Using Content Analysis to Explore Users' Perceptions and Experiences Using a Novel Citizen First Responder App

Experience Report

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ABSTRACT

Our experience report describes a pilot project that investigates users' self-reported perceptions and experiences using PulsePoint—a novel citizen first responder app. Our study includes analyzing select reviewer comments posted on the iOS and Android platforms and using grounded theory distillation practices to develop an evaluative heuristic/framework. We argue that these comments provide a rich source of untapped data for understanding how users experience mHealth apps from users' perspectives. We propose that the preliminary findings from this study can be used to inform the development and design of mHealth apps in the future from a patient/user-centered perspective, especially those that rely on citizen first responders.

CSS CONCEPTS

• Human-centered computing → User studies; • HCI theory, concepts and models → Smartphones

KEYWORDS

mHealth Apps; Content Analysis; User Experience; Grounded Theory

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1 INTRODUCTION

As mHealth apps have continued to rapidly proliferate so, too, have their uses. For instance, patients can download a wide range of programs on their smartphones that facilitate health promotion behaviors (e.g., diet and exercise trackers and stress management and mindfulness tools). They can also use these technologies to manage chronic conditions like diabetes (e.g., see [1]) and prevent the spread of infectious and communicable diseases. For instance, the citizen science flu-tracking app Flu Near You provides reports in real time from other citizens who are experiencing flu-related symptoms [2].

mHealth apps that rely on such crowdsourced information are becoming increasingly common (e.g., Healthmap, SickWeather), and citizens may be using this information to make particular kinds of health-related decisions (e.g., see [3]). However, the ways that users perceive and experience these emergent digital spaces have not been well explored.

This experience report describes a pilot project that investigates users' self-reported perceptions and experiences using PulsePoint—a novel citizen first responder app. We begin by explaining citizen first response as a concept, then provide an overview of the PulsePoint app. We then describe relevant mHealth app usability research background followed by an exploration of our dataset and methodology and share our preliminary results. We conclude by discussing the potential implications of our results and next steps. We propose that our preliminary findings can be used to inform the development and design of mHealth apps in the future from a patient/user-centered perspective, especially those that rely on citizen first responders.

2 ABOUT PULSEPOINT

PulsePoint (PulsePoint.org) was created in 2010 as a not-for-profit organization, which released two location-aware apps in 2010 designed to work together to reduce deaths from sudden cardiac arrest (SCA): PulsePoint Respond and PulsePoint AED. PulsePoint

Respond is integrated with local emergency services, and sends a smartphone alert (triggered by a 911 call) to users who have registered to provide CPR when someone in their nearby area (within a quarter of a mile) is experiencing SCA (Figure 1; left).

SCA kills 70-90% of people who experience this adverse health event because frequently CPR or defibrillation is not administered in time to save a person's life [4]. Indeed, studies investigating volunteer-based networks of lay-trained CPR responders found that individuals who experience SCA and receive CPR by bystanders showed increases in survival [5].
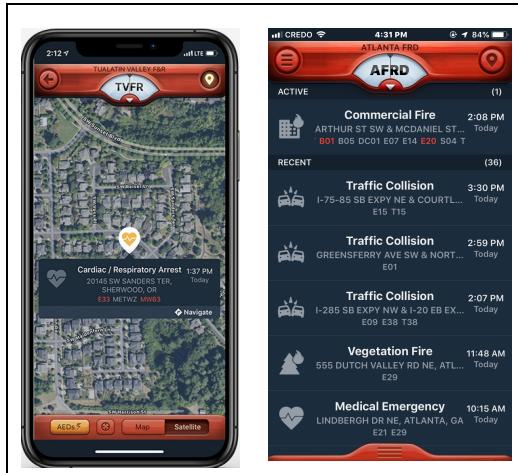
Figure 1: Screenshots of the PulsePoint interface showing a CPR alert (left) and the app's traffic scanner (right) (images used with permission).

PulsePoint AED uses crowdsourcing to document locations of AED machines (Figure 2), which users who respond to an alert for CPR can access, if needed. Using this app, users can view AEDs in their area as well as add machines. This crowdsourced map information is reviewed for accuracy and approval (i.e., vetted) before it is added to the AED app. Users contributing crowdsourced information about an AED also need to describe the AED's location as well as provide a panned image of its location and immediate surroundings.
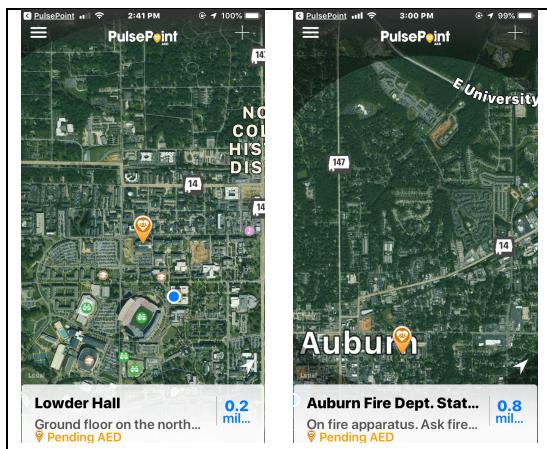
Figure 2: Screenshots of Pulse Point AED (images used with permission).

3. MHEALTH APPS, USABILITY, CONTENT ANALYSIS

Since their inception, mHealth apps have been touted for their potential to improve health outcomes [6,7], particularly when used as intervention tools that can help patients manage chronic illness and conditions like depression [8], for example. This intervention-driven perspective, which focuses on the extent to which the app effectively enables patients/users to engage in behaviors that improve health outcomes (e.g., better manage their blood sugar), also tends to be the main emphasis of usability research on these apps [9,10]. Indeed, this perspective can also be seen in studies on CPR training apps for non-experts [11-13] as well as studies investigating the PulsePoint apps [14,15].

Usability research is concerned with "user cognition and user performance in human technology interactions" [16], which can provide valuable insight into how mHealth apps might better achieve measurable health outcomes. At the same time, this emphasis may also reflect the objectives and interests of developers and creators of these tools—including healthcare providers and other subject matter experts—rather than the needs of patients who may be using mHealth apps to achieve their own health-related objectives and needs. With the shift toward patient-centered medicine [17], participatory healthcare practices [18], and changing notions of patient agency [19], we suggest that better understanding patients/users' experiences and perceptions of these technologies from a broader user experience (UX) perspective [16] presents the opportunity not only to inform the future development and design of mHealth apps but can also lend insight into strategies for making these tools more patient/user centered.

Toward this end, content analysis has been used as a methodology in usability studies on mHealth apps (e.g., see 20,21). However, the focus of such studies has tended toward analyzing the content of the app rather than content from patient/user feedback, for instance. This methodology, we propose, can be used to lend insight into patients'/users' experiences and perceptions of PulsePoint by analyzing reviewer comments posted on platforms where users download the app (iOS and Android). To date, thousands of comments have been posted to these forums, which provides an existing and rich dataset that can be mined for potentially useful information.

4. STUDY DESIGN

4.1 Description of the Dataset

We downloaded comments (n=803) from both the iOS and Android platforms for inclusion in our pilot analysis. Due to technology limitations, only the most recent 500 reviews could be downloaded from iOS, which were posted between Sept, 2016-Feb, 2019 (the date we stopped compiling comments). Therefore, to ensure consistency, we analyzed reviews that we downloaded from Android for this same timeframe. We eliminated comments (both positive and negative) that only gave a general, wholistic assessment/opinion and did not provide specific or substantial detail(s) about the user's experience (e.g., "app works great!" or "very informative"). A total of 289 comments (iOS=228; Android=61) were included in our final pilot dataset.

4.2 Grounded Theory Analytical Approach

To identify trends in reviewers' comments, we used a grounded theory [22] approach to see what themes might emerge from the dataset rather than applying an existing usability heuristic. For instance, PulsePoint positions the apps on their website primarily as a citizen first responder tool, promoting its potential to save lives and encouraging users to engage in "active citizen first response" and to "connect with your community" [23]. However, we noticed early on that in some reviewer comments, respondents self-identified as current or retired emergency response workers. Thus, we classified reviewers as "experts" or "non-experts." Reviewers classified as "experts" self-identified and/or discussed using the app to make, respond to, or be informed about emergency response decisions using terms such as "dispatch" and/or "clear" calls in their review. To illustrate, one respondent observed that the app "used to post at the same time the units were dispatched." Another stated "I use this app at work…to know what units are on calls." Users who did not meet these criteria were classified as non-experts.

We also noticed fairly quickly that rather than discussing using the app to provide CPR, most reviewers focused on their experience using PulsePoint's traffic scanning feature (Figure 1, right; Figure 3). Consequently, the subject matter of most—but not all—comments was related to how respondents used this aspect of the app. Our grounded theory approach allowed us to develop initial categories from reviewers' comments and then further refine these classifications into the heuristic shown in Table 1 as we identified more nuanced themes.

Table 1. Major Evaluative Categories/Heuristic

Category	Definition
Criticism	reviewer critiques the app (provides a general and/or a specific criticism)
Provided CPR	reviewer describes his/her experience(s) using the app to provide CPR
Specific UX Function	reviewer describes how s/he uses the app
UX Improvement	reviewer discusses some aspect of the app that s/he believes needs to be improved
UX Praise	reviewer praises the app (general praise and/or a specific aspect or functionality)
UX Problem	reviewer describes a usability problem

We also developed the following secondary categories in efforts to further clarify reviewers' responses within the main categories in Table 1 when possible:

- Accuracy (comment is about app's accuracy)
- AED (discusses the AED functionality and/or the AED app)
- Audio (comment is about the app's sounds and/or radio feedback)
- Battery (discusses how the app affects the user's phone battery)
- Coverage (comment is about the app's coverage)
- Customization (describes user's customization preferences)
- Decision-making (discusses using the app to avoid car accidents and/or other emergency response sites)
- Design (discusses the appearance of the app)
- Detail (requests that the app provide more information, like include addresses and/or legends for the app's emergency response codes)
- Emergency response decision-making (discusses providing CPR and/or attempting to respond to a CPR alert)
- Function (discusses a specific feature/aspect of the app)
- Map (discusses the mapping function)
- Notifications (discusses the alerts function)
- Police features (asks that police activity be added)
- Privacy concerns/privacy (discusses privacy aspects)
- Platform (requests that the app be available on different platforms, e.g., iPad, Apple Watch)

We used an iterative process to code each of the comments using the main categories in Table 1 as well as to assign the subcategories listed above as applicable. To ensure interrater reliability, all comments were coded twice.

4.3 Limitations and Methodology Justification

Because we did not directly interact with users, our methodology poses several limitations. More specifically, it was not possible to follow-up with reviewers to either clarify and/or to acquire additional information about their comments. Further, using other methodologies—observations and/or user testing, for instance—may have provided a wider and more focused range of information about users' experiences. Finally, reviewer comments are subjective and opinion-based, and thus may not accurately reflect the functionality of the app (in other words, a user might report a particular problem or experience that is unique to that user but is not necessarily reflective of how the app works).

In responding to these limitations, we have endeavored to ensure consistency in our interpretation of user comments through our coding process. Secondly, our methodology does not endeavor to replace other methods like observations and/or user testing but rather to uncover information about users' experiences that may not be procured through more structured approaches. Rather, because reviews are open-ended, users can, in theory, focus on the aspects of the app that most interest them rather than being guided by specific evaluation tasks and criteria created by app developers, which may not reflect users' values and interests and may only emphasize the functional aspects of the app. Our analytical approach for this pilot project focuses on user comments because we sought to better understand users' experiences and perceptions of this tool from their perspective and not to necessarily make recommendations about improving the app's design and/or functionality.

The contexts in which PulsePoint was created to be used (e.g., provide emergency medical aid), too, pose patient privacy concerns as well as logistical challenges in implementing methodologies that include direct interactions with users. In other words, observing someone using the app in a real world scenario is not feasible. Indeed, the studies conducted on PulsePoint referenced in the literature review do not involve direct contact with users but rather use surveys to collect information. Further, the PulsePoint organization collects no personal information about users.

Finally, our grounded theory approach allows for a more user-centered perspective in exploring how users experience and perceive mHealth technologies because this method allowed us to derive our evaluation criteria/heuristic directly from users' experiences.

5. PRELIMINARY RESULTS

PulsePoint is positioned primarily as a citizen first responder app. However, we found that most reviewer comments discussed users' perception of and experiences using the traffic scanner feature. When users launch PulsePoint Respond, the traffic scanner loads (Figure 1, right), and users can then use their touchscreen to select a particular alert, which appears on a map that shows the location of the incident as shown below (Figure 3).
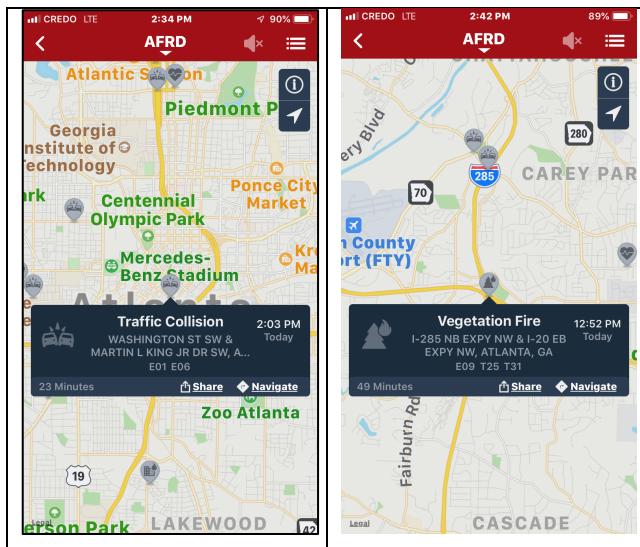
Figure 3: Screenshots of specific alerts—traffic collision (left) and a vegetation fire (right) that can be accessed through the traffic scanner (images used with permission).

The description of the traffic scanner is also less prominent on the organization's website, appearing on the PulsePoint Response page under "Informed Communities" [24]. The Apple Store explains this functionality of the app as follows: "[it] allows you to keep informed of emergency activity occurring in your community in real time. Use this information to know when there is an accident on your commute or if that smoke you smell is an approaching wildfire" [25].

The majority of reviews discussed this feature with only four reviews discussing both PulsePoint Respond and PulsePoint AED.

Additionally, only ten reviews discussed PulsePoint AED; consequently, we do not discuss these findings in our preliminary results. Furthermore, the PulsePoint Foundation responded to reviewers' feedback for certain comments, which was surprising.

5.1 Analysis of Reviewer Comments: Major Categories

Table 2 shows our major subject matter categories and the number of reviewers' responses classified as each. To illustrate, seven respondents reported using the app to respond or attempt to respond to a SCA event (coded as "Provided CPR"). Of these, two reported arriving on the scene after emergency services personnel. Two of these reviewers were classified as experts with the remaining classified as non-experts.

Many reviewer responses were coded as more than one category; therefore, the number of responses below exceed 289. For instance, one reviewer stated: "Site is very useful. I use it to locate fire damage to our fiber optic system." This response was coded as "UX Praise" (because the reviewer stated that the app was useful) and also "Specific UX Function" (because the reviewer described how she uses the app—"to locate fire damage"). As Table 2 shows, UX Improvement, UX Praise, and UX Problem were the three most common categories.

Table 2. Three Most Common Major Categories and Number of Responses

Main Category	Number of Responses
UX Improvement	123
UX Praise	116
UX Problem	112

5.2 Analysis of Reviewer Comments: Subcategories

Table 3 shows the three most common subject matter categories from Table 2 and the five most common subject subcategories. More specifically, the subject matter of most reviewer comments that focused on UX Improvement discussed Coverage, Customization, Design, Detail, and/or Notifications. Conversely, Accuracy, Decision-making, Emergency Response, Function, and Notifications were the most common subcategories for the UX Praise category.

Table 3. Most Common Major Categories and Subcategories

Main Category	Number of Responses for Most Common Subcategories
UX improvement (total=123)	Customization: 18 Design: 26 Notifications: 21
UX Praise (total=116)	Accuracy: 26 Decision-making: 29 Emergency Response: 14
UX Problem (total=122)	Audio: 16 Function: 25 Notifications: 50

As with our major category classifications, many reviewers' comments could also be classified into more than one subcategory. For instance, one reviewer stated:

"As a paramedic I love the information but I believe the details are too generic when identifying a medical emergency. I respect the HIPPA laws but if you were able to rate the medical emergency from a low to high response it would be better information for the first responders. I wish there was more detail in the description."

The above review was categorized as UX Improvement (function, detail) and Criticism (privacy) because the reviewer is citing specific details that can be improved in the app's functionality.

5.3 Analysis of Review Comments: Expert versus Non-Expert Users

Most reviews were classified as written by non-experts (n=205; 69%) with the remainder (n=85; 29%) classified as written by experts. In terms of our major categories (Table 2), the most common category for comments from experts was UX Praise while the most common category for non-experts was UX Improvement as shown in Table 4 below.

Table 4. Number of Responses per Category by Expert and Non-Expert Reviewers

Main Category	Experts	Non-Experts
UX Improvement	36	87
UX Praise	56	60
UX Problem	33	79

As with the full data set, UX Improvement, UX Praise, and UX Problem were the most common categories. The most common subcategories for experts and non-experts are shown in Tables 5 and 6, respectively.

Table 5. Most Common Major Categories and Subcategories (Expert)

Main Category	Number of Responses for Most Common Subcategories
UX Improvement	Customization: 7 Design: 7 Notifications: 10
UX Praise	Accuracy: 16 Decision-Making: 11 Emergency Response: 7
UX Problem	Notifications: 17 Function: 10 Audio: 3

Table 6. Most Common Major Categories and Subcategories (Non-Expert)

Main Category	Number of Responses for Most Common Subcategories
UX Improvement	Design: 13 Coverage: 16 Notifications and Customization: 11
UX Praise	Accuracy: 10 Decision-making: 18 Emergency-response: 7
UX Problem	Audio: 13 Function: 17 Notifications: 33

Interestingly, some experts noted that they use PulsePoint Respond on the job with some commenting that the app was as accurate (if not more so) than the system they were using at work. As one reviewer who self-identified as a firefighter stated: "When our technology in our truck goes down, PulsePoint is always our first back up." Another stated: "Keeps me abreast of the happenings in the area when I am away from my scanner. App is amazingly time appropriate with the scanner, no lag at all. Have not had to respond with an AED or CPR call as of yet."

6. DISCUSSION

In this pilot study, we endeavored to explore these citizen first responder apps from a broader UX perspective, which Law et al. have defined as "dynamic, context-dependent, and subjective" [16]. Indeed, PulsePoint is not a common type of mHealth app because although it is still intervention-focused, it was designed to be used in a very specific healthcare context to address a very specific purpose—connect citizens with other citizens who can provide life-saving care (i.e., CPR) in the event of SCA.

The results from our analysis suggest that most users generally view the app positively, which aligns with a study that investigated citizen support for the app [26]. Further, many reviewers report having positive experiences using the app. While some offered criticism, others suggested specific kinds of improvements, and still others described a specific usability problem they were experiencing, there were still a high number of comments that we classified as "praise." Further, of these, "decision-making" and "accuracy" were the primary reasons that we coded (see Table 3). These findings suggest that for many users, the app effectively allows them to make the kinds of decisions they want to make (e.g., go to the scene of an emergency and offer assistance or, conversely, take a different route to avoid the emergency).

In terms of going to the scene, some reviewers reported using the app specifically because the opportunity might arise for them to provide CPR to someone in need. To illustrate, one reviewer who reported responding to a CPR alert seemed upset that she did not arrive in time to administer aid, and attributed this delay to having to use Google maps rather than being able to effectively use PulsePoint's mapping feature. She stated: "By the time I entered

the info into google [sic] maps and got there, the ambulance was already there. Where is it??? How do I map a location in your app?"

Further, because many reviewers self-identified as experts, we suggest a primary audience of the app may be current and retired emergency response personnel. While it is not possible to know the exact percentage of experts who use the app, the results from studies that sought to improve implementation of the app had a high number of respondents who would be classified as experts (e.g., firefighters, nurses, EMTs; [14,15]) and confirming the findings from our study that experts use the app to make specific kinds of health-related decisions. This finding in particular has important implications for the design of PulsePoint and other citizen first responder apps moving forward because experts may use the app differently and have different informational needs. Indeed, while the three most common reasons that experts and non-experts offered "praise" of the app were the same, there were some differences in the other two categories (UX Improvement and UX Problems). A more detailed investigation is needed to determine if these differences are significant.

Finally, by using a grounded theory approach, we developed an evaluative heuristic/framework informed by users' perspectives, which can be adapted for patient-centered, UX-focused investigations in other contexts in the future. In this way, new theories can potentially emerge about users' experiences and perceptions of mHealth technologies.

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