Full Length Article

Expert or peer? Understanding the implications of virtual advisor identity on emergency rescuer empowerment in mobile psychological self-help services

Manning Li\textsuperscript{a,}\textsuperscript{*}, Zhenhui (Jack) Jiang\textsuperscript{b,c,}\textsuperscript{*}, Zhiping Fan\textsuperscript{a}, Jie Hou\textsuperscript{d}

\textsuperscript{a}Department of Information Management and Decision Sciences, School of Business Administration, Northeastern University, Shenyang 110819, China
\textsuperscript{b}School of Computing, The National University of Singapore (NUS), 117417, Singapore
\textsuperscript{c}National University of Singapore (Suzhou) Research Institute, Suzhou, 215123, China
\textsuperscript{d}School of Information Science and Engineering, Northeastern University, Shenyang 110819, China

A R T I C L E   I N F O

Article history:
Received 11 April 2015
Received in revised form 6 October 2016
Accepted 5 January 2017
Available online xxx

Keywords:
Mobile health advisory services
Psychological self-help systems
Empowerment theory
Symbols of authority
Emergency rescuers

A B S T R A C T

Psychological self-help services on mobile devices play a vital role in supporting emergency rescuers who engage in highly stressful and self-devoting careers with frequent exposure to dangers and traumatic scenes right after disaster strikes. In this study, we propose and design a low-cost and widely deployable strategy for empowering emergency rescuers through an intelligent mobile psychological self-help tool. This tool will help reduce the gap between the limited number of qualified professional counsellors and the high demand for timely psychological support by rescuers. We start with a thorough investigation of user requirements, extant work, and relevant IS design theories to inform our system design choices, among which we identified that “virtual advisor identity” (VAI) needs further research. We then empirically examined how VAI influences the empowerment effect of ERMS. Involving 120 emergency rescuers who have just finished rescue tasks, our experiment shows that VAI has important effects on a user’s cognitive and emotional routines, which is significant empowering enablers that lead to positive empowerment outcomes. Interestingly, virtual peer advisor empowers users mostly through evoking emotional resonance from them, whereas virtual expert advisor is better at empowering users through cognitive channels. Important theoretical and practical implications of the findings are then discussed.

1. Introduction

When a disaster occurs, a large number of emergency rescuers need to react urgently to the situation and rush to the field of disaster. In face of extreme stressors such as catastrophic scenes, disaster victims, and intense workload, there is a high chance (around one-third) that they will suffer from acute stress disorder (ASD), which, without timely and proper intervention, can develop into life-long chronic mental problems [1]. However, due to a lack of qualified psychologists, there are insufficient resources to conduct large-scale intervention strategies in developing countries.

The e-health Task Force Report “Redesigning health in Europe for 2020” recommends that people actively manage their health through virtual devices or tools [2]. More commonly, citizen empowerment through innovative online self-help services is becoming a popular strategy advocated by governments and health agencies in many parts of the world. Further inspired by the recent champions of online psychological therapies, i.e., countries such as UK and Australia [3–5], our study proposes the design of an effective online mental health self-help system to empower emergency rescuers, so that it facilitates their healing, personal growth, and mental well-being, to ensure that they continue their invaluable services to the community. This study is also enlightened by the recent emergence of a large number of virtual advisory services on user mobile devices in many fields [6–9] such as healthcare, travel, commerce, and academia. These virtual advisory services play a vital role in people’s lives by providing timely and effective advice for users to accomplish a variety of tasks. However, limited practical human–computer interaction (HCI) design guidelines are in place to support practitioners in their system design and development, in particular for health advisory systems.

In literature, although there is sufficient attention dedicated to “virtual therapies” alone [4,10–14], very few studies empirically

\textsuperscript{*} Corresponding author.
E-mail addresses: mml@mail.neu.edu.cn (M. Li), jiang@comp.nus.edu.sg (Z. Jiang).
examine the various aspects of the HCI system design implications and the resultant empowerment effects on health consumers. Further, “empowerment,” which means “to give power to” people to actively take the initiative to support or help themselves [15], is shown to be of paramount importance to assist patients in need of psychological and physical support in the healthcare sector [16], to boost the morale of employees in management discipline [15,17], to make the general public more informed and feel transparent about the public policies in the public administration sector [18], and to provide support for the relatively underserved minority or disadvantaged groups in the society [19]. Given that one of the ultimate purposes of having online mental health self-help system is to empower emergency rescuers to actively take the initiative to “self-help” through assessing and managing their psychological well-beings, empowerment theory, which needs more empirical verification in the Information Systems (IS) discipline, is examined further in this mental self-help context. Consequently, there is an urgent need to advance design theories for mental self-help systems from an empowerment perspective in the IS discipline.

In particular, on the basis of our thorough investigation of existing studies, more research is warranted concerning the design characteristics of the virtual advisors, which are popular elements in many innovative virtual advisory systems. Virtual advisor identity (VAI) is considered to be among the most important HCI design factors for intelligent agents in virtual environments, with other factors being facial expressions, body gestures, and speech [20–22]. Few prior studies have investigated the effect of these design factors on user empowerment. A detailed scrutinization and synthesis of popular virtual advisory systems in use in the healthcare domain (cf. Section 2.1.1) also led us to focus on the strategies for adopting different “virtual advisor identity” for rescue empowerment, as have been revealed in our analyses of existing systems.

Motivated by the compelling need in practice and the gaps in the literature, we designed and developed a mobile Emergency Rescuer Mental health Self-help system (ERMS) to provide psychological first aid to emergency rescuers in terms of personalized stress-relief and health-promotion strategies, with high interoperability, ubiquity, security, and adaptivity [23]. Consequently, we research into the following questions:

1. What are the key factors in the system design that influence the value of ERMS?
2. How does VAI affect the empowerment effect of virtual ERMS for emergency rescuers?

To delimit the scope, throughout the paper, emergency rescuers refer to people serving in organizations that ensure public safety by addressing different major emergencies such as tsunami, earthquake, fire, and flood. The “value” of the virtual advisory system refers to the potential service usage outcome that users can obtain from being empowered through positive experiences in interacting with an appropriately designed system. Further, it is important to note that mental self-help systems are frequently used to complement existing psychological resources in the national health framework rather than aim at replacing those health services provided by professionals.

In summary, the present study aims at making the following contributions: from a theoretical and methodological perspective, we propose a theoretically founded innovative approach to address one of the key challenges in postdisaster management. To the best of our knowledge, the ERMS is the first mobile mental health self-help system targeted at emergency rescuers. This study also serves as an interesting example of HCI research for mobile applications that provokes further thoughts on how such studies could be both of high relevance to practice and design theories in the IS field. The impact of VAI on the empowerment effect of mental self-help systems provides insights on how the similarity-attractiveness theory underlies the empowerment processes and outcomes related to virtual advisory systems. From a practical perspective, the results of this study are expected to provide concrete advice on virtual advisor design choices for practitioners working in the area of mobile self-help systems. It also aims at drawing more attention and resources of support from the public and the government for emergency rescuers who are devoting themselves to this self-less career. Most importantly, this research will provide meaningful lessons for the national mental health support network in developing long-term, effective, and large-scale intervention strategies for the long run.

The remainder of this paper is organized as follows. We first present the research background for ERMS, weaving together theories, applicability checks, and user requirements underlying the design of such a system. Next, on the basis of in-depth discussions of research hypotheses, we develop our research model. We then present our experiment results and related important findings. Finally, we conclude the study with theoretical and practical implications.

2. Research background

In this study, we developed a mid-range theoretical model. According to Gregor [24], mid-range models are “moderately abstract, have limited scope, and can easily lead to testable hypotheses” and are particularly important for practice disciplines such as IS (p.616). This process involves the following activities that complement and inform each other: (a) examining relevant literature and (b) preliminary data collection to conduct applicability checks to ground user requirements. This results in constant reflection of the research model along with adjustments in our understanding and refinement of the model.

2.1. Literature review

2.1.1. VAI in virtual advisory systems

For face-to-face advisories, our immediate cognitive and emotional responses after the interaction can be largely shaped by whom we believe we have been talking to and what our perceived “self-presentation” or identities are relative to that advisor [25]. Likewise, in an online advisory session, the identity of the virtual advisor also has important implications for the intervention outcomes of such services, both cognitively and emotionally [20–22].

To ensure the study considers multiple design perspectives drawn from prior research and the industry, we scrutinized a series of virtual health services and psychological health applications in literature and on various platforms, with exemplars shown in Table 1. While existing systems in practice represent the status quo, those systems reported in research labs showcase the trends of development for this field. Drawing on the merits of prior systems, we found that the presence of humanoid virtual advisor is a popular strategy adopted by online advisory systems to support users cognitively or emotionally. During our review, we also noted an interesting phenomenon in VAI design: in many instances, the virtual advisor’s identity appears either as a “domain expert” (e.g., Dr. Schueler in Table 1), providing systematic guidance on people’s well-being [12,26,27], or as a “self-referent character” (e.g., features that explicitly or implicitly pointing to the self, such as “depressed little prince” in Table 1), which can potentially invoke feelings of social presence and experiential resonances during interactions [3,4,6,28]. Correspondingly, we term these two types of virtual advisors as virtual expert advisor (VEA) and virtual peer advisor (VPA) for the rest of this study.

Please cite this article in press as: M. Li et al., Expert or peer? Understanding the implications of virtual advisor identity on emergency rescuer empowerment in mobile psychological self-help services, Inf. Manage. (2017), http://dx.doi.org/10.1016/j.im.2017.01.002
Questions then emerged from these observations: what are the design considerations behind up-taking these different VAls (i.e., VEA vs. VPA), and, in particular, how does VAI affect the empowerment effect of ERMS on emergency rescuers? Nevertheless, consulting prior work, it is not clear which design choices are considered more ideal for ERMS – few prior studies have investigated the potential effect of VAI on emergency rescuer empowerment [29].

As a result, we focus on examining the perplexing issue of VAI in ERMS design from an HCI perspective. In particular, our observation and analysis of humanoid virtual advisors in existing systems revealed primarily two types of VAls, namely VPA and VEA, with interesting and possibly diverse effects on user empowerment through the virtual advisory systems. With these preliminary findings and design questions in mind, we then explored the theories behind this phenomenon in virtual advisory services.

2.1.2. Emergency rescuer empowerment through virtual advisory systems

Empowerment helps people to cope with disaster and deal with challenging environmental demands. It is vital not only for the survival and recovery of disaster victims but also for the quality of life of emergency rescuers [29]. Emergency rescuers are both witnesses and participants in these traumatic events. They are very likely to perceive feelings of disempowerment, including losing their inner emotional control and a sense of powerlessness facing

Table 1
Sample systems in the healthcare self-services area.

<table>
<thead>
<tr>
<th>Source</th>
<th>Virtual Advisor Identity (VAI)</th>
<th>System Description</th>
<th>Sample Screenshots</th>
</tr>
</thead>
</table>
| Depressed little prince [28] depression.edu.hk | Self-referent VPA | Educational tool: self-help guide; discussion groups  
- Provide important and fundamental knowledge of depression  
- Mental health self-assessment  
- Participate in virtual discussion groups to share experiences and gain insights from other users | ![Sample Screenshot 1] |
| FreeMD [4] freemd.com | Domain expert VEA | Decision support tool  
- Dr. Schuler analyzes a variety of symptoms by step-by-step guidance  
- Generate reports on the potential causes of symptoms  
- Help users determine the most appropriate time and place to receive face-to-face healthcare services | ![Sample Screenshot 2] |
| Simcoach [12] simcoach.org | Self-referent VEA | Medical information references and psychological self-assessment tool  
- Provide critical information on psychological health and self-recovery skills via interactive dialogues  
- Information on seeking appropriate care from healthcare providers  
- Options of neurocognitive and psychological testing | ![Sample Screenshot 3] |
| Virtual nurse agents | Domain expert VEA | Tracking tool: Educational tool  
- Educate/counsel hospital patients via interactive dialogues  
- Test patients' comprehension  
- Produce a machine-readable index file, specifying the spatial location of the information that will be discussed  
- Display unresolved issues to human nurse | ![Sample Screenshot 4] |
stressful scenes and challenging work situations on a regular basis [30]. The high stress and the increasing number of suicides among emergency rescuers have recently drawn much attention from government agencies and the society [31]. There is also an increased awareness of research studies and availability of support programs for emergency rescuers. Along with these positive changes, views of mental health and wellness within the emergency service community have gradually transformed over the years. What was once suffered in silence is now recognized as being integral to an emergency rescuer’s health and career.

Table 1 (Continued)

<table>
<thead>
<tr>
<th>App/Website</th>
<th>Domain/Classification</th>
<th>Description</th>
</tr>
</thead>
</table>
| MoodGYM                      | Self-referent VPA     | Psychological testing and assessment, self-help guide  
- Teach the concepts of cognitive restructuring and behaviour therapy  
- Train assertiveness and self-esteem  
- Test depression and anxiety  
- Act as an adjunct to treatment by health professionals. |
| iCoach CBT                   | Self-referent VPA     | Medical information references, tracking tool, self-help guide  
- Help users who have experienced symptoms of insomnia and would like to improve their sleeping habits  
- Guide users to learn about sleeping  
- Develop positive sleeping routines  
- Information on improving users’ sleeping environment  
- Ideal tool for health providers and patients who have symptoms of insomnia |
| The Stress and Anxiety Manager | Domain Expert VEA   | Educational tool, self-help guide  
- Advice on coping with stress and anxiety via multimedia and animations  
- Provide basic information for learning psychological knowledge  
- Provide corporate service  
- Show clients’ feedback and comments in the system  
- Allow users to make appointments online |
| OneHealth                    | Self-referent VPA     | Discussion groups  
- Access to communities (e.g., depression, anxiety and parent support) and network of peer health coaches, expert discussions and group chats  
- Access services from browsers or mobile applications  
- Encourage positive behaviour change  
- Game mechanics  
- Check in ‘emotionally’ to see how other members are feeling |

Please cite this article in press as: M. Li, et al., Expert or peer? Understanding the implications of virtual advisor identity on emergency rescuer empowerment in mobile psychological self-help services, Inf. Manage. (2017), http://dx.doi.org/10.1016/j.im.2017.01.002
sustainability. Emergency rescuers face challenging and traumatic events that can affect their mental well-being daily in an intensive way. A high percentage of them suffer from emotional problems such as anxiety, fear, and depression and are struggling to maintain their inner sense of control and the confidence to face the challenges in their work and continue their rescue career [30–32]. Without proper and timely intervention strategies, these problems may develop into a series of post-traumatic stress disorder symptoms such as sleeping disorder, vomiting, and frequent nightmares or even destructive behaviors such as self-injury, alcohol or drug addictions, and suicidal behaviors [29,31].

Early intervention is key to resolving the current issue. Therefore, emergency rescue empowerment through always-accessible, low-cost, and large-scale ICT intervention strategies helps to ensure the sustainability of this critical public resource, which supports the safety and well-being of the public and the society [29,32]. To empower emergency rescuers through online ERMS means that through the provision of an intelligent psychological advisory tool to assist emergency rescuers in recognizing, managing, and seeking assistance for their mental health issues, they are more prepared to combat the aforementioned issues of disempowerment. Through the resources provided by ERMS, emergency rescuers become more familiar with mental health issues and are also more aware of ways to maintain their inner emotional control and their perceived confidence or power to deal with work challenges, facilitating the general well-being of the rescue career [32].

Empowerment as an identifiable concept originally emerged from the research areas of organizational science and management [33–35], psychology [36,37], and health and nursing [38–40]. The different conceptualizations of empowerment include “to give power to” [33] (p. 666); “to enable people to do things that they would otherwise be unable to do” [41] (p. 37); “encourage them [people] to be more involved in decisions and activities” [35] (p. 9); and “a process by which people, organizations, and communities gain mastery over issues of concern to them” [37] (p. 581).

Specifically, in the context of patient and healthcare provider interactions, empowerment is defined as “a social process of recognizing, promoting, and enhancing people’s abilities to meet their own needs, solve their own problems and mobilize the necessary resources in order to control their lives” [38]. Empowerment theory is said to be applicable to both the micro level (e.g., individuals) and the macro level including organizations and communities, which interact and influence each other. Moreover, at the individual level, the empowerment of people can be achieved by two major dimensions: empowering them through (1) cognitions (e.g., learning new knowledge or skills) and (2) emotions (e.g., feelings of support and affiliation) [33,37,38,42–44].

A thorough scrutinization of relevant literature identified a wide range of theories and factors in system design that potentially affect the value of virtual advisory services [45–53]. However, as suggested by Swearing et al. [53], designers should be clear that they need to focus on the “purported role” of the advisory system, i.e., “it’s primary purpose.” Thus, despite the rich set of design dimensions and constructs raised in literature, we centered our study around the theme of “emergency rescue empowerment” because of its high relevance in healthcare systems and in particular the “patient self-help” domain as mentioned in a number of prior studies [38,54]. In the context of this study, emergency rescue empowerment means to give power to emergency rescuers to self-help through virtual mental health advisory systems to achieve more power and control over their lives. Further, Zimmerman [15] indicated that it is essential to differentiate between two components of the empowerment theory: empowering enabler/processes and empowerment outcomes. Empowering enablers can be viewed as the resources or opportunities that allow patients to control their own fate or influence their decision-making and behavior [15]. Empowered outcomes refer to achieving a sense of control and perceived power as consequences of the interventions or mechanisms designed for an empowering process [15,55], as discussed further below.

a. Empowering enablers

Literature suggests that people such as employees, patients, and consumers can be empowered mostly through two major dimensions, namely the cognitive and emotional dimensions [33,37,38,42–44]. Typical strategies for empowering people through their cognitive dimensions include allowing them to acquire new knowledge or skills and equipping them with capabilities to solve their own problems that they are otherwise unable to achieve [35,38], whereas empowering people through emotions or feelings can be achieved through promoting their feelings of affiliation, support, or other positive affects within a certain context [37,43,44]. Considering the role of ERMS, this above classification aligns well with Benbasat’s [56] idea that IT artifacts are not only productivity-enhancing tools but also enablers of “interpersonal” communications, in which they are regarded as social actors or agents. In other words, except for serving as educational tools (e.g., to acquire knowledge), a rich set of emotive interactions such as human-like behavior, emotions, and personality can also be attributed to virtual advisory services that potentially invoke different user feelings [57]. If appropriately designed, ERMS can not only pass on psychological knowledge for emergency rescuers but also potentially create feelings of social and interpersonal interactions for them. Furthermore, a number of salient studies in the IS field analyzed the effect of virtual advisory systems or web stores on users from two aspects, namely the cognitive and emotional (or affective) aspects [50,58].

Drawing on the above understandings, we investigated the role of ERMS in emergency rescuers’ empowering processes from two major dimensions: (1) the cognitive aspects (e.g., knowledge acquisition) and (2) the emotional aspects (e.g., feelings of social emotional support).

The cognitive aspects of user experiences include the processing of information (e.g., attention and memory), applying knowledge, and changing preferences, which can be a natural or artificial and conscious or unconscious process [59]. In health promotion, the development of the cognitive skills of patients plays a critical role in empowerment and determines the motivation and ability to obtain, understand, and use the information to stay healthy [17]. The social cognitive paradigm also states that people’s cognitive ability has a significant influence on people’s judgment and behavior [60]. Given that one of the primary purposes of ERMS is the effective delivery of psychological knowledge, it is reasonable to expect that the cognitive empowering enablers or processes are primarily demonstrated by users’ enhanced level of perceived understanding and actual understanding of psychological knowledge, which has significant values for the mental well-being of emergency rescuers. Moreover, we study both PU and AU to differentiate between people’s own perception and the actual knowledge obtained, which allows for a comprehensive understanding of how the ERMS passes on knowledge to users. Similar approaches have been demonstrated to be effective in digging more insights behind complex problems of inquiry [48]. To elaborate, perceived understanding reflects the extent to which the knowledge is considered easy to read and understand [61]. This can be enhanced through appropriate service delivery mechanisms such as choosing a suitable style of presentation of the information content and providing animations or live examples in explanations [62]. Emergency rescuers with a higher level of PU of psychological knowledge are more likely to feel empowered through this cognitive empowering process. In contrast, while using a virtual advisory system, actual understanding reflects a user’s actual absorption of knowledge, which potentially influences
the subsequent application of this knowledge. Prior studies have shown that information contents that originate from authoritative sources can promote users’ actual understanding of advisory contents [63], which subsequently influences users’ confidence and effectiveness [64]. Therefore, from the cognitive dimensions, we consider both perceived understanding and actual understanding as among the key empowering enablers that affect emergency rescuers’ empowerment outcomes after using ERMS.

From an emotional perspective, social-emotional support is a well-established strategy for the empowerment and healing of people with mental problems to regain a sense of control and power over their lives [44]. Obtaining social companionship (i.e., social presence) and empathy (i.e., experiential resonance) are the two most important elements to attain empowerment affectively [44,65,66]. For example, traditional mutual help groups are found to be extremely effective in promoting a sense of empowerment for people [67]. Support from peers or similar others can help people obtain emotional relief and resonance through sharing similar experiences or confusions; this can create empathy and support, fostering [55]. The demand for such emotional support from ERMS, including a sense of social presence and feelings of experiential resonance, has also been raised by emergency rescuers [32]. To elaborate, social presence refers to feelings that “an artifact is perceived as sociable and some power is vested in the person interacting with it” [68]. People have a higher sense of involvement and companionship when interacting with human-like elements in a virtual environment, which results in a sense of social presence [45]. This is also reflected in the requirements elicitation process, in which emergency rescuers wish to communicate with a virtual advisor who can make them feel warm and sociable. In addition, experiential resonance is another important emotional empowering dimension examined in this study. It describes the ability of information to move through available affective channels to the client, subsequently invoking the client’s mental models about themselves [69]. Social interactions, through availability of rich mediums, are found to enhance users’ sense of resonance [69]. Moreover, resonance or empathy can also be evoked by performing similar actions or experiencing a similar emotion [22]. Thus, emergency rescuers are expected to go through ER during their interactions with virtual advisors in ERMS, especially when the advisor exhibits similar traits in a number of important dimensions. In summary, we consider social presence (SP) and perceived experiential resonance (ER) the two key elements of the user’s emotional empowering aspects after using ERMS.

b. Empowerment outcomes

Sense of control and perceived power, which are considered the two key dimensions of empowerment as raised by Zimmerman [15], are critical for forming a sense of “emotional safety” for emergency rescuers when dealing with external threats such as catastrophic scenes or inner threats such as stress or depression [70].

A number of studies have shown that when people become empowered during a certain interaction process, they perceive a greater sense of self-control over their mental conditions or life values and generate greater power or confidence toward challenging situations [15,16,36,37]. If appropriately designed, the cognitive and emotional empowering processes through ERMS are also expected to reduce emergency rescuers’ feelings of helplessness [59], subsequently allowing them to gain more control and power over their lives [16,67]. Therefore, we focus on “sense of control” and “perceived power” as the two primary dimensions of empowerment outcomes to be assessed in our research model.

In summary, in the scope of ERMS being a virtual advising system in the health domain, we have taken an empowerment theory perspective in examining the effectiveness of our system design. This rationale is also supported by “emergency resucer empowerment,” a core theme underpinning the idea of designing ERMS, to empower rescuers with readily available psychological knowledge and feelings of social support to boost their inner sense of control and perceived power toward future work challenges.

2.1.3. Virtual advisor identity and empowerment

Identity has been viewed by many theorists as “the joining point” between an individual and the society. It occurs in any communication or interaction in which a person internalizes on a self-ascribed role and projects these understandings onto the other communicator [25]. During social interactions, people’s cognitive and emotional responses are frequently manipulated by the identity of the other interaction party, just as you may respond differently to advices offered by your friends than those offered by your parents. The same holds for online interactions. A very recent study on online P2D (Patient–2–Doctor) community uncovered that patients consider information from physicians and peers as two distinct sources and that they value both sources differently [71]. In particular, patients regard physicians as authoritative experts who are able to provide “reliable” and evidence-based information based on scientific research, whereas advice from peers is considered to be experience-based information, which results in more personal reflections or self-resonance.

To further explore what different VAs (e.g., VEs and VPAs) mean for ERMS user empowerment, the “symbols of authority” and similarity-attraction view in literature provide unique lenses that help us uncover users’ underlying cognitive and emotional reactions toward virtual health advisors with authoritative or similar identities.

“Symbols of authority” are frequently reported to lead to mental shortcuts that make people believe that they should be listening to the party exhibiting these traits, including behavior, manner, title, appearance, and others [46]. Hewgill and Miller [72] found that the same communicator when manipulated to dress up in Professor style gains more appreciation and trust from message recipients than when dressed up in high school sophomore style. Participants also perceive the message content as more credible. Another interesting study by Bickman shows the “social power of the uniform.” In their study, they showed that a person imposed as a security guard to ask strangers to do things achieved more compliance than a person wearing normal clothes [73]. Hofling et al. revealed that the title of “Dr.” was a compliance-gaining device for effective persuasion [74]. In particular, uniforms are recognized symbols of authority that can potentially bring about monotonous compliance [46]. In real life, emergency rescuers are people who frequently need to follow instructions from their officers or group leaders to ensure a rescue task being performed effectively. We expect that when the virtual advisor appears in VEA style, users are more likely to accept and follow the persuasive message and psychological knowledge, which potentially leads to better empowerment outcomes including heightened sense of perceived power toward work challenges and better inner sense of control.

In contrast, the similarity-attraction view states that individuals are attracted by persons who share similar character traits with themselves [75]. People who are similar can get along well with each other and improve mutual understanding, which can result in spiritual and emotional support. In Theories of Human Communications, Littlejohn and Foss [25] state that when communicators discover similarities with each other, “their attraction to one another goes up, and their apparent need for more information goes down” (p. 131). A number of researchers have investigated similarity theory in different contexts such as facial similarity, personality similarity, behavior similarity, decision process similarity, and communication style similarity [25,46,76,77]. Nevertheless, few studies have focused on the influence of identity
similarity on system users in the IS discipline. To elaborate, identity similarity means that people share similar social identities, as a result of which they might have suffered from similar experiences that could enhance their feelings of social rapport or support [78]. In our study, emergency rescuers can consult a VPA who has gone through similar difficulties or distress in their work. The helpful advices from a virtual fellow mate who shares his/her own experiences on effective ways of dealing with troubles and problems in an online environment can bring users emotionally closer and create feelings of social presence and experiential resonance [44]. Moreover, peer support is of pivotal importance to personal empowerment: interacting with a peer advisor can strengthen people’s personal competence, self-determination, and social engagement [67]. Consequently, by interacting with a VPA that potentially evokes feelings of social presence and experiential resonance, emergency rescuers are expected to feel empowered, having more self-control over inner emotions and more confidence or power in dealing with external challenges in social environments [78].

Given the above theoretical backgrounds, we found it important and interesting to scrutinize empirically how these two types of VAs affect the empowerment effect of ERMS.

2.2. Exploratory reality check to ground user requirements

As an integral part of the research process, conducting “reality check” (a.k.a., applicability check) prior to the core part of the research activities was advocated in the seminal work by Rosemann and Vessey [79]. When carried out prior to the core research activities, this approach helps to ensure the research problem “was grounded in practice.”

To ground our study in user requirements, we interviewed 10 emergency rescuers randomly chosen from a fire brigade in a large city in China. The average age of the participants was 25 years. When we arrived at the interview site, we were told that because of the specific nature of the occupation, most of the onsite rescuers are male. Thus, our interview participants were all male. Eight participants were senior high school graduates and the other two participants were college graduates. Their working experiences in the rescue field ranged from 2 to 10 years. In addition, all reported that they had accessed the Internet through both personal computers and mobile phones. A semi-structured and in-depth approach was taken to interview each emergency rescuer on their psychological needs in their work contexts and their requirements for ERMS [80]. Each interview lasted for 30–50 min. During the interview, we centered around two major issues: (a) reality checks on the problem context to explore whether there is any actual need for psychological support from emergency rescuers. Typical questions included the following: “How do you feel after completing your rescue tasks?” and “Do you think the current supporting strategies from your organizations are sufficient in this aspect?” (b) What do emergency rescuers need from ERMS to empower them? The core questions include “What do you wish to see in an emergency rescuer mental self-help system?” and “How do you want such a system to help/support you?” After data collection, the transcribed interview data were analyzed, following the procedures of qualitative data analysis proposed by Corbin and Strauss [81,82] (Appendix A, Table A2). Two coders independently conducted the coding of the transcript. The Cohen’s Kappa scores averaged 0.82, indicating a high level of inter-coder reliability according to Landis and Koch’s criteria [83]. On the basis of the feedback from the respondents, the major findings have been summarized as follows.

a. Reality checks on the research context

First, the need for ongoing emotional support for the rescue occupation has been raised. Emergency rescuers, especially novices, frequently experience negative emotions such as fear, anxiety, insecurity, and even the related symptoms of physical discomfort (e.g., vomiting or apopleisis). A number of them frequently felt upset or experienced reoccurring nightmares in which the traumatic scenes are reproduced after rescue tasks. They report feeling worse when alone or at night. Existing mental health supporting strategies are neither timely nor sufficient to address these issues. In addition, while being exposed to traumatic scenes or after completing difficult rescue tasks, some of them had occasions of feeling powerlessness or losing confidence toward their future work challenges. The participants also mentioned that some people resign from rescue careers or change their role/positions because of the great psychological pressure they encounter.

Second, emergency rescuers are currently lacking ready access to appropriate psychological self-help knowledge. A few traditional intervention measures have been taken by their organizations, such as paper-based screening tests and award ceremonies, to boost rescuers’ morale. However, emergency rescuers call for more readily accessible psychological support, such as ongoing self-assessment and tailored advice to maintain their psychological well-being. Many have limited psychological self-help knowledge and biased views such as “bearing with these negative emotions” is the only way to resolve their psychological unfitness. Further, most new recruits have not received sufficient formal training on mental health prior to beginning rescue tasks. They mainly rely on themselves or talking to more experienced peers to alleviate their negative emotions.

From this reality check, we identified the compelling need from emergency rescuers for more readily cognitive and emotional support and confirmed that the current situation urgently calls for large-scale intervention strategies targeting emergency rescuers’ psychological well-being.

b. Requirements for ERMS

To address these aforementioned issues, respondents felt that for ERMS to be truly empowering, the following requirements should be met, as summarized below.

First, in terms of cognitive empowerment through ERMS, they proposed that ERMS should be able to provide tailored professional psychological knowledge targeted at the rescuer occupation, displaying this information and knowledge in a lively and intuitive way, as text, video, or animation, to facilitate their knowledge acquisition and understanding. In addition, ERMS should also have psychological self-assessment functions and capabilities to generate personalized health evaluation reports for further reference to “empower” them to have a better understanding of their own situation, which they otherwise normally would not be able to achieve. Emergency rescuers also mentioned that it would be good to incorporate into the ERMS the functionalities of monitoring emergency rescuers’ physical and mental indices using mobile devices or portable hardware devices. They also raised the idea of displaying psychological information that reflects the mental status of rescuers intuitively in the form of graphs or column diagrams, providing timely and effective practical advice.

Second, to fulfill their needs of emotional empowerment through ERMS, they commented that ERMS designer should take note to include functions that can help with adjusting the psychological pressure of rescuers, including (1) feelings of human warmth and accompany, and (2) emotional support and resonance from those who share similar occupational experiences with them. For example, they reflected that the company of an always-available, friendly and intelligent virtual advisor would give them more control over their emotional status and confidence in dealing with negative emotions and work challenges. Moreover, some rescuers suggested social networking functions, while highlighting the importance of protecting their privacy.

Finally, what forms a difficult, yet interesting, design choice is that some emergency rescuers suggested having a counselor-type
virtual advisor (i.e., VEA), whereas others preferred having someone with similar experiences to interact with (i.e., VPA). There is no consensus among these rescuers. Further, it remains unclear how VAI affects the aforementioned empowerment effect of ERMS for emergency rescuers. Therefore, the effect of VAI (VEA vs. VPA) on the value of ERMS needs further exploration.

Given these feedbacks from emergency rescuers during the reality check, we are confident in the high relevance and value of this research. Moreover, through subsequent user requirement elicitation for ERMS, we identified how ERMS can empower emergency rescuers both cognitively and emotionally. We also noticed an important design concern of VAI that potentially affects the above value of ERMS and thus needs further empirical examination. Our preliminary interview results align very well with those in the literature in that the main identified concepts conform to our theory predictions. To elaborate, in terms of cognitive empowerment, emergency rescuers need a good understanding of psychological knowledge facilitated by such a system. While for emotional support, emergency rescuers are longing for a sense of accompany (i.e., social presence) and empathy (i.e., experiential resonance) from such an intelligent advisory system. Therefore, we analyzed user experiences with ERMS surrounding these key concepts underpinned by empowerment theory in our research model.

3. Research model and hypotheses development

As discussed in the “Research Background” section, the virtual advisor’s identity appears either as a VEA, who delivers knowledge in the style of a domain expert, or as a VPA, a self-referent character providing support as a peer worker. VAI is deemed an important aspect of the system design choice for affecting the intended empowerment outcomes of a psychological self-help system. Yet, for this relatively under-researched topic, more attention is warranted to understand the potential effects of VAI on user perceptions. From the exemplar systems in Table 1, we can see that “self-referent” features, which usually appear in forms of virtual advisors sharing similar identities with the users, can potentially attract users and enhance their feelings of familiarity, support, and experiential resonance. On the other hand, systems that use “domain experts” with authoritative or professional images are shown to have the potential to provide users with systematic guidance that can enhance their understanding of psychological knowledge. The implications of VAI for ERMS design are discussed in each hypothesis in further detail below.

ERMS aims at empowering emergency rescuers both cognitively and emotionally. Thus knowledge is one of the most important resources to equip emergency rescuers with the necessary cognitive skills to cope with difficult situations. Perceived understanding in this study refers to how informed the user felt that he or she is on the knowledge learnt through ERMS. Literature has shown that in contrast to non-professionals, knowledge provided by experts is regarded as more authoritative and professional [71]. Prior studies also raised that people frequently “embrace the short cut of assuming that people who simply display symbols of authority should be listened to” [46][46] (p.460). A number of interesting empirical studies also revealed that people would think higher of and follow those who dressed up with uniforms that show more authoritative identities such as professors or security guards [12,72]. As a result, the majority of people are likely to perceive knowledge provided by experts as more acceptable [84]. Further, compared with peers’ advice, experts’ advice can facilitate users’ trust in information with increased sense of transparency [85]. Therefore, people tend to perceive that they are more informed about the knowledge being transferred to them through expert advisors than peer advisors. Consequently, we anticipate the same holds for emergency rescuers while interacting with virtual advisors.

H1. In contrast to VPAs, emergency rescuers’ PU of the psychological knowledge provided by the mental health advisory system is better with VEAs

In comparison with perceived understanding, actual understanding refers to how much actual knowledge users have grasped by using the virtual advisory system. A number of empirical studies have proved that there is a gap between PU and AU of knowledge (Southwell et al., 2012). While PU resembles more of the user’s satisfaction, AU represents how much exactly the users have learned. Assessing the users’ AU of knowledge through quizzes or tests is a common consensus among educators and researchers; we have therefore used the same approach in this research. In literature, the reputation of the sources of recommendation agents is reported to influence users’ acceptance of the tool and the advice, including the recommended agent’s competence, benevolence, and integrity in users’ perception [63,86]. There is also a social norm that people in general would regard those who seek for expert advice as more competent than those seeking advice from non-experts [87]. In addition, significant increase in advice utilization has been observed when the advice source (i.e., the advisor) has higher level of task-related expertise [86]. Literature has also shown that knowledge that is systematically elaborated by an authoritative source can satisfy patients and promote more in-depth AU of the knowledge [12]. People would also achieve better performance through accepting experts’ advice than with non-professional sources [86]. Hence, it is likely that emergency rescuers process knowledge provided by VEs with more serious attitude and cognitive effort than for those provided by VPAs. Moreover, when emergency rescuers form positive perceptions toward the online advices given by credible sources such as experts, they are more likely to digest and follow the advice to a greater extent and achieve good learning outcomes [88]. Thus, for emergency rescuers, who are frequently trained to follow instructions from officers and authorities in their occupation, it is expected that they will accept and digest the psychological knowledge from VEs in a more in-depth way.

H2. In contrast to VPAs, emergency rescuers’ AU of the psychological knowledge provided by the mental health advisory system is better with VEs

Social presence refers to the users’ feelings that the virtual advisor in ERMS is perceived as “sociable, warm, personal, or intimate when interacting with it” [68]. The existence of humanoid virtual advisors can potentially make individuals perceive that they are coexisting with other social beings [89]. When appropriately designed, this addresses one of the primary emotional needs of emergency rescuers: feelings of having human support, warmth, and accompanying. Abundant literature suggests that individuals enjoy communicating with people with traits similar to themselves [25]. This is because during social interactions, people have an anxiety to reduce uncertainty about the other party so as to predict his or her behavior and other relevant consequences of this interaction. Similar personal traits such as body gestures, dressing styles, and social identity help to eliminate this uncertainty and tend to bring people closer emotionally [25]. In contrast, authoritative figures such as VEs are more likely to generate emotional distancing. Prior studies have also revealed that users perceive stronger SP when interacting with advisors with similar backgrounds such as ethnicity and similar decision processes [46,90]. Similarly, we expect that for emergency rescuers who are seeking for emotional and cognitive support from ERMS, VPAs will make rescuers perceive more rapport and human
warmth than VEs and are therefore expected to enhance the users’ feelings of social presence.

**H3.** In contrast to VEs, VAs will result in higher sense of SP for emergency rescuers while using the system

Perceived experiential resonance refers to people’s perceptions that the virtual advisor in the system shares traits of similar personal experiences as they themselves have gone through. Thus, they are considered as “in-group.” The special feelings of having gone through similar events or things in life can greatly facilitate the formation of a relationship of mutual understanding, trust, and agreement [25]. “I have gone through similar things in life” is considered to be of utmost importance while establishing rapport with emergency rescuers. People who share similar experiences, expertise, or preferences have similar interpersonal traits [91], which can arouse a sense of emotional resonance. Prior study also demonstrated that performing similar activities or experiencing similar emotions or situations can evoke interpersonal resonance among people [22]. By interacting with a peer advisor, emergency rescuers have the feeling that this advisor has a high degree of overlap and commonality with them, such as in beliefs, expectations, perceptions about career goals, and professional knowledge. Goal similarity was also demonstrated to have positive effects on interpersonal attraction in literature [92]. In addition, shared understanding can help in bringing people together, particularly by establishing rapport, commitment, satisfaction, and longevity in collaborations [93]. Therefore, if emergency rescuers consult a VPA who is considered to share common career goals, understanding, and experiences with them, they are likely to feel more ER during the consultation process. Hence, we expect that VAs can positively influence perceived ER compared with VEs.

**H4.** In contrast to VEs, emergency rescuers perceive VAs as more capable in triggering their ER while using the system

(Inner) sense of control in this context refers to emergency rescuers’ belief that their voluntary activity of using ERMS can have a positive influence on their inner mental status such as becoming more calm and emotionally stable Sense of control is said to be closely related to people’s thought patterns, emotional arousal, and changes in behavior [50] and is therefore considered as one of the most important empowerment outcomes for emergency rescuers. Gibson sees empowerment as a social process through which people mobilize the necessary resources to obtain sense of control of their own lives. In this process, people proactively recognize, promote, and enhance their own abilities to fulfill their own needs and solve their own problems [38]. While using ERMS, emergency rescuers actively mobilize their cognitive resources (i.e., knowledge learnt from virtual advisors) to gain a better sense of control over their inner status.

Literature suggests that perceived mental transparency enables users to enjoy a high level of sense of control [50]. This is because perceived clarity about what will be experienced and what the process will be like potentially leads to greater predictability and consequently greater sense of control [94]. Moreover, actual knowledge acquisition as a result of using an advisory system significantly affects users’ sense of control [95]. Knowledge has been demonstrated in healthcare literature to significantly increase patient’s sense of control [96]. Furthermore, one key assumption underlying empowerment theory is that acquiring psychological skills or information can enhance patients’ sense of autonomy, self-efficacy, and self-awareness [16]. Given that ERMS is a knowledge-based resource that allows emergency rescuers to conduct self-help with autonomy, we expect that such a cognitive support can make emergency rescuers feel more calm and emotionally stable, i.e., a higher sense of control over their inner emotional status. Thus, we expect that both PU and AU of psychological knowledge can contribute to a better sense of control over their inner mental status for emergency rescuers.

**H5.** Improvement of PU will increase emergency rescuer’s sense of control

**H6.** Improvement of AU will increase emergency rescuer’s sense of control

Emotional support is also of paramount importance for emergency rescuers in developing a sense of inner control over their mental status. Studies have shown that is a significant antecedent to users’ behavior and attitudes in the context of virtual worlds [97] and that individuals perceive more self-control while experiencing SP [98]. Similarly, when emergency rescuers perceive a higher sense of human warmth and companionship by interacting with the virtual advisor in ERMS, they are more likely to develop a sense of inner strength and control. Moreover, sense of control can also be enhanced through self-referent mechanisms [99], a core mechanism for invoking personal ER. This happens as a result of reflecting on one’s own situation upon witnessing or listening to other people’s stories in similar contexts. It is found in literature that people perceive more sense of control and support while sharing common experiences with each other on social networking sites [70]. Prior research has also uncovered that

![Fig. 1. Research Model.](image-url)
shared languages and codes in social networks are positively associated with a sense of control [100]. We thus expect that feelings of heightened ER while interacting with ERMS will lead to a higher sense of control as perceived by emergency rescuers. Therefore, we hypothesize the following:

**H7.** A better sense of SP will increase emergency rescuer's sense of control

**H8.** A higher level of perceived ER will increase emergency rescuer's sense of control

(External) perceived power in this study is defined as rescuers' sense of confidence to mobilize the motivation and cognitive resources and course of action in dealing with external difficulties and challenges [101]. In contrast to sense of control over inner emotions, perceived power focuses more on rescuers' outward reactions to external threats or tasks.

Informativeness or PU is a key element during the empowerment process, which can enhance people's perceptions of their power and self-efficacy [15]. A number of studies have demonstrated that messages with high transparency are more persuasive and effective in building confidence and are therefore expected to be more effective in increasing emergency rescuers' perceived power after using the system [25,102]. To elaborate, when emergency rescuers perceive that they have developed a clearer understanding through ERMS on questions such as why they are experiencing certain mood swings and how to actively manage their mental well-being, they are more likely to feel more powerful toward upcoming work challenges. Moreover, equipping emergency rescuers with actual psychological knowledge or self-help expertise is also expected to have a positive effect on their perceived power. In healthcare settings, patients feel empowered through acquiring knowledge from experts, which allows them to be actively involved in self-care [12]. It is also found that high-quality advice, which enhances the extent of AU, makes users of recommender systems feel more confident and comfortable [46].

**H9.** Improvement of PU will increase emergency rescuer's perceived power

**H10.** Improvement of AU will increase emergency rescuer's perceived power

Emotional support from empathetic virtual advisors can be an effective facilitator of learner interest and confidence. Prior studies have indicated that stronger SP can help boost people's positive emotions, in particular self-assurance or confidence [103]. As specified by Cummins, SP of an online learning community can empower student learning outcomes [104]. Specifically, positive SP enhances social persuasion and positively affects and increases the level of learners' confidence [105]. Hence, we expect that a stronger sense of SP, i.e., feelings of human warmth and support, can strengthen emergency rescuers' perceived capability to overcome dilemma and handle challenging situations in future rescue tasks. Further, studies surrounding people's perceived power indicate that individuals can obtain a higher level of confidence from similar others with ER [106]. For example, researchers would gain more confidence when they meet regularly with other researchers in social work to share their experiences and insights [107]. Survivors who were traumatized by the experience of natural disasters such as bush fire benefited greatly from the experience sharing and encouragement of group members in terms of letting out emotions and building confidence [108]. Similarly, virtual advisors who can trigger a user's ER are considered as "in-group" by emergency rescuers, and thus, it is easier for the virtual advisor to probe the emergency rescuers' true feelings. Encouragements and advices from "in-group" advisors, who are considered to share common emergency rescue experiences, strongly boost the rescuer's perceived power in dealing with challenging situations. Consequently, it is expected that both SP and perceived ER are expected to positively influence users' perceived power.

**H11.** A better sense of SP will increase emergency rescuer's perceived power after using the system

**H12.** A higher level of perceived ER will increase emergency rescuer's perceived power after using the system

Individual differences play an important role in people's perceptions and behaviors when using IS [109–111]. Goldberg classifies personality into five aspects: agreeableness (AG), conscientiousness, openness, extraversion, and neuroticism [112]. AG is most concerned with orientations of ER [113]. Moreover, this dimension tests persons' traits of trusting, generous, sympathetic, cooperative, aggressive, and cold [114]. In other words, AG to a large extent assesses whether people are welcoming or hostile, which is very likely to affect their reactions toward advice given by VEAs or VPs. Therefore, we consider the individual character, in particular, AG as a moderating variable that potentially affects the dependent variables in our research model.

From the above discussions, we propose our research model for the virtual ERMS (see Fig. 1).

### 4. Experiments

#### 4.1. Participants

The participants were 120 emergency rescuers, serving in a remote country border area that the research team arrived at after traveling a long distance. The experiment was conducted in meeting rooms. Of the 120 participants, 83.6% had performed a rescue mission and all of them were male. The average age was about 20 years, and 99.2% were not married. In total, 60.5% of the participants had completed senior high school education, 34.2% had completed secondary school education, and the remaining 5.3% were college graduates. In addition, 22.8% of the participants had installed healthcare applications on their mobile phones, and 29.8% reported experiencing mental health dilemmas to consult. We sampled our respondents from this distant area because this region had just experienced serious floods, and these emergency rescuers had just returned from their emergency tasks when we arrived at the site.
4.2. Experiment system descriptions

The ERMS was designed involving two versions of VAs that were tested in our research model: VPA and VEA (Fig. 2). On the basis of the (1) analyses of the extant literature in the IS discipline, including existing systems in practice and research laboratories, and (2) semi-structured and in-depth interviews with emergency rescuers, we designed and developed the mobile ERMS, a tool that addresses the psychological needs of emergency rescuers whenever and wherever they wish to access such support. More technical details of the ERMS and other exemplar screen shots are shown in Appendix A Table A3.

ERMS was deemed to be an ideal experimental tool because we could easily manipulate and control for different design aspects according to our experimental design. To realize two practical identities (i.e., VEA vs. VPA) in the current application context, we treat the virtual advisor’s identity as a unity encompassing qualification symbols of their appearance along with the respective customized language such as apppellations and greetings they use in their conversation addressing their identity. This is based on findings from literature that identity can be established by appearance and addressing of identity in the language [115,116]. It is also important for the addressing of identity in the language to conform to the actual identity to avoid ambivalence and psychological discomfort so as to address each interlocutor in a meaningful, natural, and believable way [115–117]. Except for the above manipulations surrounding the identity changes, all advisory contents were held consistent to ensure rigor of the experiment design. Moreover, we fully considered the different gender options for the virtual advisors. Consulting literature, Qiu and Benbasat [90] have advised a strategy of matching the ethics and gender of the virtual advisor to make the advisory process more compatible and comfortable for the users. In another study on advisor gender choices, it was revealed that for the tutoring context, male tutors are considered more competent in many aspects than female tutors [118]. However, for the psychological counselling context, female virtual advisors are preferred by both male and female patients given that female counsellors are generally perceived as more empathetic, attentive, caring, and soft [119,120]. Therefore, in our experiment, we have set the genders of virtual advisors for both groups to be female, with a sole focus on comparing VAs. This was also confirmed during our pilot testing with emergency rescuers, most of whom expressed their preferences for female advisors. The ERMS prototype will also be continuously refined and used in future field studies to ensure that our project has high relevance for practice and will eventually benefit emergency rescuers in the real life. More technical details are not explained further here due to our focus on HCI issues in this study.

4.3. Measurement scales

The questionnaire that was used to collect participant feedback consisted of seven parameters: Perceived Understanding (PU), Actual Understanding (AU), Social Presence (SP), Experiential Resonance (ER), Sense of Control (SC), Perceived Power (PP), and Agreeableness (AG). The measures for the subjective constructs utilized in the questionnaires were all derived from existing scales that exhibited good psychometric properties. Table A1 in Appendix A outlines all the scales in the questionnaire along with their sources. All psychometric questions used a seven-point Likert scale. For the parameter AU, evaluating the users’ actual understanding of knowledge through quizzes or tests is a common strategy used by many educators and researchers [121]; therefore, questions were tested on the mental health knowledge provided by the virtual health advisor during system–user interactions, with the total score scaled down to the same base to facilitate further statistical analysis. Typical multiple choice questions in the quizzes include the following: “Which of the following are effective methods for reducing stress as suggested by the virtual advisor?”; “Based on your understanding of the virtual advisor’s advice, which of the following falls under the umbrella of ‘positive attribution’?”; and “according to the virtual advisor, which of the following statements belong to the category of the ‘locus of control’?” among others.

4.4. Pilot

Before conducting the experiment, we performed a pretest with 10 participants to check the experiment material including questionnaires and videos, and to fine-tune the experiment procedures. The participants were also asked to provide feedback on the system performance. Most were able to complete the entire process within 40 min. Feedback from the participants of the pretest indicated that the experiment design and the experiment material were appropriate. They also confirmed their preferences for a female counselor. In addition, these participants considered the system performance to be well accepted, except that the loading time took a bit long on a few occasions. However, most of them commented that this did not interrupt their tasks.

4.5. Experiment procedures

The experiment consisted of three phases: (1) watching a 5-min video that described the virtual ERMS; (2) demonstrating to rescuers how to use the virtual advisory system through exemplar use cases; and (3) completing a questionnaire. This approach ensures maximum control over user experiences with ERMS. In particular, video and real-time demonstration were used for three primary reasons. First, within the iterative prototyping process, this approach is considered more practical in case where user misuse of this novel information system distorts the intended experiment control. Second, with limited ICT resources near the country border location, there are limited opportunities and given-time to capture emergency rescuers’ responses immediately after the natural disaster, which results in precious data collected, although with some compromise; in addition, it is not yet feasible.
at the present stage for us to install our prototyping software on each users’ mobile with many different versions of operating systems as this procedure may introduce chaos and intervening factors to the experiment design that greatly exceed the permitted time and hinder experiment control during the process. Finally, our sole focus on the design choice of VAI also implies that video and live demonstration are sufficient for imposing this experimental condition on the participants while achieving maximum control over what participants are exposed to on the user interface of the prototype. In the industry, conceptual video is a popular strategy adopted by many high-tech companies to introduce innovative product prototypes to potential customers to gather feedback while protecting the product from being overly explored in situations such as patent application. For example, Google has used conceptual video to showcase Project Glass, and Drew Houston also released his Dropbox video for similar purposes.

A two-group between-subject design yielded two conditions in the experiment: (1) a VEA group and (2) a VPA group (Fig. 3). All participants were randomly assigned to one of the two groups. Because of the differences in their arrival times, emergency rescuers returned from their rescue tasks in teams and were guided into different conference rooms. This resulted in two groups, one with 64

![Table 2](image)

Table 2

R², composite reliability, Cronbach’s α, AVE, and inter-construct correlations.

<table>
<thead>
<tr>
<th>Construct</th>
<th>R²</th>
<th>CR</th>
<th>Cronbach’s α</th>
<th>AVE</th>
<th>Inter-construct correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU</td>
<td>0.104</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>PP</td>
<td>0.504</td>
<td>0.918</td>
<td>0.897</td>
<td>0.585</td>
<td></td>
</tr>
<tr>
<td>PU</td>
<td>0.212</td>
<td>0.926</td>
<td>0.906</td>
<td>0.640</td>
<td></td>
</tr>
<tr>
<td>ER</td>
<td>0.232</td>
<td>0.961</td>
<td>0.919</td>
<td>0.925</td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>0.579</td>
<td>0.907</td>
<td>0.865</td>
<td>0.710</td>
<td></td>
</tr>
</tbody>
</table>

![Table 3](image)

Table 3

Path coefficients, t-statistics, and p-value.

<table>
<thead>
<tr>
<th>Paths</th>
<th>Path coef.</th>
<th>t</th>
<th>Interpretation (S: Supported; NS: Not supported)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: VAI → PU</td>
<td>-0.308</td>
<td>3.848</td>
<td>S: In contrast to VPAs, emergency rescuers’ PU of the psychological knowledge provided by the mental health advisory system is better with VEA. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H2: VAI → AU</td>
<td>-0.272</td>
<td>3.169</td>
<td>S: In contrast to VPAs, emergency rescuers’ AU of the psychological knowledge provided by the mental health advisory system is better with VEA. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H3: VAI → SP</td>
<td>0.196</td>
<td>2.311</td>
<td>S: In contrast to VPAs, VEs will result in higher sense of SP for emergency rescuers while using the system. (p &lt; 0.05).</td>
</tr>
<tr>
<td>H4: VAI → ER</td>
<td>0.429</td>
<td>5.650</td>
<td>S: In contrast to VEs, emergency rescuers perceive VPs as more capable in triggering their ER while using the system. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H5: PU → SC</td>
<td>0.179</td>
<td>2.190</td>
<td>S: Improvement of PU will increase emergency rescuer’s sense of control. (p &lt; 0.05).</td>
</tr>
<tr>
<td>H6: AU → SC</td>
<td>0.085</td>
<td>1.940</td>
<td>NS: Improvement of AU will increase emergency rescuer’s sense of control. (p &gt; 0.05).</td>
</tr>
<tr>
<td>H7: SP → SC</td>
<td>0.498</td>
<td>4.914</td>
<td>S: A better sense of SP will increase emergency rescuer’s sense of control. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H8: ER → SC</td>
<td>0.283</td>
<td>2.777</td>
<td>S: A higher level of perceived ER will increase emergency rescuer’s sense of control. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H9: PU → PP</td>
<td>0.399</td>
<td>4.985</td>
<td>S: Improvement of PU will increase emergency rescuer’s perceived power. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H10: AU → PP</td>
<td>0.080</td>
<td>0.908</td>
<td>NS: Improvement of AU will increase emergency rescuer’s perceived power. (p &gt; 0.05).</td>
</tr>
<tr>
<td>H11: SP → PP</td>
<td>0.392</td>
<td>4.611</td>
<td>S: A better sense of SP will increase emergency rescuer’s perceived power after using the system. (p &lt; 0.01).</td>
</tr>
<tr>
<td>H12: ER → PP</td>
<td>0.157</td>
<td>1.969</td>
<td>S: A higher level of perceived ER will increase emergency rescuer’s perceived power after using the system. (p &lt; 0.05).</td>
</tr>
</tbody>
</table>

![Fig. 4](image)

Fig. 4. Structural model results.
persons and the other with 56 persons. We then gave the participants a brief introduction to the research. Next, we played a video that described the system comprehensively to set the background context for the following demonstration. For one group (n = 64), we played a video in which the advisor was an emergency rescue worker (i.e., a VPA); for the other group (n = 56), the advisor was a professional psychologist (i.e., a VEA). Then we demonstrated live interactions with the corresponding version of the systems. The procedures were held consistent, with the only difference being the identity of virtual advisor in each group. During the live demonstration, the experimenter projected the use of the software onto the wall screen with the presence of another observer and helper in the same room. The live demonstration not only allowed us to observe and gather richer user implicit reactions but also ensured a better match and control of the pace of user information digestion during the demo, such as user facial expressions of interest or confusion and body languages of nodding or shaking heads. To ensure roughly consistent timing and procedure for both groups, we trained our experimenters before the formal experiment and during the pilot testing phase. The experimenters had also done several rounds of rehearsal in front of each other with timers to ensure consistency across the two groups. Afterward, we issued paper-based survey questionnaires and asked users to answer the questions according to their own feelings. The whole experiment process lasted for about 40 mins. Finally, every participant received a thank-you gift for their time.

The participants’ perceptions of the virtual advisor’s identity were used to verify that the advisor’s identity was effective. As a manipulation check, participants were asked to answer the following question: Was the virtual advisor you consulted with a rescuer worker or a psychological expert? Out of the 114 effective questionnaires, approximately 81.5% of the participants answered the virtual advisor’s identity correctly, with 81.3% in the VPA group and 81.8% in the VEA group. Following the methods described previously [122], a chi-square analysis of the result yielded significant results ($\chi^2 = 45.46$, $p < 0.01$), showing that the two conditions are designed in a distinguishable way as perceived by most participants. Hence, we are confident that our manipulation of the experiment condition as VEA and VPA was successful.

4.6. Control variables

To investigate other potential effects, we performed analysis of variance (ANOVA) and t-tests to examine whether demographic data affected these dependent variables. The results showed that user demographics such as age, marital status, educational level, rescue experience, and mobile application experience had no significant effect on the dependent variables. Further, it is believed that user characters are likely to affect the way the users react to other people’s advice—in this context, the advice from VEAs or VPAs. Thus, to alleviate the potential impact of user’s characters on the research model [123], we analyzed it with the partial least squares (PLS) method, and the outcome indicated that only the agreeableness construct had a significant influence on the dependent variables, while conscientiousness, openness, extra- version, and neuroticism were found to have no effect on dependent variables. Consequently, the AG aspect of the character, which to a large extent describes whether a user is more welcoming or hostile, was used as a moderating variable in further investigations.

5. Experimental results

Six questionnaires were excluded from 120 cases based on initial data screening and checking for incompleteness. Hence, data from 114 subjects was used in the subsequent analysis. After preliminary data screening, we analyzed our research model using the PLS method. PLS was used because (1) it is suitable for testing predictive research models where the emphasis is on early theory development that characterizes this study [124]; (2) PLS can easily cope with statistical identification and potential convergence problems with formative constructs in a complex model [125,126]; (3) PLS has limited requirements on significant sample size and data distribution properties [126]; and finally, on the basis of the suggestion by Dijkstra and Henseler [127], if the composite model holds, PLS should be the method of choice (p.311), which is the case in our study. The model was mainly evaluated from two aspects (1) the measurement model and (2) the structural model, as elaborated below.

First, the measurement model was examined for internal consistency, convergent validity, and discriminant validity [128]. Cronbach’s $\alpha$ was used to reflect the internal consistency of the constructs. Table 2 shows that Cronbach’s $\alpha$ for every construct exceeded 0.7, which demonstrates the high internal consistency of the corresponding constructs. Then, we consider the average variance extracted (AVE) to assess the convergent validity of these constructs. The AVE value of all these constructs exceeded the commonly accepted threshold of 0.5, implying that at least 50% of the construct variance was due to its indicators [129]. A rule for assessing discriminant validity requires that $\sqrt{AVE}$ (bold values in the table) should be larger than the correlations between the constructs (off-diagonal values in the table) [128]. All the constructs in our research model met this requirement.

Second, the structural model was analyzed using the bootstrapping technique in PLS. In total, 700 samples were used for bootstrapping iterations following the suggestions in [129]. Controlling for AG, VAI had negative effects on both PU ($\beta = -0.308$, $p < 0.05$) and AU ($\beta = -0.272$, $p < 0.05$). Besides, VAI positively affected SP ($\beta = 0.196$, $p < 0.05$) and ER ($\beta = 0.429$, $p < 0.05$). At a higher level, SP ($\beta = 0.179$, $p < 0.05$), PU ($\beta = 0.498$, $p < 0.05$), and ER ($\beta = 0.283$, $p < 0.05$) all positively affected participants’ (inner) sense of control. While PU ($\beta = 0.399$, $p < 0.05$), SP ($\beta = 0.392$, $p < 0.05$), and ER ($\beta = 0.157$, $p < 0.05$) significantly affected (external) perceived power. However, AU had no significant effect on (inner) sense of control and (external) perceived power ($\beta = 0.085$, $p > 0.05$ and $\beta = 0.080$, $p > 0.05$, respectively) (see Table 3). In summary, the above results indicate that Hypotheses 1, 2, 3, 4, 5, 7, 8, 9, 11, and 12 were supported. Hypotheses 6 and 10 were not supported by the data.

Regarding the overall fitness of our model, most R$^2$ values in Table 2 exhibit moderate to substantial strength in explaining the dependent variables [129]. Among these, AU has a relatively weak R$^2$ value of 10%. This occurs because AU is a single-value construct without indicator variables (as elaborated in the Measurement Scales section) [129]. We initially incorporated a series of user demographics and all five factors of personality [112], namely agreeableness, conscientiousness, openness, extraversion, and neuroticism in our research model as potential control variables. Of these factors, only agreeableness was shown to significantly affect the dependent variables in this study. As a result, the model was reanalyzed excluding these insignificant control relationships, with agreeableness serving as the moderating variable. Altogether, the structural model results of the PLS analysis are shown in Fig. 4.

6. An experience sampling study

On the basis of a series of research efforts including preliminary interviews, scrutinizing existing systems, and field experiments with emergency rescuers right after natural disaster strikes, we identified VAI as an important yet largely ignored design consideration and empirically assessed its effect on the empowerment effect of ERMS. To gain further insights on how users would react to the VEA and VPA.
versions of ERMS after interacting with it for a longer period of time in real-life settings, a third study was designed using the Experience Sampling Method (ESM) [130], an effective tool for tracking user experiences systematically and capturing variations in users’ mental processes in natural environments. This further study centers around the core question of whether different VAs make any difference for ERMS users who experienced it for a longer time. Although in this ESM study we do not have the external major disaster stimuli as in the first field experiment, with the help of biofeedback device of ERMS, we can objectively track the overall emotional empowerment effect of ERMS on users via heart rate variability (HRV) [131] in more natural settings and for longer period of time, which allows us to triangulate the previous results and obtain a more comprehensive story of the research issue of concern. That is, these physiological data are complementary to the analysis of user experience booklet, knowledge quizzes, and end-of-period interviews in this ESM study.

To triangulate user emotional empowerment, we analyzed user feedback in the user experience booklet and end-of-period interviews (i.e., comparing the concepts and key themes to those in Fig. 4). As an additional measure to gain further insights, we objectively tracked the improvements in user emotional states through HRV-based physiological data [131,132], HRV indices capture a user’s psychophysiological coherence, representing sustained positive emotions as well as good mental and emotional stability [133]. Prior studies also used HRV indices to reflect a person’s inner emotional stability and emotional self-regulatory strength or effort when confronting with challenging situations [131]. In virtual environments, a higher sense of social presence or experiential resonance is frequently coupled with users’ psychophysiological coherence or sustained positive emotional experiences [25,134] that potentially enhance their inner sense of control and perceived power in dealing with challenges [15]. Therefore, we interpret physiological data as the indirect evidence of the emotional empowerment effect of ERMS for emergency rescuers. For user cognitive empowerment, we assessed this through analyzing self-reported learning experiences on the user experience booklet and psychological knowledge quiz on what the virtual advisor has suggested to emergency rescuers. Moreover, due to difficulty in obtaining long-term usage data with emergency rescuers and the resultant limited sample size, we do not intend to statistically infer complex relationships between all variables in our research model in Fig. 1. This has already been done in study 1. Instead, we combined self-reported qualitative data and biofeedback data on system usage by an experience sampling method, together with qualitative interviews conducted at the end of the field study period, to triangulate our research findings in the previous stage. A total of 21 emergency rescuers recruited from four fire brigades in a large city in China agreed to participate in our study and installed our ERMS software on their mobile phones. All the participants were male and had experience of participating in rescue tasks. Their average age was about 20 years, with 33% reporting that they have installed various health-related applications on their mobile phones before. To avoid interruptions to their important daytime tasks, we asked them to complete their self-assessment tasks after work. Given the limited number and the high price of biofeedback devices, 21 emergency rescuers who have compatible Android phones for ERMS could participate in the study.

In a meeting room, participants separately signed the informed consent and completed the questionnaire on demographics. They were randomly assigned to experience one of the two versions of ERMS, with 11 people using the VEA version and 10 people using the VPA version. They then received a live demonstration of what they need to do during the 2-week period of using ERMS. During this process, participants need to measure and record their emotional status before and after using ERMS towards the end of each day and comment on their feelings before, during, and after using ERMS in a booklet. The bio data was tracked using the heart rate devices that were the HRV, a standard way of reflecting the actual emotional status of a person [131,132]. We focused on comparing emergency rescuers’ positive emotion score (PES) derived from HRV indices for each group following the methods discussed in [131,132], since maintaining a higher level of positive emotions is regarded as the ultimate goal of achieving psychophysiological coherence by prior researchers [133]. Towards the end of the field study period, participants were asked to openly comment on their overall experience of using ERMS and complete a psychological knowledge quiz that consists of multiple choice questions including “Which of the following are effective methods for reducing stress as suggested by the virtual advisor?”; “Based on your understanding of the virtual advisor’s advice, which of the following falls under the umbrella of ‘positive attribution’?”; and “According to the virtual advisor, which of the following statements belong to the category of the ‘locus of control’?” and others. The total score was then scaled to be out of seven to make it easier for further statistical analysis. Participants were also requested to hand in their user experience booklet and return the ERMS hardware devices to our research assistants.

During data analysis, one case was discarded because the participant dropped out halfway on short leave. This left us with two equal-sized group of 10 people in each condition. An independent samples t-test was conducted on the two groups to compare the effects of VEA with VPA. The data set met the basic requirements of t-test including normality and equal population variances (Levene’s test result F = 3.74, P > 0.05). The results of the study revealed that VPA acts better for improving emotional coherence, as reflected by the significantly larger extent of improvement in HRV-based PES, than VEA (c.f., [131,132] for deriving PES from HRV indices). To elaborate, comparing the average or mean of PES differences of all individuals for each day in each group, the results of independent t-test also showed significant differences between the VPA and VEA group [mean difference (VPA vs. VEA) = 4.14, T = 5.80, p < 0.05]; comparing the average PES improvement for each person over 14 days, the results of t-test also showed significant differences between VPA and VEA group [mean difference (VPA vs. VEA) = 3.96, T = 3.13, p < 0.05]. From Fig. 5, we can see that in general, VPA group performs better in enhancing user positive emotions over the 2-week observation period. On the other hand, for the final test of psychological knowledge recall at the end of the 2-week period, the VEA group performs significantly
better than the VPA group in transferring knowledge [mean difference (VEA vs. VPA) = 1.15, T = 2.31, p < 0.05].

Through analyzing the qualitative interviews using content analysis method, we also identified similar concepts and themes that align very well with our research model and previous field experiment results. For example, participants in the VPA group reported that they feel like “having the closeness, warmth and intimacy . . . and their past experiences interests and enlightens me”; “talking to a co-worker advisor who seems to share common experiences helps me to relax and cool down”; and “the emotional support from fellow rescuers would make me feel calm and confident.” These findings are congruent with the previous result that VPAs empower emergency rescuers mostly through emotional channels, including a better sense of social presence and experiential resonance. In contrast, participants in the VEA group put more emphasis on what kind of knowledge they obtained and showed more reflections on how they would count on the knowledge to solve their own problems. Typical comments include “[the advisor’s] professional advice equipped me with psychological knowledge that allows me to better interpret my current dilemma”; “I now feel more powerful toward challenging situations since I got the right knowledge from psychiatrist to tackle them”; and “with these useful tips from the expert, I expect myself to have good control over my always-fluctuating emotions.”

This supports our findings that VEAs facilitate better in transferring rescuers through cognitive channels. Below we only highlight the extra findings apart from the results of the previous field experiment. On the basis of users’ daily experience data and end-of-period comments, we identified the following key insights.

First, over time, emergency rescuers felt that the longer they use the system, the more they care about the identity of the virtual advisor. For example, VAI that seems boring, uninteresting, or unrealistic can only be distracting or distancing for the user and cause them to drop out of the service. Second, emergency rescuers noted that improved sense of control and perceived power means different things for them; sometimes they feel internally calm, but when facing with external challenges, they still felt threatened. Therefore, emphasizing both sense of control and perceived power as key empowerment outcomes are essential for ERMS design. Third, a number of them suggested that virtual advisor characters with more comprehensive and concrete identities should be included in the next version of the ERMS, possibly with “introductions of detailed past experiences of the virtual advisor” to give users more human sense and thus reduce the feelings of interacting with a “cold-hearted machine.” Finally, emergency rescuers hope that the contents of ERMS could be richer and more dynamic in the long run, with high expectations for the successful implementation of this initiative that has a “good potential to generate positive impacts in their lives.”

7. Discussions and conclusion

7.1. Interpretation of the results

In this study, we have empirically shown that the advisor’s identity significantly influences emergency rescuers’ cognitive and emotional aspects after using the system. Further, congruent with theory predictions, emergency rescuers consider VEA to be better in transferring knowledge relative to VPAs. That is, VEs have stronger empowerment effect in imparting knowledge (as assessed by user’s PU and AU) to emergency rescuers than VPAs. However, the positive substantial effects on users’ emotional aspects, as evaluated in terms of SP and ER, imply that VPAs can empower emergency rescuers through a stronger sense of social presence and a better feeling of inner resonance. Overall, bootstrapping results show that cognition and emotion, as important empowering enablers, have substantial influence on empowerment outcomes measured by a sense of control and perceived power. Comparing path coefficients and t-values, we can also see that in general, emotional aspects play a more important role on empowerment outcomes relative to users’ cognitive aspects. This provides meaningful lessons for a psychological self-help system, in that emotional support is more critical than merely educating users with psychological knowledge.

In contrast to PU, AU does not contribute significantly to variations in empowerment outcomes. This may be as a result of the participants being unaware of their task score immediately after the tests. For example, a study conducted by Metcalfe and Greene reported that people may report a low level of control even when their performance in a certain task was high [135]. Another possible reason may be the fact that information needs time and experience to be processed into knowledge by human brain to empower people [15]. This result also aligns well with Jiang and Benbasat’s [48] empirical findings that it is ‘perceived website diagnosticity’, not ‘actual product knowledge’, that affects users’ attitude towards the website. To elaborate, these results uncover an interesting phenomenon that a user’s perceived mental transparency related to a certain virtual product or service is the key factor that matters for the empowerment outcomes of an information system, outriding how much actual knowledge was actually obtained by a user from another angle, enhancing the transparency of an ERMS, for example through reducing a user’s cognitive load in the system design via methods such as hierarchical decomposition or reasoning [136], is an effective way to boost the value of such a system.

7.2. Contributions to research

In terms of theory and methodology, this study has the following contributions.

First, the identity of the virtual advisor is an important design consideration to boost the power of virtual health advisory services. Our study has thus empirically investigated this important and novel aspect, i.e., the implications of different design choices of VAI for emergency rescuer empowerment. In this research, we extend existing HCI theories on mobile psychological self-help services through our empirical study. In contrast to the increasing popularity of mobile psychological self-help systems on smart end-user devices, little prior work has been conducted systematically to investigate the impacts of different HCI design strategies on the effectiveness of mobile psychological self-help services. Consequently, this study serves as a good reference for further explorations in this area.

Second, this study has implications for deepening our understanding with the “symbols of authority” theory and similarity theory in the IS discipline. Nass and Moon [137] commented that people construct social relationships and apply social cues in their relationships with technology. We explored how “symbols of authority” and similarity traits influence users in different ways. When appropriately designed, virtual advisory systems as social actors, can exert positive influences on the advisory service recipient, both cognitively and emotionally. While resonance-invoking VPAs, who exhibit identity similarity between the advisory service provider and the recipient, can potentially strengthen the emotional aspects of such positive influence, authoritative VEs are better at convincing the users with factual knowledge and sustaining their memory retention. In turn, cognitive and emotional influences can be significant empowering enablers, generating a stronger sense of control and perceived power for advisory system users. As Zimmerman [15] suggests, through the empowerment process, appropriately designed virtual advisory services can create opportunities for community
members to develop skills (emotionally or physically) to master their own fate in a way that is free from merely counting on professionals.

These results also shed light on the underlying reasons of why “symbols of authority” and similarity theory strengthen the empowerment effect of virtual health advisory systems. In the classical theories of human communications, Berger [138] mentioned that uncertainty reduction is one of the primary dimensions of developing a relationship and that attraction or affiliation can help alleviate uncertainty and vigilance—when communicators discover similarities between them, their attraction to one another goes up, and their apparent need for more information goes down [138], thus facilitating the empowerment processes for ERMS. VPAs who exhibit similar features and experiences as those of emergency rescuers can enhance the empowerment outcomes of ERMS—achieved largely through emotional channels such as the heightened sense of experiential resonance and feelings of social presence. This is in contrast to VEAs who empower emergency rescuers mostly through cognitive channels, just as a prior study suggested this is because we frequently take the mental shortcut and are more likely to believe that people who display “symbols of authority” should be accepted and followed [46].

Moreover, in terms of research methodologies used in the study, we have taken an innovative nonlinear and iterative approach in our system artifact design and development. The unique sample of our study also adds significant practical value to our research. Such samples are challenging to approach in real life, especially given that the experiment was performed when emergency rescuers completed their rescue tasks right after a natural disaster. As stated by Henver et al., “understanding the meaning of design characteristics as they impact the user is known to be elusive and complex from a methodological standpoint” [139]. To ensure the relevance of our research focus, we collected requirements from emergency rescuers and features of existing systems as inputs and then centered our study on “virtual advisor identity” as the major design issue of concern. To ensure the rigor of our study in theory development, we consulted the grounding theories and past knowledge for our research project to develop our research model. In system design and development, we iterated through system design and the evaluation of design “artefacts.” Through the refinement of a concrete system artefact based on a mixture of research methods, our research methodology ensured both rigor and relevance in our study [140].

7.3. Implications for practice

From a practical point of view, the results of this study also provide numerous useful insights for system designers and policy makers.

First, our study results reveal that VEAs, who appear as authoritative figures, are suitable when the system design emphasizes on knowledge acquisition. In other situations, where the system’s focus is on establishing rapport and a sense of support for depressed users, VPAs should be used as they appear to exhibit more human warmth and experiential resonance. As an interesting implication to system designers of virtual advisory services, different VAs can be used for different scenarios or sections of the system, with innovative design themes to cater for different purposes.

Further, to our knowledge, existing mobile mental-health advisory systems for emergency rescuers are sparse. We have empirically shown that appropriately designed ERMS can be an effective tool for empowering emergency rescuers in actively managing their mental health. Our study therefore hopes to draw more attention and resources from the government and the national health framework to support this self-devoting career.

More interestingly, this project combines mobile technologies with a medical device to monitor emergency rescuers’ physiological indices on the go. While part of this project is under patent application, more details of the system hardware and software design are available upon request.

Finally, through the experience sampling study, it is revealed that virtual advisors with more comprehensive identities could potentially help with bridging the emotional gap between interacting with a virtual advisory system and a real human advisor. Therefore, practitioners could consider incorporating detailed introductions of the virtual advisor character such as his/her prior work experiences, life stories, and demographics information to boost the value of virtual advisory services for users.

7.4. Limitations and future research

There are a few limitations to note while interpreting the research findings. First, this study focuses on the compelling need of emergency rescuers. On account of the nature of rescue work in emergency settings, the scope of the study is limited to frontline male emergency rescuers in China. Future studies could examine or extend the research model to other research settings. It would also be interesting to examine further, in different culture backgrounds, how users of both gender would rate their virtual advisors. Second, we have traveled to and sampled our respondents from the remote border area because this region has just experienced a natural disaster; these emergency rescuers have just returned from their emergency rescue tasks when we arrived at the site. Given that these rescuers are usually recruited from different provinces in China, it will also be helpful to investigate the feedback from more sites in different provinces after a natural disaster occurs. Third, considering that less than 60% of the total population own smart phones in developing countries [141] and there are mobile devices with various operating systems such as IOS, Symbian, and Windows, we first played videos and then demonstrated the system functions in a comprehensive and systematic way instead of installing ERMS on each participants’ mobile phones. While the former approach was chosen in the study to guarantee more control over the experiment design, the latter approach could be undertaken when richer user experiences are needed in field settings in future studies. Further, the study revealed that it is user’s perceived mental transparency of the obtained psychological knowledge that matters most for user empowerment outcomes right after system usage, we expect AU to gradually take over this important role in user empowerment in the long term. More future research is warranted in examining this confounding “taking-over” process along the time dimension. In addition, to realize two practical VAIIs in the scope of our current application scenarios, we consider that the language of virtual advisors such as appellations and greetings should be customized to match the respective identity as shown via appearance (e.g., uniforms) of the virtual advisor. This will ensure more natural and believable interactive experiences for the users. Thus, these intertwining qualification symbols should be treated as an unified “identity social object” that makes an overall impact on the users [115–117]. Future studies could consider dissecting and scrutinizing the identity social object more in-depth in different application scenarios and research contexts. While we tried our best to eliminate confounding factors in our research study, one should interpret our findings with these limitations in mind.

Finally, we discuss ideas that potentially inspire further research opportunities. First, future studies could examine the proposed research framework in different settings to investigate its applicability and generalizability. It is also beneficial to incorporate more
comprehensive personal backgrounds to VAs in the system and investigate its related usage outcomes. Second, context-aware features through Internet of Things technologies could be integrated into the design of similar systems to enhance the usability and value of such systems for health consumers [142]. The HCI implications of customizing such services by detecting user locations, environments, emotions, body gestures, and/or physiological data real-time on mobile devices could be further investigated. These emerging directions in the IS field are expected to tremendously enhance user experiences in various application settings and improve their overall satisfaction with the mobile virtual advisory service.

**Acknowledgments**

We gratefully acknowledge the very insightful advice given by the A/E and two anonymous reviewers, which was instrumental in enhancing the quality of the project and inspired our future work. We also wish to thank a number of researchers such as Prof. Shirley Gregor, Dr. Stephen P. Smith and Mr. Lin Ge for their invaluable support and encouragement along the process. This project is supported by grants from the National Natural Science Foundation of China (Project No.: 71201021 and 71571039), NUS (Suzhou) Research Institute (No. NUSRI2011-005), Singapore Ministry of Education (Project No.: T1 251RES1401) and China Ministry of Education (Fundamental Research Funds for the Central Universities (No. N150604002) and SRF for ROCS (No. 47-2)).

**Appendix A.**

**Table A1**

Variable names, measurement scales, mean, standard deviation, and item loadings.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measure</th>
<th>Mean (Std. dev)</th>
<th>Std. Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived Understanding (PU)</strong> (7-point Likert Scale, ranging from “Strongly Disagree” to “Strongly Agree”; adapted from the informativeness scale in [143]) Cronbach’s alpha: 0.864</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU1</td>
<td>I feel informed about how to deal with stress.</td>
<td>5.4950 (0.97)</td>
<td>0.785</td>
</tr>
<tr>
<td>PU2</td>
<td>I feel informed about what is resilience.</td>
<td></td>
<td>0.870</td>
</tr>
<tr>
<td>PU3</td>
<td>I feel informed about what is positive attribution.</td>
<td>0.792</td>
<td></td>
</tr>
<tr>
<td>PU4</td>
<td>I feel informed about what is locus of control.</td>
<td>0.761</td>
<td></td>
</tr>
<tr>
<td>PU5</td>
<td>I feel informed about the effective methods to reduce stress.</td>
<td>0.850</td>
<td></td>
</tr>
<tr>
<td>PU6</td>
<td>I feel informed about how the system can help me in the future.</td>
<td>0.778</td>
<td></td>
</tr>
<tr>
<td>PU7</td>
<td>I feel informed about what I can do if my friends, family members or I encounter similar things in the future.</td>
<td>0.761</td>
<td></td>
</tr>
<tr>
<td><strong>Social Presence (SP)</strong> (7-point Likert Scale, ranging from “Strongly Disagree” to “Strongly Agree”; adopted from [68]) Cronbach’s alpha: 0.857.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP1</td>
<td>There is a sense of human contact when interacting with the virtual advisor.</td>
<td>4.5614 (1.14)</td>
<td>0.803</td>
</tr>
<tr>
<td>SP2</td>
<td>There is a sense of personalness when interacting with the virtual advisor.</td>
<td></td>
<td>0.717</td>
</tr>
<tr>
<td>SP3</td>
<td>There is a sense of sociability when interacting with the virtual advisor.</td>
<td></td>
<td>0.855</td>
</tr>
<tr>
<td>SP4</td>
<td>There is a sense of human warmth when interacting with the virtual advisor.</td>
<td></td>
<td>0.855</td>
</tr>
<tr>
<td>SP5</td>
<td>There is a sense of human sensitivity when interacting with the virtual advisor.</td>
<td></td>
<td>0.784</td>
</tr>
<tr>
<td><strong>Experiential Resonance (ER)</strong> (7-point Likert Scale, ranging from “Strongly Disagree” to “Strongly Agree”; adapted from [144]) Cronbach’s alpha: 0.932.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER1</td>
<td>I see the virtual advisor as a person (with common experiences).</td>
<td>4.044 (1.48)</td>
<td>0.966</td>
</tr>
<tr>
<td>ER2</td>
<td>I perceive that the virtual advisor is similar to me as a person (with common experiences).</td>
<td></td>
<td>0.958</td>
</tr>
<tr>
<td><strong>(Inner) Sense of Control (SC)</strong> (7-point Likert Scale, ranging from “Strongly Disagree” to “Strongly Agree”; adapted from [50] and [95]) Cronbach’s alpha: 0.817.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1</td>
<td>I felt confused after using the system. (R)</td>
<td>4.6140 (1.19)</td>
<td>0.857</td>
</tr>
<tr>
<td>SC2</td>
<td>I felt calm after using the system.</td>
<td></td>
<td>0.845</td>
</tr>
<tr>
<td>SC3</td>
<td>I felt in control after using the system.</td>
<td>0.811</td>
<td></td>
</tr>
<tr>
<td>SC4</td>
<td>I felt frustrated after using the system. (R)</td>
<td>0.858</td>
<td></td>
</tr>
<tr>
<td><strong>(External) Perceived Power (PP)</strong> (7-point Likert Scale, ranging from “Strongly Disagree” to “Strongly Agree”; adapted from the self-efficacy scale in [101]) Cronbach’s alpha: 0.897.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP1</td>
<td>After using the system, I feel I have power to keep a stable mental status to achieve my goals.</td>
<td>5.7171 (0.95)</td>
<td>0.698</td>
</tr>
<tr>
<td>PP2</td>
<td>After using the system, I am certain that I can cope with stress when I perform rescue tasks.</td>
<td></td>
<td>0.794</td>
</tr>
<tr>
<td>PP3</td>
<td>After using the system, I think I can obtain good state of mind that is important to me during my work.</td>
<td>0.757</td>
<td></td>
</tr>
<tr>
<td>PP4</td>
<td>After using the system, I believe that I can succeed to overcome unhealthy emotions when performing tasks.</td>
<td>0.847</td>
<td></td>
</tr>
<tr>
<td>PP5</td>
<td>After using the system, I feel that I have power to successfully handle stress when facing many challenges.</td>
<td>0.808</td>
<td></td>
</tr>
<tr>
<td>PP6</td>
<td>After using the system, I think that I can perform effectively on many different tasks in my work while keeping a healthy mental status.</td>
<td>0.632</td>
<td></td>
</tr>
<tr>
<td>PP7</td>
<td>After using the system, I have a stronger sense of power to do most tasks well compared with my peers.</td>
<td>0.765</td>
<td></td>
</tr>
<tr>
<td>PP8</td>
<td>After using the system, I feel psychologically prepared to be able to perform tough rescue tasks well.</td>
<td>0.760</td>
<td></td>
</tr>
<tr>
<td><strong>Agreeableness (AG)</strong> (7-point Likert Scale, ranging from “Strongly Disagree” to “Strongly Agree”; adopted from [123]) Cronbach’s alpha: 0.874.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AG1</td>
<td>I see myself as someone who tends to find good side of other people.</td>
<td>5.4800 (1.04)</td>
<td>0.801</td>
</tr>
<tr>
<td>AG2</td>
<td>I think I’m helpful to people and selfless to others.</td>
<td></td>
<td>0.723</td>
</tr>
<tr>
<td>AG3</td>
<td>I think I seldom start disputes with other people.</td>
<td>0.797</td>
<td></td>
</tr>
<tr>
<td>AG4</td>
<td>I think I have a tolerant nature.</td>
<td>0.846</td>
<td></td>
</tr>
<tr>
<td>AG5</td>
<td>I think I am generally trustworthy.</td>
<td>0.748</td>
<td></td>
</tr>
<tr>
<td>AG6</td>
<td>I think I am treating others with enthusiasm instead of coldness.</td>
<td>0.751</td>
<td></td>
</tr>
<tr>
<td>AG7</td>
<td>I think I am thoughtful and kind to almost all people.</td>
<td>0.732</td>
<td></td>
</tr>
</tbody>
</table>

Please cite this article in press as: M. Li, et al., Expert or peer? Understanding the implications of virtual advisor identity on emergency rescuer empowerment in mobile psychological self-help services, Inf. Manage. (2017), http://dx.doi.org/10.1016/j.im.2017.01.002
Table A2
Overview of coding processes.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Category</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reality check</td>
<td>Compelling need from emergency rescuers</td>
<td>The need for emotional support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The need for cognitive support</td>
</tr>
<tr>
<td>ERMS empowerment</td>
<td>Cognitive empowerment through ERMS</td>
<td>Psychological knowledge for empowerment (e.g., self-assessment information, bio data etc.)</td>
</tr>
<tr>
<td>Emotional empowerment through ERMS</td>
<td></td>
<td>Experiential resonance/empathy for empowerment</td>
</tr>
<tr>
<td></td>
<td>The need for confidence and power in dealing with work challenges</td>
<td>Social presence/accompany for empowerment</td>
</tr>
<tr>
<td></td>
<td>Limited psychological knowledge and biased view toward consultation</td>
<td>New staff needs formal training on psychological knowledge</td>
</tr>
<tr>
<td></td>
<td>New staff needs formal training on psychological knowledge</td>
<td></td>
</tr>
<tr>
<td>The choice of VAI for ERMS</td>
<td>Identity of the virtual advisor (expert vs. peer)</td>
<td>Divided view on VAI’s impact on ERMS</td>
</tr>
</tbody>
</table>

Table A3
A brief introduction and sample screen shots of the ERMS.

<table>
<thead>
<tr>
<th>Examples of user interfaces</th>
<th>Brief descriptions¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>(main page: left: VPA, right: VEA)</td>
<td>Users can interact with an animated virtual advisor who exhibits humanoid features including a rich set of facial expressions and movements. Communications via both voice and text. Detailed and transparent psychological knowledge with explanations from professional sources or fellow rescuers.</td>
</tr>
<tr>
<td>(same across two versions)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(same across two versions)</td>
<td>Users can obtain timely and personalized feedback on their mental status via psychological self-assessment tools. There are a comprehensive set of self-assessment questionnaires that were based on established professional sources.</td>
</tr>
<tr>
<td>(same across two versions)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(same across two versions)</td>
<td>Users can learn systematic and structured psychological knowledge, covering topics such as methods for coping with depression, insomnia and anxiety, with official and credible references and resources provided based on a comprehensive knowledge base.</td>
</tr>
<tr>
<td>(same across two versions)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(same across two versions)</td>
<td>Users can browse questions and responses provided by other users or present their own viewpoints for other people’s reference, while ensuring privacy. The system can also notify users that he/she has received responses from other users. Professionals need to screen all candidate posts by users to ensure consistency and correctness of the candidate answers.</td>
</tr>
<tr>
<td>(same across two versions)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(same across two versions)</td>
<td>Users’ physiological indices can be monitored via wearable devices with results presented in the form of graphs and tables. They can view personalized data displayed in an intuitive form. It also allows users to determine the appropriate place and time to receive treatment.</td>
</tr>
</tbody>
</table>

Please cite this article in press as: M. Li, et al., Expert or peer? Understanding the implications of virtual advisor identity on emergency rescuer empowerment in mobile psychological self-help services, Inf. Manage. (2017), http://dx.doi.org/10.1016/j.im.2017.01.002
Please cite this article in press as: M. Li et al / Information & Management xxx (2016) xxx-xxx.
Please cite this article in press as: M. Li et al., Expert or peer? Understanding the implications of virtual advisor identity on emergency rescue empowerment in mobile psychological self-help services, Inf. Manage. (2017). https://doi.org/10.1016/j.im.2017.01.002
Manning Li is an Associate Professor in the School of Business Administration, Northeastern University, China. Prior to this, she was an Assistant Professor in the Department of Computing, Faculty of Science, Macquarie University, Sydney, Australia (2009–2011). She obtained her PhD in Business Information Systems from the Australian National University, Australia (2009). Her major research interests include intelligent support systems, human–computer interaction, and virtual reality. She has published her works in journals such as Decision Support Systems, Information and Management, International Journal of Information Management, Electronic Commerce Research, Communications of the AIS and others. Dr. Li’s publications also include 3 books (Springer and Tsinghua University Press).

Zhenhui (Jack) Jiang is an Associate Professor in the Department of Information Systems of National University of Singapore. He is the Chair of SIGHCI of AIS. Prof. Jiang’s work has been published in top Information Systems journals, such as MIS Quarterly, Information Systems Research, and Journal of MIS, and top Human Computer Interaction conferences, such as CHI. He has served on the editorial board of MIS Quarterly (AE), Journal of AIS, IEEE Transactions of Engineering Management, AIS Transactions on Human-Computer Interaction, among others.

Zhiping Fan received his PhD degree in control theory and applications from Northeastern University (NEU), Shenyang, China, in 1996. He currently works as a Professor in the Department of Information Management and Decision Sciences, School of Business Administration, NEU. He was a Research Fellow at the City University of Hong Kong for 2003–2005. He is the main author or coauthor of more than 60 refereed articles published in international journals including the IEEE Transactions on Systems, Man and Cybernetics and Information Sciences. His current research interests include decision analysis and knowledge management.

Jie Hou is a Graduate of Northeastern University in LiaoNing, China. She has been awarded the Distinguished Graduates of NEU in 2013. She is now a a senior data analyst at JD.com, a well-known B2C e-commerce platform in China. Her major research interests include intelligent systems, human–computer interaction, and cyber-physical systems.