

SHORT PAPER

A Quantitative Analysis of User Interaction and Security Behaviour with Quick Response (QR) Codes

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ABSTRACT

The abundance of quick response (QR) codes in our environments is increasing, yet limited observational research has examined if and how users engage with QR codes in public spaces. Moreover, previous research has relied on estimated measures of visitor traffic to an area, limiting our understanding of real-world QR code-engagement behaviour. The present study addresses this gap, combining entry and exit data with naturalistic observation to examine QR code-engagement behaviour in a UK university library. Of the 7356 people who entered the space where the QR code was displayed, 58 (0.79%) approached the QR code and only 22 (0.30%) scanned it. The QR code directed users to an online questionnaire which measured users' reasons for scanning the QR code and any security precautions users took when interacting with the QR code. The questionnaire revealed that the scanning incentive and curiosity were influential motivators for engagement. Only five users checked the website URL and took security precautions before accessing the link. Thirty-six (0.49%) individuals approached the QR code but did not scan it. Nine of those individuals completed an additional questionnaire after being approached by the researcher, which highlighted effort, inconvenience, and disinterest in the incentive as being influential factors in their decision not to scan. This paper suggests that QR code-engagement behaviour in public settings is low and users generally do not consider security whilst interacting with QR code technology.

KEYWORDS

quick response (QR) code, observational research, QR code engagement, naturalistic observation

1 INTRODUCTION

Quick response (QR) codes are two-dimensional barcodes consisting of a matrix of black and white modules (pixels) [1]. QR codes store a range of information that, once scanned by a device with a camera, directs users to online materials [2]. QR codes are free to generate, quick to deploy, and for many, convenient to use, making

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them a popular tool for both organisations and users in a diverse range of sectors, from retail to marketing to public health [3].

The presence of QR codes in public spaces is predicted to increase [4], and therefore it is crucial to understand if and how individuals are engaging with the technology in real-life environments. Prior research has conducted naturalistic observations to explore QR code engagement in public settings. Early work by [5] reported 61% (of 139) of flyers distributed around Carnegie Mellon University and Pittsburgh, USA, were scanned at least once, and 64% of users reported curiosity as the main reason for scanning the QR code. The authors also reported that only 58% of users who had scanned the QR code had checked the webpage link (URL) to examine where they were being directed to. More recently, [6] found 28 individuals (of 42) scanned the QR code and accessed the link in busy US metropolitan settings (e.g., malls and cafes) without inspecting the URL to assess its authenticity, a concern given the increasing threat of QR code-based fraud [3]. Building on this work, a study by [7] found design characteristics influenced QR code engagement, as individuals were more likely to scan QR codes at a US university campus when the flyer displayed more contextual information (11 of 22) (50%) than just a plain QR code (18%) or a QR code with a simple university logo (32%).

Recognising the global and prevalent threat of QR code phishing attacks (Quishing), [8] extended this body of research into QR code engagement by conducting a real-world Quishing study in Germany. Two variations of posters presenting a QR code, one plain and one professionally designed, were displayed at a research campus. The plain poster was white with little contextual information, whilst the professional poster was designed in blue to increase trust, displayed more contextual information, and advertised the chance to win a voucher. The posters were scanned 51 times, and 30 unique email addresses were entered into the “phishing” draw. Engagement was higher for the professional poster (83% of total scans) than the plain poster (17% of total scans). An additional survey revealed the voucher incentive and professionalism of the poster were important factors influencing QR code engagement; meanwhile, a lack of trust would have discouraged users from scanning the QR codes.

Existing research suggests QR code engagement in public spaces is low relative to the estimated total number of people who could have been present in the area. However, there is no data in previous studies on how many people were at the location and so could have scanned the QR code, making it difficult to establish the true proportion of QR code-engagement behaviour. The studies were also largely conducted in America and Germany, limiting our understanding of QR code engagement to other countries. This paper aimed to address these gaps in the literature. To our knowledge, this is the first paper to combine accurate entry and exit data with naturalistic observation to examine QR code-engagement behaviour in a public setting. It is also the first study to investigate QR code-engagement behaviour in a UK university library. This paper contributes to the literature by calculating a conversion rate of engagement relative to overall footfall. In doing so, it reports a more accurate measure of authentic QR code-engagement behaviour. Furthermore, to address the increasing risk of QR code-based fraud, this paper also examined if individuals considered security whilst engaging with QR codes. The study was pre-registered on the Open Science Framework prior to data collection (<https://doi.org/10.17605/OSF.IO/VYUZ7>).

The following research questions were explored:

1. What proportion of people scan a QR code?
2. What factors influence people to scan a QR code in public?
3. What actions do people take when interacting with a QR code?
4. How aware are people of QR code security strategies and phishing threats?

2 METHOD

2.1 Participants and ethics

A total of 7356 people entered the experimental place (see Section 2.2). Of that number, 58 participants approached the QR code. Among those individuals, only 25 participants provided a complete dataset – 16 participants who scanned the QR code (eight males, seven females, and one non-binary aged between 18 and 59 years old ($M_{age} = 24.44$, $SD_{age} = 10.48$)) and nine who approached the poster but did not scan the QR code (two males and seven females aged between 19 and 29 years old ($M_{age} = 21.78$, $SD_{age} = 3.87$)). For a summary of participants' demographics, see [Supplementary Materials A \(Table S1\)](#).

This experiment was reviewed and approved by the Faculty of Science and Technology Research Ethics Committee at Lancaster University (FST-2025-5295-RECR-2). To ensure authentic QR code-engagement behaviour was measured, participants provided consent for their data after scanning the QR code and completing the questionnaire and debrief sheet. No data was collected from any of the library entrants who did not complete the questionnaire and consent form.

2.2 Apparatus and materials

Setting. The study was conducted in the foyer of Lancaster University Library (see Figure 1). The library was chosen because it measured precise footfall data through entrance gate counts. The foyer was selected because it allowed the poster to blend in with existing displays, ensuring a “natural” setup and that everyone who passed the entrance gates could see the QR code. In line with preregistration, a poster advertising the chance to win a voucher by scanning a QR code was displayed for a total duration of 14 hours between nine A.M. and four P.M. during two weekdays in October 2025. To aid the researchers in measuring engagement in a busy environment, tape was placed on the floor a metre in front of the poster. If a person stepped in front of the tape and paused to look at the poster, the researcher coded this as engagement. The two researchers were seated unobtrusively away from the poster (with a clear view) to not raise suspicion.

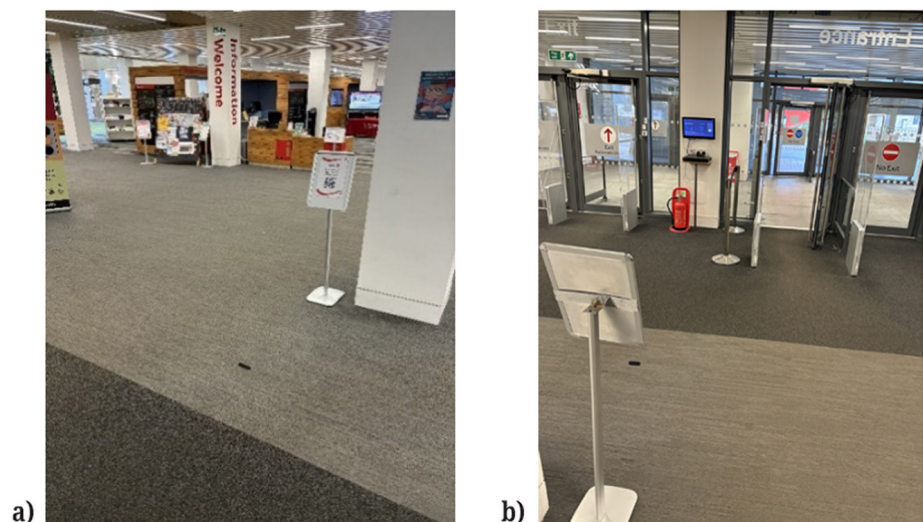


Fig. 1. (a) The experiment setup from an entry-facing perspective, as it would have been seen by participants, (b) The experiment setup viewed from behind and shows the entry's relation to the QR code

Entrance gate. The total number of people who entered and exited the library was measured using the library's entrance gates, which measure visitor traffic in and out of the library continuously. During the experiment, this data was recorded per hour on the hour from nine A.M. to four P.M.

Poster. The poster was created using Canva [9] and printed in size A4. The poster was designed with the university logo and colour scheme to appear credible in the university library (see Figure 2). The poster's context was guided by previous research [8], advertising a voucher prize draw. The poster was designed to be plain to see how many people would scan the QR code and input their personal information (e.g., email address) with little contextual information.



Fig. 2. The poster advertising the voucher prize draw

Surveys. To understand QR code-engagement behaviour, two online questionnaires (see [Supplementary Materials: Section B](#)) were created on Qualtrics [10]. One questionnaire was designed for individuals who had scanned the QR code on the poster and the other for those who had approached the poster but had not scanned it. To start, both questionnaires asked users to confirm they were 18 years or older. The questionnaires then asked participants for their demographic information, frequency of QR code use, attitude towards QR codes, and motivation for scanning/not scanning the QR code. Questionnaire one, for those who had scanned the QR code, asked individuals to provide their email address for the prize draw at the beginning of the survey to maintain the ecological validity of the study. A question timer was included in the survey flow to measure time spent on this page (seconds). Additionally, individuals were also asked about any security precautions they took and their awareness of QR code scams. For questionnaire two, for those who had not scanned the QR code, individuals were asked to provide their email address at the end of the questionnaire and were not asked questions relating to security precautions or knowledge of QR code scams.

2.3 Procedure

Individuals who had scanned the QR code on the poster were directed to a Qualtrics webpage [10] to complete the online questionnaire. If an individual engaged with the poster but did not scan it, Researcher One approached the individual away from the foyer to ask if they would answer a short questionnaire about their decision not to scan the QR code for the same opportunity to win a voucher. To answer this questionnaire, individuals scanned a separate QR code on the researcher's iPad. Participants who completed both the survey and consent form were entered into the £50 voucher prize draw, where two winners were picked using a random number generator.

3 RESULTS

3.1 What proportion of people will scan a QR code?

The total number of individuals entering and exiting the library during the experiment was 7356. Of the total, 58 (0.79%) individuals engaged with the poster. Twenty-two (0.30%) people scanned the QR code on the poster, and 17 (0.23%) individuals submitted their email for the draw, but only 16 (0.22%) completed the online questionnaire and consent form. Thirty-six (0.49%) individuals engaged with the poster but did not scan the QR code. The researcher approached 26 (0.35%) of those individuals, and 15 (0.20%) individuals agreed to answer the questionnaire, but only nine (0.12%) completed it and provided consent (see Figure 3).

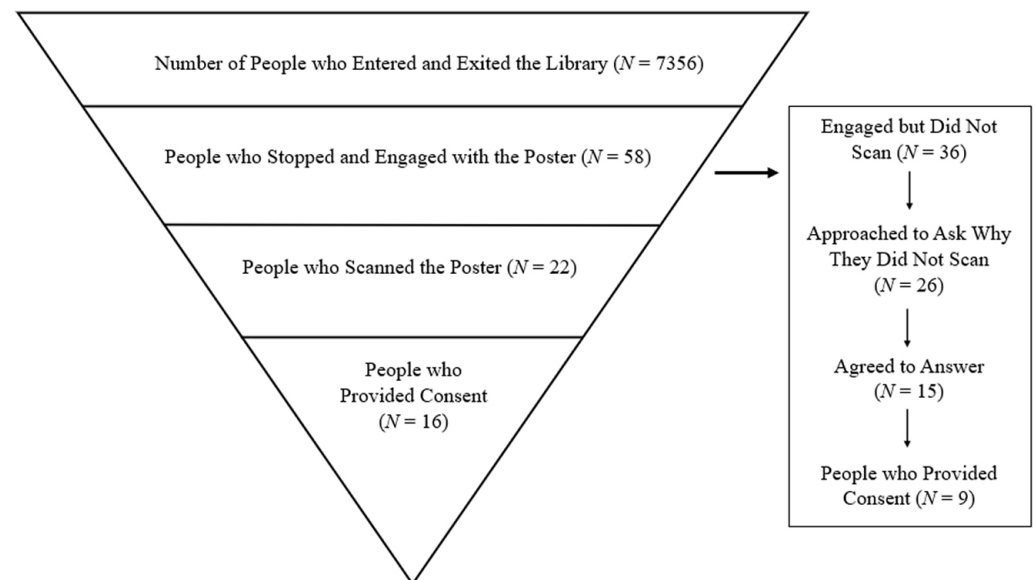


Fig. 3. The attrition of engagement across the experiment

3.2 What factors influence people to scan a QR code in public?

Fourteen (87.5%) individuals highlighted the main motivation for scanning the QR code was the voucher prize incentive. Other reasons included four (25%) mentioning curiosity, two (12.5%) mentioning the legitimacy of the library setting, and

one (6.25%) participant mentioning they had time to scan it. For the individuals who decided not to scan the QR code, six (66.67%) people stated that inconvenience was a large factor in their decision, three (33.33%) individuals mentioned disinterest in the voucher prize draw, and three (33.33%) people felt it was too much effort.

3.3 What actions do people take when interacting with a QR code?

Of the individuals who had scanned the QR code on the poster, only five (31.25%) reported having checked the shortened URL before proceeding to the online survey. After scanning the QR code and accessing the link, users spent an average of 40.54 seconds ($range = 7.90 - 160.53$, $SD = 39.65$) on the webpage before submitting their email.

3.4 How aware are people of QR code security strategies and phishing threats?

Of the individuals who had scanned the QR code on the poster, only five (31.25%) reported having taken steps to check the QR code was secure before scanning it. See Table 1 for a summary of their responses. In addition, only eight (50%) people had reported having heard of QR code scams.

Table 1. A summary of the security precautions individuals reported they took

Yes Responses To “Did You Take Any Steps To Check If The QR Code Was Safe Before Scanning?”
“Scanned the QR code in a private browser”
“Asked library staff if they knew information about the poster”
“I verified the source using a google transparency report”
“Assessed the legitimacy of the QR code by physically checking it and its environment”
“Waited until later in the day to scan it, because if it was unsafe, library staff would have taken it down”

4 DISCUSSION

Studies examining QR code engagement in public settings are limited. This work builds on previous research by combining naturalistic observation with entry and exit data to report a more precise measure of QR code-engagement behaviour. Moreover, it contributes to the literature by being the first paper to investigate QR code engagement in a UK university library.

4.1 What proportion of people scan a QR code?

Overall, this paper found QR code engagement was only 0.30% of the individuals in the library. This suggests QR code engagement is low compared to the high number of individuals entering and exiting the public space. Previous studies have described low QR code engagement in other high-traffic areas like other university campuses [5], [7] and shopping centres and cafes [6] but could not provide a conversion measure of engagement. As the prevalence of QR codes in our public spaces

increases [3], conversion rates of QR code scans relative to footfall of individuals in a public setting will aid users in anticipating how many QR codes need to be advertised or how much time the QR codes need to be displayed for to reach a certain level of QR code interaction.

4.2 What factors influence people to scan a QR code in public?

The voucher prize draw incentive and curiosity were primary reasons for individuals scanning the QR code, which is consistent with previous research examining QR code engagement in public settings [7], [8]. Individuals who did not scan the QR code reported inconvenience to be an influential factor in their decision. In this instance, feelings of inconvenience could be attributable to the experiment setting, as typically individuals' primary focus in a university library is to complete academic-related tasks, not to be drawn away by non-essential activities. Together, these findings highlight how both the purpose of a QR code and the public setting it is displayed in can shape QR code-engagement decisions.

4.3 What actions do people take when interacting with a QR code?

Despite the poster displaying little contextual information, we found that less than one third of individuals who scanned the QR code reported that they inspected the URL before accessing the link. This aligns with research showing less than half of users who scanned the QR code in busy metropolitan settings had studied the URL before opening the link [6]. A lack of action to check the URL is concerning, as they can provide information about where users are being directed to and can aid in detecting phishing attacks [11]. In addition, we found that the time individuals spent on the webpage before submitting their email address varied widely, indicating that whilst some individuals were very quick to engage with the QR code, others took a more considered approach. Finally, we found that the majority of individuals, although not all, who scanned the QR code on the poster, inputted their email address. This suggests that even with little contextual information, individuals are willing to interact with a QR code and submit their personal information. However, it also highlights that not everyone who scans a QR code in a public setting will go on to fully engage with it.

4.4 How aware are people of QR code security strategies and phishing threats?

Few individuals reported having taken steps to verify the security of the QR code whilst interacting with it. Those who had used technological support and considered the legitimacy of the poster in its environment. These actions are encouraging and follow commonly suggested practices aimed to minimise user susceptibility to phishing attacks [12]. Despite the increasing prevalence of quishing attacks in our environments [3], [13], most users overlooked security whilst scanning the QR code, and only half of users were aware of QR code scams. Taken together, these findings underscore users' susceptibility to QR code-based fraud, highlighting significant gaps in users' awareness of QR code cybersecurity. To protect individuals against malicious QR codes, user awareness of quishing attacks and knowledge of security precautions individuals can take to protect themselves need to be improved.

4.5 Implications

This current study indicates that whilst exposure to a QR code can be high in a public library setting, user engagement can be very low. A direct implication of this research is that practitioners can use this information to inform interactive technology training. Specifically, it suggests that QR codes may need to be placed in higher-visitor traffic environments than libraries to achieve more desirable rates of engagement with the technology. Beyond this primary application, this research suggests other broader directions for practitioners; however, these suggestions should be interpreted with caution because of the study's low sample size. Firstly, the findings revealed that the voucher incentive and curiosity encouraged engagement, highlighting that individuals may be more motivated to scan a QR code when there is an incentive. Practitioners could consider making it clear to users on QR code material what the benefit is to engage with the QR code, e.g., an exclusive offer or a beneficial service. Secondly, the findings suggest that feelings of inconvenience contributed to a lack of user interaction with the QR code material, highlighting that QR codes may need to be placed in areas where it is convenient to scan. Practitioners may need to consider positioning their QR code materials in locations that are spacious and easy for users to access and in less task-focused environments than a library.

4.6 Limitations and future research

This experiment was restricted to a university library, limiting the generalisability of the findings to other public settings. To extend our knowledge of how people engage with QR codes in different public locations, future research should extend this study to other public spaces such as supermarkets or train stations that similarly monitor the footfall of individuals entering and exiting the space through entrance gates or ticket barriers. Additionally, due to the location of this experiment, the participants were predominantly students and university staff, limiting the generalisability of the observations to the wider UK population and other international communities. Culture plays an important role in shaping how individuals engage with QR code technology. For instance, in Asia there is a significant focus on using QR codes as a form of mobile payment [14]. Future work should replicate this study in different international settings and locations like train stations and airports to examine how cultural factors affect QR code engagement in public settings. Moreover, the QR code poster was developed within the context of a voucher prize draw, limiting the generalisability of the findings to other contexts of use. Future research could examine if similar levels of QR code engagement are observed for other contexts of QR code material.

5 CONCLUSION

This paper combined accurate entry and exit data with naturalistic observation to examine QR code-engagement behaviour for the first time. In doing so, the findings provide direct evidence of low QR code-engagement behaviour relative to overall footfall (0.30%), addressing a gap in the literature which has previously relied on less accurate estimations of possible visitor traffic in an area. Beyond low engagement, the findings highlight the decision to scan the QR code was influenced by curiosity and

the prize draw incentive, and few individuals considered security whilst interacting with the QR code, a finding that has important implications for user susceptibility to QR code scams. Taken together, this paper demonstrates that whilst exposure to a QR code in a public setting can be high, engagement with a QR code can remain very low, highlighting a clear gap between exposure and engagement.

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