for visitors, with the Stedelijk Museum in Amsterdam introducing an audioguide as early as 1952 (Tallon, 2008). Since then audioguides and more recently multimedia guides, have become commonplace in cultural spaces.

The most recent technological development in cultural spaces is the use of smartphones as a vehicle for guides. In some instances (for example at Tate Modern in London), the cultural space provides the device with the guide loaded onto it for visitors to borrow, but increasingly cultural spaces are developing smartphone apps for visitors to download to their own devices. This has a number of advantages for both visitors and those managing cultural spaces. For visitors, it means they can use a device that they are familiar with and potentially browse content both before they visit the cultural space (perhaps to plan their visit) and afterwards (to follow up on items of interest), as well as use it during their visit. For managers of cultural spaces, although there is the upfront cost of developing an app, they do not have to worry about the expense and space taken up by dedicated equipment for guides and the staff required to manage the service, which is considerable. This means that smaller and less well-financed cultural spaces are now considering deploying apps, whereas deploying dedicated guides would not be a possibility.

But what effect do these new technologies have on the experience of visitors in cultural spaces? How can cultural spaces, particularly smaller, less well-financed cultural spaces, evaluate the use of such apps? In our research, we are interested in exploring the usability and visitor experience with technologies in a range of cultural spaces, as well as

supporting those managing such spaces in effective yet cost-efficient evaluation of their spaces and the technologies they have deployed.

In this paper we present a case study of using two short scales to measure usability and visitor experience of technology in cultural spaces, the Multimedia Guide Scale (MMGS) (Othman, Petrie, and Power, 2011) developed to measure the usability and user experience of multimedia guides and the Church Experience Scale (CES) (Othman, Petrie, and Power, 2013), developed to measure visitor experience in historic churches. These were used in an “in the wild” evaluation of a smartphone multimedia guide, deployed by the Holy Trinity Church, Stratford-upon-Avon, the church where William Shakespeare was baptized, where he worshiped when he lived in Stratford-upon-Avon, and where he was buried. As this research was conducted truly “in the wild”, this brought a particular set of challenges and problems, which will also be discussed.

### **Background**

#### **Measuring Visitor Experience in Cultural Spaces**

Visitors have different ways of spending their time in cultural spaces, be it for information discovery, education, or just passing time with family and friends. According to Kimmelman (2001), we go to a museum or other cultural space to “remind ourselves who we are ... [it] serves the pleasures of spirit ... the curiosity” (p1).

As with user experience (UX) in HCI, measuring visitor experience in cultural spaces is a complex undertaking. Some discussions proceed from a purely theoretical perspective. For example, Pallud and Monod (2010) proposed, from a theoretical position, that visitor experience in museums can be understood in terms of context, self-projection, embodiment, re-enactment, historicity and possibilities of being. On the other hand, Pekarik, Doering, and Karns (1999) used data from interviews and surveys to extract the experiences that visitors found satisfying in museum visits. They found that there were four key categories: object experiences, cognitive experiences, introspective experiences, and social experiences.

A number of researchers have made further classifications of the possible outcomes of visits to cultural spaces. Gammon (2003) argues that learning in a cultural space is not merely the acquisition of new knowledge but a range of educational experiences that could fall under one of the five components: cognitive, affective, social, skills development and personal outcome. Gammon added further educational experiences in museums to include

interacting with objects, using interactive guided tours, visiting exhibitions, and attending events in a museum. Hooper-Greenhill et al. (2003) produced another classification, specifically of learning in museums, the Generic Learning Outcomes (GLO), which comprise: increase in knowledge and understanding; increase in skill; a change in values and attitudes; enjoyment, inspiration and creativity; activity; behaviour and progression.

Building on the work of Pekarik et al. (1999), Gammon (2003), and Hooper-Greenhill et al. (2003), we developed a scale to measure visitor experience in museums and other cultural spaces (Othman, Petrie and Power, 2011) using a full psychometric scale procedures (Anastasi & Urbina 1997; DeVellis, 2003). The Museum Experience Scale (MES) is a 20 Likert item scale with four factors: *Engagement* with the exhibitions and exhibits; *Knowledge/Learning* gained from the exhibition and exhibits; *Meaningful Experiences* from the interaction with the exhibitions/exhibits and/or other visitors; and *Emotional Connection* with the exhibits/exhibitions. We validated the MES in a study with 255 participants, who rated their experience of a recent visit to a museum or other cultural space.

### **Technologies for visitors to Cultural Spaces**

For the past 60 years, many efforts have been made to improve the quality of visitor experience in cultural spaces with the use of technology. When audioguides were first introduced, in the 1950s, there was little public domain research as the devices were proprietary, although there may well have been confidential reports (Tallon, 2006). However, with the explosion of mobile devices from the 1990s onward, a growing body of research on the use of technologies for visitors in museums has developed.

Since 1997, the Getty Museum has been making the digital content about its collection available to visitors via kiosks in the galleries and subsequently on guides, the GettyGuides (Hamma 2004a, 2004b; Marshak, 2003). Opperman and Specht (1998, 1999) developed an early personalised location-based museum guide which drew information about exhibits from the Web which would be of interest to visitors with different profiles. Aoki et al. (2002) developed a highly influential guide, *Sotto Voce*, that allowed visitors to share audio information, overcoming the isolating effect of guides at the time. Inspired by *Sotto Voce*, Yatani, Sugimoto, and Kusunoki (2004) developed a PDA-based guide for children in a Japanese museum to support their learning of material for a revised national curriculum.

More recently, a location-based game for visitors was designed for a contemporary art museum using mobile technologies (Manoli, Sintoris, Yiannoutsou, and Avouris, 2015). Other research efforts have included the Blanton iTour (Manning & Sims, 2004), the Tate Modern Multimedia Tour (Wilson, 2004), MoMo (Jaěn, Mocholl, Esteve, Bosch, & Canós, 2005), the Turin MultiMuseum (Cigliano & Monaci, 2003), and the Renwick HandHeld (Larkin, 2004). In addition, researchers and practitioners have investigated the personalization of the guide experience for visitors to cultural spaces. For example, the Cultural Heritage Information Presentation (CHIP) Project developed a range of tools which allow people to be their own curators, plan their own tour, receive recommendations about interesting exhibits to view and quickly find their way through a cultural space (Roes, Stash, Wang, and Aroyo, 2009; Wang et al., 2008).

The recent design of visitor experiences has begun to change how visitors interact with their mobile devices. For example, Augmented Reality (AR) systems have been embedded into mobile apps for cultural spaces. Kounavis, Kasimati, and Zamani (2012) highlighted several AR applications using mobile apps in the tourism industry and how this technology has changed the way visitors interact with the cultural spaces and artefacts. Researchers have also explored how other technologies, such as Near Field Communication (NFC) and Quick Response (QR) codes can improve visitor experience (Ceipidor et al., 2013; Pérez-Sanagustín, Parra, Verdugo, and García-Galleguillos, 2016). However, our study focuses on multimedia guides delivered via smartphone apps, particularly because these allows visitors to access the information about the cultural space and its artefacts before, during and after the visit.

### **Measuring User Experience of Technologies in Cultural Spaces**

Researchers have taken into consideration user experience (UX) when designing and developing guides for cultural spaces. For example, Boiano, Bowen, and Gaia (2012) discuss the different aspects in designing mobile apps for cultural heritage based on their experiences with the Malta Culture Guide App. Andolina, Pirrone, Russo, Sorce, and Gentile (2012) discussed the use of various mobile apps in cultural spaces and how different technologies (e.g. QR codes, AR, virtual reality) may affect visitors' experiences. They also discussed the challenges that many cultural institutions have in developing systems, such as the definition of user experience, selection and production of contents, user localization and routing. A study by Ceipidor et al. (2013) highlights the potential of using NFC technology integrated

with mobile phones that could enhance visitor experience in cultural spaces such as museums.

Ciolfi, Bannon, and Fernström (2001) investigated issues that arise as a result of integrating technology into the physical space of the museum and that need to be addressed to ensure successful interaction between visitors, exhibits and technologies. They discussed the design of the exhibition environment, especially the installation of interactive multimedia that are not close to the relevant artefact, as well as the amount of information available to visitors. They suggested how to reduce the information overload without compromising visitors' enjoyment, fun and other meaningful and an engaging experience.

A particular problem which arises with the use of guides in cultural spaces is visitors splitting their attention between the guide and the cultural space, its artefacts and features. As explained by cognitive load theory (Sweller, Merrienboer, & Paas, 1998), this means that visitors may have less cognitive capacity to interact effectively with the guide and also to interact with the cultural space; this may lead to poorer perceived usability of the guide and a poorer visitor experience with the cultural space. Therefore, it is crucial to investigate the balance between the cognitive load and perceived usability of the multimedia guide and the cognitive load of interacting with the cultural space.

Another problem for visitors is the large amount of information that can be available in guides. This can also lead to cognitive overload and possibly being 'being lost in the hyperspace' of the organization of the information (Otter & Johnson, 2000). Thus, investigating the perceived usability of the content and information architecture of multimedia guides is also important.

### **Technologies for Visitors in Spiritual Spaces such as Churches**

A small number of studies have investigated the impact of interactive technologies in spiritual spaces such as churches, for example the use of technology by the minister in a church service (Grinter, Wyche, Hayes, and Harvel, 2011; Wyche, Hayes, Harvel, and Grinter, 2006). However, these studies focused on the use of technologies for religious practices, for example to improve pastoral care, the religious service, or the means of communication. Our literature review did not reveal any studies that have focused on interactive technologies for visitors to churches or other spiritual spaces for cultural or tourist experiences. Yet many historic churches and spiritual spaces share similar functions with other cultural spaces, in which visitors see the church or spiritual space as a place of historic

or cultural interest, a touristic diversion or a place for learning in an informal setting rather than (or perhaps in addition to) a place of worship or spiritual inspiration.

There are several studies that have explored the emotional connection and spiritual experience visitors have in cultural spaces. For example, Sturken (1991) discussed how the Vietnam Veterans Memorial in Washington DC and its history, objects, images and other features have a profound impact on visitors, as well as the actual design of the memorial. She also focused on what lay behind the design of the memorial, and the significance of the memorial for remembrance of the war. Doering (1999) included spiritual experiences in his classification of visitor experiences in museums. van Dijk, Kerstens, and Kresin (2009) designed a GPS-based walking route called Rituals that connected religious monuments and aimed to support personal spiritual and emotional experiences.

We considered using the MES to measure visitor experience in historic churches, but it may be that the characteristics of visitors' experience are substantially different from those in other cultural spaces. Therefore, we developed a separate scale, again using appropriate psychometric scale procedures (Anastasi & Urbina, 1997; DeVellis, 2003). The Church Experience Scale (CES) (Othman, Petrie, and Power, 2013) is a 20 Likert item scale with five factors: *Emotional and Spiritual Experience* of the church; *Enjoyment, Intellectual Stimulation and Curiosity* in the church; *Immersion* in the church environment; *Information Overload*; and *Knowledge and Learning* from the church visit.

### **Motivation for the Current Study**

The motivation for the current study is the evaluation of visiting an historic church with a smartphone multimedia guide, both in terms of the usability and user experience of the Guide and the visitor experience of the historic church.

We were given the opportunity to evaluate the use of a smartphone multimedia guide for a particularly interesting historic church, Holy Trinity, Stratford-upon-Avon, the church where William Shakespeare was baptized, where he worshipped when he lived in Stratford-upon-Avon and where he is buried. Two versions of the guide had been developed, one a guided tour through the church; the other a "free choice" guide, in which the visitor can choose any point of interest within the church, and receive text, image and 3D information about its location.

The findings from this study should provide a method for less-well financed cultural spaces, such as historic churches, to be able to evaluate new technologies they might deploy

for visitors in an efficient and inexpensive way. The study also highlighted some of the issues of conducting studies “in the wild”, which will be described in the Discussion section.

### **Method**

The study took place at the Collegiate Church of the Holy and Undivided Trinity in Stratford-upon-Avon, England, also known as Holy Trinity Church or Shakespeare’s Church. It is best known for being where the playwright William Shakespeare was baptized and buried and where he worshiped when he lived in Stratford. The church now receives over 200,000 visitors each year, and recently the Centre for Christianity and Culture at the University of York (<http://www.christianityandculture.org.uk/>) created an iPhone-based multimedia guide to the church for visitors, with two versions either free choice (allowing visitors to select points of interest to receive information about) or a guided tour of the church (see Materials and Equipment section below for more detail). This setting provided an ideal opportunity for an ‘in-the-wild’ study of the use of multimedia mobile guides in an historic church.

The research questions investigated in the study are:

1. Will using an iPhone Guide increase visitor experience, as measured by the Church Experience Scale (CES)?
2. Will there be a difference in visitor experience between the two versions of the iPhone Guide (Free Choice and Guided Tour)?
3. Will using an iPhone Guide increase the amount of time visitors spend in the church?
4. Is there a correlation between visitor experience (as measured by the CES) and the amount of time visitors spend in the church?
5. Is there a difference in the user experience of the Free Choice and Guided Tour versions of the iPhone Guide, as measured by the Multimedia Guide Scale (MMGS)?
6. Is there a correlation between visitor experience (as measured by the CES) and user experience of the iPhone Guide (as measured by the MMGS)?

### **Design**

The study was a between-participants design with the independent variable being use of the iPhone guide or not. Two different version of the iPhone Guide were available, Free

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Choice or Guided Tour version, with the No Guide condition, making three levels of the independent variable. The dependent variables were scores on the five factors of the Church Experience Scale (CES), the time spent on the visit to the church, and for the participants in the iPhone Guide conditions, the scores on the three factors of the Multimedia Guide Scale (MMGS) and participants' answers to questions in a short semi-structured interview.

Participants were assigned to a condition depending on whether they had some experience with an iPhone or expressed an interest in trying one (see Participants section below for further detail). If they wished to use the iPhone multimedia guide, they were then assigned randomly to one of the two Guide conditions. Participants in the Guide conditions were given a short introduction to the appropriate iPhone guide before starting the church visit. After their visit, all participants completed the CES and were briefly interviewed by one of the authors. Participants in the iPhone conditions also completed the MMGS about their experience with the iPhone Guide.

### **Participants**

In total 59 visitors to Holy Trinity Church took part in the study, 21 in the Free Choice Guide condition, 19 in the Guided Tour condition and 19 in the No Guide condition. All visitors who entered Holy Trinity Church during a two-day period in December 2011 were approached and asked if they were willing to participate in the study. Participants were offered a modest incentive to participate in the study, a gift voucher to a popular department store worth £5 (approximately USD 7.50 at the time). A small number of potential participants were discreetly rejected from the study, as from initial interactions with one of the researchers their English did not appear to be sufficient to answer the questions required. A small number of potential participants also declined participation, usually because they only wanted to make a very short visit to the church. 93% of all visitors approached were accepted for the study and agreed to participate.

The participants were from a wide range of countries around the world (including Australia, Canada, China, Korea, New Zealand, Thailand, and United Kingdom). 25 participants were women and 34 were men. As this was an "in the wild" study, it was decided not to ask participants their ages as this might have been considered intrusive, but the researchers estimated the ages of participants, and these appeared to range from 20s to 60s. Participants came alone or with family and friends, so made the visit either singly or in small groups. We did not attempt to control that aspect of participation, as this was a study "in the wild".

## **Materials and Equipment**

**The iPhone Multimedia Guide to Holy Trinity Church, Stratford-upon-Avon.** The iPhone Multimedia Guide was developed by the Centre for Christianity at the University of York. The present authors were not involved in the development of the Guide, so the design rationale is not reported as part of this paper.

From the main menu (see Figure 1) visitors can select, amongst other options, either a Guided Tour (from Trails) and a Free Choice guide (from Explore the Interior). Three different Guided Tours are available, but participants in the study were asked to follow Shakespeare's Church Guided Tour which took them through a series of points of interest in the church of relevance to William Shakespeare, for example the memorial to Shakespeare erected soon after his death (see Figure 2). The screens include both combinations of text and images (as in Figure 2) and full screen interactive panoramas of the interior of the church with the point of interest indicated (see Figure 3). The Free Choice guide presents visitors with a plan of the church with points of interest marked (see Figure 4), which they can select in any order they wish; these points of interest lead to the same screens as in the Guided Tour.

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Insert Figures 1, 2, 3 and 4 about here

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**The Church Experience Scale (CES).** A scale of 20 5-level Likert items, yielding five factors measuring visitors' experience of churches as cultural spaces, developed by Othman, Petrie and Power (2013). Scores on each factor are the mean of the items in the factor. The factors of the scale are:

**Emotional and Spiritual Experience (CES-ES)** with the church and its features

**Enjoyment, Intellectual Stimulation and Curiosity (CES-EIS)** from the interaction with the church and its features

**Knowledge and Learning (CES-KL)** gained from learning information about the church, its features, its history and historical connections

**Immersion (CES-I)** in the church as an environment and the experience of actually being in the church

**Information Overload (CES-IO)** with the amount of information provided about the church and its features (this factor in the current CES is based on only one question, which is a weakness which will be addressed in a future version of the questionnaire).

**The Multimedia Guide Scale (MMGS).** A scale 20 5-level Likert items, yielding three factors measuring users' experience with multimedia guides used in museums and other cultural spaces, developed by Othman, Petrie and Power (2011). Scores on each factor are the mean of the items in the factor. The factors of the scale are:

**General usability (MMGS-GU)** of the multimedia guide, for example whether the functionality of the guide is appropriate, whether it is easy to use

**Learnability and control (MMGS-LC)**, whether the guide is easy to learn to use, whether the user felt in control, and whether the information presented in meaningful ways

**Quality of interaction (MMGS-QI)** with the guide, this is often considered part of usability or user experience, but interestingly in this scale, the aspects concerning interaction with and feedback from the guide form a separate component.

A semi-structured interview schedule which included questions about each factor of the CES, as well as information about participants' experience with the iPhone Guide for those in the Free Choice and Guided Tour conditions, brief demographic information and information on a number of issues the church wanted to explore (e.g. reaction to the onsite shop).

iPhones for visitors to borrow pre-loaded with the two versions of the Guide, to save them time of downloading the app.

### **Procedure**

When visitors entered the church, they were approached and asked if they would like to participate in the study. They were told that the researchers were conducting research for the church and the University of York on visitors' experience of the church, with or without a multimedia iPhone guide. As an incentive to participate in the study, they were offered free admission to the part of the church where Shakespeare's grave is located and a £5 (approximately USD 7.50 at the time) gift voucher for a well-known store. Admission to the main part of the church is free, but visitors are asked to contribute £2 (approximately USD 3.50 at the time) to visit the Choir.

Participants in the iPhone Guide conditions were lent an iPhone with the guide already loaded on it. This avoided participants having to waste time downloading the app to their

own phone, as mobile reception in the church was not good. However, participants were given information about how to download the app for free to their own phone later, if they wished to use it again, as it was free. They were given a brief introduction to how to use the guide. Participants were also given a one-page set of instructions to take with them to explain the use of the guide.

Participants in the No Guide condition were given the brief paper guidebook provided by the church and the physical labels in the church about its features to use as their source of information during their visit.

The time that participants left on their visit to the church was discreetly noted, as was the time when they returned at the end of the visit, in order to measure the length of visit.

When they had finished their visit, participants returned to the researchers at the entrance to the church. They were given a copy of the CES to complete by themselves, and if they had been in one of the iPhone Guide conditions, the MMGS. They were then interviewed by one of the authors, debriefed and thanked for their participation and given their £5 gift voucher.

## Results

### Effect of an iPhone Guide on Visitors' Experience of the Church

To investigate the effect of the Guide conditions on the visitors' experience of the church, scores on the factors of the Church Experience Scale (CES) were compared. A one way MANOVA with the three Visit Conditions (Guided Tour, Free Choice Guide and No Guide) as the independent variable and the five factors of the CES as the dependent variables was conducted. (Levene's test of equality of error variances showed that the variances in the five factors did not differ significantly from each other, so a MANOVA was an appropriate statistic). The MANOVA showed a significant mean effect for Visit Condition:  $F(10, 160) = 2.70, p < .005, \eta^2 = 0.21$ . Inspection of the individual variables showed that only the Knowledge and Learning factor (CES-KL) was significant:  $F(2, 56) = 7.57, p < 0.001$ , Bonferroni correction means were needed  $p < 0.01$ ). Orthogonal planned comparisons on the CES-KL scores showed significant differences between the two Guide conditions and the No Guide condition ( $p < .005$ ) and between the Guided Tour and the Free Choice Guide ( $p < .025$ ). The Guided Tour condition produced significantly higher CES-KL scores than the Free Choice Guide (mean Guided Tour: 4.21, Standard Deviation: 0.51; mean Free Choice: 3.75, SD: 0.52, see Figure 5 and Table 1). Thus, using an iPhone Guide had a positive

influence on visitor experience, as measured by the CES, which was mainly due to the CES-KL factor. Both Guide conditions produced significantly higher visitor experience than the No Guide condition (on CES-KL), with the Guided Tour condition producing a significantly higher visitor experience than the Free Choice Guide.

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Insert Table 1 and Figure 5 about here

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In addition, the overall level of visitor experience was investigated for each condition by conducting a series of one sample t-tests comparing the scores on each CES factor with the midpoint of the scale. If scores are significantly above the midpoint, this suggests that participants were having a positive experience on that factor. Table 1 shows that the Guided Tour produced significantly positive results on the CES-EIS, CES-KL and CES-I factors, although not on the CES-ES or CES-IO factors (one would hope that a guide would not produce a significant effect on the latter factor, the guide should not produce information overload). The Free Choice Guide produced significantly positive results on the CES-ES, CES-EIS, and CES-KL factors and not on the CES-I or CES-IO factors. The No Guide condition also produced significant positive results on the CES-ES, CES-ESI, CES-KL and CES-I factors, and a significantly negative result on the CES-IO factor (meaning scores were significantly below the midpoint for information overload). Thus, all visits to the church produced significant Enjoyment, Intellectual Stimulation and Curiosity (CES-EIS) and Knowledge and Learning (CES-KL). However, the Free Choice Tour and the No Guide condition produced significant Emotional and Spiritual Experience (CES-ES) whereas the Guided Tour and the No Guide condition produced significant Immersion (CES-I). No condition produced significant information overload.

### **Effect of an iPhone Guide on the Length of Visits to the Church**

Participants in the Free Choice condition spent an average of 17 min 11s (SD: 6min 30s) visiting the church, those in the Guided Tour condition spent an average of 22 min 35 s (SD: 8 min 30 s) and those in the No Guide condition an average of 13 min 3 s (SD: 5 min 36 s). The mean time spent visiting the church for the two Guide conditions was 19 min 45 s

(SD: 7 min 44 s). To investigate the effect of the Guide conditions on length of time participants spent on their visit to the church, a one way ANOVA was conducted on the time spent between the three Guide conditions. There was a significant difference,  $F(2, 56) = 7.88, p < 0.001$ . Orthogonal planned comparisons showed significant differences between the two Guide conditions and the No Guide condition ( $p < .0025$ ) and between the Guided Tour with Free Choice Guide ( $p < .025$ ).

### **User Experience with the different iPhone Guides and effect on visitor experience of the church**

To investigate the user experience differed between the two Guide conditions, scores on the three factors of the Multimedia Guide Scale (MMGS) were compared. A one way MANOVA showed no significant differences between the two conditions:  $F(3, 36) = 0.72, n.s., \eta^2 = 0.06$ .

In addition, the overall level of visitor experience was investigated for each Guide condition by conducting a series of one sample t-tests comparing the scores on each MMGS factor with the midpoint of the scale. Table 2 and Figure 6 show that both versions of the Guide scored somewhat poorly on the General Usability factor (MMGS-GU), producing scores significantly below the midpoint. However, both Guides also scored positively on the Learnability and Control factor (MMGS-LC), producing scores significantly above the midpoint. On the Quality of Interaction factor, both Guides produced neutral scores, not significantly different from the midpoint.

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Insert Table 2 and Figure 6 about here

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To investigate the effect of the user experience with the Guide on the visitor experience of the church, Pearson correlations were calculated between scores on the MMGS factors and scores on the CES factors. There were significant positive correlations between the MMGS Quality of Interaction (MMGS-QL) factor and three of the CES factors: CES-ES ( $r = .39, p < .025$ ), CES-EIS ( $r = .47, p < .005$ ) and CES-KL ( $r = .40, p < .025$ ). There was also a significant negative correlation between the MMGS Learnability and Control factor (MMGS-LC) and the CES-IO factor ( $r = -.357, p < .025$ ).

### **Relationship between visitor experience and length of visit**

To investigate the relationship between the visitor experience and the length of visit to the church, Pearson correlations were calculated between scores on the CES factors and the length of visit. There was a significant positive correlation between CES-EIS and length of visit ( $r = .32, p < .025$ ) but a negative correlation between CES-I and length of visit ( $r = -.27, p < .05$ ).

### **Discussion**

This study evaluated the use of two versions of a smartphone Guide for the historic church of Holy Trinity Stratford-upon-Avon for their usability and effect on visitor experience and compared the visitor experience with a smartphone guide with a traditional paper guide.

In addressing Research Question 1, using a smartphone Guide did have a significantly positive effect on visitor experience, as measured by the CES, with both Guide conditions producing higher CES scores than the No Guide condition, largely due to higher scores on the Knowledge & Learning factor. Thus visitors felt they acquired more knowledge and learnt more when they visited with a Guide, even though information was available to visitors in the no Guide condition from a paper guide. One of the problems of the “in the wild” situation, was it was not possible to track whether visitors in the No Guide condition actually consulted their paper guide or not, and if they did how much. So it may have been that visitors in the Guide conditions consulted the information provided more than the visitors in the No Guide condition, as the smartphone Guide conditions presented the information in a more appealing way. There may also have been a social desirability effect (Rosenthal & Rosnow, 2007), as participants knew that the study was evaluating the smartphone guides (we needed to tell them that to obtain informed consent), so they may have felt more obliged to use the guides than they might in other circumstances.

On Research Question 2, there was a significant difference in the visitor experience of the two Guide conditions, with the Guided Tour version producing a significantly more positive visitor experience than the Free Choice version. Again, we do not know whether visitors followed the whole Guided Tour, and thus received more information about the church than visitors in the Free Choice condition, the latter may have only selected some points of interest

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to receive information about. In future work we would choose to instrument an app to collect detailed information about which pages of a guide had been accessed and for how long. However, this would not solve the problem of understanding how much the participants in the No Guide condition consulted the paper guide.

Interestingly, all conditions produced significantly positive experiences in terms of the Enjoyment, Intellectual Stimulation and Curiosity factor (CES-EIS) and the Knowledge and Learning factor (CES-KL). However, only the Guided Tour and the No Guide conditions produced significantly positive experiences in terms of Emotional and Spiritual experience (CES-ES) and only the Guided Tour condition produced a significantly positive Immersion experience (CES-I). These results show the advantages of a Guided Tour version of a Guide, which appears to draw visitors more into a fuller experience with the church than the Free Choice Guide in which visitors can pick and choose which points of interest they receive information about. Visitors may well prefer the latter, thinking it will give them greater control, but in fact have a better experience with the Guided Tour, as it is more immersive. Finally, none of the conditions created a significant information overload, a very positive result, as this is a common fear with multimedia guides in cultural spaces.

It was also interesting that in the post-study interviews, the great majority of visitors said that they were expecting to have a purely touristic or cultural experience in the church, and were not expecting to have any kind of emotional or spiritual experience, even those visitors who felt closely connected with Shakespeare. However, a number of visitors remarked that they were surprised how emotional the experience of visiting the church had been.

In relation to Research Question 3, using a smartphone guide increased the time that visitors spent in the church by nearly 50%, from a mean of just under 14 minutes to just under 20 minutes. This result fits with those from a number of previous studies, for example Kuflik et al. (2011) at the Hecht Museum of the University of Haifa in Israel, found that the average time visitors spent in a museum with a multimedia guide was 20.69 minutes compared with 4.96 minutes without such a guide. However, the “visitors” in that study were university students specifically recruited to take part in the study, not real visitors to the museum, so the result lacks a certain face validity. However, a study at Tate Modern in London found that (real) visitors spent more time on their visit with a multimedia tour, although it is not clear how this was established (Proctor & Tellis, 2003). Manning and Sims (2003) also found that visitors with multimedia guides not only spent more time in an exhibition but also showed significantly more learning outcomes from their visit.

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It may be that the more positive visitor experience in the Guide conditions came from the fact that visitors using the guides spent longer in the church (Research Question 4). Therefore, we investigated the correlation between the length of visit and scores on the CES factors. There was a positive correlation between length of visit and the Enjoyment, Intellectual Stimulation and Curiosity factor of the CES. However, this correlation does suggest two possible directions of causation – either visitors who find the church particularly enjoyable and stimulating stay longer, or the longer people stay the more enjoyable and stimulating they find the visit. Further research would be helpful to untangle the nature of this relationship. There was also a somewhat surprising significant negative correlation between length of visit and immersion, so the longer the visit, the less immersed visitors were. Given that immersion is often associated with a loss of sense of time (Haywood & Cairns, 2005), it might have been expected that visitors with high immersion would lose track of time and spend longer than they anticipated in the church. One reason for this observed relationship, very specific to this “in the wild” study, was that it was very cold in the church (it took place on a particularly cold weekend in December), so the longer visitors spent, the colder they became, which would not be conducive to being immersed in a visit.

On the usability and user experience with the Guides themselves (Research Question 5), there was no difference between the two versions of the guide on the three factors of the MMGS. However, scores on general usability (MMGS-GU) were somewhat poor, not being significantly different from the midpoint of the scale for the Free Choice Guide and being significantly below the midpoint for the Guided Tour. Thus, there needs to be more work on developing the usability of the smartphone guides. However, on the Learnability & Control factor (MMGS-LC) both versions of the guide scored significantly above the midpoint, so participants did think the guides were easy to learn to use and they felt in control of the use of the guide. Thus, there are other aspects of the usability and user experience with the guides that need to be addressed. Finally, participants scores the Quality of Interaction (MMGS-QI) around the midpoint of the scale, so there is also work to be done in improving the quality of interaction in the guides for visitors.

As Zhang and Adipat (2005) noted, usability testing of mobile applications has brought a new set of challenges for HCI researchers which require new methods. Applications for cultural spaces, as with other classes of system (see for example, Lindgaard, 2015) also require usability testing in realistic situations of use. However, conducting usability and user experience studies in realistic situations of use, particularly genuinely “in the wild”, imposes many challenges. In this study, the first challenge was that we could only conduct the study

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on particular days and at particular times, when the church was not being used for religious activities (which included weddings and baptisms as well as church services). In addition, although the church is very popular with tourists, the study was conducted in winter, then the flow of visitors was not nearly as high as it would be in summer. So, planning the timing of a study in a cultural space needs careful consideration of such external constraints. Although we had a very high acceptance rate for participation in the study, recruiting participants was not easy and required considerable diplomacy. The researchers had to quickly assess whether potential participants spoke sufficient English to be able to participate, and to negotiate whether participants would be assigned to the Guide or the No Guide conditions.

This situation was helped by two factors. Firstly, we could offer participants a device with the Guide loaded on it. When asked whether they used a smartphone, numerous potential participants said they did, but did not want to take the time to download an app (and indeed, the wifi reception in the church meant this was not possible), but were happy to take a smartphone with the app already loaded. It was very fortunate that there was only one door to the church working, as we were extremely nervous that participants would leave without returning the smartphone, either inadvertently or deliberately. Secondly, we were able to offer free entry to the part of the church where Shakespeare's grave is located, which is the main item which visitors come to see in the church. We also offered participants a gift voucher as thanks for their time and effort, but in this instance, free entry to the church would probably have sufficed. Although we could assign participants one of the two Guide conditions randomly once they expressed interest in a smartphone guide, the assignment to the Guide versus No Guide condition could not be random – those visitors to the church who said they did not use a smartphone, were not interested in trying one or did not want to use a smartphone guide were offered the paper guide to the church, also for free (normally there is a small charge for this guide). Most of those who were offered this condition accepted it. But we do not know whether these participants differ in some particular way related to their choices, which may have affected the results of the study. A final, and very severe constraint on the study, was that after making their visit, participants were very eager to leave the church (not made easily by the cold environment), so it was sometimes difficult to persuade them to complete the two questionnaires, and often difficult to persuade them to take part in the short interview.

For this study we used two questionnaires specifically developed for evaluating visitor experience in historic churches and the usability and user experience of multimedia guides in cultural spaces. Although these questionnaires have good face and construct validity (Cairns,

2013), it means that the results cannot easily be compared with evaluations of other smartphone applications in other domains. Kortum and Sorber (2015) used the System Usability Scale (SUS, Brooke, 1996) in a large scale evaluation of mobile applications for phones and tablets and Lewis (2014) recommends the use of standardized usability questionnaires such as the Questionnaire for User Interaction Satisfaction (Chin, Diehl and Norman, 1988) and the Post-Study System Usability Questionnaire (PSSUQ, Lewis, 1995). While these questionnaires are undoubtedly useful, they were all developed in the 1990s for desktop machines, and interaction with mobile devices is very different. Thus these questionnaires may not capture all the characteristics of modern, mobile interaction. There is a need for both general questionnaires to capture the characteristics of mobile interaction across a wide range of domains, and questionnaires to capture the characteristics of mobile interaction in specific domains.

This study has shown that a large corpus of useful data about a multimedia Guide could be collected in a short period of time (two days with two researchers working at any one time) from a substantial sample of participants. Even if only the questionnaires had been used, and the participants had not been interviewed, this would have yielded very useful information for the organizers of a cultural space, at not a very high cost. We hope that such methods will be useful for the evaluation of multimedia guides for cultural spaces, particularly those who may not be able to afford complex and expensive evaluations.

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**Footnotes**

<sup>1</sup> We will use the term “cultural space” to refer to the wide variety of spaces with cultural and historical significance that are open to visitors, for example archaeological sites, art galleries, historic houses, museums, places of religious and spiritual importance, sculpture parks; this usage is somewhat broader than the GLAM (galleries, libraries, archives and museums) term often used.

<sup>2</sup> We will refer to both audio and multimedia guides generically as “guides”, for simplicity.

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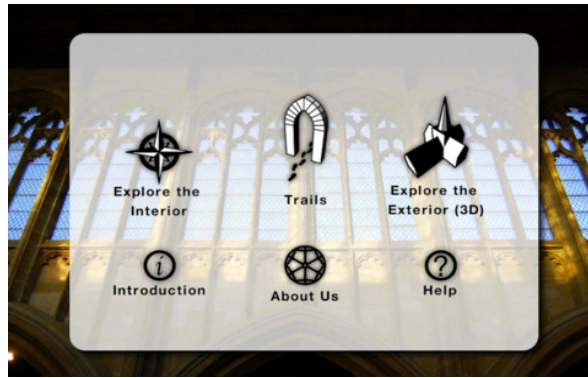


Figure 1. Main menu for the iPhone Guide to Holy Trinity Church, Stratford-upon-Avon

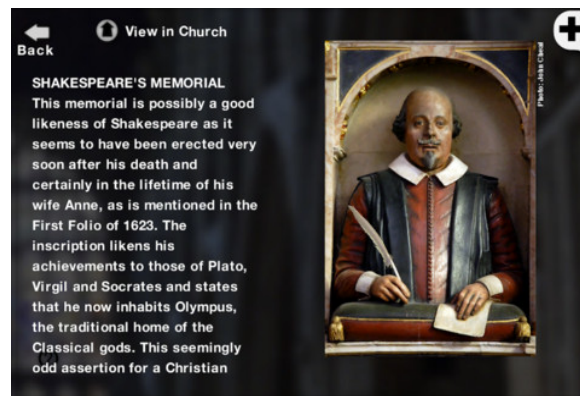


Figure 2. Point of interest screen: Shakespeare's memorial

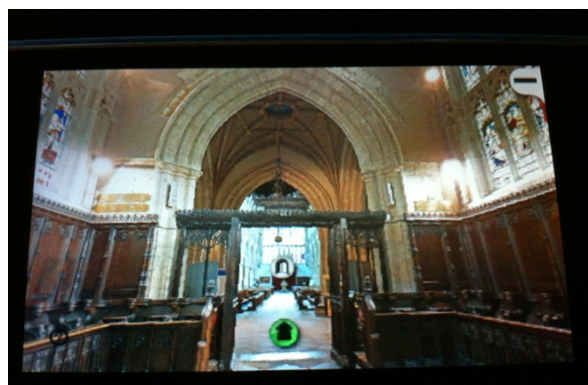


Figure 3. Full screen interactive panorama of the interior of Holy Trinity Church, Stratford-upon-Avon with point of interest icon

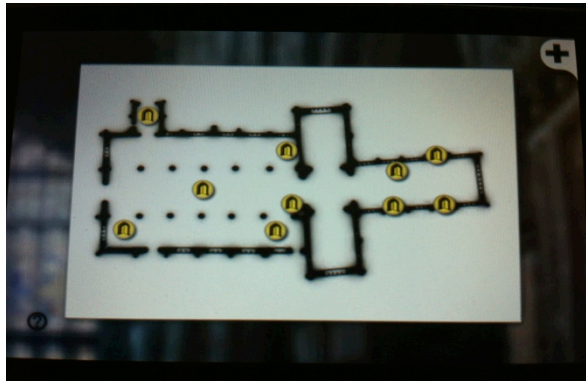


Figure 4. Plan of Holy Trinity Church with points of interest marked

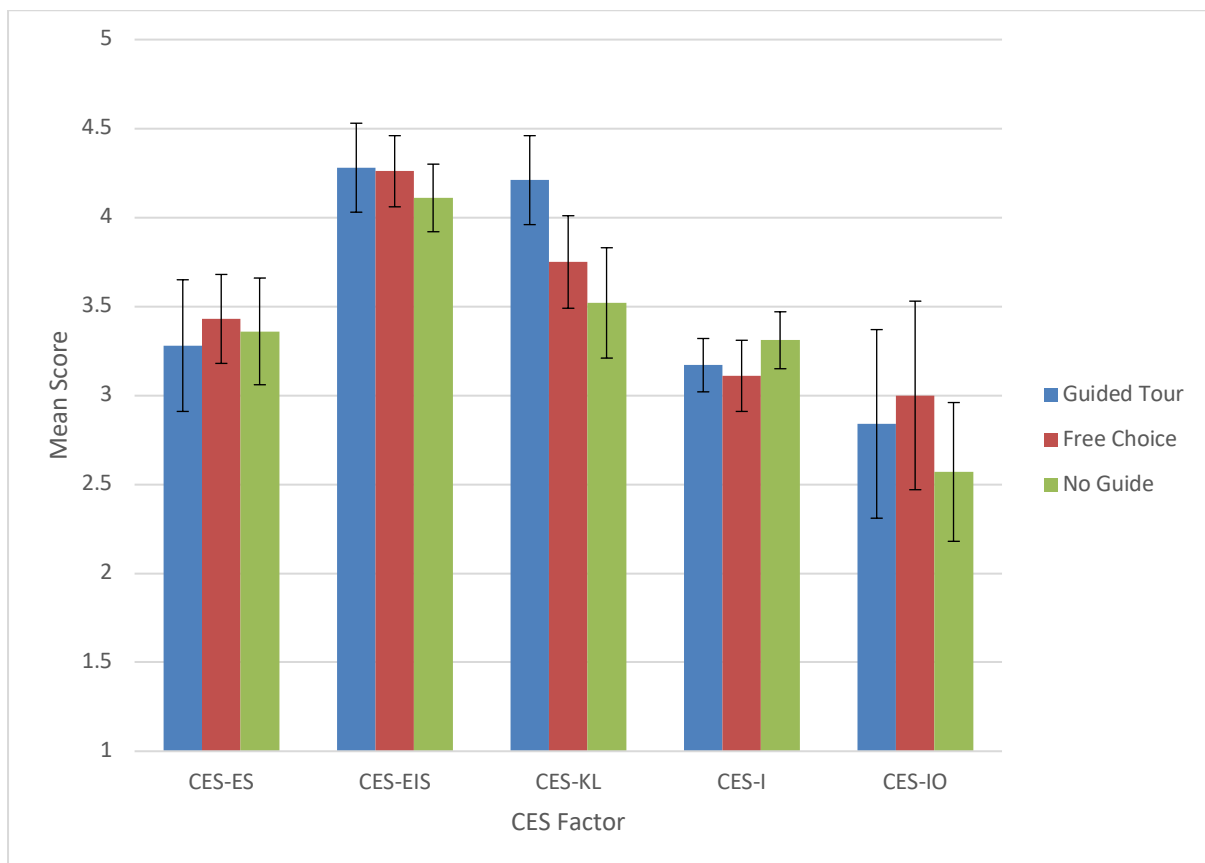


Figure 5. Mean scores on the five Church Experience Scale (CES) factors for Guided Tour, Free Choice Guide and No Guide conditions

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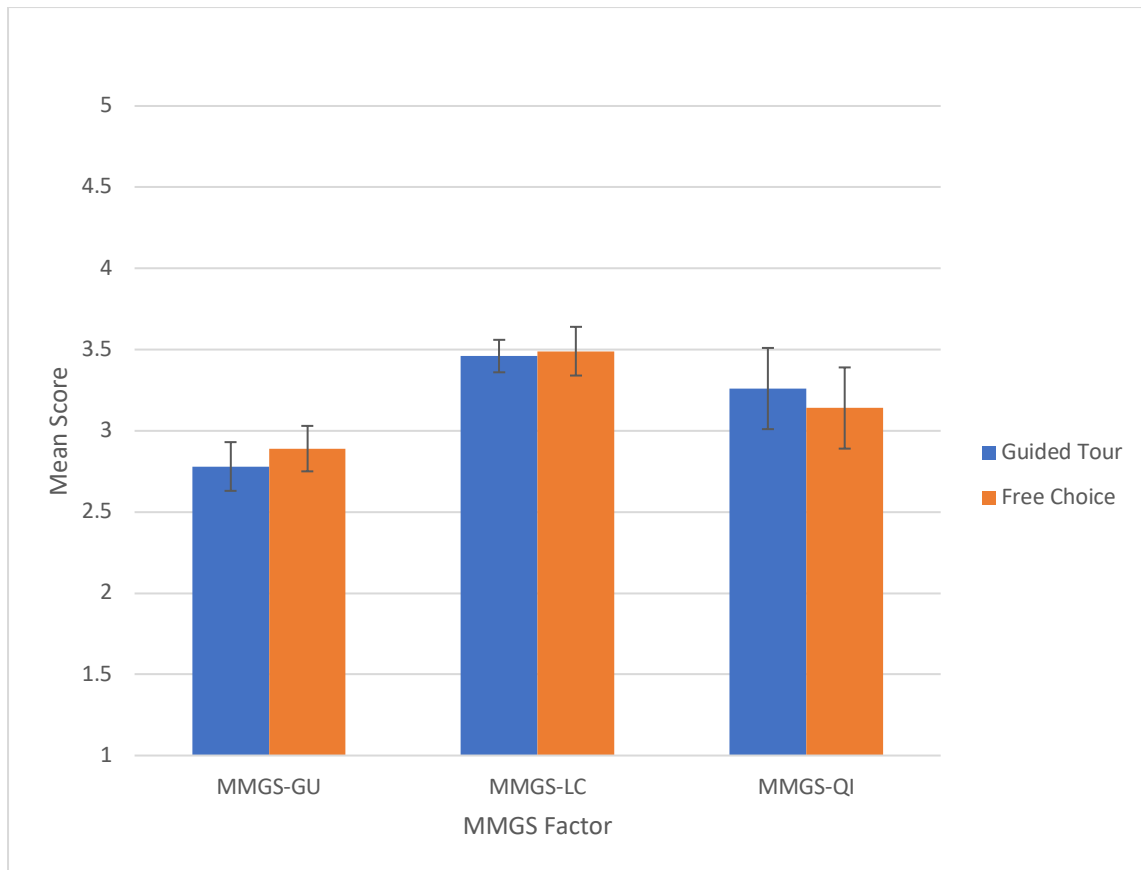


Figure 6. Mean scores on the three Multimedia Guide Scale (MMGS) factors for Guided Tour and Free Choice Guide conditions

Table 1 Analysis of CES factors in relation to the midpoint of the rating scale

CES Factor	Guided Tour df = 18	Free Choice Guide df = 20	No Guide df = 18
Emotional and Spiritual Experience (CES-ES)	Mean: 3.28 SD: 0.73 t = 1.70, n.s.	Mean: 3.43 SD: 0.49 t = 4.11, p < .001	Mean: 3.36 SD: 0.61 t = 2.66, p < .01
Enjoyment, Intellectual Stimulation and Curiosity (CES-EIS)	Mean: 4.28 SD: 0.51 t = 11.12, p < .001	Mean: 6.25 SD: 0.39 t = 14.96, p < .001	Mean: 4.11 SD: 0.38 t = 12.88, p < .001
Knowledge and Learning (CES-KL)	Mean: 4.21 SD: 0.51 t = 10.37, p < .001	Mean: 3.75 SD: 0.52 t = 6.55, p < .001	Mean: 3.52 SD: 0.62 t = 3.68, p < .05
Immersion (CES-I)	Mean: 3.17 SD: 0.30 t = 2.54, p < .05	Mean: 3.11 SD: 0.49 t = 1.05, n.s.	Mean: 3.31 SD: 0.32 t = 4.26, p < .001
Information Overload (CES-IO)	Mean: 2.84 SD: 1.07 t = -0.65, n.s.	Mean: 3.00 SD: 1.05 t = 0.00, n.s.	Mean: 2.57 SD: 0.77 t = -2.39, p < 0.05

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Table 2 Analysis of MMGS factors in relation to the midpoint of the rating scale

<b>MMGS Factor</b>	<b>Guided Tour</b> df = 18	<b>Free Choice Guide</b> df = 20
General Usability (MMGS-GU)	Mean: 2.78 SD: 0.29 t = -3.32, p < .005	Mean: 2.89 SD: 0.27 t = -1.92, n.s.
Learnability and Control (MMGS-LC)	Mean: 3.46 SD: 0.21 t = 9.55, p < .001	Mean: 3.49 SD: 0.31 t = 7.18, p < .001
Quality of Interaction (CES-QI)	Mean: 3.26 SD: 0.59 t = 1.93, n.s.	Mean: 3.14 SD: 0.55 t = 1.18, n.s.