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Research Article

Why Older Adults Integrate Digital Health Technology Into Their Everyday Lives: The Role of Basic Psychological Needs

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There is growing consensus on the potential of digital health technology to improve individual health and well-being outcomes. Existing research examining digital health technology adoption among underserved populations has largely relied upon theoretical lenses with an emphasis on perceived benefits and costs at the preadoption or initial use stage. This study demonstrates an alternative approach, relying on basic psychological needs as an explanatory framework to explore *how* and *why* older adults integrate digital health technologies into their everyday lives in a sustained manner. A whole-of-community approach was taken to examine this question, with 17 focus groups held with 107 older adults, volunteers, and the people who work with them. Overall, we found that the integration of digital health technology into the day-to-day life of older adults is contingent on the different ways in which it satisfies or frustrates the basic needs of competence, autonomy, and relatedness. The social environment, user interface design choices, reward, and feedback systems were found to both satisfy and frustrate needs. Researchers and designers intending to study or implement digital health technology for older adults ought to consider how different implementation decisions impact psychological needs.

Keywords: adoption; health; older adults; self-determination theory; technology

1. Introduction

Widespread digitalization across everyday life has driven a significant push toward digital innovation in public health. These range from online consultation services—such as telehealth solutions—to mobile and wearable health devices for the purposes of health promotion and monitoring. The potential benefits of mobile health technologies range from better sensing of real-time health indicators for timely clinical intervention to influencing lifestyle choices such as encouraging physical activity and reducing sedentary time [1, 2]. Due to their promise in improving health outcomes, there have been concerted efforts by various governments to encourage use of digital mobile and wearable health technologies to manage the healthcare burden. For example, in Singapore and other parts of the world, there has been an increasing number of national initiatives driving digitalization in different domains of healthcare [3, 4].

Despite the potential benefits, scholars have long raised the issue of equity in the use of digital technology. Beyond

concerns about *access* to technology, there are also concerns about unequal *use* and, consequently, the benefits derived from its use among underserved communities [5]. Specifically, given the growing prevalence of smartphone and wearable health technologies, the possible inequitable adoption and use of technology appears to be a growing area of concern. Instead of closing health gaps, digital health technologies may exacerbate social inequalities [6–8].

One group at risk of being left behind in digital health initiatives is older adults [9, 10]. In Singapore, recent survey data indicate that two-in-three (66.2%) older adults report regular digital technology use, yet only about one-in-five (21.4%) report using digital tools for their health in the prior month [11]. This suggests substantial headroom for health-related use within the older-adult population, with implications for equity and care access when health services and incentives are increasingly digital (e.g., telehealth and wearables). For older adults managing chronic conditions, digital health tools can support day-to-day decisions and timely escalation, but only if tools become integrated into routines rather than tried and abandoned. In addition, scholars have raised concerns that digital health technologies may inadvertently exacerbate health inequalities when underserved populations cannot effectively integrate them into their daily lives [6–8]. Consequently, scholars suggest that more should be done to ensure that the needs of older adults are considered when innovative technologies that can impact our daily lives are developed [9, 12, 13].

Understanding digital health technology integration is particularly crucial for older adults for several reasons. First, this population has the highest healthcare burden and stands to benefit substantially from technologies that enable remote monitoring, timely intervention, and greater autonomy in health management [1, 2] [1, 2]. Second, older adults face unique challenges in technology use—including physical limitations (reduced dexterity and visual impairment), limited prior exposure to digital interfaces, and age-related changes in learning and adaptation [14, 15]. Third, as healthcare systems increasingly rely on digital platforms for service delivery, older adults who cannot integrate these technologies into their daily routines risk being excluded from essential health services [12]. Therefore, understanding not just *whether* but *how and why* older adults integrate digital health technologies into their everyday lives is essential for ensuring equitable access to digital health benefits.

True digital inclusion and equity should go beyond just providing digital access and involve the *integration* of technology into the daily lives of underserved and excluded populations [16]. In rapidly aging societies, like Singapore, it is therefore paramount to understand older adults' motivations behind adopting healthcare technologies. Through a whole-of-community approach involving stakeholders and older adults themselves, we conducted a qualitative focus group study with a total of 107 participants to better understand the motivations behind the adoption and continued use of digital health technologies in their lives. We grounded our analysis on the basic psychological needs theory (BPNT) [17]. Overall, we wanted to identify issues surrounding age-based inclusion and provide suggestions for policy, communication, and design of future digital health interventions.

1.1. Acceptance Versus Integration of Technology Into Everyday Life. Given that technology adoption among older adults has been examined through several different disciplinary perspectives, it will be useful to provide a brief overview of the overarching approaches researchers have used to understand the phenomenon thus far. Generally, we note that researchers have largely leaned toward one of two approaches: an approach focusing on older adults' *acceptance* of technology and one that focuses on their *integration* or *continued use* of technology in daily life. This aligns with what previous scholars have suggested—that despite the myriad and inconsistent ways in which terms like "acceptance," "adoption," and "acceptability" have been used by researchers, technology acceptance can be viewed as comprising two broad phases: preadoption and postadoption [18].

In the context of *health technology* adoption, many studies have focused on exploring individual-level factors driving one's *initial acceptance* or *intention* [18, 19]. Extant research—characterized by the unified theory of acceptance and use of technology (UTAUT) and technology acceptance model (TAM)—has largely revolved around identifying and empirically verifying the barriers and facilitators to older adults' intention to use various technologies, especially at the preadoption stage [19]. These models tend to conceptualize technology acceptance as *intention* to use a piece of technology, which is driven by various *perceived* conditions and barriers, such as one's perceived ease of use, perceived usefulness (or performance expectancy in UTAUT), and price value, among others (e.g., [20, 21]).

In accordance with expectancy–value models like the theory of planned behavior (TPB) [22], it is assumed that one's actual use of technology is then determined by one's *intention* to use said technology. Based on a recent review, more than 60% of studies exploring health apps and wearable use rely on theoretical approaches related to TAM, UTAUT, TPB, and similar or derivative models [19]. Based on these theoretical perspectives, the implication for designers and policymakers interested in increasing the adoption of novel technologies would be to target these barriers and facilitators, such as making a piece of technology easy to use and highlighting its usefulness to the user (e.g., [23]).

Beyond perceived usefulness and intentions, some scholars have explored other factors that drive acceptance and/or nonuse of technology, such as value alignment, affect, and self- and other-focused motivations [24–26]. Despite this, scholars argue that there is a need to distinguish between factors driving adoption at the preuse and postuse stage [18, 27]. While extant research provides a comprehensive understanding of *initial* acceptance or explaining why older adults may *intend* to use a piece of technology, there is a lack of studies attempting to unpack the nuances of why digital health technology is embedded and integrated into older adults' daily lives [28]. Karapanos et al. [27] suggest that the factors driving *prolonged* use of technology are often qualitatively distinct from those driving *initial* use. Specifically, prolonged use—or what we term the *integration* of health technology into daily life—is characterized

by how a technological product becomes *meaningful* in one's life. In this paper, *integration* refers to routine, self-directed, and socially embedded use that persists beyond initial incentives and minor breakdowns, distinguishing it from short-term trial or sporadic use. The present study links this meaningful use to the satisfaction (or frustration) of basic psychological needs.

To uncover the underlying psychological mechanisms influencing the *integration* of technology into the lives of older adults—or what makes digital health technology meaningful to older adults—we grounded this study in the BPNT. As part of self-determination theory (SDT), BPNT posits that human well-being and motivation revolve around the three basic psychological needs of autonomy, competence, and relatedness [29]. BPNT was developed to better understand how the satisfaction and frustration of these fundamental needs can impact the innate capacity of humans to optimally function, develop, and promote their well-being [30].

We use BPNT to explain why certain technologies become *embedded* in everyday life. BPNT holds that sustained, self-regulated engagement depends on whether activities satisfy or frustrate needs for competence, autonomy, and relatedness [30]. As Karapanos et al. [27] argue, factors driving prolonged use of technology are often distinct from those driving initial use. Specifically, sustained engagement—or what we term the *integration* of health technology into daily life—is characterized by how a technological product becomes *meaningful* in one's life [18, 27]. This notion of meaningfulness aligns closely with SDT's core premise: that human well-being and sustained motivation depend on the satisfaction of basic psychological needs [30].

Evidence from adjacent, continued-use contexts (e.g., online learning, video games, and virtual reality) links need satisfaction to meaningful, ongoing engagement [31–34]. In digital health, qualitative work similarly distinguishes need-satisfying from need-frustrating experiences with patient technologies, including among older adults [35]. Accordingly, we treat integration as a pattern of routine, self-directed, socially embedded use that persists beyond initial incentives, and we expect integration to track the degree and direction of need experiences around specific features and implementation choices.

In this study, we therefore use BPNT to account for integration, including postadoption, routine, and meaningful use. Building on evidence that need satisfaction predicts continued engagement in adjacent domains and maps onto older adults' digital health experiences, we examine how specific design and implementation choices satisfy or frustrate the three needs and, in turn, shape whether use becomes embedded in daily life. Our theoretical proposition is that the integration of personal health technologies into older adults' daily lives should correspond with how much a particular technology satisfies or frustrates the basic psychological needs of the individual through the lenses of competence, autonomy, and relatedness. Competence refers to the basic need of individuals to feel effective, autonomy refers to the feeling of agency and control, and relatedness refers to the feeling of being connected with others [30]. Overall, the BPNT provides a useful lens to help us understand older adults' sustained use of digital health technology, beyond the acceptance stage. Despite the potential, a recent review found that only 3% of studies have utilized BPNT and related SDT frameworks to understand digital health apps and wearable use [19].

We focus on mechanisms that enable or hinder integration (embedding of digital health tools into older adults' routines and identities), drawing on perspectives from older adults and from proximal stakeholders who scaffold or potentially gatekeep everyday use. Understanding *what factors* drive technology integration is significant in three ways. First, from a practical standpoint, as healthcare delivery becomes increasingly digitized, it is not enough for older adults to simply acquire or initially try digital health technologies—they must integrate them into their daily routines to realize health benefits. Identifying the specific factors that facilitate sustained use can inform the design of more effective interventions and reduce health inequalities. Second, from a theoretical standpoint, shifting from acceptance models (which predict intention) to integration frameworks (which explain sustained, meaningful use) represents an important conceptual advancement in understanding technology–behavior relationships. Third, from a design and policy standpoint, understanding how technologies satisfy or frustrate specific psychological needs provides actionable, targeted guidance for designers and policymakers, rather than generic recommendations about making technology "easy to use" or "useful."

The literature reviewed above reveals several key tensions that motivate our research. First, while extensive research examines preadoption factors (perceived usefulness, ease of use, and intention to use), scholars argue that postadoption integration is qualitatively different and requires distinct theoretical approaches [18, 27]. Second, despite growing recognition that digital health technologies may exacerbate inequalities for older adults, only 3% of studies employ theoretical frameworks that explain sustained, meaningful use rather than initial acceptance [19]. Third, existing research provides a limited understanding of how the social environment, design choices, and reward structures interact with psychological needs to facilitate or hinder integration. Our research addresses these gaps by examining integration factors through the lens of basic psychological needs, using a whole-of-community approach that captures perspectives from older adults at different stages of technology adoption as well as the people who support them. Building on these, our research question guiding the design and interpretation of our data is as follows: What mechanisms and contextual conditions drive the integration of digital health technology in older adults' daily life in Singapore?

2. Method

To gain a better understanding of the motivations and experiences that older adults have with regard to digital technologies, focus group discussions were conducted with older adults and the people who work and interact closely with them across different senior activity centers[1] (SACs) in

Singapore. We adopted a whole-of-community approach for several reasons. First, we sought to understand integration from multiple perspectives—not only from older adults who have successfully integrated technologies, but also from those who tried and discontinued use, those who never adopted, and the people who support them in learning and using technology. This diversity of perspectives allows us to identify both facilitators and barriers to integration. Second, the experiences and observations of staff, volunteers, and digital ambassadors provide important contextual information about the social and environmental factors that shape integration. Including their observations may reveal contextual information invisible to older adults themselves. Third, this approach aligns with community-based intervention frameworks that recognize health behavior is shaped by multiple levels of influence [36, 37]. In total, 17 focus groups were held virtually with 107 participants, including older adults ($n = 37$) aged above 65, SAC staff ($n = 13$), digital ambassadors[2] ($n = 12$), and volunteers ($n = 45$). Older adults were recruited if they were above 65 years old and were *primarily* frequent *users* of the SAC facilities and activities (as opposed to a volunteer who helps organize activities). Their mean age was 72.71 (SD = 7.54), with most participants having experienced using a digital health app or wearable (67.57%; $N = 25$). This relatively high proportion of participants with digital health experience reflects our recruitment strategy through SACs, where older adults who are more socially engaged congregate. However, this group represented a spectrum of use patterns, as some were sustained daily users, some were occasional users, some had discontinued use after initial trials, while others have tried multiple technologies with varying success. This diversity provided rich data about both integration facilitators (from sustained users) and integration barriers (from discontinuers and nonadopters). Importantly, our whole-of-community approach also captured perspectives from staff, volunteers, and digital ambassadors who work with a broader range of older adults, including those who never visit activity centers or who face more significant barriers to technology adoption. SAC staff and digital ambassadors qualified to participate in the study if they were currently employed in their respective roles working with older adults.

For the SAC staff, they were between the ages of 28 and 65 ($M_{age} = 51.43$; SD = 10.23) and have worked at their centers between 10 months and over 7 years ($M_{months} = 44$; SD = 22.11). The digital ambassadors were between the ages of 24 and 68 ($M_{age} = 48$; SD = 15.45) and have typically been working in the role between 1 and 7 months ($M_{months} = 6$; SD = 2.35). Finally, volunteers were recruited if they were active volunteers at each respective SAC. Interestingly, the volunteers were also often older adults themselves ($M_{age} = 66.07$; SD = 10.50), with only six volunteers below the age of 60. This was because volunteers at the SACs are oftentimes older adults who still have the physical ability to contribute to making the SACs a vibrant community.

To recruit older adults, volunteers, and SAC staff members, we utilized convenience sampling, where we first reached out to SAC operators in Singapore to briefly introduce them to the study. In the recruitment phase, we held meetings with SAC staff to brief them on the details of the study. Upon receiving their intent to participate, the research team worked with SAC liaisons to recruit participants. The SAC liaisons posted recruitment advertisements through various digital and physical mediums, from online chat groups to in-person flyers. The SAC liaisons, upon collating the sign-ups from their own centers, worked with the research team to schedule online focus groups with each category of participants. In each focus group, participants could choose to join using their own devices or by visiting the SAC, where they were placed in a room to take part in a videoconferencing-based focus group with the researchers and other participants. To recruit the digital ambassadors, the research team worked with the government agency team responsible for the management of digital ambassador services in various communities across Singapore. Like the SAC liaisons, an agency liaison helped to recruit participants. The research team then worked with interested participants to schedule the focus groups, which occurred over a videoconference platform, with every digital ambassador participating through their own devices. The full recruitment procedure can be found in Figure 1.

During the focus groups, participants discussed a range of digital health technologies they had personal experience with or had observed others using. These included the following: (1) *fitness trackers and wearables*: government-provided fitness trackers from Singapore's Healthy365 program, Apple Watches paired with the LumiHealth app, Fitbit devices, and various generic step-counting wearables; (2) *health monitoring devices*: Bluetooth-enabled blood pressure monitors that sync with smartphone apps, blood glucose monitors with digital connectivity, and smartwatches with heart rate monitoring; (3) *mobile health applications*: the government-initiated Healthy365 app, LumiHealth (Apple–Singapore Health Promotion Board partnership), step-counting apps, and medication reminder apps; (4) *telehealth platforms*: video consultation services for doctor appointments; and (5) *health information apps*: general health information and symptom-checking applications and websites.

Each focus group session was facilitated by an experienced and trained focus group facilitator from the research team and lasted between 1 and 3 h. Participants in the older adult, volunteer, and SAC staff group each received a token of appreciation of SGD50 worth of vouchers, while digital ambassadors were not remunerated as they were government officials and not permitted to receive monetary incentives for participating in studies. They were conducted in both English and Chinese, recorded, and then transcribed. Transcripts in Chinese were translated before analysis. The study design and recruitment procedure were approved by the Singapore University of Technology and Design's ethics committee (IRB-20-00347).

The design, interview guide, and data analysis of this research were informed by the theoretical framework of BPNT. The full facilitator guide with guiding questions is attached as a supporting information (available here) document. The analysis process involved two main phases: an

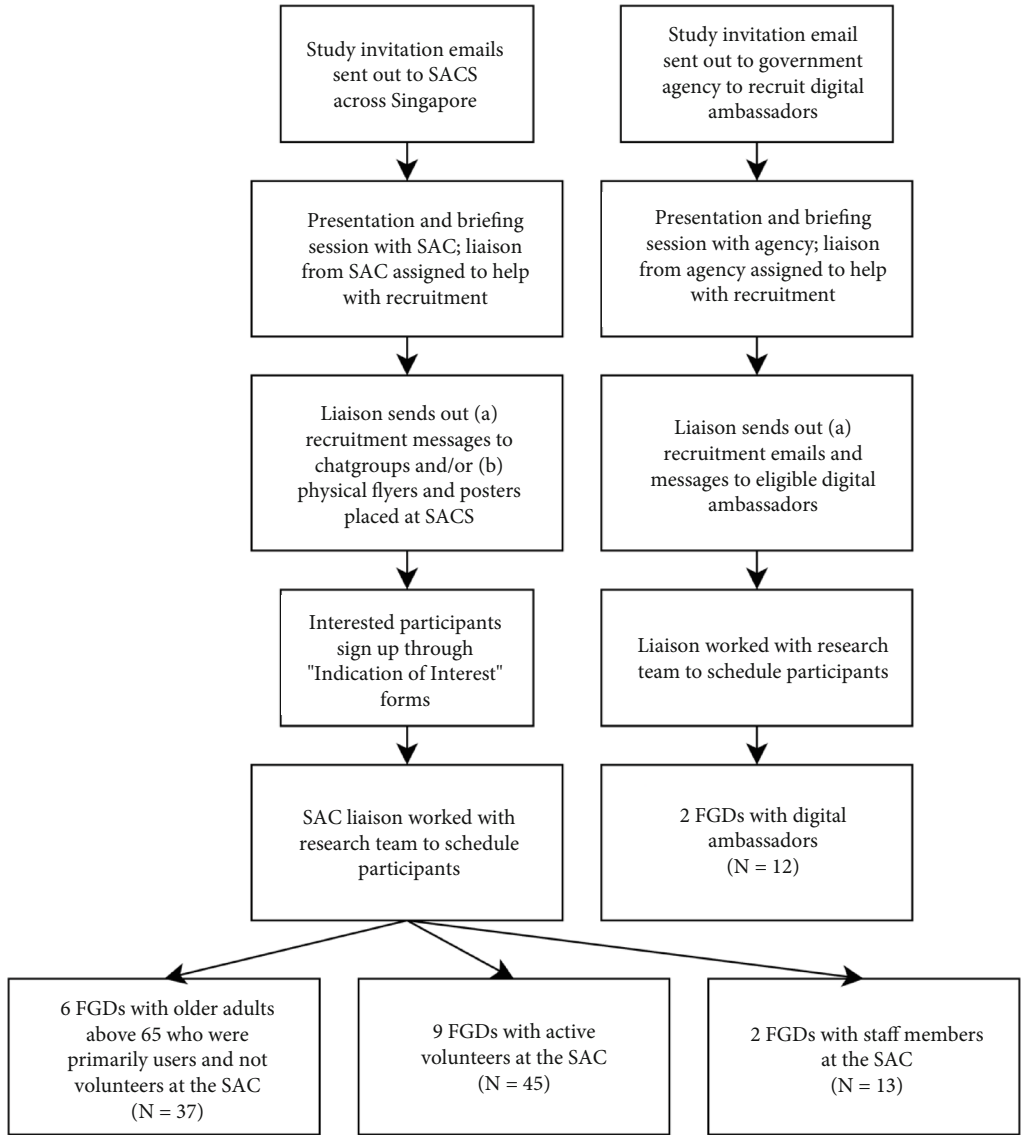

Figure 1: Recruitment procedure.

open-ended reading and a theory-based reading, consistent with other theory-driven qualitative studies [33, 38, 39].

Phase 1: Open-ended reading. Transcripts were first read independently by four members of the authorship team to develop a general understanding of the content and context. During this phase, readers highlighted passages they found particularly salient, without attempting to apply theoretical codes. They then met to discuss initial impressions, identify recurring topics across focus groups, and note areas of convergence and divergence.

Phase 2: Theory-based coding. The second author then conducted a systematic, line-by-line coding of all transcripts using BPNT as a sensitizing framework. This involved (1) identifying segments where participants explicitly or implicitly discussed feelings of competence (or lack thereof), autonomy (or control), and relatedness (or social connection); (2) creating descriptive codes for how technologies satisfied or frustrated each need (e.g., "competence satisfaction: mastery experience," "competence frustration: family discouragement," "autonomy satisfaction: empowerment through self-monitoring," and "autonomy frustration: feeling controlled by app goals"); and (3) grouping related codes into broader themes under each psychological need.

For example, when a participant stated, "After that [learning], I can do anything," this was coded as competence satisfaction through mastery experience. When another stated, "Sometimes I feel like a nuisance to them [family] because I ask and they sometimes will feel very frustrated," this was coded as competence frustration through inadequate social support. When a participant said, "That means the gadget is controlling you, rather than you controlling yourself," this was coded as autonomy frustration through perceived external control. When participants discussed comparing step counts with friends, this was coded as relatedness satisfaction through social connection around technology use.

Emergent themes that did not map cleanly to the three BPNT constructs were flagged for team discussion. Once all the coded data were mapped to the themes, an abductive approach was taken to generate new themes that did not map to the BPNT, to ensure we did not force-fit the data [40]. The most prominent example was the extensive discussion of external rewards (vouchers and incentives) provided by Singapore's government health programs. While these rewards sometimes enhanced competence (providing positive feedback) and sometimes threatened autonomy (creating external pressure), they constituted a sufficiently distinct theme that we treated them separately. Throughout the process, the authorship team acted as critical friends and readers, serving to challenge and refine the interpretations as it was mapped [41]. The transcripts were coded using *QCoder*, an *R*-based package designed to allow researchers to analyze and code textual data, before exporting them into suitable formats for collaborative discussions [42].

3. Results and Discussion

Overall, we found that the data aligned with previous research on BPNT and technology use, as the psychological needs of competence, autonomy, and relatedness were often expressed—although at times indirectly—as key reasons for why older adults decided for or against integrating novel health technologies into their daily lives. A fourth theme—-which we term external motivators—emerged, likely due to the unique context of the government of Singapore's use of external incentives to motivate digital adoption and health behaviors. We explore these in greater detail next.

3.1. The Need for Competence and Support. Competence needs were particularly salient in the context of *health* technologies, where successful use not only required technical skill but also affected participants' sense of efficacy in managing their own health. In the context of health technology, interviewees very often emphasized the importance of feeling competent as a key reason for whether they integrated a piece of technology into their daily lives. This sense of competence is enabled by older adults' task knowledge, the sense of satisfaction and validation they receive, and the sense of confidence in their abilities when utilizing these technologies. This aligns with previous research, which found that task knowledge, satisfaction, and confidence are among the predictors of competence [43].

One older adult expressed the feelings of competence that can arise from successfully learning to use new technology—even though they may require substantial scaffolding and help in the beginning: "[For me], if I want to learn something, my son-in-law must teach me quite few times, [to] make me really understand. After that [though], I can do *anything*." Such feelings of competence can lead to a positive cycle of self-efficacy, or what some scholars call efficacy–performance spirals [44]. This is also in line with Bandura's [45] idea that mastery experiences play an important role in facilitating greater self-efficacy surrounding a behavior.

Beyond such intrinsic experiences of competence, older adults highlighted that the external validation they received upon successfully completing tasks or achieving goals set within different apps and devices can also contribute to feelings of competence. Another older adult mentioned, "[The achievements on these apps help you] cherish yourself...[-showing] how active you are… [for example], today I can achieve twenty thousand steps…that kind of [feeling]." This is in line with previous research highlighting how self-tracking and instant graphical feedback on devices can contribute to feelings of competence and the enjoyment of effortful activities [46].

On the other hand, the desire to use such devices in daily life can also be severely diminished when older adults do not have the right support structure. Specifically, poor social support and discouragement from family members and friends can often diminish the sense of competence in technology use among older adults. In these instances, digital health technologies contribute to a *reduced* sense of competence, which, in addition to reducing older adults' motivation to use these technologies, can impact their psychological well-being as well [47]. One older adult, with a tinge of sadness, reflected on his experience with learning technology from his son: "[The] younger generation are more informed. Usually, my son teaches me how to use [these] apps. [However], we don't pick up [these skills] fast. So, sometimes [I feel] like a nuisance to them, because I ask [about technology] and they sometimes will feel very frustrated."

A digital ambassador, whose full-time job is to help older adults get acquainted with digital technology, raised a similar point: "One point I like to make is that the sometimes it's because their children *discourage* them from using [new technology]… [even] before they start to learn, [their] children will say 'you better don't learn this, better don't', because they probably underestimate them…so the first thing you must [do], [is to] get encouragement from the children and then they'll feel better to learn." This highlights important considerations about the unintended consequences of encouraging the use of novel health technologies for older adults. Without proper support systems, there is a possibility that, instead of helping older adults achieve better health, merely giving access to health devices and apps may undermine their sense of competence.

Several volunteers, digital ambassadors, and SAC staff members pointed out that attempts at getting older adults to use new devices or apps in their daily lives often fail when they do not consider what older adults struggle with. This includes seemingly simple things, such as getting confused and frustrated with not knowing which wires to use to charge newly acquired devices, such as wearables. One SAC staff member described how an older adult she interacted with gave up using a wearable once the battery went flat, simply because he could not figure out which wire to use to charge the device. A frequent volunteer with older adults mentioned, "I think you need to make whatever technology you are introducing to the elderly *idiot-friendly* in a sense. Like you press one button, just like you have certain [mobile] phones for the elderly and you simplify it such that

they only need to press one button. Press another button and then that's it." Another participant also emphasized how the user interface needs to be simple enough to use for older adults, citing an example: "Yeah, LumiHealth[3]…that's pretty user friendly for me, it would just sync to your device and your record, your progress, like how far [you have] come…that's the only [usable] health app. The rest [are] quite confusing. Like the *365*[4], I do not even know how to use it."

Related to this is actual physical dexterity, which a digital ambassador highlighted: "We had some folks who were 80 plus. They have worked [for] 40, 50 years and their fingers are arthritic, and they cannot control the tactile motions as well as some of us. So, they find it a huge challenge." Some smartphone manufacturers have customizable accessibility options, such as increasing font sizes, but participants often have no knowledge of how to adjust these settings, defeating the purpose of these accessibility options in the first place. These points align with larger calls for inclusive design (e.g., [48]) and the need for designers of digital health technologies to ensure equitable user experiences.

3.2. The Need for Autonomy and Health Empowerment Tensions. The need for autonomy refers to an individual's need to feel that one's actions are volitional and that they align with one's self-concept. In other words, it is the feeling that one can freely make decisions aligned with our personal values [30]. How various pieces of health technology contributed to a sense of autonomy was frequently mentioned by older adults. Several participants shared about the various health devices and services they use, such as blood pressure monitoring, step counting, and online consultations. We found that frequently used health devices and apps tended to enhance a sense of autonomy and control in older adults' daily life, such as in strengthening their ability to act upon their own interests and values when it comes to health decisions. For example, one participant spoke about using his blood pressure monitoring device every day, as it helped him know if he needed to talk to a doctor. These findings are consistent with existing literature on the desire of older adults to gather and manage their own health information [49], as well as how routine monitoring empowers greater participation and control over personal health decisions [35].

Adjacently, participants recalled how the availability and immediacy of health information derived from digital health technologies empowered them. This sense of freedom in directing their health journeys upon leveraging health technologies has allowed participants to take ownership of certain health activities, such as health monitoring, that would have otherwise required the participation of healthcare professionals. One older adult reflected, "I do [things] *myself*. Every morning, I check my blood pressure. Then I know, oh [it's] quite high, my blood pressure. So, I know what to do. I know what to do because I stay alone, so I must know *everything*. I check my blood pressure, if [it is] borderline, I [know I must] do something to bring down my blood pressure back to normal again." As we can see, when technologies provide a sense of agency and empowerment, it can lead to sustained, long-term usage of health technologies [50]. For this particular participant, it also aligned with his self-concept and personal values, as being an *independent* person is highly important to how they see themselves [51]. This corroborates previous research on how *value alignment* is crucial in encouraging older adults to participate in technology-based social interventions [26]. In the case of older adults who value independence, technologies that facilitate independence become more appealing, and they would be more motivated to integrate them into their everyday lives.

Digital health technologies revealed a unique tension around autonomy: While health monitoring devices could empower independent health management, health tracking features could also create feelings of external control that threatened autonomy. Interestingly, some participants felt that self-tracking can result in a loss of agency. One older adult said, "No need [wearables]! You know yourself! Why would you count your steps? That means the gadget is controlling you, [rather than] you controlling yourself. [For example], [the app tells you that] you must walk 10,000 steps a day. If I don't use the gadget, I can walk more than 10,000 steps a day!" This resistance reveals a crucial tension in digital health technology design: The same features intended to motivate healthy behavior (tracking, goals, and feedback) can undermine the sense of autonomy that supports sustained integration. Unlike general productivity or entertainment technologies, health technologies directly intervene in intimate bodily practices and personal health decisions, making autonomy concerns particularly acute. This is reminiscent of the overjustification effect [52], which describes the subsequent decrease in intrinsic motivation to perform an activity when an external reward is given for the activity. Some scholars have pointed out that certain digital rewards, such as achievement badges, can indeed decrease intrinsic motivation when used as an external reward [53]. In essence, such feedback and goals that exist in digital health applications are seen as manipulative, rather than encouraging. This suggests a fine line in designing digital health applications for older adults. When designing features and rewards, it is crucial that these rewards are not "telling them what to do" but rather serve as sources of encouragement that can fuel one's feelings of competence.

3.3. The Need for Relatedness and Connection. Relatedness needs took on unique significance in the digital health context, as older adults were acutely aware that health technologies could reshape their relationships with healthcare providers, family caregivers, and peers. In our discussions, older adults frequently expressed their desire to remain socially relevant and included in society. Specifically, they see a need to adopt technologies to stay socially connected. For some older adults, staying in touch with friends and family and keeping photo memories and contacts were their main reasons for learning to use a smartphone. This desire to stay connected also informed older adults' decision to adopt WhatsApp and Facebook over Telegram and Instagram, as their social networks were more present on the former than the latter platforms.

Relatedly, digital health technologies can foster feelings of connectedness in varied ways, and when they do so, they can help encourage older adults to integrate them into their daily lives. For example, the government-provided fitness tracker gave older adults a common topic for conversation. A SAC staff member recounted seeing older adults compare the number of steps on their watches and encouraging each other to walk together. Older adults describe being more motivated to adopt and maintain the use of health technologies when these technologies are perceived as a form of connection with others. Indeed, previous research has found that subjective norms were found to be important precursors to the use of health apps and wearables among older adults [23]. Much like youths who flock to social media platforms as a way of connecting with their friends [54, 55], technologies that connect and contribute to a sense of relatedness are more likely to be integrated into an older adult's everyday life.

Yet older adults are particularly wary of health technological innovations that may threaten social connections. This concern is specific to digital health technologies that explicitly substitute for face-to-face healthcare encounters and caregiving relationships. One older adult cited the example of telehealth and its implications on their social life: "When an older adult can see a doctor, he walks all the way there…*these are things that we should not discount* because we always think that telemedicine is good but [in the] end… we are isolating each other." This reveals a crucial consideration for digital health implementation: Technologies designed to improve healthcare efficiency and access may simultaneously frustrate relatedness needs by reducing valued social contact. Walking to the doctor's office, chatting in waiting rooms, and face-to-face consultations serve social and emotional functions beyond the medical transaction itself.

This was further emphasized: "I come here [to the senior activity centre] because I [get] social interaction. All my friends [are] here, [and] I can at least say hello. These are [issues] researchers need to know, [one's] social and emotional health [comes] from all these [unintentional interactions]." What the participant intended to say was that serendipitous interactions occur when people are physically out and about and that digital health technologies that reduce such encounters must be approached with care. Scholars have discussed certain affordances which may facilitate or disrupt serendipity [56], and older adults appear to be cognizant of the impact in which technology may negatively affect serendipitous social interactions. This aligns with previous research on healthcare technology adoption, where researchers found that older adults preferred face-to-face interactions with healthcare providers [57].

Designers and policymakers intending to develop interventions or digital health technologies for everyday life should consider that social connectedness can be facilitated [58]. For example, Waycott et al. [59] proposed a design framework incorporating three dimensions of social connectedness that ought to be considered when designing technology for older adults—personal relationships, community connections, and societal engagement. It is often easy for designers to focus on the *health problem* one is attempting to address with a digital health intervention—whether it is fall detection or increasing physical activity. Our findings suggest we should also consider its impact on social connectedness across these different dimensions if we want to encourage older adults to integrate them into their daily lives.

3.4. The Role of Extrinsic Rewards. In addition to our exploration of the role in which basic psychological needs play in facilitating the everyday use of health technology, we found that many older adults were *initially* motivated to use digital health technologies such as health apps and wearables due to external rewards. Specifically, in the context of Singapore, the Health Promotion Board has put in place an annual health program that rewards users with financial incentives in the form of shopping vouchers for the achievement of various health-related goals facilitated through digital technology. For example, for performing certain behaviors like achieving a certain number of steps taken per day or in purchasing healthier options at the supermarket, users are provided with in-app currency called "Health Points" which can be exchanged for shopping vouchers. In our study, we found that several older adults indicated that the vouchers were the *most* attractive incentive for learning to use the technology that they had never used before—such as wearables.

Having said that, we found that older adults responded differently to the provision of such external rewards. A SAC staff member shared that some older adults who initially adopted the fitness tracker for these financial rewards do continue to exercise routinely after the rewards ended. In this sense, an activity encouraged through external motivators could eventually become self-regulated [60]. In contrast, an older adult who did not continue to use the device said, "It's not encouraging [me] to actually be healthy, it just encourages [me] to get a reward." As with digital rewards, the overjustification effect means that rewards might have an adverse effect on one's motivation to use these technologies when one's sense of autonomy is threatened [52].

One way to better understand why there may be different responses to external rewards would be to view it through the lens of causality orientations [61]. Causality orientation theory suggests that different individuals may perceive the cause of their actions as coming from themselves or others, depending on how they *tend* to interpret their actions [62]. Specifically, individuals with high autonomy orientation tend to interpret events (e.g., external rewards) as informational and self-relevant, focusing on how activities align with personal values and goals. When given external rewards, they can internalize the behavior, eventually continuing it even after rewards cease because they have adopted it as personally meaningful. In contrast, individuals with high control orientation tend to interpret events as externally pressuring, viewing rewards as the reason for behavior rather than a supportive enhancement. For these individuals, external rewards can undermine intrinsic motivation through the overjustification effect. Hence, when rewards stop, so does the behavior, because it was never internalized as personally valued.

Individuals who tend to orient themselves toward characteristics in an environment that support autonomy—such as in looking for personal challenges—reflect people with high autonomy orientation. Those who tend to orient themselves specifically toward external events—such as in looking for reward and avoiding punishment—reflect high control orientation. Finally, those who do not see reasons behind their behaviors reflect high impersonal orientation. Scholars have found that such individual differences in causality orientations can mitigate the impact of rewards on intrinsic motivation, such that those with high autonomy orientation are unaffected by the detrimental impact of external rewards, while those with high control orientation are more likely to be negatively affected by the presence of a reward [63]. Indeed, individuals with high autonomy orientations are likely to better *internalize* their use of digital devices as being autonomously motivated, potentially resulting in its use even after external rewards stop [61]. This has important practical implications for the design of reward systems in digital health interventions, which we discuss further in our recommendations below.

4. Conclusions

In this project, we adopted an emic approach and explored older adults'—and community—perspectives on why they integrated digital health technologies into their daily lives. Going beyond acceptance models that predict individuals' intention to use technology, we sought to understand the deeper reasons behind why technology is integrated into everyday life and identify important considerations for encouraging such integration. Using the BPNT as our conceptual lens, our findings show that the integration of digital health technology into older adults' day-to-day lives depends on whether one's psychological needs—namely competence, autonomy, and relatedness—are fostered through their interaction with it. Furthermore, these psychological needs can be facilitated or hindered by the social environment, the design of the technology itself, and reward structures. This has important implications for healthcare professionals, researchers, policymakers, and designers. We detail some key considerations when attempting to design digital health interventions for older adults.

First, we found that the social environment must be supportive of basic psychological needs for older adults to feel motivated to use digital health platforms, apps, and products. While the concept of *motivational climates* tends to be studied and applied to the domains of education and sports science [64–68], our findings suggest that it may be useful to consider motivational climates in future research on technology adoption. Specifically, the extent to which family members, friends, social workers, and volunteers encourage and support the psychological needs of older adults can be crucial to whether digital health technology is integrated into their lives. Practically, this means that digital health interventions targeted at older adults must take a holistic approach and include the social network surrounding the target population. Indeed, this is in line with community-based interventions, which take an ecological approach in health promotion [36, 37]. Some suggestions, based on our findings, include educating a target population's immediate network to provide verbal encouragement and validation, provide a "kickstart" and helping an older adult break through efficacy–performance cycles by helping them get through early mastery experiences (e.g., patiently guiding users through an app or wearable), and refrain from diminishing their sense of autonomy and competence (e.g., through harsh words or by helping to do everything for them).

Second, the design of digital health platforms, apps, and products must consider specific challenges that older adults face, as well as in facilitating the satisfaction of basic psychological needs. As reflected in our findings, digital health technology is widely acknowledged by our participants to be empowering, giving older adults a sense of agency when they can use it to monitor their own health. In addition, knowing how to navigate and use these technologies can also facilitate a sense of autonomy. However, these same platforms, apps, and products can be incredibly *disempowering* when users have trouble operating them. To encourage the integration of technology into daily life, there is a need for the design of digital health technology to be inclusive and consider older adults' physical dexterity, visual acuity, and prior knowledge [14, 15].

Third, our findings suggest that social connection and feelings of relatedness are important concerns for participants. They are highly conscious of technologies that reduce opportunities for social interaction. In our conversations, when discussing telehealth and fall detection systems, participants often brought up concerns that these systems might reduce social interaction. For example, they cite concerns that telehealth may reduce serendipitous social interactions that may occur when they visit the doctor, while fall detection systems might reduce how often their family members visit or check up on them. Designers ought to pay attention to ensuring that solutions targeted at older adults afford, rather than diminish, social interaction.

Finally, our findings on external rewards reveal a complex challenge: Reward systems can jumpstart technology adoption but may either support or undermine sustained integration depending on how they interact with psychological needs. Rewards and feedback may work differently for different individuals, and designers of digital health intervention programs can consider tailoring the design of rewards to the psychosocial profiles (e.g., causality orientations) of different older adults. Tailoring has been discussed as an effective strategy to improve the effectiveness of health interventions [69, 70]. Our findings also showed that when older adults felt the reward was the only reason to use technology, integration failed. Reward systems in digital health technologies and campaigns must therefore be accompanied by features that satisfy basic psychological needs, such as in embedding choice (opt in or out of rewards and being able to choose one's reward), connection, and mastery experiences.

These findings echo those in other studies examining older adults' use of digital technology. For example, Zhao et al. [34] found that older adults in Australia turned to

communication technologies during the COVID-19 pandemic to support various psychological needs, suggesting that digital technology is perceived to be deeply meaningful to everyday life when it is used to perform activities that support feelings of autonomy, relatedness, and competence. Distinct from Zhao et al.'s [34], our study reveals challenges specific to integrating *health* technologies. Specifically, digital health technologies create unique autonomy concerns (tracking can feel controlling), relatedness concerns (replaces human care), and competence concerns (health statistics can lead to feelings of competence). The context of our study—in Singapore, where the active promotion of digital health through incentives is commonplace—also reveals distinct and unique interactions between public health policy and psychological needs.

There are several limitations that must be considered when drawing conclusions from this study. First, our study is set in the specific cultural context of Singapore, and our findings are possibly colored by specific practices, beliefs, and cultural norms held by the participants. For instance, family support and involvement in the everyday lives of older adults can be viewed as a cultural obligation for adult children [71]. For those without children, there is also a strong emphasis on community, including friends and neighbors as crucial components of one's social network that contributes substantively to older adults' well-being [72]. Hence, this emphasis by participants in our study who do not want to be a "burden" to their children may be more pronounced in Singapore and similar cultures in Asia. Second, given that this was a qualitative exploration, we did not formally test the hypothesis that digital health technology use in older adults' everyday lives was related to how a piece of technology engenders feelings of competence, autonomy, and relatedness. Future research should investigate whether our findings are supported by larger scale quantitative studies. Third, we utilized a convenience sample of participants, relying on voluntary sign-ups, which may introduce sample selection bias. Given the nature of the study topic, it was possible that participants who may be more interested in digital technology signed up for the study. While this limits the generalizability of the findings, it aligns with the goals of qualitative inquiry, which prioritize depth and richness of data over representativeness. Nonetheless, we acknowledge that certain viewpoints may be underrepresented, and future research could benefit from broader recruitment strategies to further validate and expand upon these findings. Fourth, the sample included a substantial proportion of volunteers, many of whom had varying durations of volunteering experience with older adults. Our recruitment strategy prioritized accessibility and relevance to the research topic, resulting in the distribution of participants skewing toward volunteers, who were more willing to contribute their time to this project. This is a limitation of the study and should be considered when interpreting the results. Having said that, many of the volunteers were also older adults themselves, but who also serve as *volunteers* at the SACs. Nevertheless, future research will benefit from a more balanced sample across other roles to deepen understanding of the dynamics between older adults and their support networks.

Despite these limitations, we believe that this study is a sound contribution to the literature, as it provides a detailed and qualitative account of how basic psychological needs play an important role in the adoption of digital health technologies. Our hope is that future research on technology adoption can build on this and move further toward understanding how technology becomes integrated and intertwined in the day-to-day activities of people. Beyond that, our study brings the voices of older adults, as well as the people who work with them daily, into the forefront. Inclusive design should include the voices of people we want to serve, and this study can be a resource for future work aimed at addressing the potential inequalities that may arise from unequal adoption and use of technology for good.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Endnotes

[1]SACs are community-based centers located across Singapore, where full-time staff and volunteers work to provide older adults with activities, a safe location to connect with each other and to share and develop their interests. These are typically run by different operators and companies that serve similar functions.

[2]Digital ambassadors who took part in the study were full-time staff hired by the Digital Office of the Infocomm Media Development Authority of Singapore. These ambassadors were part of the "Seniors Go Digital" campaign aimed toward helping and aiding older adults learn about, adopt, and use digital technology, often being in the front line in aiding and assisting these older adults in the setting up of digital accounts, digital devices, and so on.

[3]LumiHealth is an app-based program designed in a partnership between Apple and the Singapore Health Promotion Board to encourage citizens to lead healthier lives (https://

www.lumihealth.sg/). It is only available to users on the Apple ecosystem (Apple Watch, Apple iPhone, etc.).
[4]Healthy365 is also an app-based program designed by the Singapore Health Promotion Board. In this program, participants can collect a free smartwatch and fulfil certain goals set inside the app. Naturally, the app itself is much less polished compared to LumiHealth, which was developed in partnership with Apple.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. *(Supporting Information)* This document was distributed to and used as a focus group guide by the facilitators. In the guide, we provide broad framing questions as well as the approximate time allotted for each question. Facilitators were trained in probing techniques to go beyond these broad framing questions. As this is only a guiding document, facilitators were instructed to use this as a framework rather than as a strict set of instructions.s

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