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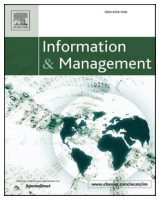

Are real-time volunteer apps really helping visually impaired people? A social justice perspective

Huilin Gao [a], Evelyn Ng [b], Bingjie Deng [c,*], Michael Chau [a]

[a] Faculty of Business and Economics (HKU Business School), The University of Hong Kong, Hong Kong
[b] Discipline of Business Information Systems, The University of Sydney, Sydney, New South Wales, Australia
[c] Department of Intelligent Operations and Marketing, Xi'an Jiaotong-Liverpool University, Suzhou, Jiangsu, China

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ABSTRACT

While digital technologies have undoubtedly enhanced the quality of life for individuals with visual impairment, their influence on social justice remains underexplored. Drawing upon intergroup contact theory, this study employs a mixed-methods approach, utilizing both surveys and interviews, to examine the impact of *real-time volunteer apps* on social justice from the perspectives of both visually impaired people (VIP) and non-impaired people (NIP). Our results reveal unintended adverse effects associated with the use of real-time volunteer apps. Despite enhancing perceived social connection, these apps paradoxically increase VIP's prejudice vulnerability, which is potentially attributed to the social contrast effect. Meanwhile, app usage increases NIP's stereotyping and reduces their social acceptance of VIP groups, as these apps fail to create equal status contact between NIP and VIP. This research illuminates the complex dynamics of how information technology (IT) affects social justice for VIP and highlights the overlooked downside of IT. It advances our understanding of intergroup contact theory by providing empirical evidence on contact effects when equal status conditions are lacking and serves as a reminder to app designers and developers of the crucial role of social influence in app design, particularly in the development of apps intended for minority groups.

1. Introduction

Although smartphones and digital technology seem to be inaccessible to visually impaired people (VIP), they have in fact become critical companions for them [1]. Following the screen reader called VoiceOver launched by Apple in 2009, many digital technologies designed for VIP have appeared, including mobile apps. These digital technologies have largely been adopted to help VIP overcome the challenges of daily life [2,3]. In a global survey on the use of smartphone-accessible apps, over 95 % of VIP regard these special apps as helpful and accessible [4]. These apps, in turn, have a significant impact on VIP in various ways. Previous studies have focused on how digital technologies affected the quality of their daily life [5–7], but the social effect of digital technologies on VIP has received insufficient attention in both the psychology and information systems literature [8–11].

While research has shown that digital technologies effectively assist VIP in performing daily and occupational tasks [12,13], there is a pressing need for greater attention to the potential social effects of these technologies on VIP. According to the U.S. Bureau of Labor Statistics, VIP exhibit the highest unemployment rate among all disabled groups. Emphasized in an interview study[1] by the Danish Blind Society, the primary factor contributing to unemployment among VIP is prejudice from non-impaired people (NIP), rather than the disability per se. An article[2] published in 1989 by the *Harvard Business Review* showed that, with digital technologies, VIP can produce work of quality and quantity comparable to that of NIP in certain jobs. Despite the increasing number of assistive digital technologies designed for VIP, the persistently high unemployment rate among VIP has remained unchanged over the decades.[3] Prejudice from NIP may contribute significantly to the low employment rate of VIP [14], and more attention should be paid to the

* Corresponding author at: BS122(SIP Campus-IBSS Building), Department of Intelligent Operations and Marketing, Xi'an Jiaotong-Liverpool University, Suzhou Dushu Lake Science and Education Innovation District, Suzhou, Jiangsu, China.
E-mail address: Bingjie.Deng@xjtlu.edu.cn (B. Deng).

[1] https://www.blind.dk/nyheder/med-teknologiske-hjaelpemidler-er-vi-helt-almindelige-medarbejdere
[2] https://hbr.org/1989/03/how-technology-brings-blind-people-into-the-workplace
[3] https://news.microsoft.com/on-the-issues/2019/08/08/smart-tech-blind-low-vision/

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issue of prejudice and social injustice. Beyond the workplace, VIP need to contend with negative societal attitudes related to their disability in their everyday life [15]. To enhance their quality of life, they must adjust to living in a society dominated by NIP [16]. A straightforward example of this is the numerous reports[4] of VIP suffering rejection in public areas or on buses with their guide dogs. Visual impairment subjects them to injustice in terms of social status and respect [17,18]. Greater attention should be directed to addressing the social justice issues VIP face.

In this context, social psychologists have suggested improvements from the perspective of both the minority group (VIP) and the majority group (NIP; [19]). To gain a more comprehensive understanding, this study focuses on how digital information technologies affect social justice from both sides by testing a type of digital technology designed to help VIP in their daily life through video phone calls. For the minority group (VIP in our context), strengthening their self-sufficiency and mindset is an effective way to deal with justice issues [20]. A strong mindset allows VIP to have confidence to speak up for themselves when they face injustice at work or in their daily life more generally. Thus, we focus on whether digital technologies can help VIP with their mindset development. Meanwhile, for the majority group (NIP in our context), evidence shows that their prejudice against the minority group is a primary reason for injustice in the workplace, at school, and in daily life [21,14]. Thus, we focus on how digital technologies could affect NIP's prejudice against VIP.

Most existing phone assistant applications are designed to assist individuals with practical, well-defined functional tasks that are exclusive to VIP. Examples of such systems include those supporting navigation, aiding in identifying objects or their characteristics, identifying people's movements, and assisting with detecting text, images, handwriting, and more. Only a few examples extend assistance systems beyond individual users to include social support from others. For instance, VizWiz [22] allows VIP to post their questions online and NIP to respond and assist. However, it faces latency issues, and VIP do not receive immediate responses; this poses challenges for researchers studying the effects of instant interactions between VIP and NIP. Fortunately, one type of application—real-time volunteer applications—presents an ideal scenario to study these effects from both perspectives. These apps enable VIP to seek help from online volunteers (NIP) instantly via a one-way video call (only the VIP's camera is on). For example, an NIP can read and tell a VIP the expiration date of a food package shown through the camera. Fig. 1 shows some sample interfaces of one of these apps, Be My Eyes.[5] The app was proposed by a visually impaired craftsman in 2012 and, as of November 2023, has over 550,000 VIP users and over 7 million NIP volunteers in over 150 countries covering 180 languages.

Although Be My Eyes supports different languages, the number of users in non-English-speaking countries is significantly lower [23,24]. Thus, several similar apps have been developed in different language settings, with no major differences in their functions and interfaces. In this study, we mainly focus on users of four main apps of this kind that are widely adopted in China: Be My Eyes, Rebuild Eyes, SmalloveHelps, and Angel's Eyes. As these apps are among the first to provide channels that allow VIP to communicate directly with non-impaired strangers through video calls and provide NIP volunteers with opportunities to learn about VIP's daily life, they are ideal for studying the social impact they have on both VIP and NIP.

Given the popularity of these apps, the media started to commend them for not only helping VIP in their daily life but also helping to improve the social justice situation of VIP.[6] However, there is no study that explicitly tests whether and how these apps help with the social injustice faced by VIP.

Drawing on intergroup contact theory, this study aims to answer four main research questions (RQs), two addressing VIP and two addressing NIP.

For VIP:

RQ1. Does the adoption of real-time volunteer apps help visually impaired people achieve more social justice?
RQ2. What are some explanations of the effects in RQ1?

For NIP:

RQ3. Does the adoption of real-time volunteer apps influence non-impaired people to provide more social justice to VIP?
RQ4. What are some explanations of the effects in RQ3?

To answer our research questions, we test the effect of these apps from the perspective of both the minority group (VIP) and the majority group (NIP), utilizing a mixed-methods approach. As an exploratory study of the effect of digital technologies on the social justice situation of VIP, this research aims to serve as a first step and offer implications for app design from the perspective of minority groups and social justice, as well as advancing intergroup contact theory. Our study makes three primary contributions. First, we contribute to social justice research in the IS literature by advancing our understanding of how digital information technologies affect VIP from a social justice perspective. To the best of our knowledge, we are among the first to explore the effects of digital technologies on VIP from the social justice perspective in the IS literature. Second, our research contributes to the existing literature on intergroup contact theory by offering empirical evidence of the detrimental consequences of not fulfilling one of the four essential conditions of the contact effects framework—specifically, the equal status condition. Third, we provide practical insights for app designers. Most studies related to app design for VIP focus on the improvement of their basic accessibility. Our work analyzes the social effects of digital apps to provide designers with insights on paying more attention to disabilities' online social influence.

The rest of the article is organized as follows. We first review the related literature and develop our hypotheses. Then we describe our research methods and illustrate and discuss our results. We conclude by discussing our contribution, limitations, and future research.

2. Literature review

In this section, we discuss the related literature that lays the foundation for our research hypotheses. We first review literature about information technology and VIP to build a general background on our focal area; then we examine Fraser's social justice theory, wise intervention, and intergroup contact theory.

2.1. Information technology and visually impaired people

Current IS research on minority groups is primarily related to racism [25,26], sexism [27–29], and chronic and emotionally distressed patients [30–32]. Only a handful of IS studies related to disability have been conducted [33,34]. In particular, few IS studies have focused on visually impaired people.

[4] https://www.theguardian.com/society/2023/oct/07/nhs-says-sorry-to-blind-woman-amy-kavanagh-after-security-tried-to-bar-her-guide-dog

[5] Website of Be My Eyes: http://www.bemyeyes.com

[6] NOW Design nominated Be My Eyes for Social and Community-Oriented Design Awards, which emphasize the importance of addressing social issues such as inequality and isolation. https://awards.design/now/project.asp?ID=17248

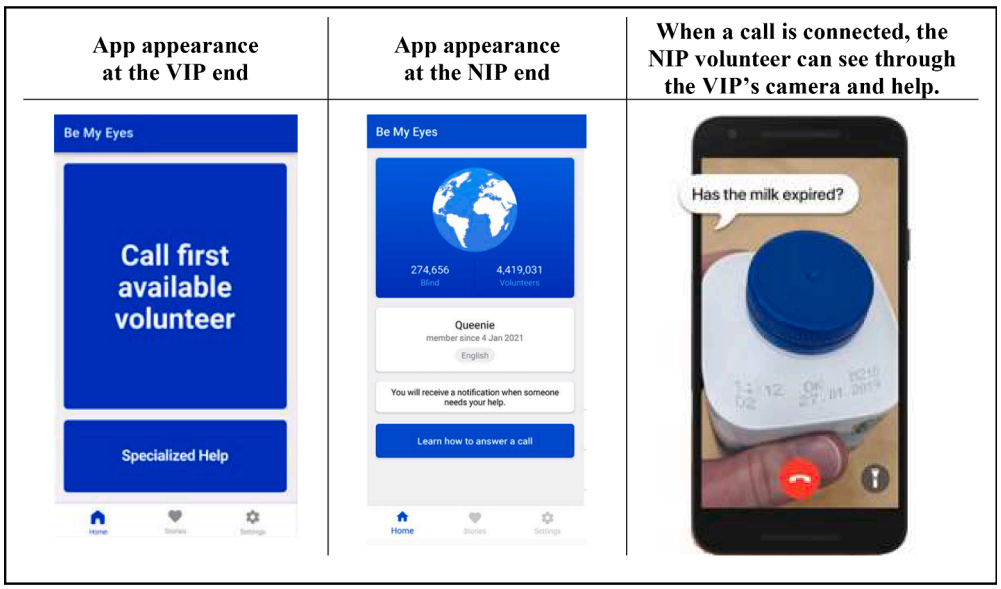

Fig. 1. Sample interfaces of a real-time volunteer app.

Beyond the IS literature, research related to digital technologies and VIP mostly examines their access to daily travel or independent living. For example, in the computer science literature, researchers have aimed to develop assistive app tools for VIP to have better access when going out alone [35], getting educated [36], and going shopping independently [37,38]. The only apps related to social interaction use facial recognition and facial expression recognition technology [39] to improve their face-to-face interaction quality. However, no study has examined how these assistive apps affect VIP's social justice situation—in other words, the social value of these apps. A recent study found a "mixed" social media experience: Some VIP regarded social media as an easier and safer way to communicate, while others mentioned a comparison to offline connection and the need for a balance of offline and online socializing [9]. That article is among the first to study VIP's online connections from the VIP's perspective, but it says little about how this kind of online experience would help VIP increase their social equality or gain more social respect. It would be interesting to explore whether online communication between NIP and VIP helps improve VIP's social justice situation from not only the VIP perspective but also the NIP perspective.

2.2. Fraser's social justice theory and wise intervention

According to Fraser's (2007) social justice theory, there are three dimensions of social justice: economic redistribution, political representation, and cultural recognition. Our study mainly focuses on the cultural recognition dimension, which is related to social value. Specifically, it refers to social value patterns that allow or deny people's social status as comprehensive partners in social interactions and offer equal opportunities to gain social respect.

According to social justice theory, self-sufficiency is an important factor in culturally achieving social justice for disabilities [10]. One approach to achieving social justice through self-sufficiency is *wise intervention* [40], developed based on basic theory and research in social psychology. It proposes different kinds of interventions that can help minority groups to develop strong mindsets (i.e., better self-sufficiency). The mindsets developed through wise interventions have been shown to bring great positive impacts on social justice in different settings, such as education [20,41] and organizations [42]. It would be interesting to evaluate whether real-time volunteer apps can serve as positive wise interventions for VIP, which would help them achieve better justice.

Wise intervention proposes two kinds of effective interventions to achieve justice. The first is related to how people regard themselves (self-identity): need-to-understand and need-for-self-integrity interventions illustrate the importance of people's reasonable understandings of themselves, other people, and the world around them. The second perspective is related to the connection to society (societal perspective): need-to-belong interventions focus on the necessity for people to feel connected to others. The two kinds of interventions supplement each other and do not work independently [40]. By testing the impact of real-time volunteer apps on the two kinds of interventions, we can test how these apps impact the social justice situation of VIP.

2.3. Intergroup contact theory

The current study was first inspired by intergroup contact theory [43], which suggests that intergroup contact under particular conditions can reduce prejudice between majority and minority group members. This theory suggests that authority-supported contact between groups with common goals in a non-competitive environment at equal status helps reduce prejudice between groups. The contact happening in a real-time volunteer process fits these conditions, aside from the "equal status" one, as the relationship between a helper and a visually impaired user of the app is unequal and hierarchical. However, previous literature argued that the four conditions are not essential for the effect but merely facilitate it [44]; quality (whether satisfying the four conditions or not) is a predictor of effect efficiency. In addition, given that contact through real-time volunteer apps takes place online, previous literature suggested that online intergroup contact can still significantly affect prejudice between groups [45]. Thus, it is unclear whether the usage of real-time volunteer apps will have an effect on reducing prejudice between VIP and NIP.

Early studies on intergroup contact have focused on how positive and optimal contact conditions can have an impact. Over time, greater emphasis has been placed on the examination of negative and non-optimal intergroup interaction [46]. Most past studies have focused on examining the difference between positive and negative contact [47]. For example, Fuochi et al. [48] found that the impact of positive intergroup contact is especially strengthened in close, personal interactions, whereas negative contact effects are magnified in shallow, superficial interactions. Researchers have indicated that the ramifications of non-optimal contact are surprisingly intricate. However, there remains a dearth of empirical evidence on the impact of non-optimal contact, particularly in a general context. As researchers have been emphasizing

the lack of negative factors that prevent the effects of intergroup contact theory [44], this study provides empirical evidence on the negative effects of non-optimal contacts.

Despite the presence of prejudice, studies have demonstrated the notable impact of intergroup contact on various affective factors related to prejudice, such as satisfaction, liking, and acceptance, among others [44]. Additionally, the effect sizes of affective factors were found to be significantly larger than cognitive factors such as stereotyping. It was also found that the effects on affective factors may differ from those on cognitive factors, as individuals may develop positive feelings toward an outgroup even while retaining their stereotyping of that group [44]. Consequently, it is important to explore both cognitive and affective factors to obtain more precise assessments of the effects of intergroup contact.

3. Hypothesis development

In this section, we elaborate on the impact of real-time volunteer apps on VIP and NIP and propose several hypotheses related to the research questions in this study. To disentangle the effects of these apps on VIP and NIP in terms of social justice, we first propose four dependent variables that represent the social justice achieved by VIP and provided by NIP. Next, we illustrate how we define the independent variables. Then, we propose the hypotheses for VIP and NIP respectively based on the dependent variables. Fig. 2 shows our research model.

3.1. Dependent variables

3.1.1. Visually impaired people's prejudice vulnerability and perceived social connection

For VIP, we chose the dependent variables following the research on wise interventions. By evaluating the effects of real-time volunteer apps on the two types of interventions, our study aims to assess the extent to which these apps influence the achievement of social justice among VIP. First, from the self-identity perspective, we need a variable that is related to prejudice and can also align with the self-identity interventions. Thus, we used *prejudice vulnerability*, which measures the extent to which they perceive others' behavior as prejudiced. Theoretically, prejudice vulnerability refers to the phenomenon of disadvantaged group members (VIP) attributing unfavorable interpersonal feedback to prejudice from the dominant group (NIP) in unclear situations [49]. Specifically, high prejudice vulnerability means that people are more likely to perceive others' behavior as prejudiced. This construct aims to examine changes in VIP's attitudes to NIP's behavior and their perception of self-worth. Increased prejudice vulnerability can have negative effects on an individual's well-being, including increased stress, anxiety, and reduced self-esteem. It can also lead to avoidance of certain situations or social groups, which can further limit an individual's opportunities and experiences. Thus, we measured VIP's prejudice vulnerability toward normal NIP in general (not only online volunteer NIP) to assess the impact of these interventions on their self-sufficiency and ability to achieve social justice through the usage of these apps.

Second, from the societal perspective, we used *perceived social connection*. Perceived social connection (or social connectedness) is defined as an individual's subjective sense of feeling connected to others in their social environment. Perceived social connection is important for mental and physical well-being, as it provides a sense of social support and reduces feelings of loneliness and isolation. Research has shown that individuals with higher levels of perceived social connection tend to have better mental health outcomes compared to those with lower levels of perceived social connection [50], which could help individuals achieve better justice in their social life. Improving perceived social connection not only serves as a variable from the societal perspective in wise intervention, but it also improves social justice [51,52].

3.1.2. Non-Impaired people's prejudice

Social psychologists have suggested that prejudice reduction is a possible solution to social injustice [19]. Thus, we investigate whether real-time volunteer apps have the potential to improve the attitudes of NIP volunteers and, in turn, promote social justice for VIP. To examine reduction of NIP's prejudice toward VIP, we tested the changes that these apps bring to NIP's stereotyping (cognitive factor) and social acceptance (affective factor) of VIP. In this context, we measured the effect of NIP volunteers' app usage on their prejudice toward VIP in general.

The *Oxford English Dictionary* defines *stereotype* as a "widely held but fixed and oversimplified image or idea of a particular type of person or thing." Stereotyping illustrates whether NIP consider the personal capabilities of VIP to meet a proper standard. While stereotyping is a cognitive factor of the attitude of NIP, we also tested a more affective factor, *social acceptance,* to capture prejudice attitude changes more

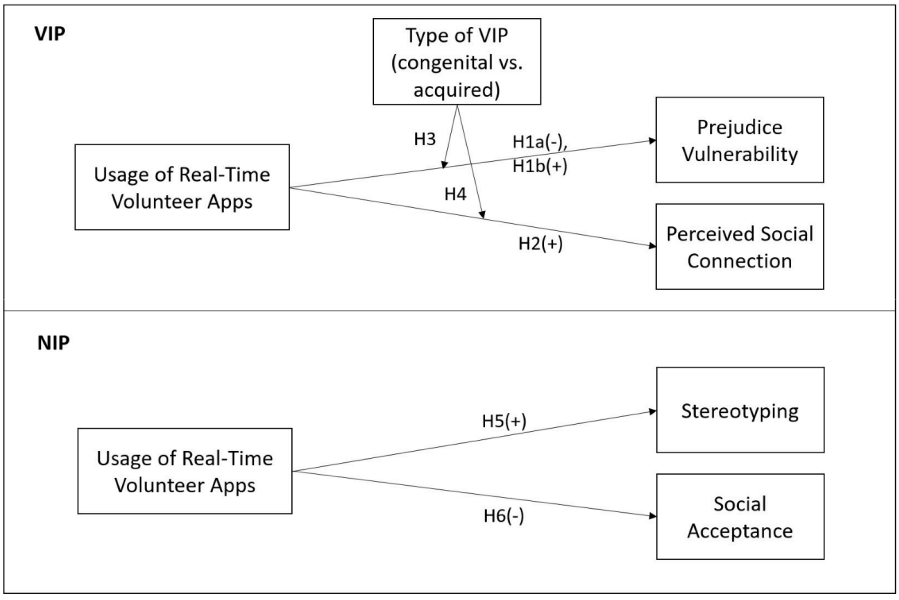

Fig. 2. Research model.

accurately. Social acceptance is defined as the extent to which a phenomenon is accepted, liked or disliked, and actively supported or opposed by relevant social actors [53]. We thus used it to test the attitudes of NIP toward VIP, which can also correspond to the perceived social connection variable on the VIP side.

3.2. Independent variables

The independent variables employed in this study are binary variables designed to capture the distinction between individuals who have previously utilized these apps and those who have not engaged with them. For VIP, the observations were drawn from VIP online chat groups and VIP online communities. We used those who have downloaded and used these apps as the treatment group and those who have never downloaded these apps as the control group. As the VIP samples were obtained from the same pool, the two groups of VIP have similar accessibility to digital technologies and willingness to interact with other people.

For NIP, the samples are those who have downloaded these apps. Usage of these apps is distinguished by whether NIP users have been assigned a phone call (treatment group) or not (control group). In this way, the two groups of NIP are comparable, as the app systems decide the assignment of calls exogenously. The dichotomous nature of this variable allows a clear differentiation between the two groups, facilitating an examination of the potential effects of prior app usage on the dependent variables under investigation.

3.3. Hypothesis development

3.3.1. Visually impaired people

3.3.1.1. Prejudice vulnerability. As these apps are designed to help VIP with their daily tasks, volunteers using these apps are more likely to show kindness and patience to VIP, and VIP users may in turn perceive increased kindness from sighted volunteers. Perceived kindness has been tested as a positive predictor of increased liking and familiarity [54]. Also, a meta-analysis conducted by Pettigrew and Tropp [55] found that although the effect size of intergroup contact on minority groups (VIP) is smaller than that on majority groups (NIP), the effect is still significant. As mentioned before, previous literature has argued that the four conditions facilitate the effect but are not essential for it [44]. Even though the contact condition provided by real-time volunteer apps does not perfectly satisfy the four conditions, there is still the possibility that contact through these apps can help reduce VIP's prejudice vulnerability. Therefore, we hypothesize that:

H1a: The use of real-time volunteer apps decreases the prejudice vulnerability of VIP.

An alternative argument is based on social contrast effect, which suggests that individuals tend to evaluate others based on their past experiences. Empirical evidence from laboratory experiments has shown that exposure to images of attractive individuals can influence one's perception of beauty, causing average individuals to be rated as less attractive [56]. In the context of real-time volunteer apps, VIP may perceive volunteers to be more kind and patient than the general NIP population due to the nature of their interactions in these apps. This perceived increase in kindness may raise VIP's expectations of favorable treatment from the NIP population as a whole [57]. However, this comparison between the attitude of online volunteers (high expectations) and in-person random passersby (reality) may leave VIP users more vulnerable to prejudice and discrimination in their everyday interactions. Therefore, we also pose the following competing hypothesis:

H1b: The usage of real-time volunteer apps increases the prejudice vulnerability of VIP.

3.3.1.2. Perceived social connection. These apps enable VIP to engage in social interactions with sighted volunteers who can help them with everyday tasks such as reading labels, identifying objects, and navigating unfamiliar environments. Previous literature has suggested that increased interaction opportunities are a positive predictor of perceived social connection [58]. These apps provide a sense of belonging and support to VIP. By being connected with sighted volunteers, VIP can feel that they are not alone—that they have a community of people who are willing to support them. Increased perceived social support is another indicator of increased social connection [59]. Moreover, the use of these apps empowers VIP by increasing their independence in daily activities and social communications, which may make them feel closer to society. By relying on the assistance of sighted volunteers, VIP can accomplish tasks that were previously challenging or impossible—for example, shopping, attending events, or exploring new places. Specific supportive online guidance and interactions are a positive indicator of confidence and independence in social communications [60,61]. We thus hypothesize that:

H2: The use of real-time volunteer apps increases the perceived social connection of VIP.

3.3.1.3. Moderating effects. Previous literature has provided evidence of the different characteristics of congenital VIP and acquired VIP. It has been suggested that congenital VIP are more likely to have impairment in social interactions, cognition, and daily living skills, while acquired VIP are more likely to experience lost roles [62]. As congenital VIP are reported to have a lower ability to understand others and are more likely to have impairment in cognition than acquired VIP, there are fewer opportunities for them to perceive others' behavior as prejudice and catch others' real prejudice. Thus, we argue that congenital VIP are less prejudice-vulnerable, and the effects on prejudice vulnerability will be less significant than for acquired VIP. We thus hypothesize that:

H3: The effect of real-time volunteer apps on prejudice vulnerability is less significant for congenital VIP than for acquired VIP.

Congenital VIP suffer from having fewer social skills and from more difficulties in building social connections than acquired VIP [63]. Congenital VIP have been exposed to visual limitations from birth, which may result in more obstacles when they seek social connections with strangers [63–65], leading to a heightened reliance on technology and alternative communication methods to establish social skills and maintain social connections (Dobransky & Hargittai, 2006; Lupton & Seymour, 2000). In contrast, acquired VIP may have already developed social networks and communication strategies before the onset of their visual impairment [63]. Loss aversion ([66]; Schmidt & Zank, 2005) for acquired VIP may also lead to smaller effects of these apps on their social connection. The past better experienced offline social interactions with strangers make the online interaction appear as a loss; even if these apps indeed bring more opportunities for them to interact, the perception of loss can lead to dissatisfaction and make it harder to help them feel more socially connected [67]. While real-time volunteer apps can still offer valuable support, the existing resilience, social experience, and social skills of acquired VIP may mitigate the perceived impact on social connection. We thus hypothesize that:

H4: The effect of real-time volunteer apps on perceived social connection is more significant for congenital VIP than for acquired VIP.

3.3.2. Non-Impaired people

3.3.2.4. Stereotyping. As intergroup contact theory suggests, the contact created through these apps is not optimal (missing the equal status condition). Even though the four conditions facilitate the effect but are not essential for it [44], we argue that in our context, missing the equal status condition may make the contact effects less significant or even result in an unfavorable outcome for sighted volunteers. First, helping VIP with fundamental daily living tasks may make the reliance of VIP on NIP more noticeable, which may enhance NIP's stereotyping of VIP. By connecting with VIP through these apps, sighted volunteers may only see VIP in the context of their needing assistance, rather than as individuals with their own unique skills and abilities. This may reinforce the negative stereotype of VIP as being unable to care for themselves and reliant on the help of others [68]. Second, the use of these apps may also lead to pity toward VIP, rather than promoting empathy and understanding [69,70]. When sighted volunteers assist VIP through the app, they may feel sorry for them or see them as objects of charity, rather than as equals. Contact without equal status can create a power dynamic between sighted volunteers and VIP [71], which can be detrimental to their relationship and hinder the development of a genuine connection. Third, although previous literature has suggested that through interactions between groups, sighted volunteers could learn more about VIP's life and the likelihood of misconceptions could be reduced [72], we suggest that the contact in these apps can lead to a superficial understanding of VIP's experiences. By connecting with VIP through these apps, sighted volunteers may only see a small part of their life, rather than experiencing the full range of their daily experiences and challenges. Volunteers may only notice the difficulties VIP face instead of getting to know their ability to live in society. The lack of understanding of the comprehensive experiences of VIP can perpetuate stereotyping and misconceptions. Therefore, we propose:

H5: The use of real-time volunteer apps increases NIP's stereotyping of VIP.

3.3.2.5. Social acceptance. Social acceptance, an affective factor testing sighted volunteers' attitude toward VIP, has been shown to be significantly affected by intergroup contact (Birtel et al., 2018; [44]). As H5 suggests, contact through these apps can perpetuate sighted volunteers' stereotyping of VIP. As Pettigrew et al. [44] argue, the effect size of intergroup contact on the affective factor (social acceptance) is larger than that on cognitive factor (stereotype). Thus, a lack of social acceptance can be more significantly perpetuated by such contact. Besides, the use of these apps may reinforce the idea that VIP are a separate and distinct group from NIP, as the contact often happens when VIP are in need, which may lead to increased pity and misconception of sighted volunteers toward VIP (Dovidio et al., 2003; [73]). It may emphasize the NIP's view that VIP are fundamentally different from and dependent on themselves, rather than independent individuals living in the same community (Chen & Hamilton, 2015). This can lead to a lack of social acceptance of VIP, as they are seen as being outside of the "normal" social group [74]. Thus, we hypothesize:

H6: The usage of real-time volunteer apps decreases NIP's social acceptance of VIP.

4. Research methods

We adopted a mixed-methods approach in this study. Mixed methods combine elements of qualitative and quantitative approaches to investigate research questions with a greater breadth and depth of understanding and corroboration [75]. Previous research has highlighted three advantages of mixed methods [76]. First, this approach facilitates addressing confirmatory and explanatory research questions simultaneously. Our initial research question pertains to the effects of using these apps on VIP/NIP (confirmatory), followed by an explanatory question. Second, the inferences drawn are more robust and comprehensive. Following the acquisition of quantitative results in the initial phase, there is an opportunity to revalidate these findings through a qualitative method. Third, this approach enables researchers to obtain more comprehensive and/or divergent perspectives on focal questions. The qualitative method allows us to explore unhypothesized explanations of the inferences obtained in the first step.

We followed the guidelines of Venkatesh et al. [76] for conducting mixed-methods research to design our study. This guideline is widely utilized and adhered to in the IS literature [77–81]. We initiated the process by formulating our research questions. Following Creswell [82], who proposed three methods for framing research questions in mixed-methods studies, our quantitative and qualitative questions were formulated independently. We then outlined our rationale for employing the mixed-methods approach—expansion purposes (i.e., to explain or expand upon the understanding obtained in a previous strand of a study), which are among the seven primary purposes that researchers choose when utilizing the mixed-methods design [83,76]. It is common to use a quantitative study to test a relationship and derive inferences for confirmatory questions and then employ a qualitative study to explore potential explanations and revalidate the results [84–86]. We thus initially conducted a quantitative study to explore the relationship between using these apps and the social justice achieved/provided by VIP and NIP respectively; then we utilized a qualitative study to explain and revalidate the results.

To answer our research questions, we used a sequential explanatory research design [82]. The mixed-methods sequential explanatory design involves two distinct phases: the collection and analysis of quantitative data, followed by the collection and analysis of qualitative data. The quantitative phase offers a general understanding of the research problem, while the qualitative phase refines and elaborates on the quantitative results by exploring participants' perspectives in greater depth. These two phases are intricately connected, enhancing the comprehensiveness and depth of the research findings; this makes it a valuable approach in mixed-methods research [82,87,88]. In terms of epistemological perspectives, we followed the complementary strengths stance [89], which combined various paradigms in different phases of our research. Specifically, we used the positivist paradigm in the quantitative study and the interpretive paradigm in the qualitative study. Detailed information on our research design can be found in Appendix A1. To better elaborate on the two phases of our study, we present our research flow in Fig. 3. In the following sections, we illustrate the two phases in detail.

4.1. Quantitative phase

We first collected survey data to test our hypotheses through online questionnaires. The survey approach offers a foundation for generalizing the population, making results repeatable, and demonstrating statistical power [90]. The online questionnaires were first reviewed and pilot tested by five VIP and five NIP before the formal data collection. As VIP rely on screen readers to complete the online questionnaire, we tested the online questionnaire system on the top three screen reader apps[7] and the top two phone systems[8] in China, where the main study would be conducted, to ensure that VIP could access the design and questions.

The measurement items were adapted and revised from existing scales from the literature. All measurement details are provided in Table 1. A 7-point Likert scale was utilized in questions for both VIP and NIP, in which 1 indicates "strongly disagree" and 7 indicates "strongly agree." The measurement of prejudice vulnerability was adapted from

[7] Apple Voiceover, NVDA, ZhengDu.
[8] IOS, Android.

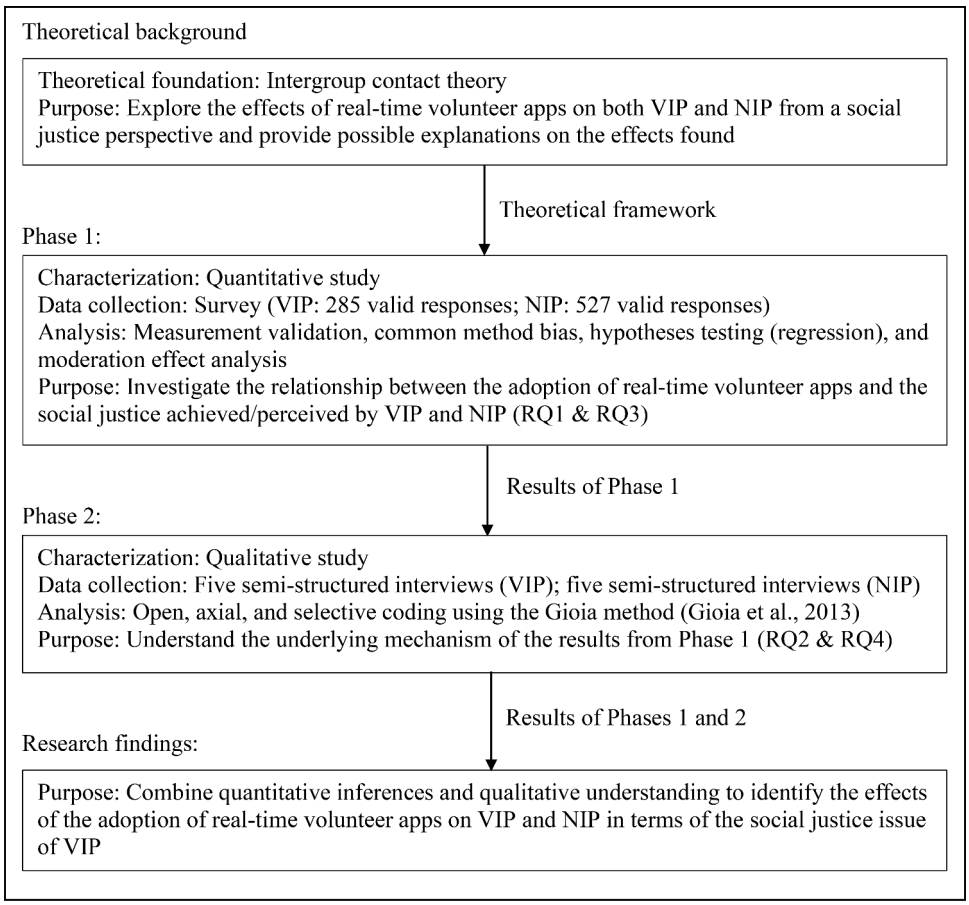

Fig. 3. Research flow.

Table 1
Measurement items

	Variables	Item description	References
VIP	Prejudice Vulnerability (PV)	Four scenarios and reflection (Appendix A2)	[49]
	Perceived Social Connection (SC)	SC1: I feel disconnected from the world, especially the world outside the visually impaired community. SC2: Even around people I know, I don't feel that I really belong. SC3: I feel distant from people.	[91,92]
NIP	Stereotyping (S)	P1: The basic reasons for many of the social and economic problems that people with visual disabilities suffer from are their own mental weaknesses. P2: Even though there are some exceptions, it seems that most people with visual disabilities simply lack those qualities that community members should have. P3: People with visual disabilities should live in protected places because of the dangers in society.	[93]
	Social Acceptance (SA)	SA1: People with visual disability find it harder than others to make new friends. SA2: People with visual disability have problems getting involved in society. SA3: People with visual disability are a burden on society. SA4: People with visual disability are a burden on their families. SA5: People with visual disability are a burden on their friends and peers.	[94]
Demo-graphics	Acquired VIP	Were you born with visual impairment or did you acquire visual impairment?	Self-developed
	Age	What age group do you belong to?	
	Gender	What is your gender?	
	Visual impairment degree	What is your visual impairment degree?	
	Previous experience	Do you have any experience in helping visually impaired people before downloading or using this app?	
	Having VIP family or friends	Do you have a family member or friend with visual disability?	

Gilbert's [49] study measuring the prejudice vulnerability of black students, based on which we constructed four real-life scenarios and let VIP reflect based on those scenarios. The online questionnaires were developed in English and then translated into Mandarin Chinese by one person on our research team who is proficient in both English and Mandarin Chinese; then the translated questionnaires were reviewed and revised by two other people—not on the research team—who are also proficient in English and Mandarin Chinese, to ensure consistency and accuracy. We also checked the translation in our pilot test procedure to make sure that the participants understood the questions correctly.

4.1.1. Quantitative data collection procedure

Two independent surveys (one for VIP and one for NIP) were conducted. For VIP, the online questionnaires were distributed to eight VIP

online chat groups (around 300 people each) and two major VIP online communities in China. For NIP, the online questionnaires were distributed on a real-time volunteer discussion forum in one of the largest Chinese online communities. Each participant was offered 20 RMB upon their completion of the questionnaire. The collecting process was conducted in early May 2022. After discarding responses that had an unreasonable completion time (too short or too long), chose "No" on the ethical question, or failed the attention check and falsifying questions, 285 valid responses from VIP and 527 from NIP were collected. Detailed information about the cleaning process can be found in Appendix A3. Table 2 shows the demographic information of the participants in our survey.

4.2. Qualitative phase

We conducted a qualitative study to generate an in-depth understanding of our quantitative findings. This is a way to provide the "voice behind the numbers" [95]. In addition, this enables further theory development because it incorporates the perspectives of the human subjects related to the phenomenon under study [96], and it is especially suited for exploring known causal relationships in an in-depth manner [97]. This approach is especially likely to generate insights relevant to our research objectives because it facilitates the inductive derivation of theoretical concepts that provide a deeper understanding of the hypothesized relationships and the phenomenon under examination: *how* the influence of real-time volunteer apps on helping VIP enhances social equality and *how* the influence of real-time volunteer apps on helping NIP changes their attitude on social equality to VIP (see [98]).

4.2.1. Qualitative data collection procedure

Qualitative data were collected in two phases. In an initial preparatory phase that lasted from March to May 2022, we gathered data from a variety of secondary sources, including news articles, journal articles, and books. The information from these "nontechnical" ([99], p. 52) sources was used to enhance our knowledge of social justice and prejudice vulnerability, which formed the basis for formulating our subsequent interview questions [100,101]. The preparatory phase was followed by a virtual fieldwork phase in June 2022, involving a team of four researchers. The advantage of involving multiple researchers was that we were able to triangulate our observations and interpretations of the collected data [102]. As part of this phase, we organized virtual meetings to conduct interviews with VIP and NIP. The interviewees were identified via purposive [98] and chain referral sampling [103] based on a set of preliminary interview questions (see Appendix A4) that we sent in advance to our "gatekeeper" ([97], p. 165) from Angel's Eyes. We adopted this method of identifying interviewees because, as external researchers, we did not possess enough inside information to identify the most appropriate individuals for our interview questions independently [97].

A total of 10 semi-structured interviews were conducted with five VIP and five NIP (see Table 3). All interviewees were experienced users of the real-time volunteer apps and have utilized these apps on a regular basis, at least once a week. This is because users who use real-time volunteer apps frequently are more likely to provide reliable and informed feedback, and their experiences are not limited to initial impressions, allowing a more comprehensive assessment of the effectiveness of using the apps. In terms of the five VIP, with ages between 18 and 30 years old, three interviewees acquired visual impairment later in life, while two had congenital visual impairment. This diversity allows a more comprehensive understanding of how different life experiences shape their interactions with real-time volunteer apps. In addition, including both acquired and congenital VIP ensures that the study covers a wide spectrum of visual impairment experiences. This is essential for evaluating the app's ability to cater to the diverse needs of individuals with varying degrees and types of visual impairment.

For the selection of NIP interviewees, we invited five frequent users of these apps from the discussion forum where the survey was distributed. None of the NIP interviewees has any disability, or disabled family or friends, and their ages range from 20 to 45 years old. The interviewees have varying durations of user experience with the real-time volunteer apps, ranging from 1 month to 3 years. This diversity of user experience provides comprehensive insight into the potential social implications of the apps over time.

The interviews took an average of around 60 minutes to complete;

Table 2
Sample characteristics.

Items	Category	VIP		NIP	
		Frequency	Ratio	Frequency	Ratio
Gender	Male	193	0.68	305	0.58
	Female	92	0.32	222	0.42
Age	Below 18	34	0.12	2	0.01
	18–30	201	0.70	262	0.50
	30–45	37	0.13	229	0.43
	45–65	11	0.04	28	0.05
	Above 65	2	0.01	6	0.01
Visual impairment degree	First degree blind	185	0.65		
	Second degree blind	25	0.09		
	First degree low vision	37	0.13		
	Second degree low vision	23	0.08		
	Don't know	15	0.05		
Previous experience	No experience			96	0.18
	Fewer than 2 times per year			181	0.34
	2–5 times per year			180	0.34
	More than 5 times per year			70	0.13
Having VIP family or friends	Yes			347	0.66
	No			180	0.34

Table 3
Summary of interviews conducted.

Interviewee	User Background	Use of Real-Time Volunteer Apps	Themes Discussed
Visually Impaired Users			
A	25 years old; acquired VIP	1–2 times per week	The usage of real-time volunteer apps, implications of using real-time volunteer apps, responses of NIP to the VIP, responses of passersby to VIP, social connections between VIP and society
B	36 years old; congenital VIP	2–3 times per week	
C	28 years old; acquired VIP	3–4 times per week	
D	23 years old; congenital VIP	3–4 times per week	
E	20 years old; acquired VIP	1–2 times per week	
Non-Impaired Users			
P	22 years old; 2–3 years of app experience	1–3 times per week	The rationale behind using real-time volunteer apps, the experience of using real-time volunteer apps, reflection on the use and impact of real-time volunteer apps, perceptions and attitudes toward VIP
Q	45 years old; 1 month of app experience	10 times per week	
R	19 years old; 2 months of app experience	Fewer than 1 time per week	
S	26 years old; 1–2 months of app experience	7–12 times per week	
T	23 years old; 6–12 months of app experience	2–3 times per week	

they were digitally recorded and later transcribed for analysis. The interviews were conducted in Mandarin Chinese, but because every member of the research team was bilingual and proficient in both Mandarin Chinese and English, we retained and analyzed all the textual data in the original language and only translated the data at the time of writing (see [104]). A single member of the research team performed the translations to ensure consistency, but other members carefully examined and validated these translations to ensure coherence [102].

4.2.2. Data analysis

As the aim of our qualitative study was to explore the underlying mechanisms behind our hypothesized relationships, we organized and coded the data using Straussian grounded theory techniques of open, axial, and selective coding [99]. Specifically, open coding was used to assign descriptive labels to our data (our interview excerpts) to form first-order concepts [105]. The purpose of these labels is to "capture the core issues, as identified by the speakers, in conceptual language" ([106], p. 735). Wherever possible, the labels were taken directly from words used by the interviewees and included concepts such as "contrast of attitudes from passersby and volunteers" and "lack of trust in passersby." Axial coding was then used to relate the first-order concepts to a number of second-order themes [105]. This technique involves coding for conditions (causal, intervening, and contextual), actions and interactions, and consequences [99], while taking care to ensure that the second-order themes were based on the data and not coming from an external framework or our theoretical preconceptions [106]. To illustrate, the first-order concepts of "contrast of attitudes from passersby and volunteers" and "lack of trust in passersby" were categorized as a second-order theme related to the "negative implications of prejudice vulnerability."

Finally, with selective coding, we further examined our data to abstract our first-order concepts and second-order themes into aggregate theoretical dimensions. For instance, the second-order theme "negative implications of prejudice vulnerability" was abstracted as an aggregate dimension representing the app's "impact on VIP's mindset." If we were confronted with data that challenged or did not fit easily into our existing first-order concepts and second-order themes, our coding scheme would be modified accordingly (i.e., we would modify/delete an existing second-order theme or first-order category or add a new one—see [99]), and coding would be restarted. Selective coding allowed us to move beyond description to a more abstract level of conceptualization [107]. This process continued until a state of theoretical saturation was reached [108], which refers to a state where the inductively derived model can comprehensively account for the case data, and "incremental learning is minimal because the researchers are observing phenomena seen before" ([109], p. 545). The final set of first-order concepts, second-order themes, and aggregate dimensions that was produced from our analysis is summarized in a data structure (as prescribed by [105]) in Appendix A5. The supporting evidence is provided in Appendix A6.

5. Results and discussion

5.1. Quantitative results

In this section, we first examine the validity and reliability of our survey measurement items. Then we demonstrate how we control for common method bias. After that, we illustrate the method and results of our hypothesis testing.

5.1.1. Measurement model evaluation

In this subsection, we explicate the implementation of validity and reliability controls in our measurement procedure using SPSS Version 28.0.1.0. Reliability, convergent validity, and discriminant validity are important aspects of verifying the measurement properties of survey items in quantitative studies. Table 4 shows our factor analysis results.

Table 4
Factor analysis results

	Items	Factor Loading	Cronbach's α	Composite Reliability	AVE
VIP	**Prejudice Vulnerability**				
	PV1	0.722	0.71	0.81	0.52
	PV2	0.715			
	PV3	0.735			
	PV4	0.715			
	Perceived Social Connection				
	SC1	0.847	0.85	0.91	0.76
	SC2	0.893			
	SC3	0.878			
NIP	**Stereotyping**				
	S1	0.827	0.71	0.81	0.59
	S2	0.762			
	S3	0.719			
	Social Acceptance				
	SA1	0.895	0.82	0.95	0.78
	SA2	0.872			
	SA3	0.859			
	SA4	0.893			
	SA5	0.902			

The composite reliability values of all variables are greater than 0.7, the level recommended by Nunnally and Bernstein [110]. The average variance extracted (AVE) was used to measure convergent validity [111]. The AVE values of all variables were higher than 0.5, indicating that each variable explains over half of the variance of its indicators. Discriminant validity is the degree to which a variable is truly different from other variables. We followed Gaski and Nevin [112] by testing that the square roots of AVE were greater than the inter-construct correlations (Table 5), which means that each construct in our study shares more variance with its indicators than with other constructs.

5.1.2. Common method bias

Common method bias refers to a potential methodological issue in quantitative survey studies where the measurement method itself introduces systematic variance that is unrelated to the constructs being measured [113]. Following Podsakoff et al. [114], we utilized two approaches to avoid common method bias—procedural remedies and statistical remedies.

In the process of designing and administering the questionnaire, several procedural remedies were employed to ensure the reliability and validity of the questionnaire items. First, as it is not possible to obtain the predictor and criterion variables from different sources, we try to separate their measurement methodologically. In the beginning of our questionnaire, we used our predictor variable as the selection criterion of participants before the main part of the questionnaire. Second, to minimize the potential influence of social desirability bias, complete anonymity was maintained throughout the questionnaire, and participants were reassured that there were no correct or incorrect responses, thereby encouraging honest and unbiased answers, effectively reducing evaluation apprehension. Third, a counterbalancing approach was adopted for item presentation, specifically for those assessing the same concept, in order to control for the influence of retrieval cues facilitated by contextual factors. Last, to promote comprehension, the

Table 5
Correlation matrix.

	Items	Correlation Coefficients		Square Root of AVE
VIP	Prejudice Vulnerability	1	0.2375	0.72
	Perceived Social Connection	0.2375	1	0.87
NIP	Stereotyping	1	0.3752	0.77
	Social Acceptance	0.3752	1	0.88

questionnaire items were crafted with precision and clarity, incorporating examples where necessary to facilitate understanding. Rather than relying on purely numerical scale values, verbal labels were employed for each midpoint of the scales, tailored to the question context. By implementing these procedural remedies, the questionnaire items were rendered clear, specific, and concise, while also eliminating potential ambiguities and bias, thereby enhancing the overall quality of the data collected.

In addition to the aforementioned procedural remedies, statistical remedies were also employed to further mitigate the common method bias. We used Harmon's single-factor test [115], a typical approach, to assess common method bias after data collection [116,114]. This test involves conducting an exploratory factor analysis on all the questionnaire items. If a single factor emerges that explains a large proportion of the variance, it suggests the presence of common method bias. In our study, for VIP instruments, one constrained factor accounted for 38 % of the variance; for NIP instruments, one constrained factor accounted for 43 % of the variance. Both are within the recommended threshold of 50 % of Harmon's one-factor test, which suggested that common method bias is not a major concern in our study [117,114,118].

5.1.3. Hypothesis testing method

We utilized multiple regression (implemented in the R language in RStudio Version 2021.09) to test the hypothesized relationship in our research model empirically. Multiple regression is applicable for the following reasons. First, it allows examination of the effects of individual independent variables on the dependent variable and provides a channel to avoid possible confounding factors by considering control variables. Second, compared with CB-SEM, regression does not demand a lot from the data [119]. Third, for the sake of avoiding bias, regression is preferred over PLS-SEM, as previous literature has shown that PLS path modeling is biased, and our sample size is not large enough to mitigate this bias [120,121].

The regression models we used are discussed below. Models (1) and (3) are basic models that examined the main effects for VIP and NIP, respectively. Model (2) was utilized to test the moderating effects. In Model (1), Y represents the dependent variables for VIP—prejudice vulnerability (PV) and social connection (SC), which have values from 1 to 7, where a higher value represents higher PV or SC. *App* is a dummy variable that represents whether the participant has used these apps before they completed the survey. A value of 1 means they have used these apps before, and 0 means otherwise. To control for the confounding factors that may contribute to the effects on our dependent variables, we included several control variables in our model: Age, Gender, and the degree of visual impairment (Degree). Degree represents a VIP participant's visual impairment degree. It ranges from 1 to 4; a higher value means less severe impairment. Age has a value from 1 to 5, which represents different age groups; a higher value means an older age group. Gender is a dummy variable, where 1 represents male and 0 represents female. Including these control variables in our model enabled our model to rule out the effects brought by these factors. Model (1) is thus

$$Y = \alpha + \beta_1 \text{App} + \beta_2 \text{Age} + \beta_3 \text{Gender} + \beta_4 \text{Degree} + \varepsilon. \quad (1)$$

Model (2) aimed to test the moderating effect of whether the participants are acquired VIP or congenital VIP. AcquiredVIP is a dummy variable that equals 1 when the participant's visual impairment is acquired and 0 when it is congenital. Model (2) is

$$Y = \beta_1 \text{App} + \beta_2 \text{AquiredVIP} + \beta_3 \text{APP} * \text{AcquiredVIP} + \beta_2 \text{Age} + \beta_3 \text{Gender} + \beta_4 \text{Degree} + \varepsilon. \quad (2)$$

Model (3) aimed to test the main effect of NIP. Y represents the dependent variables for NIP, stereotyping (S) and social acceptance (SA). The two variables have values from 1 to 7; a higher value represents higher stereotyping or higher social acceptance. Control variables are also utilized to rule out possible confounding effects. Besides Age and Gender, Experience represents whether a participant has previous experience in helping VIP in real life; it has values from 1 to 4, where a higher value indicates more experience. VIP represents whether the participants have VIP friends or family; it equals 1 if they have and 0 if otherwise. Model (3) is

$$Y = \alpha + \beta_1 \text{App} + \beta_2 \text{Age} + \beta_3 \text{Gender} + \beta_4 \text{ Experience} + \beta_5 \text{VIPs} + \varepsilon. \quad (3)$$

5.1.4. Hypothesis testing results

Table 6 presents the hypothesis testing results. From the columns of Model (1), we can see that for VIP, the usage of real-time volunteer apps significantly increased prejudice vulnerability ($p < 0.05$). In other words, using real-time volunteer apps makes VIP attribute unfavorable interpersonal feedback to prejudice from NIP more easily. Thus, H1b is accepted while H1a is rejected. However, we do see significant positive effects of real-time volunteer apps on the perceived social connection of VIP ($p < 0.01$). Therefore, H2 is accepted. This implies that contact between VIP and NIP through real-time volunteer apps makes VIP feel more connected with society, but it also makes them more vulnerable when connecting with NIP in real life.

The results of Model (2) show that congenital and acquired VIP react differently to these apps regarding perceived social connection. The use of these apps increases perceived social connection significantly only among congenital VIP ($p < 0.1$). Thus, H3 is rejected and H4 is accepted.

For NIP, the results of Model (3) show that the use of these apps significantly increased NIP's stereotyping toward VIP ($p < 0.05$). Thus, H5 is accepted. Also, the use of these apps significantly decreased their social acceptance toward VIP ($p < 0.05$). Therefore, H6 is accepted.

5.2. Qualitative results and discussion

5.2.1. Visually impaired people

From the quantitative analysis above, we found these apps to have negative implications for prejudice vulnerability even as they contributed to increasing the perceived social connection of VIP. Our qualitative results explain these findings further and illustrate a possible mechanism. First, regarding the negative implications for prejudice vulnerability, the qualitative results resonate with our proposed mechanism for the social contrast effect. VIP A highlighted the social contrast he experienced after using these apps: "One of my friends doesn't go out often and mainly uses these apps at home . . . as volunteers in the apps are very nice and friendly; after he started to face the unfriendly things in society, *he needed a process to get used to it*." NIP P also explained this mechanism: "Because of the presence of these apps, VIP can *feel significantly the contrast* of attitudes from passersby and volunteers, which makes them feel more sensitive."

In addition, after using these apps, VIP showed higher expectations for NIP changing their stereotypical perceptions. To illustrate, VIP C mentioned, "I think these apps can help NIP to *know VIP better and change their stereotype of VIP*. [For example, they] make NIP not to regard VIP who are able to use phones and computers to be extremely good, or think VIP can do nothing without a good eye vision." VIP B also stated: "After using these apps, when I meet unfriendly passersby, I would think *if there were more people using these apps, there would be more people who know us better and know how to help us*. For example, one passerby I met would let me walk hundreds of meters more just to avoid a single stair step [because they think a single stair step is too dangerous to me]."

VIP also talked about the contrasts between volunteers and the offline NIP they met. VIP B, who uses the app approximately 2–3 times a week, indicated that "I prefer using the app than asking passersby for help. This is because I trust app volunteers, who are accommodating and friendly. This is unlike passersby, who sometimes give me a very bad attitude, and even purposely provide me with wrong information." VIP D also stated, "When I ask random passersby for help, they usually first express confusion and doubt my ability to go out alone without

Table 6
Hypothesis testing results.

	VIP				NIP	
	Perceived Vulnerability		Social Connection		Stereotyping	Social Acceptance
Model	(1)	(2)	(1)	(2)	(3)	(3)
Intercept	3.91	3.91	4.59	4.40	3.02	4.99
Real-time volunteer app usage	0.29**	0.30*	0.45**	0.70***	0.25**	−0.28**
(Usage = 1)	(0.14)	(0.17)	(0.19)	(0.23)	(0.1)	(0.1)
Acquired_VIP		−0.02		0.32		
		(0.21)		(0.27)		
App × Acquired_VIP		−0.03		−0.74*		
		(0.31)		(0.41)		
Age	−0.02	−0.02	−0.03	−0.01	0.22***	−0.47***
Gender (Male =1)	−0.37**	−0.37**	0.22	0.22	−0.09	−0.05
Previous experience					0.13**	0.17***
Visual impairment degree	−0.02	−0.02	−0.11	−0.11		
Having VIP family or friends (Yes = 1)					−0.21*	0.24*
No. of observations	285	285	285	285	527	527
R^2	0.04	0.04	0.03	0.04	0.05	0.08

Notes: Real-time volunteer app usage is a dummy variable that equals 1 if subjects have used such apps before. *, **, and ***denote significance levels of 0.1, 0.05, and 0.01, respectively.

company; I have already got used to it [but still feel uncomfortable]." VIP C added, "When I ask passersby for help, they usually ask me some silly questions, like 'Do you usually accidentally pass your food to your nose when eating?', but online volunteers never do that. I think it is because online volunteers know us better."

From these VIP quotations, we can see a contrast between volunteers and passersby. After using these apps, VIP may have higher expectations for NIP's attitudes toward them. As the social contrast effect illustrates, the contrast between these expectations and real NIP behavior would make them more likely to feel prejudiced against in their daily life [56].

In terms of positive implications for perceived social connection, we found an interesting explanation from VIP interviewees. The increase in perceived social connection comes from the secure feeling these apps provide when VIP go out alone, rather than from increased social interaction or an increased sense of belonging between groups. VIP E explained, "The interactions [from these apps] didn't make me feel more connected, but these apps helped me to feel *more accessible to society* and not afraid of going into the whole society independently, which makes me feel more belonging." VIP C added, "With real-time volunteer apps, I *feel safer and more confident* to go out alone without company." Additionally, VIP A described that "These apps are mainly providing ways for helping me when I go out, which makes me feel safer because *I don't have to worry about not being able to find people to help me . . .*; these apps helped me connect to society more frequently." As previous literature has suggested, people need to explore and use all their senses to interact with other people and the environment in order to feel connected [122]. Going out without company gives VIP more opportunities to interact with the world using all their senses, with better self-representation. This, in turn, increases perceived social connection.

5.2.2. Non-Impaired people

Regarding prejudice (stereotyping and social acceptance) toward VIP among sighted volunteers, the quantitative survey results indicated negative implications. Our qualitative findings support these outcomes and provide some reasons for these unfavorable effects. First, in terms of the negative implications on stereotyping reduction, NIP R said, "The usage of these apps refreshed my thoughts about the VIP groups. I could not understand their pain this much before using these apps. I feel *pity* for them. . . . I realized that the *disconnectedness from society* and the *difficulties they face every day* are far more severe than I thought." Moreover, NIP T said, "I just feel such *pity* for them after I use these apps. I sympathize with them so much." Instead of gaining a better understanding of the abilities of VIP, volunteers observed more of the challenges VIP experience in their daily life. This emphasized the dependence of VIP on NIP and heightened a sense of empathy from NIP toward VIP.

Furthermore, from our qualitative results, we can see that the contact through these apps is superficial and instrumental, which has negative implications for social acceptance. Volunteers only notice the difficulties VIP face instead of getting to know their ability to live in society. VIP B stated, "The apps assist me with solving basic problems I encounter in my daily life, such as reading instructions for medicines and choosing fresh food from supermarkets. Other than that, I do not see how the apps help me connect to society." VIP E stated, "*I only use the app when necessary*, and I do not actively participate in social activities. It is very troublesome for me." From the NIP perspective, NIP S said, "I met a *weird* VIP using these apps. He asked me about my personal situation, like 'What is your job? And how old are you?'" This illustrated that some volunteers feel uncomfortable chatting with VIP about topics other than providing assistance, which indicates that the engagement between VIP and NIP volunteers may be superficial, instrumental, and transitory [123]. Sighted volunteers could only see a small part of VIP's experience through these contacts and refused to know more about VIP users in these apps. This lack of understanding of the comprehensive experiences of VIP can increase stereotyping.

6. Discussion

6.1. Key findings

This study is a first step in evaluating the effect of digital technologies on visually impaired people in terms of social justice, considering both the VIP side and the NIP side. We employed a mixed-methods sequential explanatory design. From the perspective of VIP, these apps have counterintuitive effects that worsen VIP's prejudice vulnerability. Through qualitative analyses, we found social contrast effect as a possible mechanism of this. However, we also found that the use of these apps is increasingly associated with VIP's social connection. Our qualitative study showed that this increase does not come from the increased interaction with NIP but rather from the feeling of security these apps provided. Even though these apps helped VIP feel more belonging by increasing their perceived social connection, we found that these apps have an overall negative effect on helping VIP achieve more social justice. This is because reliance on these apps seems to harm the interactions of VIP and normal NIP in the real world. VIP feel more socially connected because of the security provided by these apps (online volunteers); however, when they are interacting with normal NIP in the real world without these apps, they feel more prejudice vulnerability. This does not foster the development of a resilient mindset and self-efficacy in navigating real-world challenges for advocating justice; rather, it leads

to a constriction of interactions, as individuals limit their engagement predominantly to online volunteers, thereby reducing their interactions with broader societal groups.

From the perspective of NIP, these apps also have negative effects. The use of these apps increases NIP's stereotyping and reduces social acceptance. Based on our qualitative investigation, a possible mechanism that emerged is that using these apps may produce greater VIP dependence on NIP in these apps. This finding provides empirical evidence for the negative effects of non-optimal contact (lacking equal status conditions) in intergroup contact theory. The constrained nature of interactions facilitated by these apps inherently restricts the scope of engagement, in which online volunteers engage with VIP only when they need help. In summary, considering the viewpoints of both VIP and NIP, while these apps are beneficial for VIP's daily routine activities, their efficacy in advancing social justice for VIP is lacking; in fact, they exacerbate the overall situation for both VIP and NIP.

6.2. Theoretical contributions

This paper contributes to the IS literature on digital technologies and social justice. Although research has shown that digital technologies improve the quality of life and enhance independence for people with disability [124], the impacts of digital technologies on social justice—a pressing global concern—are inconclusive [8]. To the best of our knowledge, this paper is among the first to test the effect of information technology on visually impaired people in the IS literature.

This paper also provides important theoretical contributions to intergroup contact theory. First, as most attention regarding non-optimal contact has focused on the difference between optimal contact and non-optimal contact [47], we provide empirical evidence on the negative impact of non-optimal contact—specifically, contact lacking equal status conditions. Second, while most articles test intergroup contact theory in specific settings [55], such as schools [125] and industries and organizations [126], this article offers new insights by studying it in a general social setting. Third, most previous papers have focused on one-side effects, that is, the effects for the majority or minority group only. Few studies have focused on both groups in the same contact setting, as this paper does [44]. Fourth, our study provides empirical evidence indicating that contact and connections through real-time apps may exhibit unfavorable outcomes for both minority and majority groups in terms of prejudice reduction. This provides evidence for the findings of Fuochi et al. [48], which argued that the impact of positive intergroup contact is especially strengthened in close personal interactions, whereas negative contact effects are magnified in shallow, superficial interactions, as in the case of real-time volunteer apps. Last, researchers have mentioned the lack of negative factors that prevent the effects of intergroup contact theory [46,44]. We found that the attitude of the specific contacted person influences the effects of contact. If the person who makes contact with minority group members is significantly nicer than a general majority group member, then, due to social contrast effect, this contact may harm the minority group members. This is important since tolerant people are likely to seek out contact with those in the other group, while prejudiced people avoid it [127]. People refer to this as selection bias when analyzing intergroup contact theory [55], but we argue that the selection bias itself may cause severe consequences for minority group members. In addition, this paper contributes to the literature on congenital and acquired visual disabilities. We illustrated that acquired VIP feel more belonging to society than congenital VIP, but the feeling of belonging cannot be easily affected through interactions with non-impaired people.

6.3. Practical contributions

First, we offer insights for app developers from the perspective of social influence, especially for apps designed for disabled groups. While most apps designed for disabled groups aim to help them in various ways, they may have unintended drawbacks in terms of mental and social aspects. Our findings also advanced the understanding of the dark side of IT, illustrating that although real-time volunteer apps aim to help VIP with their daily life, they may unintendedly result in worsening their prejudice vulnerability. Given that a wider genre of apps designed for disabled groups have appeared, and more apps are embracing social features, our work showed that analyzing social influence in this subcategory is imperative for the social justice issue for disabled groups. Hence, our study not only shows the unintended drawbacks of this kind of app but also provides a new perspective for both app designers and researchers.

Moreover, we further the understanding of improving the social justice situation of minority groups based on actual usage. We found that improving strong-tie relationships is important in reducing intergroup social injustice, which is crucial for app designers who aim to help with the social engagement problem of minority groups, including disabled people and people with mental illnesses. Other than creating a one-time link between majority and minority groups, building a long-lasting relationship between the two groups may be a good way to improve. For example, real-time volunteer apps can change their matching algorithm by increasing the priority of volunteers who have helped the same person before when assigning calls. Showing nicknames for the helper and the visually impaired user on the volunteer apps may be another way to encourage bonding.

7. Limitations and future research

Our study has several limitations that highlight directions for future research. First, we only explored the effects of these apps in China. Future work can improve the generalizability of this research by conducting more studies in different cultural settings. Second, several VIP in our interviews mentioned privacy concerns when using real-time volunteer apps. "I prefer to use Angel's Eyes because it explicitly told me that only my back camera is on and volunteers cannot see my face," said one VIP during the interview. While we did not have the chance to touch on the area of information privacy in this paper, future research on the information privacy of these apps is needed. Third, while we utilized several procedural remedies during the questionnaire design stage, we used only Harman's single-factor test as the statistical remedy when controlling for the comment method bias. Future research can address this limitation using partial correlation procedures by adding marker variables to further control for the common method bias. Last, our study suggested that strong-tie relationships with NIP work better to help VIP with their social and physical well-being. Future work can investigate the effects of different design features of these apps. For example, adding a community section in these apps to create a sharing social community for both NIP and VIP may improve the social justice situation. Online communities that aim to help NIP know more about VIP's daily life may be a good way to achieve better justice and reduce their misconceptions about each other. Moreover, adding more detailed screening mechanisms for VIP and NIP during their registration process may improve users' perceptions and attitudes when using these apps.

8. Conclusion

This study investigates the effects of real-time volunteer apps on social justice from the perspectives of both VIP and NIP. Utilizing a mixed-methods approach, combining surveys and interviews, we find that despite the apps enhance perceived social connection for both VIP and NIP, they paradoxically increase VIP's vulnerability to prejudice, possibly due to the social contrast effect. The app usage can only significantly increase perceived social connection among congenital VIP, rather than acquired VIP. In addition, app usage leads to stereotyping among NIPs and diminishes their acceptance of VIP groups. This study inspires more research on disability in the IS literature and serves as a starting point by examining the effect of digital technologies on

social justice for VIP and underscoring the overlooked drawbacks of IT. It contributes to our comprehension of intergroup contact theory by offering empirical evidence on contact effects under unequal status conditions and emphasizes the importance of social influence in app design, particularly for minority groups, to app designers and developers.

This study aims to inspire more research on disability in the IS literature and serves as a starting point by examining the effect of digital technologies on social justice for VIP. It sheds light on how social justice for disabled people may be enhanced or worsened by technology. It is imperative to investigate how different technologies affect social justice for different minority or disadvantaged groups. There is still much to be done.

9. Declaration of generative AI in scientific writing

No generative AI was used in the writing of this manuscript.

CRediT authorship contribution statement

Huilin Gao: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Evelyn Ng:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Bingjie Deng:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Michael Chau:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

None.

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Appendix A1. Research design following the guidelines of Venkatesh et al. [76]

Property	Design Decision	Decision References
Step 1: Appropriateness of mixed-methods design		
Research questions	Mixed-methods research questions offer a valuable advantage by encompassing both the broad, exploratory nature of qualitative research questions and the precision of quantitative ones within the same inquiry. This approach provides a comprehensive and nuanced understanding of the research phenomenon, making it a preferred choice when researchers seek both depth and specificity in their investigations. Therefore, the mixed-methods research question design is adopted.	Following Creswell [82], we separately wrote the quantitative and qualitative questions. The qualitative questions are dependent on the results of the quantitative questions because we are seeking more explanatory results from the qualitative questions based on the quantitative questions.
Purposes of mixed-methods research	The purpose of mixed-methods design in this study is expansion. The quantitative study gives us inferences on the effects of real-time volunteer apps on VIP and NIP; then the following qualitative study helps to expand our understanding and explain the effects better.	Venkatesh et al. [76] summarized seven main purposes of using mixed-methods designs based on several resources including Greene et al. (1989), Creswell [82], and Tashakkori and Teddlie (2003b): (1) complementarity, (2) completeness, (3) development, (4) expansion, (5) corroboration/confirmation or triangulation, (6) compensation, and (7) diversity. Our work falls under (4) expansion, which aims to "explain or expand upon the understanding obtained in a previous strand of a study."
Epistemological perspectives	We used multiple paradigms.	Multiple paradigms provide researchers more opportunities to build a more rigorous, rich, and in-depth study.
Paradigmatic assumptions	We followed the complementary strengths stance, which combined various paradigms in different phases of our research. Specifically, we used the positivism paradigm in the quantitative study and the interpretive paradigm in the qualitative study.	Venkatesh et al. [76] revealed three most popular mixed-methods paradigms: dialectic, alternative paradigms, and complementary strengths stances. The complementary strengths stance allows the quantitative study and the qualitative study to have different paradigmatic assumptions. In our case, the quantitative study is used to make inferences based on existing hypotheses generated from previous literature and the positivism paradigm fits it validly, which is "premised on the existence of a priori fixed hypotheses or relationships among constructs that are typically investigated with structured instrumentation." The qualitative study is utilized for understanding more about the results obtained from the quantitative study, which is more valid to be executed under the assumption that participants construct their own understanding as they interact with the apps and the world around them—that is, the interpretivism paradigm.
Step 2: Develop strategies for mixed-methods research design		
Strands/phases of research	Multiple phases. We have two separated phases for quantitative study and qualitative study.	Mixed-methods multistrand designs
Priority of methodological approach	Quantitative dominant mixed design	A quantitative-dominant design is grounded in a post-positivist perspective of research, prioritizing quantitative methodologies while acknowledging the potential advantages of incorporating qualitative data and methods to enhance the comprehensiveness of research endeavors.
Design investigation strategy	Exploratory investigations	We position our study as an exploratory investigation because the effects of these focal apps on the social justice issue of VIP and NIP is an untapped area in the IS literature.
Mixing strategies	Partially mixed-methods design	The quantitative study and qualitative study are mixed during the data analysis and data inferences stage.
Time orientation	Sequential explanatory design. We conducted the quantitative study first and then the qualitative study.	We followed Creswell et al. (2003), who proposed the sequential explanatory design.
Step 3: Develop strategies for collecting and analyzing mixed-methods data		

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Property	Design Decision	Decision References
Sampling design strategies	The participants of qualitative study are a nested population of the quantitative study.	For VIP, we selected our populations in eight online chat groups in which only VIP were allowed. For NIP, we selected our populations in the biggest discussion forum of the focal apps. After the quantitative study data collection, we randomly choose our qualitative study sample from the quantitative study sample.
Data collection strategies	Quantitative data collection: online questionnaires with close-ended questions Qualitative data collection: 10 semi-structured interviews with open-ended questions	The closed-ended questions in the quantitative study helped us do numerical data analysis and make more precise inferences, and the open-ended questions in the qualitative study encouraged participants to share more about their understanding and experiences.
Data analysis strategies	Sequential quantitative–qualitative data analysis	The qualitative phase of our study sought to generate an in-depth explanation for the results of the quantitative phase.
Step 4: Draw meta-inferences from mixed-methods results		
Theoretical reasoning	Combination of inductive and deductive theoretical reasoning	For the quantitative study, we used deductive theoretical reasoning, where we predicted the outcomes that might occur and then tested these predictions. For the qualitative study, we used inductive reasoning to generate an explanation for the uncovered causal relationship. We had our hypotheses before the data collection, but we were also open to other possibilities that an inductive approach could yield.
Step 5: Assess the quality of meta-inferences		
Inference quality	Design quality	The study employed a sequential design, commencing with a quantitative survey and subsequently conducting qualitative interviews. The quantitative findings laid the groundwork for and complemented the qualitative investigation, allowing us to leverage the strengths of both methods to address exploratory and confirmatory research inquiries comprehensively. This approach facilitated a nuanced examination of the phenomenon under study, encompassing both its depth and breadth.
	Analytic quality	Quantitative: (1) demonstration of the selection of analytical techniques, (2) mitigation of common method bias Qualitative: (1) triangulation of data sources, (2) transparency of analysis, (3) ensuring theoretical saturation.

Appendix A2. Prejudice vulnerability testing scenarios

1. You arrived at a bus station waiting for a bus. You took a seat and noticed that the person sitting next to you got up after you sat down. In your opinion, the likelihood that the person who left the seat is having prejudice against VIP is
   a. Extremely unlikely
   b. Very unlikely
   c. Somewhat unlikely
   d. Unable to determine
   e. Somewhat likely
   f. Very likely
   g. Extremely likely
2. You are on the street waiting for your friends and notice someone standing next to you is talking to someone on her phone and expressing that she needs help with her bag right now. You offer to help, but she refuses. In your opinion, the likelihood that the lady rejects your help is because she is prejudiced against VIP is
   a. Extremely unlikely
   b. Very unlikely
   c. Somewhat unlikely
   d. Unable to determine
   e. Somewhat likely
   f. Very likely
   g. Extremely likely
3. You are using a real-time volunteer app when buying a pen in a grocery store. You notice that the store is crowded, and there are lots of salesclerks. The volunteer you are talking to notices that there is a salesclerk following you and glancing at merchandise as you are trying to find the right pen. In your opinion, the likelihood that the salesclerk does this is having prejudice against VIP is
   a. Extremely unlikely
   b. Very unlikely
   c. Somewhat unlikely
   d. Unable to determine
   e. Somewhat likely
   f. Very likely
   g. Extremely likely
4. You are on a job interview at a massage shop. The shop owner is not a VIP and the massagers there are all non-impaired. When you arrive at the shop, you notice that there is someone else who is non-impaired talking casually with the owner. You are sure that the shop owner knows you are there. However, the shop owner does not immediately acknowledge your presence or let you know how long you may be waiting. After waiting about 10 minutes, you are starting to wonder if you should stay or leave. In your opinion, the likelihood that the shop owner's actions are due to prejudice against VIP is

a. Extremely unlikely
b. Very unlikely
c. Somewhat unlikely
d. Unable to determine
e. Somewhat likely
f. Very likely
g. Extremely likely

Appendix A3. Data cleaning for the quantitative analysis

VIP (487 Collected):

Step 1: Attention check (458 remain in the sample after this step)

We eliminated responses that failed the attention check, which is choosing the same option for any 13 consecutive questions.

Step 2: Ethical question (425 remain in the sample after this step)

We asked an ethical question ("Can we trust that all your answers reflect your real feelings and can be used for academic research?") in the survey. All responses that answered no are eliminated.

Step 3: Unreasonable completion time (285 remain in the sample after this step)

We noticed that there were some responses that had an unreasonably long or short completion time. We only kept responses within two standard deviations of the mean of completion time in logarithmic scale.

NIP (2511 Collected):

Step 1: Out of standard (992 remain in the sample after this step)
We only kept NIP who had downloaded these apps.
Step 2: Attention check (986 remain in the sample after this step)
We eliminated responses that failed the attention check, which is choosing the same option for the last 13 consecutive questions (some of them are reverse-coded).
Step 3: Ethical question (927 remain in the sample after this step)
We asked an ethical question ("Can we trust that all your answers reflect your real feelings and can be used for academic research?") in the survey. All responses that answered no are eliminated.
Step 4: Falsifying questions (546 remain in the sample after this step)
We asked two questions that had the same meaning in different places on the questionnaire. All responses that gave inconsistent answers were eliminated.
Step 5: Unreasonable completion time (527 remain in the sample after this step)

Similarly to the VIP, we only kept responses with completion time within two standard deviations of the mean of completion time in logarithmic scale.

Appendix A4. Sample interview guide used in the qualitative analysis

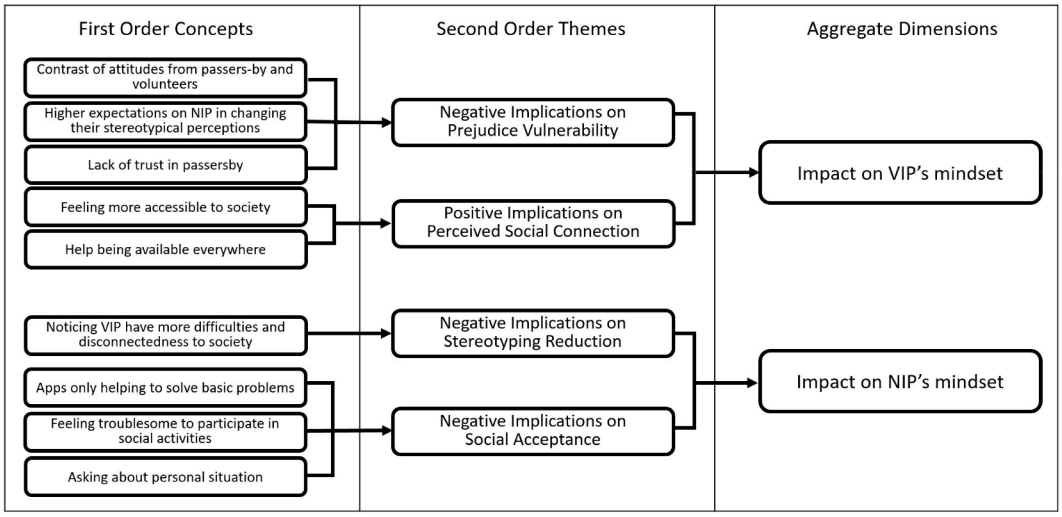
VIP Interview Questions:

1. Can you briefly introduce yourself? Were you born with visual impairment, or did you acquire posterior visual impairment? What is your visual impairment degree?
2. How long have you been using this app? How often do you use this app? When are you most likely to use the app?
3. What are the things (including app-related features and other issues) that you feel comfortable with or uncomfortable with when using the app? How do you think this type of app can be improved to better help you?
4. Can you provide us a scenario where you used the app previously to seek help?
5. Do you prefer using the app to seek help or seek help by other means (e.g., ask people around you)? Why?
6. How do you feel about getting help from a passerby vs. an app volunteer? How helpful are they? How easy is it to get help from a passerby vs. an app volunteer?
7. Do you experience prejudice in your daily life? Can you provide some examples?
8. Do you think using this app increases or reduces the prejudice that you are exposed to? Why do you feel this way?
9. Do you think using this app increases or reduces your perceived social connection? Why do you feel this way?
10. Do you think you are given enough support to help you cope with visual impairment? Why and why not? Do you have any examples of support/lack of support?
11. How do you connect with your friends? Do you join any community events? Do you connect with others online?
12. Are you a person who likes to make new friends? If yes, how do you make new friends? If not, why do you not like to make friends?

NIP Interview Questions:

1. How long have you been using this app? How often do you use this app? When are you most likely to use the app?
2. Why did you download the app? What are the reasons behind your use of this app?
3. How do you use this app to help VIP? Can you provide us a scenario where you used the app previously to provide help to a visually impaired person?
4. What are the things (including app-related features and other issues) that you feel comfortable with or uncomfortable with when using the app? How do you think this type of app can be improved to better help you?
5. How do you feel about the support that VIP receive from society? Is this adequate or not?
6. If the app were widely used by everyone, what do you think would be its impact?
7. Do you think the app will have an effect on the prejudice faced by VIP? Why or why not?
8. Do you think the app will have an effect on the acceptance or exclusion of VIP from regular life? Why?
9. Apart from using the app, do you do anything else to help VIP?
10. Do you participate in any social activities to connect with VIP? Why and why not?
11. Do you think the app has made it easier, or made you more willing to connect with VIP?
12. Do you communicate and interact differently with VIP and regular people? How has the app influenced the way you communicate and interact with VIP? How has the app influenced your attitude and perceptions of the VIP?

Appendix A5. Data structure from the qualitative analysis



Appendix A6. Supporting evidence from the qualitative analysis

First-Order Concept	Interview Quotes
The contrast of attitudes from passersby and volunteers	"One of my friends doesn't go out often and mainly uses these apps at home . . . as volunteers in the apps are very nice and friendly; after he started to face these unfriendly things in society, *he needed a process to get used to it.*"—VIP A "Because of the presence of these apps, VIP can *feel significantly the contrast* of attitudes from passersby and volunteers, which makes them feel more sensitive."—NIP P
Higher expectations on NIP in changing their stereotypical perceptions	"I think these apps can help NIP to *know VIP better and change their stereotype of VIP*. [For example, they] make NIP not to regard VIP who are able to use phones and computers to be extremely good, or think VIP can do nothing without a good eye vision."—VIP C "After using these apps, when I meet unfriendly passersby, I would think *if there were more people using these apps, there would be more people who know us better and know how to help us*. For example, one passerby I met would let me walk hundreds of meters more just to avoid a single stair step [because they think a single stair step is too dangerous to me]." —VIP B
Lack of trust in passersby	"I prefer using the app than asking passersby for help. This is because *I trust app volunteers*, who are accommodating and friendly. This is unlike passersby, who sometimes *give me a very bad attitude*, and even purposely provide me with wrong information."—VIP B "When I ask random passersby for help, they usually first express confusion and *doubt my ability* to go out alone without company. I have already gotten used to it [but still feel uncomfortable]."—VIP D "When I ask passersby for help, they usually ask me some silly questions, like 'Do you usually accidentally pass your food to your nose when eating?', but online volunteers never do that. I think it is because online volunteers know us better."—VIP C
Feel more accessible to the society	"The interactions (from these apps) didn't make me feel more connected, but these apps helped me to *feel more accessible to society* and not afraid of going into the whole society independently, which makes me feel more belonging."—VIP E
Help is available everywhere	"With real-time volunteer apps, *I feel safer and more confident* to go out alone without company."—VIP C "These apps are mainly providing ways for helping me when I go out, which makes me feel safer because *I don't have to worry about not being able to find people to help me . . .; these apps helped me* to connect to society more frequently."—VIP A

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Noticing VIP have more difficulties and disconnectedness to society	"The use of these apps refreshed my thoughts about the VIP groups. I could not understand their pain this much before using these apps. I feel *pity* for them. . . . I realized that the disconnectedness from society and the difficulties they face every day are far more severe than I thought."−NIP R "I just feel such *pity* for them after I use these apps. I sympathize with them so much."−NIP T
Apps only help to solve basic problems	"The apps assist me with *solving basic problems* I encounter in my daily life, such as reading instructions for medicines and choosing fresh food from supermarkets. Other than that, I do not see how the apps help me connect to society."−VIP B
Feel troublesome to participate in social activities	"*I only use the app when necessary*, and I do not actively participate in social activities. It is very troublesome for me." −VIP E
Asking about personal situation	"I met a weird VIP using these apps. He asked me about my *personal situation*, like 'What is your job? And how old are you?'"−NIP S

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Huilin Gao is a Ph.D. candidate in the area of Information Systems in the Faculty of Business and Economics at the University of Hong Kong. Her research interests focus on the topics of social justice and minority groups, with research methods and tools drawn from reference disciplines including information systems (e.g., econometrics and survey) and computer science (e.g., text analytics and machine learning).

Dr. Evelyn Ng is a Lecturer of Business Information Systems (BIS) at The University of Sydney Business School. Her research interests include Fintech, Chinese IT management, digital platforms and ecosystems, and qualitative IS research. Her research has been published in leading IS journals, including *Information Systems Journal, Information and Management*, and *International Journal of Information Management*.

Bingjie Deng is an assistant professor of information systems at the International Business School Suzhou, Xi'an Jiaotong-Liverpool University. She received her Ph.D. in information systems from The University of Hong Kong. She is interested in human-computer interaction, consumer information processing, and social media. Her work has appeared in leading information systems journals such as the *Journal of Management Information Systems*.

Dr. Michael Chau is a Professor in the Faculty of Business and Economics (HKU Business School) at the University of Hong Kong. His research focuses on the cross-disciplinary intersection of information systems, computer science, business analytics, and information science, with an emphasis on the applications of data, text, and web mining in various business, education, and social domains. He has received multiple awards for his research and is a member of the AIS College of Senior Scholars. He received his Ph.D. degree in management information systems from the University of Arizona and his B.Sc. degree in computer science and information systems from the University of Hong Kong.