TRANSFORMING YOUTH MENTAL HEALTH TREATMENT THROUGH DIGITAL TECHNOLOGY

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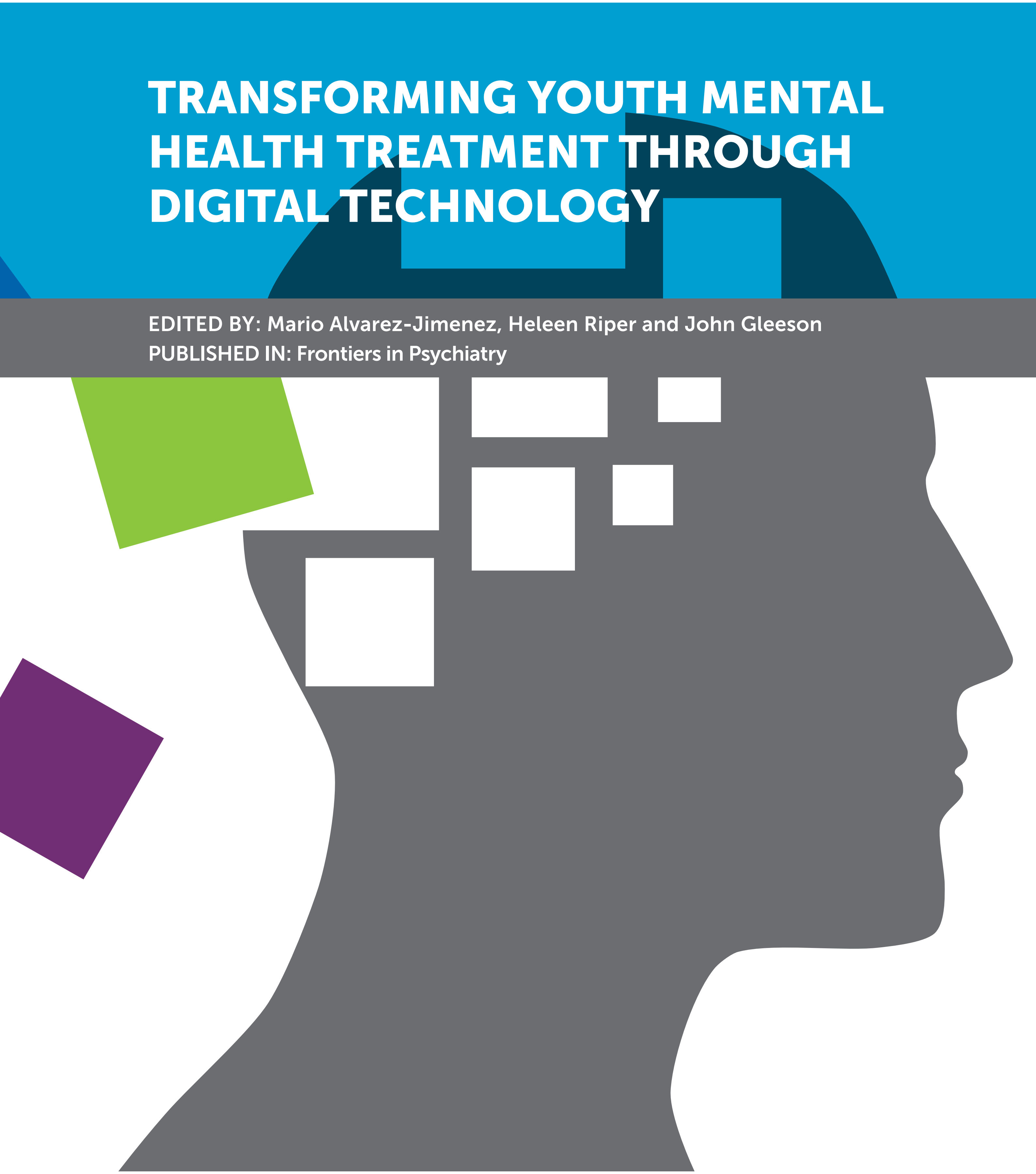

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TRANSFORMING YOUTH MENTAL HEALTH TREATMENT THROUGH DIGITAL TECHNOLOGY

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EDITORIAL
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Editorial: Transforming Youth Mental Health Treatment Through Digital Technology

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Editorial on the Research Topic

Transforming Youth Mental Health Treatment Through Digital Technology

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The historical perspective provides a powerful vantage point for recognizing progress, unfulfilled promises, potential pitfalls, and current opportunities. Leonard Bickman recently provided an example which is highly salient to the contents of this Research Topic in his conceptual paper entitled "Improving Mental health Services: A 50-year journey from randomized experiments to artificial intelligence and precision mental health" (1). Many of his observations align with our view that without significant reform current mental health service models, designed in their essential form between 50 and 75 years ago, are no longer fit for purpose given the poor access to care and the problems with their effectiveness (1).

In many jurisdictions around the world community mental health care can be characterized as a moribund system staffed by compassionate, dedicated, and competent clinicians, a status which is increasingly acknowledged even by the governments that fund them. For example, the state of mental health services has led to the first Royal Commission into mental health services in Australia (2). In launching the Royal Commission the local state political leader, Premier Daniel Andrews, declared that the Victorian mental health system is "a broken system and until we acknowledge that and set a course to find those answers and a practical plan for the future, people will continue to die, people will continue to be forever diminished." (2) p. 11.

With the wisdom of hindsight, the era of deinstitutionalization and the community mental health service reform was founded upon incorrect assumptions about the resources required, especially for those with complex comorbidities (3). Without further reform the gap between demand for mental health treatment and its supply will be intensified by the competing pressures on public funds as the world enters a fragile phase of economic and mental recovery from the COVID-19 pandemic. COVID-19 has also cruelly revealed that the expectation of inevitable business and institutional continuity is a false and dangerous implicit assumption. We have been abruptly reminded of the critical importance of sustainable platforms for service delivery and the critical importance of ready access during crises to redundant capacity, especially in health care. It's clear that in a post-COVID-19 world that current models of mental health service delivery cannot be adequately scaled to reliably meet the needs of young people and their families in the twenty-first century and beyond. Therefore, modified and alternative models of providing mental health assessment and intervention for young people are critically needed. Bickman provided a glimpse of the array of possible solutions that technology could lend to the next wave of reform (1). The papers in this Research Topic illustrate many of those possibilities and highlight the creativity and breadth of research into digital transformation of youth mental health and well-being.

The current problem of the unsustainable demand on mental health services can be reduced via effective preventive technologies which requires clinicians to pivot toward neglected environments and populations at heightened risk. There are three examples in this Research Topic including a focus on schools (O'Dea et al.), University students (Fleming et al.), and some thoughtful commentary on the prospects for preventive intervention in bipolar disorder (Murray).

As Bickman highlighted, significant work is required to harness the affordances of technology in clinical assessment, which offers the possibility of increased scale, intensity, and ecological validity. Van Dam et al.'s demonstration of the feasibility of using emojis is a creative example of a simple and familiar tool for young people for real-time assessments.

As David Mohr and colleagues have cogently highlighted, the hard won gains made in establishing feasibility and effectiveness of novel digital mental health interventions are often poorly translated into real-world outcomes (4). In line with Mohr's argument that co-design with clinical services is critical for future success, Bucci et al. highlight the importance of investing in the understanding of the frontline clinical workforce's perceptions and needs in relation to implementation of digital tools in early interventions services. Peck et al. also illustrate this approach including the involvement of peer support staff in co-design—a highly promising avenue for improving scalability of models of youth mental health service delivery.

Discerning the most appropriate treatment targets for digital interventions is a critical challenge for the field. We note recent calls for a shift away from group-based symptom reduction to trans-syndromal phenomena and psychological well-being (5), which we believe can be facilitated by the deployment of digital technology and partnering with young consumers and their carers in the collection of intensive ecologically valid data across time. Consistent with this call, in this special edition Kim and colleagues report preliminary effectiveness data from a controlled study of eye-gaze feedback to address the important transdiagnostic target of attention training (Kim et al.). Lim et al., also reports some highly promising data in relation to the critical transdiagnostic target of loneliness in youth.

Bickman foreshadowed an increasing roll for precision mental health by leveraging big data (1). The potential for individualized interventions stemming from assessment and data capture can be seen in Iorfino et al.'s description of their new platform for implementation in youth services. A significant challenge for this cutting-edge field will be determining the criteria for achieving precision in meeting the needs of the individual young person. Efficiency will also be an important consideration in further reform of youth mental health services which raises tension between allowing a 1,000 digital flowers to bloom, vs. adapting for mental health care existing digital resources. Thompson et al. present an intriguing example, embedding a mental health intervention within a familiar digital environment.

The next 5 years of research progress in digital interventions for youth mental health will be intriguing. Whilst reluctant to make predictions, we would like to proffer critical priorities. First, we argue for the need to enhance the science of digital engagement to establish the most effective strategies to optimize involvement of young people in digital mental health care and to promote their re-engagement during periods of setback. COVID-19 has also brought the preventive role of passive forms of engagement via passive sensing into public awareness and in youth mental health care the challenge will be to optimize both its effectiveness and the autonomy of the end user to create empowerment and autonomy. Another critical priority will be determining what are the most viable targets for behavior change via digital interventions and which behavior change techniques are most readily utilized via technology for young people to address those targets? Can we scale up effective behavior change strategies using natural language processing and machine learning? Can we realize the goal of precision interventions by using AI to match individuals via real-time assessment to personally salient transdiagnostic treatments? Perhaps the most urgent question is how can we optimize the integration of in-person and digital interventions as well as blended formats combining the best of both worlds (face-to-face and digital components) in integrated treatment protocols, e.g., by providing clinicians with real-time feedback on the fidelity of their interventions, by reinforcing therapy homework, and using real-time assessment to recognize when intensive in-person intervention is needed? Co-design will be critical to the success of these endeavors.

With the inevitable false starts, setbacks and success ahead it will be critical to retain the past lessons from deinstitionalization by taking account of the full complexity of digital implementation whilst also holding public and private institutions to account in building out a viable model. Finally, as researchers and clinicians continue to explore the boundaries of what's possible it will remain important to hold onto another important reminder from the COVID-19 pandemic—that technology can only reach so far in meeting the universal and fundamental human need for connection that will always require a compassionate, intelligent, and competent physical human presence.

AUTHOR CONTRIBUTIONS

JG drafted the editorial. HR and MA-J provided editorial input. All authors contributed to the article and approved the submitted version.

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ORIGINAL RESEARCH
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"They Are Not Hard-to-Reach Clients. We Have Just Got Hard-to-Reach Services." Staff Views of Digital Health Tools in Specialist Mental Health Services.

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Background: Digital health products designed to help people with severe mental health problems appear to be feasible, acceptable, and efficacious. The challenge facing the digital mental health field is implementing digital tools in routine service delivery. To date, there has been a paucity of qualitative research exploring staff views of digital health solutions in the context of mental healthcare. Engaging and involving frontline staff in the design and rollout of new technology to improve utilization is imperative for successful uptake and adoption of digital tools. The aim of the current study is to explore frontline staff views regarding the utility and appropriateness of using digital tools in the healthcare pathway for people accessing specialist secondary care mental health services.

Method: Qualitative study using framework analysis was used with 48 mental health staff working in early intervention for psychosis services. Six groups comprising 5–10 early intervention service staff members in each group were conducted across the Northwest of England. Robust measures were used to develop a stable framework, including member checking, triangulation, and consensus meetings.

Results: Three themes were identified *a priori*: i) perceived barriers to adopting smartphone apps for early psychosis; ii) acceptability of digital health tools for early psychosis patients; and iii) data security, safety, and risk. Alongside exploring the *a priori* topics, one theme was generated *a posteriori*: iv) relationships.

Conclusions: Staff working in specialist early intervention for psychosis services found digital tools on the whole acceptable in mental health service provision, but raised a number of concerns that will likely affect implementation of such systems into routine service delivery and practice. Thirteen recommendations are made in this paper as a result of the themes generated in these data. Implementing of digital systems needs to be simple and uncomplicated and improve clinical workflows for staff rather than hinder and increase clinical workflows. Furthermore, organizational support with a clear plan for implementing technological innovations is required for successful adoption of digital systems. Consideration of staff views around digital systems is important if successful adoption and implementation of such systems are to occur.

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Keywords: psychosis, digital health, mHealth, qualitative, mental health, app

INTRODUCTION

Psychosis is associated with high individual, societal, and financial costs and is a public health challenge (1). Life expectancy is reduced by 17–20 years compared to the general population, noted in the Five-Year Forward View as one of the greatest health inequalities in England (2). Treatment for psychosis is time-sensitive, with delays resulting in unplanned inpatient care for relapse. Unscheduled episodes of acute care for management of relapse continue to be major cost drivers for services. The challenge is to improve outcomes through personalized care. Digital health interventions (DHIs) can be used to deliver ecologically valid interventions at the point of need (3). Several digital tools have been developed to assist people experiencing psychosis, with promising findings (4–7). A few studies have explored clinicians' views of various digital mental health platforms, including computerized and mobile tools (1, 8–11), but these findings have generally been limited to mental health problems more generally, rather than psychosis specifically.

Early psychosis is ta critical period of development (12), and specialist early intervention for psychosis services (EIS) have been designed to offer an intensive model of care in order to minimize the impact of potential relapse. Digitizing health services is a UK National Health Service (NHS) policy priority (13), and technological innovations and solutions are being considered in an attempt to address the size and scale of mental health problems worldwide (14). However, implementation has been challenging, chiefly due to lack of staff engagement (15). Drawing on lessons learned from integrating digital tools within other large institutions, Lluch (16) identified factors including organizational structures, perceived depersonalization of healthcare, and lack of incentives for clinicians as major barriers to implementation. Engaging and involving frontline staff in the design and rollout of new technology to improve utilization is therefore imperative. Furthermore, understanding implementation facilitators and barriers from frontline staff perspectives is important as staff views and beliefs about the utility of digital tools in mental healthcare delivery will undoubtedly influence uptake and the possibility of embedding digital systems and tools in services (17).

Currently, clinicians' perceptions of integrating digital tools into specialist psychiatric services are unknown. Without such insights, we run the risk of failing to engage staff in coproducing solutions and successfully implementing potentially transformative care. The aim of the current investigation is to explore clinicians' views regarding the utility and appropriateness of using digital tools in the healthcare pathway for people receiving treatment from early intervention for psychosis services (EIS) in the Northwest of England, UK.

MATERIALS AND METHODS

This was a qualitative study nested within a broader research program on the development and testing of a theory-informed smartphone system for early psychosis, Actissist (4). Throughout the life of the Actissist project, we consulted with an expert reference group (ERG) comprising service users, clinicians, and computer scientists. The ERG met regularly to feed into all phases of the project, helping to inform the design of the app and assisting with the analysis and interpretation of study data. Data were gathered from 48 staff working in EIS services. Ethical approval was granted by the National Research Ethics Committee West Midlands–South Birmingham (14/WM/0118). We used a systematic, nonprobabilistic sampling approach to recruit a maximum-variation purposive sample of staff from various roles and disciplines working in EIS. The study was collaborative, involving clinicians in study design, topic guide development, and checking of data themes. Our aims were to understand staff views around digital technology in mental healthcare and to produce findings with some (albeit cautious) transferability beyond our specific study and service setting. While recognizing the inherent subjectivity of this work, such as acknowledgment of our own roles as researchers and clinicians in the research process, we nonetheless assume a critical realist epistemological position. Critical realism combines ontological realism (the world is understood as having a concrete reality outside of human constructions of it) with epistemological relativity.

Data Collection

A researcher contacted team managers about the study and sought permission to hold a series of focus groups within clinicians' working day. For three of the six focus groups conducted, the team manager advertised the study during team meetings. Clinicians who expressed an interest to take part attended an estimated 90-min focus group that was scheduled at a time that was convenient for most responders. The remaining three groups were carried out with all staff members of a local early intervention team (split into three groups) as part of the team's annual "away" day. All participants were aware that the aim of the focus group was to gather staff views of DHIs in the context of mental healthcare. More specifically, staff were informed that the aim of the focus group was to gather healthcare professional views around how to best develop an app for early psychosis service users, ways in which we can engage service users to use a self-management app, incentives and barriers to DHI use in the mental health service setting, and any other general thoughts, both positive and negative, about service users using technology to manage their mental health problems. Staff participants were also aware that the research team would be recruiting participants for a DHI trial in early psychosis following these focus groups.

Eligibility criteria were: ability to provide informed consent, employed staff member of an EIS service in the Northwest of England, English speaking, willing to consent to group being digitally recorded, and consent to publication of deidentified data. Consenting participants were interviewed in focus groups at the team base using a flexible, semistructured topic guide (available on request) developed for the study based on a review of the literature and informed by Smith's (18) guidelines and our ERG. The topic guide broadly explored staff perceptions of the acceptability of digital health tools; incentives and barriers to the use and implementation of digital health systems; disclosure of risk information; and concerns about data privacy, surveillance, and confidentiality. Designed to reflect naturalistic conversations about specific topics, focus groups are less susceptible to researcher bias than one-to-one researcher-led interviews as participants' views and group dynamics ultimately shape the data generated (19). However, without skilled facilitation, this can silence some participants (20). The focus groups, averaging 87 min duration, were conducted by experienced facilitators SB, RM, and KB as part of an iterative and inductive process of data collection and analysis. Data collection ceased when no further themes were advanced (i.e., data saturation) (21). The order in which topics emerged was influenced by the topic guide but was not exclusively driven by it. Interviews were digitally recorded and transcribed verbatim.

Data Analysis

Data were analyzed using a framework analysis approach (22). Although framework analysis shares common features with other qualitative approaches such as thematic analysis, framework methodology makes explicit a visible, systematic process that allows for inclusion of both *a priori* and emergent themes. In collaboration with our ERG, SB, RM, DE, and NB developed the initial framework reflecting important areas we wished to seek views about before further developing the framework. The topic guide essentially informed the framework's *a priori* themes. After independently coding several transcripts, we refined the framework and subsequent iterations in consultation with the wider team, comprising academic researchers and secondary care clinicians, to discuss and refine the analytic process. Development of the framework involved the nonlinear key stages described in **Table 1**. Codes were organized using NVivo (version 10) software. Regular consensus meetings were held until a stable framework emerged. The analytical framework was not complete until all transcripts were coded and quality assurance measures completed, including independent peer verification of the framework, triangulation of analysis, and member checking of the analytical matrix (22).

Reflexivity

Reflexivity refers to the process of acknowledging the team's subjective experiences and how this may influence the process of the analysis process (23). SB, KB, and GH are qualified clinical psychologists who have worked extensively with individuals with psychosis as well as services/clinicians involved in delivering mental healthcare in the public health service. At the time of analysis, RM and NB were experienced research assistants working with people with psychosis in the context of research trials. SL is an adult psychiatrist with many years' experience working with people with severe mental health problems. DE is an experienced qualitative researcher. We acknowledge that our shared knowledge and experiences may have had an impact upon interpretation of the data.

RESULTS

The sample, broken down by group in **Table 2**, consisted of six groups comprising 5–10 EIS staff members in each group (N = 48 participants). Participants were mainly white British (n = 40), with a total mean age across focus groups of 31.6 (range: 19–50) and from a range of professions, including care coordinators (n = 10); clinical psychologists (n = 8); mental health practitioners (n = 5); team managers (n = 5); support, time, and recovery (STR) workers (n = 5); community psychiatric nurses (n = 4); social workers (n = 4); psychiatrists (n = 4); researchers (n = 2); and a team secretary (n = 1). Years of professional experience working with EIS service users ranged from 4 months to 22 years. The majority of staff used a smartphone themselves (n = 42), and of these, 38 used apps in

TABLE 1 | Description of the analytic process.

Stage of analysis	Description
1. Familiarization with the data	Listening to recordings, reading and rereading transcripts, making analytical notes.
2. Coding the data	Includes both deductive (using predefined codes based on specific research questions) and inductive approaches (using "open coding" to identify any emergent, possibly relevant information).
3. Developing the thematic framework	Initial framework developed through comparing codes assigned to the data after independently coding several transcripts and agreeing on the set of codes to be assigned to subsequent transcripts. Data were interpreted and summarized, new codes generated, redundant codes deleted, and overlapping codes merged.
4. Indexing	The framework was applied to the data set.
5. Charting	Charting a framework matrix for each emergent category across the whole data set was developed using QSR International's NVivo 10 data management software.
6. Mapping and interpretation	Emergent (*a posteriori*) and *a priori* characteristics of the data were identified and connections between categories mapped, facilitating exploration of relationships (similarities and differences) and theoretical concepts and generation of typologies.

TABLE 2 | Participant demographics and technology use by focus group.

	Focus group 1 (*n* = 6)	**Focus group 2 (*n* = 9)**	**Focus group 3 (*n* = 10)**	**Focus group 4 (*n* = 9)**	**Focus group 5 (*n* = 5)**	**Focus group 6 (*n* = 9)**	**Total (*n* = 48)**
Mean age (range)	38 (30–50)	33.6 (28–40)	34 (30–41)	36 (32–50)	35.2 (27–49)	36.1 (19–43)	36.2 (19–50)
Gender	Female: *n* = 4 Male: *n* = 2	Female: *n* = 5 Male: *n* = 4	Female: *n* = 6 Male: *n* = 3 Missing: *n* = 1	Female: *n* = 4 Male: *n* = 5	Female: *n* = 4 Male: *n* = 1	Female: 4 Male: 5	Female: 27 Male: 20 Missing: 1
Ethnicity	White British: *n* = 4 Mixed: *n* = 1 White Irish: *n* = 1	White British: *n* = 9	White British: *n* = 7 Mixed: *n* = 2 Missing: *n* = 1	White British: *n* = 7 Mixed: *n* = 1 Missing: *n* = 1	White British: *n* = 5	White British: *n* = 8 Missing: *n* = 1	White British: *n* = 40 Mixed: *n* = 4 White Irish: *n* = 1 Missing: *n* = 3
Job title	Clinical psychologist: *n* = 3 Researcher: *n* = 2 Team manager: *n* = 1	Care coordinator: *n* = 3 Community Psychiatric Nurse (CPN): *n* = 1 Psychiatrist: *n* = 1 Social worker: *n* = 2 STR worker: *n* = 1 Team manager: *n* = 1	Care coordinator: *n* = 4 Clinical psychologist: *n* = 1 Assistant clinical psychologist: *n* = 1 Consultant psychiatrist: *n* = 1 CPN: *n* = 1 Mental health practitioner: *n* = 1 Team manager: *n* = 1	Care coordinator: *n* = 3 CPN: *n* = 1 Psychiatrist: *n* = 1 Social worker: *n* = 2 STR worker: *n* = 1 Team manager: *n* = 1	Consultant clinical psychologist: *n* = 1 Trainee clinical psychologist: *n* = 1 Mental health practitioner: *n* = 2 Psychiatrist: *n* = 1	Clinical psychologist: *n* = 1 Mental health practitioner: *n* = 2 Student mental health nurse: *n* = 1 STR worker: *n* = 3 Team manager: *n* = 1 Team secretary: *n* = 1	Care coordinator: *n* = 10 Clinical psychologist: *n* = 8 CPN: *n* = 4 Mental health practitioner: *n* = 5 Psychiatrist: *n* = 4 Researcher: *n* = 2 Social worker: *n* = 4 STR worker: *n* = 5 Team manager: *n* = 5 Team secretary: *n* = 1
Mean time in post	3 years 3 months	2 years 1 month	4 years 1 month	3 years	3 years 2 months	7 years 4 months	
Mean time working with EIS service users	10 years 1 month	2 years 3 months	4 years 4 months	6 years 6 months	4 years 1 month	5 years 3 months	
Smartphone ownership	Yes: *n* = 5 No: *n* = 1	Yes: *n* = 7 No: *n* = 2	Yes: *n* = 10	Yes: *n* = 8 No: *n* = 1	Yes: *n* = 4 No: *n* = 1	Yes: *n* = 8 No: *n* = 1	Yes: *n* = 42 No: *n* = 6
Smartphone app use	Yes: *n* = 5 No: *n* = 1	Yes: *n* = 6 No: *n* = 2 Missing: *n* = 1	Yes: *n* = 8 No: *n* = 2	Yes: *n* = 7 No: *n* = 2	Yes: *n* = 4 No: *n* = 1	Yes: *n* = 8 No: *n* = 1	Yes: *n* = 38 No: *n* = 9 Missing: *n* = 1
Contact with service users *via* email or texts	Yes: *n* = 5 No: *n* = 1	Yes: *n* = 7 No: *n* = 2	Yes: *n* = 9 No: *n* = 1	Yes: *n* = 7 No: *n* = 2	Yes: *n* = 2 No: *n* = 2 Missing: *n* = 1	Yes: *n* = 6 No: *n* = 2 Missing: *n* = 1	Yes: *n* = 36 No: *n* = 10 Missing: *n* = 2
Contact with service users *via* email or texts using a smartphone	Yes: *n* = 1 No: *n* = 5	Yes: *n* = 1 No: *n* = 8	Yes: *n* = 2 No: *n* = 8	Yes: *n* = 2 No: *n* = 7	Yes: *n* = 1 No: *n* = 4	Yes: *n* = 1 No: *n* = 7 Missing: *n* = 1	Yes: *n* = 8 No: *n* = 39 Missing: *n* = 1

STR, support, time, and recovery; EIS, early intervention for psychosis services.

their personal life. Many staff also stated that they used email and text messages ($n = 36$) to liaise with service users. All teams approached agreed to participate in the study.

Three themes were established *a priori*: i) perceived barriers to adopting smartphone apps for early psychosis; ii) acceptability of digital health tools for early psychosis patients; and iii) data security, safety, and risk. Alongside exploring the *a priori* topics, one theme was generated *a posteriori*: iv) relationships. An illustrative diagram of the framework is presented in **Figure 1** and described and elaborated below, evidenced by anonymized quotes embedded within the text.

Theme 1: Perceived Barriers to Adopting Digital Health Interventions

Although staff described several potential benefits of DHIs for early psychosis, perceived barriers were also noted and are separated here by staff and service–level barriers and service user–level barriers.

Staff and Service–Level Barriers

Staff felt that resources would be better spent on investing in staff training rather than developing technology that could ultimately replace clinician skills, as well as deskill and threaten the workforce. As such, the perceived threat of apps usurping the clinician's role may be a barrier to staff recommending digital health approaches to healthcare:

> *Resources are channeled into technological advancement when perhaps it would be better channeled into staffing and training* (Participant 9, Group 2).

Staff detailed concerns regarding their own ability to use technology and expressed doubt around their own skills, familiarity, and confidence in using technology. This highlighted the need for resources to be put toward not only service users but also staff to ensure they are fully trained and offered support in the use of DHIs:

> *There's no point in [a patient] being a whizz on that computer and smartphone and me not having a clue cos I wouldn't be able to support adequately, there would be … ongoing training needs* (Participant 35, Group 5).

Staff members identified a disparity between their own use of technology and the younger generation's adoption of technology in their day-to-day life, recognizing that digital tools are culturally relevant for the younger so-called digital native generation who communicate and interact regularly with others using digital technology. For example, some of the older members of the focus groups referred to themselves or others in the service as "old-fashioned" or "old-school," reflecting some reluctance to move away from more traditional, face-to-face pathways of care:

> *I think sometimes people are, for whatever reason, don't think that's a good way of communicating; they like the old-fashioned way* (Participant 33, Group 4).

However, some staff also noted that despite not feeling entirely confident with technology themselves due to age and experience, they were willing to adapt to incorporate technology within their own clinical practice for patient need:

> *I consider myself a bit of a dinosaur with things like technology, but it doesn't stop me using certain things … I use Skype to contact one of my clients who just wouldn't leave the room; I couldn't access her any other way, so I'm not opposed to the idea of using technology* (Participant 26, Group 4).

Staff members also described low expectations and confidence in the ability of the NHS to implement digital tools within mental health services. Such perceptions stemmed from past negative experiences of the NHS having a "poor reputation of large-scale IT projects and even delivering small-scale IT projects with any level of competence" (Participant 31, Group 4). As such, some

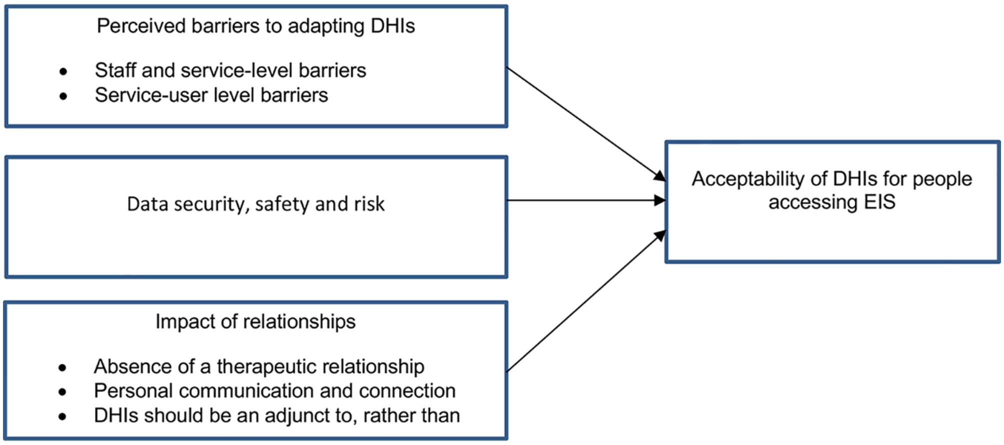

FIGURE 1 | Framework structure of themes.

staff expressed clear mistrust of NHS technology adoption and preferred paper-and-pencil methods of healthcare monitoring:

> *There's something about trying to change with the times, but I also quite like to write something down on a bit of paper, and you know it's not going to break down or you're not going to lose your internet connection* (Participant 39, Group 5).

Additionally, the level of burden placed on clinicians regarding time constraints and the potentially complicated process of coping with real-time data workflows that digital platforms can produce, as well as managing self-monitoring data input by service users themselves, was perceived to be a potential barrier that would need to be addressed to improve the likelihood of successful service implementation. Staff described the need for digital tools and web servers holding the data to be easily accessible, uncomplicated, and able to complement, rather than hinder, clinical practice:

> *If it is going to be another ten passwords, or you go in a special room to access that device to look at all other things, then you are actually thinking in the real day of a care coordinator's life where there's already so much administration that a new thing also had to be easy to use and seen as a worthwhile tool* (Participant 29, Group 4).

Service User–Level Barriers

The most prevalent service user–related barrier, as perceived by staff, related to the "digital divide." Staff felt that some service users would not own or be able to afford to use smartphone technology, rendering them unable to access digital healthcare solutions. Additionally, some staff reported that a large proportion of EIS service users did not speak English as their first language or had poor literacy skills, including digital literacy skills, and would, therefore, find it difficult to understand the information presented in digital tools such as apps. This concept of the digital divide led to perceived concerns that apps would only "be for the benefit of a real minority of people" (Participant 9, Group 2) and disadvantage people from low socioeconomic backgrounds in particular:

> *[For] people on benefits, phones are considered a luxury item … and if people aren't working because of health needs, essentially they are being denied healthcare because they can't afford a phone* (Participant 31, Group 4).

Concerns were also expressed about the potential impact of symptoms on service users' abilities and willingness to engage with digital technology. For example, many staff provided examples of working with service users who had symptoms associated with psychosis that were directly related to technology or expressed concerns that a smartphone app may exacerbate symptoms:

> *One of my clients would have a really big issue, he wouldn't like it cos all his delusional beliefs are about the Internet and computer symptoms…* (Participant 22, Group 3).

> *I think with a lot of clients, the symptoms can be similar … in terms of them feeling monitored or watched, and that could add to the distress if you say, "Here's an app, we're going to monitor what you're doing"* (Participant 27, Group 4).

Clinicians also raised concerns that low levels of motivation would prevent some service users from fully engaging with digital healthcare approaches. There was the feeling that apps specifically should use schedules and prompts to remind people to use the device and use should be incentivized, avoid repetition, and include a social media component (if possible) to facilitate connection with others and enhance engagement with the device:

> *A mobile phone app is never going to be able to engage people and motivate people, but there may be a way to do it … you offer some way of engaging them, like there's a progression, like you know our avatar grows or you get to a certain level you get and you get credit for your phone* (Participant 28, Group 4).

Theme 2: Acceptability of Digital Health Interventions for People Accessing Early Intervention for Psychosis Services

Staff viewed digital technology as a generally acceptable approach to healthcare and highlighted a number of potential benefits. One such perceived benefit was that apps are easily accessible in any place, at any time. In this sense, smartphone apps more specifically were seen to have wider reach in comparison to computerized interventions.

> *You don't have to wait till you get home for your computer … it is [available] there and then* (Participant 3, Group 1).

The on-demand access inherently available within an app was also viewed as being able to provide more ecologically valid assessment of symptoms ["The person would be recording their experiences immediately … in a way where you don't necessarily get to access when you are seeing someone on a weekly basis" (Participant 45, Group 6)]. Furthermore, staff acknowledged that digital tools could extend the reach of services to people who may struggle to access traditional services:

> *So generally speaking, they are not hard-to-reach clients. We have just got hard-to-reach services, but we know that it is tough for some people to get to services…* (Participant 2, Group 1).

Participants viewed apps as potentially destigmatizing due to the now-everyday nature of a mobile phone and availability of an app, which could normalize both the experience of psychosis and the act of self-managing one's health:

> Participant 4: *It is potentially really non-stigmatizing in that people can access it as long as the app is very, very*

> *discrete … it just looks like you're texting or just using a normal app or something.*
>
> Participant 2: *Yeah. I wonder if the fact that there is an app for it, if that makes it more normalizing in itself* (Group 1).

The majority of staff felt that smartphones are contemporary, progressive, modern, and relevant. Using digital technology in the context of healthcare can reflect the way in which individuals currently communicate with one another. In this sense, the use of digital tools such as apps to help manage symptoms and well-being was viewed as an acceptable method as "it fits with the modern day" (Participant 6, Group 1).

Staff also felt that digital tools have the potential for people to feel more empowered in their healthcare, affording them more control and choice over the way they engage with and receive mental healthcare, as well as the location and time of accessing support:

> *It could be a bit more empowering for the service user not to be reliant on a member of staff coming round. They can use it in their own time as and when they feel…* (Participant 10, Group 2).

> *Choice and option are clearly the key to it, and that's what virtually all of us would absolutely endorse* (Participant 3, Group 1).

Staff also spoke about the potential value of digital tools to provide people with a sense of ownership over their clinical data and the option to share this information with significant others in their lives, enhancing systemic ways of working with service users and their families. Staff were clear, however, that the choice about sharing data (or not) should be the service user's decision:

> *They can sort of choose who they use it with. It is sort of inclusive, as inclusive as you want it to be … you would be able to sit down and get the family involved; it could actually enhance the families' understanding* (Participant 2, Group 1).

Specifically, staff felt service users might find digital healthcare solutions more acceptable than staff members themselves, as EIS service users are younger, more likely to own smartphones, and feel comfortable using them compared to people with more chronic mental health problems:

> *A lot of our service users are, by virtue of their age, quite technically savvy* (Participant 45, Group 6).

Clinicians also felt that apps may be more acceptable for those in the early phase of psychosis. However, the time at which clinicians felt a digital health tool might be most helpful differed. For example, some clinicians suggested that an app might serve as a method to introduce service users to therapy ["It could be a good starting point. A good exposure exercise" (Participant 39, Group 5)], while others believed that an app may be more appropriate for people who had already experienced therapy and were further along in their recovery:

> *Some of the people that we meet might not be at a place where they will be able to engage with [an app], whereas further down the line, it might be something that they are more able to benefit from* (Participant 46, Group 6).

Despite fears regarding the perceived loss of face-to-face contact associated with digital tools, some clinicians highlighted that these tools may be particularly acceptable for people who find communicating face-to-face challenging due to the opportunity to receive an intervention without the need to directly speak with another person:

> *There were a few clients I thought it would work quite well with, like there's a few who kind of spend a lot of time on a computer and don't really go out much, and there's some who don't really want to interact with us … if they interact with an app, brilliant, that's a head start* (Participant 25, Group 3).

Although the majority of clinicians felt they bring something, such as the therapeutic relationship, to therapy that digital platforms do not, some staff members recognized that the combined knowledge that can be distilled in something like an app might in fact be more effective than a single clinician delivering an intervention:

> *It [a smartphone app] has got everybody's knowledge and has great potential. "The whole is bigger than the sum of its parts" kind of thing. So it's got information from all of us. So actually, it could be a huge resource in terms of knowledge and normalizing types of information* (Participant 3, Focus group 1).

> *You are not dependent on one person's training or understanding* (Participant 6, Focus group 1).

Theme 3: Data Security, Safety, and Risk

The third theme is centered around concerns and considerations for the use of, access to, and response to data inputted into digital healthcare systems. When asked about governance, data protection, and security concerns, staff highlighted that potentially highly sensitive symptom data gathered by a digital device would need to be heavily protected and secured to ensure confidentiality and anonymity. Specifically, to prevent unauthorized access and individual identification, clinicians advised that digital tools need to be password-protected and that anonymous usernames should be used rather identifiable patient data:

> *Perhaps if everything that is entered on there is anonymous so there is not the person's real name anywhere, then that may be some reassurance* (Participant 2, Group 1).

Staff also described the need to specify where service user data would be stored and who would have access to these data in a clear, user-friendly, and accessible way:

> *I think we just need to be really explicit about what the data's for and where it's going … you know when we say it's in a database or in the team, what does that mean? Who's going to have access to that?* (Participant 21, Group 3).

A common fear expressed by staff was the complexities of, and responsibility for, identifying and managing risk. Staff felt that such a "constant stream of information would be overwhelming … and impacts on whether we are able to respond" (Participant 17, Group 2), thus adding to already-stretched workloads. Additionally, some staff perceived that there would be a need to conduct robust risk assessments prior to "prescribing" a DHI to mitigate risks of an app triggering risk behaviors:

> *If it does trigger an emotional feeling … something happens and we give them the app, then who's responsible?…are we going to have to risk-assess to see if their mental health state is good enough? …[What if] something happens, and they have a bad turn and they say, "If I hadn't gone in this app"? What is the impact on us?* (Participant 22, Group 3).

Integrating the near-constant stream of data into an electronic care record was also viewed with caution. Staff felt that real-time monitoring would require additional professional responsibility that they felt cautious about. While staff raised issues around access to, and responsibility over, risk disclosures using technology, they also felt that it was important to give service users the opportunity and space to freely express distressing experiences. Staff felt strongly that DHIs should include a diary function for service users to more freely express themselves, but with the caveat that it is made explicitly clear that clinicians will not be able to access, or be responsible for, this information:

> *I would like an option for a space for people to express their distress … you would make it very clear to somebody that if they are going to write how they are feeling … it's not going to be taken up by the therapist or anybody, but it is just there for the individual themselves to see it* (Participant 1, Group 1).

In addition to clearly stipulating the limits of clinician access to a prescribed digital tool, it was also suggested that the inclusion of emergency contact numbers may help mitigate the possibility of service users inputting risk information in the hope of getting support in order to place "the responsibility with the client for their safety" (Participant 4, Group 1).

Theme 4: Relationships

Clinicians identified potentially positive and negative implications of digital technology on the staff–service user relationship. Specifically, clinicians expressed: i) doubts over the ability for a DHI to provide the relationship they considered vital for successful therapeutic care; ii) concerns that DHIs were dehumanizing and lacked the personal touch, genuineness, reciprocity, and warmth that another person can provide; and iii) the possibility that DHIs may reinforce avoidance of social situations. However, there was also the recognition amongst clinicians that, for some service users, digital healthcare tools may be preferable over face-to-face contact.

Absence of a Therapeutic Relationship

Many clinicians described the inherent need to build a therapeutic relationship with service users in order to deliver effective therapy. As digital technology potentially removes the need for human interaction, staff felt that the absence of a therapeutic relationship means that delivering therapy *via* a digital platform either was not possible or would be ineffective:

> *I think if you are going to talk evidence-based, the biggest thing is every single intervention that has ever been tested is therapeutic relationship, so you are just removing the most effective part* (Participant 15, Group 2).

While this opinion was widespread, a few participants wondered whether clinicians, rather than service users themselves, place inflated importance on the impact of the therapeutic relationship, as Participant 4 in Group 1 says:

> *But I guess therapists always hang on to the idea that the relationship is really important and part of the whole thing, but it's not. I remember hearing this one idea that relationship is necessary but not sufficient. I heard somebody else say that actually, the relationship is sufficient on its own, but it's not even necessary … So interventions can be delivered in any way really, and I'm starting to subscribe to the idea that potentially, it could just be a really effective thing. You don't need a therapeutic relationship to do effective therapy.*
>
> *I think that's quite a paternalistic way of viewing it, really, to say we do the therapy to you. I think you just let people have a go at it. Sometimes what you find is the thing they identify as they go for treatment is not what you would identify, and that's just as it should be* (Participant 45, Group 6).

Personal Communication and Connection

A common concern was that technology could seem mechanical and robotic due to the perceived inability to personalize and tailor responses to an individual. As such, staff were concerned that this would lead to reduced depth and quality of information. For example, DHIs cannot deliver more subtle or complex aspects of human interaction, and the ability to personalize information is compromised:

> *[Technology] is very depersonalized … so much of our work and what lots of us think about is it's always individualized, it's always very personalized* (Participant 13, Group 2).

Staff also described how the warmth, support, and personal contact that just the presence of another person can have is important in recovery, which they felt is something that a DHI could "never offer":

> *I think if you asked clients what they valued most about their contact with the service, it would be the contact, it would be somebody coming around* (Participant 30, Group 4).

The power of nonverbal and para-communication when seeing people face-to-face allowed staff to identify a service user's emotional responses, something they believed that a DHI was incapable of doing:

> *All of those kinds of non-verbal cues and para-language is lost in electronic communication, and a lot of what we do relies on non-verbal cues and para-language. Saying that they're fine and they're still in their bedclothes that they've been wearing for three days … IT [information technology] would never tell me that* (Participant 31, Group 4).

Staff often spoke of therapy being one of the only opportunities that some service users had to socialize and connect with others. DHIs were viewed as potentially taking away the one chance an individual has to socialize:

> *It could be the only socialization they get is with their therapist, and they've even taken that away or negated the need for that* (Participant 31, Group 4).

Additionally, staff spoke about the potential for apps to reinforce social avoidance, therefore affecting relationships in general in addition to therapeutic relationships with staff:

> *There's always an element if you want to be avoidant, of doing so, and I wouldn't, I don't know if there would be a risk that we kind of really reinforce that [avoidance] a bit here* (Participant 19, Group 2).

Digital Health Interventions Should be an Adjunct to, Rather Than Replace, Face-to Face Healthcare

Staff were concerned that service users might feel "fobbed-off," neglected, or dismissed if they were prescribed an app. Technology was described by staff as a "de-humanizing" and "unhelpful" alternative to face-to-face care. Consequently, staff believed that service users would feel let down and therapeutic relationships would be adversely affected if users felt they were being given inferior care. Staff members suggested that one way of overcoming this would be for digital tools to be presented to people as an adjunct to, rather than replacement for, their healthcare:

> *Some people might feel they are being fobbed off … but I think as long as you are able to fully explain what its purpose is and perhaps say this isn't a replacement of a service, it is more an add-on, it would probably be seen as a bit more acceptable* (Participant 35, Group 5).

In fact, an almost universal opinion expressed by clinicians was that technology should not be used to replace traditional face-to-face care. Rather, technology should be used to augment existing support. Staff were able to identify concrete situations in which an app could be used to enhance the current care that they provide. For example, some staff noted that an app could be a useful and practical tool to deliver self-guided therapy materials between traditional face-to-face therapy sessions:

> *It would be really useful for homework tasks and for supporting people to do things in between sessions rather than as a replacement for one-to-one sessions* (Participant 36, Focus Group 5).

Staff also valued the potential for DHIs to be used in conjunction with traditional mental health services to: i) monitor service users' symptoms and experiences in order to identify early indicators of relapse, ii) aid diagnosis, and iii) provide clinicians with a more ecologically valid description of service users' symptoms to inform subsequent care and facilitate shared decision-making:

> *You've got something that can actually tell you that their mood has been getting better or worse, so it would … probably add more value, to the [therapy] in itself* (Participant 29, Group 4).

DISCUSSION

Main Findings

This study examined clinicians' views about adoption and use of digital tools within secondary care mental health service delivery. Four themes were evident within the data. First, a number of barriers to adoption and uptake of digital tools within services were expressed. Clinicians on the whole expressed the view that resources should be spent on more staff training rather than developing digital health products. In a time of austerity across Europe (24), it is not surprising that clinicians are concerned that digital tools are being used as a potentially cost-cutting exercise to limit resources being spent on staff training and/or staff employment. While a similar concern was expressed in another UK-based qualitative study with clinicians working in secondary care mental health services (1), it is a finding that is not limited to urban European-based community services. In a qualitative study of clinicians' attitudes toward the use of online material in mental health service delivery in a rural Australian context, clinicians expressed concerns about the reallocation of investment into online resources at the expense of face-to-face service provision (9).

In the current study, fears were expressed around the potential for technology to usurp clinician-led care. Staff lacked confidence in using technology themselves and felt that this might impact on their own clinical judgment, although we found that younger clinicians reported more favorable views in embracing technology in their day-to-day practice than older clinicians. This may be because they themselves are more familiar with digital tools and use these more frequently in their own day-to-day life, perhaps experiencing some of the benefits digital tools afford. This supports findings in other studies that have also found that younger and more recently trained members of staff seem to readily accept integration of online approaches within their day-to-day practice (9). Furthermore, familiarity and ability of staff to use mobile technology and technology more generally has been shown to influence adoption of mobile health (mHealth) platforms across healthcare settings (25–29).

Doubts were expressed about technology being implemented in services at the organizational level. A number of staff commented on past failings of the NHS to implement technological solutions into electronic records and service workflows (15). This suggests that building confidence and trust in digital systems is an important issue to consider when implementing digital systems and pathways. In addition, the majority of staff felt that digital systems need to complement rather than hinder and complicate clinical workflows. Perceived usefulness and ease of use of digital tools were important factors found to influence mHealth adoption in a recent systematic review (30); this finding is reiterated in the current study and is important to consider when incentivizing staff to use integrated digital platforms.

Staff viewed digital technology as a generally acceptable, progressive, modern, and relevant approach to interacting with service users and implementing healthcare. These views reflect more general opinions expressed by clinicians across healthcare settings in other studies, where clinicians recognize that technology affords a new means of communicating with service users (30). Some staff recognized that they themselves might subscribe to more old-fashioned models of healthcare delivery and acknowledged that the younger digital native generation might feel more comfortable with using digital technology and might in fact see this as a preferred method of communication over face-to-face contact. A number of benefits were highlighted, including increased access to support in a manner unconstrained by time and location. Such on-demand access could potentially enhance the ecological validity of symptom/distress reporting. While the finding that mobile health (mHealth) systems can reach people anytime and anywhere has been echoed across the healthcare literature (30), it has not always been viewed as a benefit. For example, some studies of healthcare professional views about mHealth adoption in particular have shown that mobile technologies that embed real-time data into the clinician dashboard or into electronic workflows result in a sense of greater workload and disrupted workflow for staff, becoming a barrier to their adoption of mHealth systems [see (30) for a review].

As in previous studies (1), digital systems were also viewed as having the potential to improve social inclusivity, particularly for hard-to-reach groups. Although digital inclusion has improved in recent years (31), some people continue to remain digitally excluded. While digital solutions have the potential to bridge the healthcare gap and improve scalability of service, it is important that they promote inclusivity rather than further drive the social inequalities so evident among people with severe mental health problems. We support the assertion made by Robotham and colleagues (31) that a digital inclusion strategy is needed within health services to minimize rates of digitally excluded populations.

Clinicians perceived digital tools as potentially capable of reducing the stigma associated with a mental health problem, as apps are commonplace and socially accepted. Somewhat surprisingly, the issue around apps potentially normalizing the stigma associated with having a severe mental health problem has not been raised in other qualitative clinician studies in the field. In contrast, the role of mobile systems to support service user empowerment has been found across the healthcare literature (32, 33) and was reflected in the current study. A perceived benefit of digital systems was the potential to improve the sense of empowerment, control, and choice in healthcare pathways that traditional doctor/clinician and service-led care have historically not been able to provide. Data ownership, affording service users the choice in whether they wish to share digital data or not, was another perceived benefit of digital systems. Indeed, digital technology and the immediate and ubiquitous access to information, as well as intentional and unintentional digital authorship, have also changed how we engage with services and do indeed challenge the notion of data ownership, raising a number of ethical dilemmas that will require careful consideration when implementing digital systems into services (34).

A number of concerns around data security, safety, and risk were shared. Secure systems need to be in place and clearly articulated to reassure clinicians of safe and secure handling and storage of data. Security and risk concerns are commonly expressed as significant barriers to the adoption of digital tools and systems and are in fact concerns expressed by staff across a range of healthcare settings worldwide (35–37). For example, in a recent systematic review, Gagnon and colleagues (30) found that professionals are concerned about the security and confidentiality of data contained and transferred across technology platforms—such findings are echoed in our data. Concerns around data privacy and security were also expressed in another qualitative study of secondary mental health staff working with people with severe mental health problems (1), highlighting the importance of addressing such concerns to minimize barriers to adoption and implementation. In the wake of the General Data Protection Regulation (GDPR) data protection laws across the European Union (EU), the importance of protecting personal data is not only changing the landscape of regulated data protection law, but is also governing the standards with which services will be expected to control and manage personal data, which will undoubtedly raise concerns for digital workflows. On a related point, staff also felt that a clear procedure for managing risk that is potentially identified in real-time data workflows was needed. This echoes the findings of Berry and colleagues (1), which, similar to the current findings, showed that staff in secondary care mental health services raise concerns about their moral, legal, and professional obligation in assessing and managing risk in the context of digital monitoring systems. Guidance on how to respond to risk once identified was viewed as essential in making roles and responsibilities in reporting and responding to risk clear.

The final theme centered around the negative impact digital systems may have on the staff–service user relationship. Although some staff recognized that service users might in fact prefer digital methods of communication to face-to-face contact, by and large, staff were concerned that digital tools lack the nuance, warmth, and empathy a human can offer in easing distress. Concerns here and in another qualitative study of secondary clinician views of mHealth tools for service provision (1) were also expressed around the negative impact of digital tools on the therapeutic relationship, which was viewed as fundamental to improving outcomes. In a recent consensus document on the top 10 research priorities in a national study involving 600 mental health stakeholders in the UK, digital therapeutic alliance was voted into the top 10 research priorities for digital technology in mental healthcare (38). The introduction of technology into delivering therapy undoubtedly brings new challenges in service and therapy provision, particularly with regard to relationship building. There is some evidence that online therapy generates a similar therapeutic relationship to that observed and measured in face-to-face delivered therapy (39), and researchers are now starting to modify traditional measures of therapeutic alliance to capture alliance with online and mobile-based systems [see Ref. (40) for a review of digital mental health apps and therapeutic alliance]. More specifically, members of our group (41) adapted the Agnew Relationship Measure (ARM), a well-validated measure of therapeutic alliance in face-to-face therapy, and developed the Mobile Agnew Relationship Measure (mARM), which was found to have good face and content validity. A measure such as this can be used to advance our understanding of how therapeutic alliance influences outcomes in the context of DHIs. Nevertheless, blended approaches to digital system implementation in services may be more acceptable than stand-alone products, although the efficacy of this approach and whether it confers added benefit over and above stand-alone digital systems require further empirical investigation with both service users and services.

Relatedly, staff were concerned that incorporating digital systems into service delivery might negatively impact on the depth and quality of information shared and might in fact remove the only social contact a service user might have with the outside world. While the human element is indeed removed in the context of a digital system, there is considerable scope to supplement the loss in human connection by developing more precise algorithms and relapse detection methods, as is the promise with precision medicine (42).

Another concern expressed by participants was the potential for service users to feel dismissed and be given inferior care when prescribing digital products rather than face-to-face contact. Blended approaches that combine both digital systems and face-to-face contact were considered a preferable option to stand-alone digital tools being implemented. Our participants are not alone in this view. Clinicians interviewed in other qualitative studies expressed concerns that service users might feel neglected if they are referred to online or mHealth resources/packages and therefore advocate a preference for digital systems to be used as an adjunct rather than an alternative to face-to-face therapy and support (1, 9).

Strengths and Limitations

There were a number of strengths in the current study. We had heterogeneity within groups (e.g., staff of various ages/disciplines) yet homogeneity between groups; it is likely that a variety of views and attitudes were captured. We also had full representation from an entire local early intervention team in three of the six focus groups conducted in this study, thereby minimizing selection bias. On the same note, we acknowledge that for the remaining three focus groups, staff who held a particularly strong view about DHIs may have self-selected to take part in the study, thereby influencing the representativeness of the sample. We adopted a stringent approach to data analysis involving member checking with the majority of our focus groups and triangulation of data. The close working relationships observed within focus groups might have enabled participants to feel more comfortable speaking openly and honestly about their views.

There were also some limitations. We used a purposive sampling approach. Although conducted across three large NHS Trusts, findings reflect views expressed by staff working in the Northwest of England; staff views/attitudes about digital healthcare may be different elsewhere. Three of the six focus groups were from the same service; views from this team particularly influenced the data, and so findings might reflect this particular team's views rather than clinicians' views more broadly. A strength of the focus group design is that it allows people to generate ideas through discussions with each other. However, an associated limitation is that data generated are dependent on the individuals within each group; individual perspectives impede the expression of a variety of views. To minimize the interdependency of participants, group dynamics were managed by the interviewers such that all members of the group were encouraged to express their views. Finally, this was a qualitative study nested within a broader research program on the development and testing of a theory-informed smartphone app for early psychosis, *Actissist* (4). Staff were aware that this project involved developing a DHI for early psychosis, and so views expressed may be filtered.

Implications

In our study, staff recognized a number of potential benefits to embracing digital tools and systems when working with people with severe mental health problems. In particular, staff expressed the view that apps are easily accessible and unconstrained by time and location, affording the capacity to deliver support and intervention to scale while empowering service users in their healthcare. The on-demand access inherently available within a DHI can provide an ecologically valid assessment of symptoms. Furthermore, staff acknowledged that digital tools

TABLE 3 | Recommendations arising from these findings.

Recommendation	
Recommendations when considering impact of digital tools on staff and services	Staff fears around the role of technology in service delivery need to be discussed up front and addressed when considering incorporating digital tools in services. E.g., normalizing concerns, problem-solving solutions/safeguards, and providing evidence to alleviate concerns in a supportive, nonconfrontational manner are important. Training staff in using digital tools is equally as important as training service users, not just in practical terms but also by way of increasing clinician confidence and familiarity with digital technologies. Organizational support with a clear plan for implementing technological innovations is required, with targets in the implementation plan that are assessed and measured. Implementing of digital systems needs to be simple and uncomplicated and improve clinical workflows rather than hinder and increase clinical workflows.
Recommendations when considering impact of digital tools on Service users	Although ownership rates of mobile phones in psychosis are comparable to the general population (43), for those who do not have access to smartphones, services might consider loaning phones to negate the digital divide. Digital products need to be made available in multiple languages as well as in different mediums (e.g., audio and video) to not further facilitate social exclusion in an already-marginalized group. Digital systems should use schedule and prompts to engage services users with the products and consider using social media platforms to facilitate connection and communication with others. Emphasize to services/staff the positive aspects of digital systems (e.g., increased access to support; improved social inclusivity; more ecologically valid reporting of symptoms/distress; reduced stigma; digital technology is often more user-friendly for “digital natives” and the preferred method of communication for this group).
Data security, safety, and risk	Digital systems need to adhere to strict data management procedures, ensuring that systems are secure and safe. Services need to describe in clear and simple terms how digital data will be stored and who will have access to these data. A clear procedure for managing risk, especially in the context of real-time data workflow streams, is needed. At a minimum, simple features like emergency contacts built into digital systems may help both staff and service users feel supported when clinicians are not able to respond to immediate signs of risk.
Impact of digital systems on relationships	Blended approaches to implementing digital systems into services may be more acceptable to clinicians than stand-alone digital products.

could engage harder-to-reach groups of people who struggle to access traditional services.

In line with our findings, we provide a list of practical recommendations in **Table 3** for services and organizations to consider when implementing digital systems within routine mental health service delivery. However, there are some recommendations we wish to highlight here as particularly important. Firstly, our data suggest that staff fears around the role of technology in service delivery need to be openly discussed when teams are considering incorporating digital tools in services. That is, normalizing concerns, problem-solving solutions/safeguards, and providing evidence to alleviate concerns in a supportive, nonconfrontational manner are important for successful implementation. Staff training in using digital tools is just as important as training service users, not just in practical terms but also by way of increasing clinician confidence and familiarity with digital technologies. Importantly, digital systems need to adhere to strict data management procedures, ensuring that systems are secure and safe. Services need to describe in clear and simple terms how digital data will be stored and who will have access to these data. In the UK at least, mental health professionals are using digital systems routinely as part of note keeping in service users’ electronic health records. Shortly, healthcare professionals in the community will be accessing these records on their mobile devices. Organizations need to support cultural and attitudinal change using digital technologies in mental healthcare if successful implementation of the government’s Paperless 2020 and Digital NHS strategies is to take effect. There is a significant amount of work needed for NHS services (and services internationally) to move and align their information technology systems into the modern digital world and to equip staff with the training required. To understand the benefits of the process and for services to feel able to adopt, implement, and deliver a digital NHS, staff need to be fully engaged in the process. A culture shift is required to embrace technology into routine service delivery in order to fully implement digital workflows and systems into policies and commissioning frameworks. In line with the recent consensus statement about appropriate standards, principles, and practices in research and evaluation of digital tools and systems (44), and as recommended by Bucci and colleagues (45), rigorous evaluation of DHIs is also another critical step for real-world integration. Findings from the current study go some way in telling us how the rollout of digital tools will affect clinical practice in specialist mental services in the public health service model of healthcare.

DATA AVAILABILITY STATEMENT

The datasets for this manuscript are not publicly available because consent is not obtained. Requests to access the datasets should be directed to sandra.bucci@manchester.ac.uk.

ETHICS STATEMENT

This study was carried out in accordance with ethical approval from the National Research Ethics Committee West Midlands—South Birmingham (14/WM/0118) and with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. This study was carried out in accordance with ethical approval from the National Research Ethics Committee West Midlands—South Birmingham (14/WM/0118). The study was prospectively registered (ISRCTN34966555) and received.

AUTHOR CONTRIBUTIONS

SB conceived of the study and led on study design, analysis, and writing the manuscript. DE contributed to study design, oversaw data analysis and development of the framework, and approved the final manuscript. RM and NB contributed to data analysis and interpretation of results and approved the final manuscript. KB and GH independently reviewed study themes, contributed to study design and interpretation of results, and approved the final manuscript. SL contributed to editing the manuscript and approved the final version.

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Conflict of Interest Statement: SB and SL are directors of a not-for-profit community interest company spun out of the University of Manchester designed to make digital health apps commercially available in the UK National Health Service. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer JF declared a past coauthorship with one of the authors SB and SL.

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Internet- and App-Based Stress Intervention for Distance-Learning Students With Depressive Symptoms: Protocol of a Randomized Controlled Trial

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Background: Mental disorders are highly prevalent among university students. Distance-learning students are particularly burdened and have limited access to conventional university health services. Interventions for stress are sought after in distance learners and may help increase treatment coverage. Internet-based interventions have been shown to be effective in preventing and treating depression, but it remains unclear if interventions directed at academic stress also have this potential.

Aim: The trial presented here investigates the effectiveness of an Internet- and App-based stress intervention in distance-learning students with elevated levels of depression.

Methods: A sample of $N = 200$ students of a large German distance university with elevated levels of depression [Center for Epidemiological Studies' Depression Scale (CES-D) ≥ 16] will be randomly assigned to either an Internet- and App-based stress management intervention group (IG) or a control group (CG) receiving an Internet-based psychoeducational program for academic stress. The IG consists of eight Internet-based sessions promoting stress management skills using cognitive–behavioral and problem-solving techniques. A mobile App will be employed to facilitate training transfer. Self-report data will be assessed at baseline (T0), post-treatment (T1; 7 weeks), and 3-month follow-up (T2). Potential moderators will be assessed at baseline. The primary outcome is depression (CES-D) post-treatment. Secondary outcomes include mental health outcomes, modifiable risk and protective factors, and academic outcomes. Data will be analyzed on an intention-to-treat principle along with sensitivity analyses to assess the robustness of findings. Additional health economic analyses will be conducted.

Abbreviations: CG, control group; CONSORT, Consolidated Standards of Reporting Trials; IG, intervention group; ITT, intention to treat; RCI, Reliable Change Index; RCT, randomized controlled trial; SPIRIT, Standard Protocol Items: Recommendations for Intervention Trials; T0, baseline; T1, post-assessment (7 weeks after randomization); T2, 3-month follow-up (3 months after randomization).

Discussion: Results will provide the basis to assess the acceptance and effectiveness of Internet-delivered stress interventions in distance-learning students with symptoms of depression.

Ethics and dissemination: The study has been reviewed and approved by the University of Erlangen-Nuremberg ethics committee (Erlangen, Germany; 33_17 Bc). Results of the study will be disseminated through peer-reviewed publications.

Trial Registration: German Clinical Trial Registration (DRKS), identifier DRKS00011800

Keywords: distance-learning students, randomized controlled trial, stress management, depression, telemedicine, Internet, mobile app

BACKGROUND

Previous research documents that mental disorders are highly prevalent in tertiary education students (1–4). Depressive disorders are particularly common, with 12-month prevalence estimates ranging from 4.5% to 18.5% (1, 2, 4). Mental illness in the college years is associated with a broad range of adverse personal and societal outcomes, including lower academic performance (5–7) and college retention (8, 9), as well as worse physical health (10), and role functioning (11,12) in later adulthood. Suicidality is strongly associated with mental health disorders (13) and highly prevalent among university students (14–16), making it the second largest cause of mortality in this population (17).

Compared to the general university student population, distance learners may be particularly at risk for suffering from a mental disorder. Distance-learning services are frequently used by individuals over 30, by employees attaining qualifications in addition to holding a job, or by parents (18, 19). This may result in a more complicated educational environment for affected individuals (19, 20). Results from a survey among 5,721 German distance learners indicate that this population, compared to on-site students, faces great strain due to having to meet the demands of multiple societal roles (20). Resulting mental health problems have been associated with worse academic attainment in distance learners (21).

There is evidence that the large majority of students suffering from mental disorders do not receive any treatment for their mental health problems (1). Attitudinal factors such as personal stigma (22) or preference to deal with poor mental health on one's own (23) have been discussed as major barriers in help-seeking.

Internet-based interventions have gained increasing attention as an instrument to foster health care utilization in adults (24). In recent years, the potential of Internet-based interventions to address mental health issues among tertiary education students has also become increasingly evident (25, 26). Contents can be easily accessed through the Internet, and Internet-delivered programs provide high scalability (27–29). Implementing Internet-based interventions in distance-learning university settings could represent a particularly promising approach, as distance-learning students commonly do not have direct access to on-site student counseling services.

Inclination to use Internet-based services has been found to be greatest among students reporting high levels of perceived stress (30, 31). In a survey among distance-learning students, interventions for relaxation and stress management were the most sought after, with 66.9% and 54.8% indicating interest in participation (20). Previous research suggests that Internet-based interventions for stress are often used by students with clinically relevant levels of depression who did not seek help through traditional healthcare channels (32). Disseminating Internet-based stress interventions could therefore be a non-stigmatizing way to increase treatment coverage among students suffering from depressive symptoms.

It is well established that perceived stress is a common contributor to the development of depression (33) and negatively affects its clinical course (34, 35). Internet-based stress interventions not only have been shown to be effective in reducing perceived stress (27) but also have been found to show moderate to high effects on depressive symptoms [Cohen's d = 0.52–0.95 (32, 36–38)] even in participants with clinically relevant levels of depression at baseline [d = 0.67–1.19 (32, 39)]. These effects are comparable to the efficacy of conventional types of psychotherapy for depression [d = 0.62–0.92 (40)]. Together, this suggests that Internet-based stress interventions could be an effective way to reduce depression. Internet-based interventions for depressive symptoms have proven their effectiveness in preventing (41, 42) and treating (43) depression. However, no prospective trial has yet examined if Internet-based interventions for academic stress also have this potential in students with elevated levels of depression. It is also largely unknown if such interventions can have an impact on students' academic productivity and work impairment. In general, it is still unclear which characteristics explain the heterogeneity of effects in the prevention and treatment of depression (44, 45). A broad assessment of variables predictive of differential intervention outcomes, risk and protective factors associated with the onset and maintenance of depression, as well as theoretically derived variables within intervention studies has therefore been proposed to increase our understanding of effect modifiers underlying interventions for depression [(44, 46); for an overview of potential effect modifiers in the prevention and treatment of depression, see Refs. (46, 47)].

The goal of the present study is therefore to i) evaluate the effects of an Internet- and App-based stress intervention in distance-learning students with heightened levels of depression on mental health outcomes, modifiable risk and protective factors for mental health disorders, and functioning outcomes when compared to an active control group (CG) receiving an Internet-based psychoeducation program on stress management; ii) to investigate the moderators of potential treatment effects; iii) to assess the help-seeking intentions of study participants; and iv) to assess the interventions' health economic benefits when implemented into routine care. We hypothesize the Internet- and App-based intervention group (IG) to be more efficacious when compared to the active CG receiving the psychoeducation program.

METHODS

Study Design

We will conduct a two-armed randomized controlled trial (RCT) comprising two conditions: the IG, receiving an Internet-based intervention with feedback on demand (*StudiCare Fernstudierende*), and a waitlist CG receiving psychoeducation during the study phase, and access to *StudiCare Fernstudierende* after the study. Both study conditions will have full access to treatment as usual (TAU; including general practitioner visits, counseling services, psychotherapeutic and psychiatric treatment or other forms of primary, secondary, or tertiary care). The trial will be conducted and reported in accordance to the Consolidated Standards for Reporting Trials (CONSORT) Statement (48) and the Guidelines for Executing and Reporting Research on Internet Interventions (49). We aim to communicate results of this study through peer-reviewed publications in psychiatric or eHealth journals. In addition, code scripts for all statistical analyses will be made publicly available on an Open Science Framework repository (OSF; www.osf.io).

Assessments will take place at baseline (T0), post-treatment (T1; 7 weeks after randomization), and 3-month follow-up (T2; see **Figure 1** for a detailed overview of assessment points). Self-report data are collected using a secure online-based assessment system (Advanced Encryption Standard, 256-bit encryption). All procedures involved in the study are consistent with the generally accepted standards of ethical practice. The study was approved by the University of Erlangen-Nuremberg ethics committee (Erlangen, Germany; 33_17 Bc). The trial is registered in the German clinical trials register (DRKS00011800). The trial proceedings presented here are reported in accordance to the Standard Protocol Items: Recommendations for Intervention Trials (SPIRIT) statement (50). The populated SPIRIT checklist can be found in **Table S1** in the **Supplementary Material**. The SPIRIT figure is presented in **Figure S1** in the **Supplementary Material**.

Participants

Students will be included if they i) experience elevated levels of depression measured by a score of ≥16 on the German version of the Center for Epidemiological Studies' Depression Scale (CES-D) 20-item version [ADS (51), indicating subthreshold to full-blown symptoms of depression during the last 2 weeks], are enrolled in a ii) bachelor's or iii) master's degree program at a large German distance-learning tertiary education facility (*FernUniversität in Hagen*) by the beginning of the intervention, iv) are at least 18 years old, v) have Internet access, vi) declare willingness to provide self-report data at all three assessment points, and vii) give informed consent. Exclusion criteria will be i) self-reported dissociative symptoms or psychosis, currently or in the past, or ii) a considerable risk for suicide as indicated by a score higher than 1 on item 9 of the German version of the Beck Depression Inventory [BDI-II (52); "I feel I would be better off dead" or "I would kill myself if I had the chance"]. Students will not receive monetary compensation for participating in the intervention.

Recruitment

Participants will be recruited in German-speaking countries (Germany, Austria, Switzerland) *via* social media advertisement, university press reports, and information letters distributed through the distance-learning universities' mailing list. Potential participants will be able to declare interest for partaking in the study by filling out an online registration form on a website created for the intervention that also contains further information about the intervention and eligibility criteria.

Assessment of Eligibility and Randomization

Individuals who declare their interest in participating in the study will receive an online letter with detailed information about the study procedure and will be asked to provide an e-mail address as well as a first and last name (which may be pseudonyms) for their intervention platform profile. Applicants will be informed that withdrawal from the study is possible at any time without negative consequences and that all collected case data can be deleted on request during the study. Participants will then be asked to fill out the online screening questionnaire.

Individuals fulfilling all inclusion and none of the exclusion criteria will be asked to fill out an informed consent form. Individuals who provide us with their informed consent will be invited to fill out the baseline assessment, which will take approximately 30 min to complete. Subsequently, individuals will be randomly allocated to either the IG or the CG. Randomization will take place at a ratio of 1:1 and a block size of 2 using an automated computer-based random integer generator (*Randlist*, Datinf GmbH, Tübingen, Germany) and will be performed by a researcher who is not involved in the study. Participants will not be blinded to study conditions, yet during the randomization process, the allocation will be concealed from participants, researchers involved in recruitment, and e-coaches.

Participant Safety

A standardized operating procedure will be followed in case individuals are defined as showing an elevated risk for suicide. During the screening process, individuals will be excluded from the study and given detailed information about emergency contact

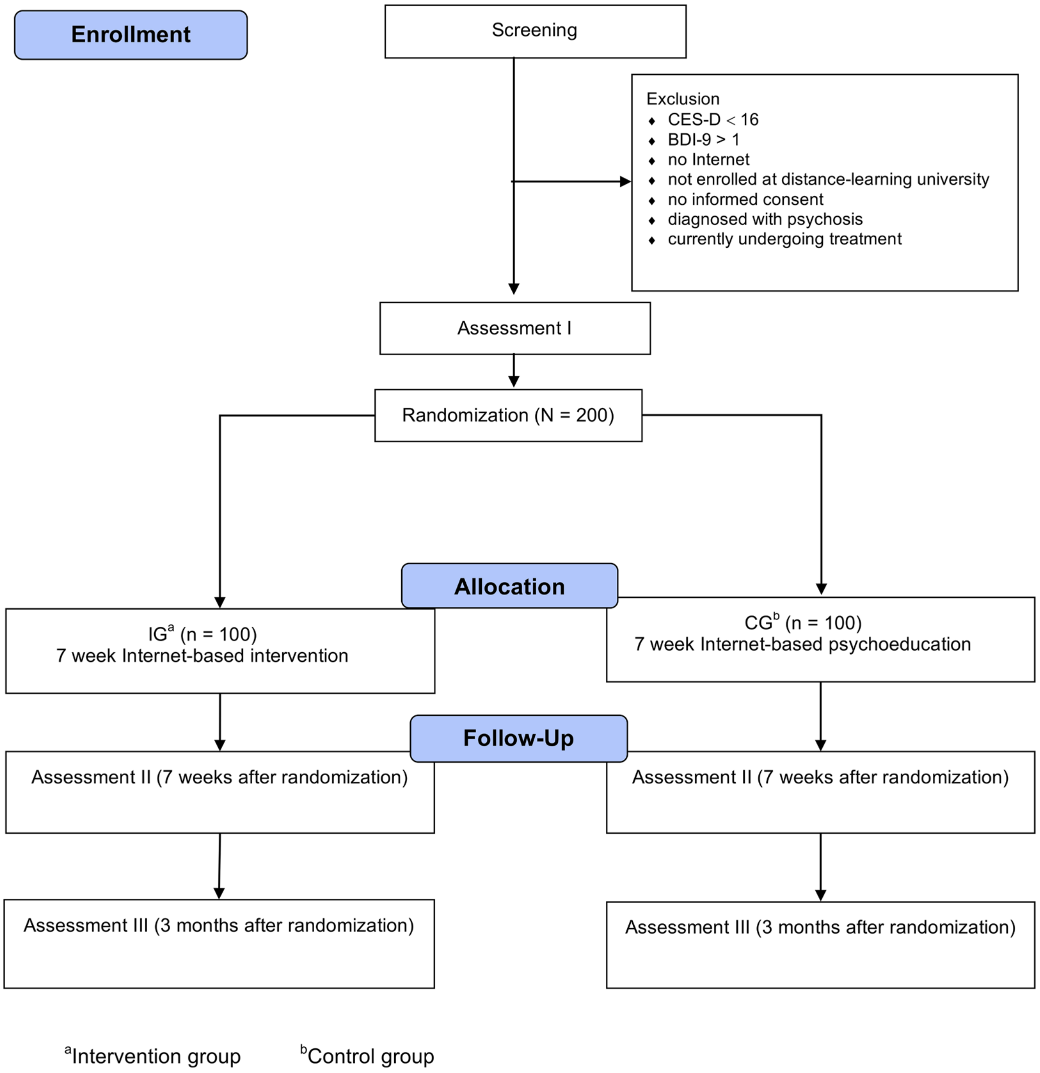

FIGURE 1 | Study flow.

numbers and treatment options for depression based on the German S3-guidelines for unipolar depression (53). Individuals will also be asked to see their physician or a psychiatrist as soon as possible to initiate psychiatric or psychotherapeutic treatment. The same procedure will be followed if participants who were included in the trial show symptoms of suicidality throughout the study phase (i.e., by mentioning symptoms of suicidality when contacting their designated eCoach, or when responses to intervention content hint at potential suicidal ideation). These participants will be contacted additionally to determine the severity of suicidal symptoms and discuss next treatment steps. This process will be supervised by an experienced clinician at the first author's host institution.

Sample Size

We aim to include $N = 200$ participants, allowing for a between-trial arm group comparison against a statistically relevant effect size threshold of $d = 0.40$, a power $(1 - \beta)$ of 80%, and an alpha of 0.05 (two-tailed) for the intention-to-treat (ITT) analysis (54). A recent meta-analytic review for Internet-based stress interventions reported effect sizes of $d = 0.64$ for perceived stress in guided interventions but considerably smaller effect sizes for unguided programs ($d = 0.34$ for depression, $d = 0.32$ for anxiety) (27). Results for Internet-based interventions addressing psychological distress in tertiary education are mixed, ranging from non-significant findings to moderate-sized effects in favor of the respective intervention (55–59). Thus, we aim for an effect size of $d = 0.40$.

Intervention Platform

The technology platform used to deliver the intervention in the IG as well as the psychoeducational material in the CG is provided by Minddistrict. This company is responsible for the provision and maintenance of the platform. Its content management system is used to upload interventions, add participant and eCoach profiles, and fill out questionnaires. The platform conforms to all required quality standards and operates according to the ISO 27000 and NEN 7510 norms. All data are securely stored on ISO 27000 certified servers and transmitted using HTTPS with SSL certificates (AES-256 and SHA-1, 2048-bit RSA). Unauthorized access to the platform is not possible.

Intervention

This trial will evaluate the *StudiCare Fernstudierende* intervention. It was adapted from *StudiCare Stress* (32), an Internet- and App-based intervention for college students. A detailed description of this pilot program can be found elsewhere (32, 60). Together with the preceding pilot intervention, the program is based on *Get.On Stress*, an Internet-based stress intervention for employees (36, 37), which was adapted to a university student context.

In terms of therapeutic content, *StudiCare Fernstudierende* only marginally deviates from *StudiCare Stress*. To tailor the intervention to distance-learning students' needs, one new student testimonial is introduced and will lead participants through the intervention. The testimonial represents an elder student with children. The testimonial was created to address the specific problems of non-traditional distant-learning students, such as limited time for studying, having to take care of children, or facing financial pressure.

Conceptually, the Internet intervention aligns with Lazarus' transactional model of stress (61). It adheres to a two-component structure, incorporating problem- and emotion-focused coping through emotion regulation strategies. In problem-focused coping, cognitive behavioral strategies are applied to solve personal problems and to reduce and eliminate stressors (62). Emotion regulation refers to processes through which individuals monitor, evaluate, and modify emotions to reach relevant goals (63).

There are various stressors in university students' lives that might be potentially solvable by applying problem-solving strategies. Problem-solving heuristics have been shown to be a practical method for addressing stressors and have been proven to be effective in improving mental health outcomes (64, 65).

To tackle situations in which problem-focused strategies are inapplicable, emotion regulation techniques may be employed to control negative emotions associated with unsolvable problems. Current findings indicate that deficits in the ability to detect and regulate negative emotion may contribute to the wellbeing of individuals, as well as the development and trajectory of mental disorders (66–69). Emotion regulation strategies have shown to be an adequate therapeutic instrument in alleviating various symptoms of mental illness (70–72).

The intervention contains seven modules, each of which can be completed in one session (see **Table 1**). Completing one session is estimated to take about 30–90 min, and participants will be advised to work on one or maximum two modules per week. The intervention is therefore intended to last about 5–7 weeks. After modules 2–7, participants will be offered optional add-on mini-modules. These mini-modules cover information and exercises on student-specific topics of interest: social support, rumination and worrying, time management, procrastination, test anxiety, sleep, motivation, nutrition and exercise, dealing with writer's block, and concentration. An additional booster session allowing participants to recap and rehearse previously learned strategies will be offered 2 weeks after completion of the main modules. Therapeutic content is presented as an illustrative story of a backpacking trip around the world, with each module representing a new continent.

Some technical features were added to strengthen the transfer of intervention content into participants' everyday life. Homework assignments are given after every module to practice techniques presented during the session. To keep track of mood

TABLE 1 | Modules of the intervention (StudiCare Fernstudierende).

Session	Name	Content	
1	Introduction	Psychoeducation, information about stress and preview of subsequent sessions	
2	Problem-solving	Stress management strategies, systematic problem-solving using a 6-step problem solving heuristic	
3	Muscle and breath relaxation	Information on basic principles of muscle and breath relaxation, audio exercises for daily usage	
4	Mindfulness	Coping with self-criticism, mindfulness exercises	
5	Acceptance and tolerance	Dealing with unsolvable problems, psychoeducation on and exercises for acceptance and tolerance of unpleasant emotions	
6	Self-compassion	Self-criticism in precarious situations, defusion of self-worth and performance, exercises for positive self-support, overcoming dysfunctional perfectionistic thought-action patterns	
7	My master plan	Recognizing physiological warning signs, creating a plan for the future	
8	Booster session	Further information on self-help and psychotherapy, evaluation of training transfer, recap of all sessions, repetition of previous exercises	
2–7	*Elective mini-modules*	*Social support*	communication styles, receiving and providing support
		Rumination and worrying	reflection on positive and negative aspects of worry, coping with uncertainty
		Time management	effective time scheduling, common planning fallacies, learning to prioritize
		Procrastination	identifying situations in which procrastination occurs, strategies to reduce procrastination
		Test anxiety	effective studying techniques, using paradoxical intentions, de-catastrophizing blackouts
		Sleep	sleep restriction
		Motivation	finding reasons for lacking motivation, exercising delay of gratification
		Nutrition and exercise	creating an individual eating and exercise schedule, dealing with relapses
		Dealing with writer's block	reasons and mechanisms for writer's block
		Concentration	audio-based concentration exercises

fluctuations and describe experiences in transferring acquired knowledge, a personal diary App is introduced in the first lection and can be downloaded afterward. After every module, audio files and module summaries can be accessed, containing exercises to be worked on until the next session.

Psychoeducation

Participants in the active CG will receive psychoeducational information about cognitive, emotional and physical determinants, symptoms, and outcomes of psychosocial stress in general and with respect to distance-learning students. The psychoeducation lessons are delivered through the same platform as the intervention in the IG. In contrast to the intervention, the psychoeducation lessons are largely text-based and do not contain any interactive components. In line with the weekly intervals of the IG, the psychoeducation consists of seven main sessions and one booster session, and is designed to be completed within 5–7 weeks. An overview of the psychoeducation material provided in each module is presented in **Table 2**.

Guidance

In order to support participants in adhering to the intervention while minimizing human capital costs, we will apply an adherence-focused guidance concept with personalized feedback on demand [for a detailed description of an application, see Refs. (38, 73, 74)]. The supportive accountability model suggests that the adherence and effectiveness of Internet-based interventions are enhanced by providing a minimum of human support by a professional seen as benevolent and competent by participants (75, 76). The guidance concept for this study was developed in line with these core elements.

Guidance for the IG will be performed by a specially trained student in a master's program in psychology and consists of three parts: i) monitoring adherence to the intervention, ii) sending standardized motivational messages after every module, and iii) providing feedback on demand. Adherence monitoring involves personal reminders for participants who had not completed a session in the designated timeframe (7 days). Standardized motivational messages tailored to each session will be sent when participants completed one of the main modules, summarizing the content of the previous module and motivating trainees to stay engaged. Feedback on demand will be provided through the internal messaging system of the training platform, which participants may use whenever individualized content feedback is needed. Participants will then receive feedback within 48 h. If requested, participants in the IG will be able to receive automatic messages containing short, motivational prompts *via* SMS.

Participants in the active CG will receive parts (i) and (ii), but will not receive feedback on demand.

Primary Outcome

The primary outcome is symptoms of depression as measured by the German version of the CES-D 20-item version [ADS (51); 20 items; range 0–60] at post-treatment (T1). Participants will be asked to indicate the frequency of depression-specific symptoms for a retrospective timeframe of 2 weeks on a four-point Likert scale [0 = *rarely or none of the time present* (less than 1 day), 3 = *most of the time present* (5–14 days); e.g., "During the past two weeks I had trouble keeping my mind on what I was doing."]. Higher scores indicate greater depression severity. The CES-D shows high correlations up to r = 0.90 with other measures such as the Hamilton Depression Scale or the Beck Depression Inventory, and has a high retest reliability of r_{tt} = 0.81, indicating the high internal validity of this instrument (51).

Secondary Outcomes

The number of items and range of below-mentioned instruments is reported in parentheses. Unless otherwise specified, all outcomes will be measured for a retrospective timeframe of 2 weeks. For a comprehensive overview of all variables, see **Table 3**.

Mental health. Further outcomes on mental health include perceived stress as measured by the Perceived Stress Scale 10-item version [PSS-10 (77); 10 items, range 0–40], state anxiety [short form of the Spielberger State-Trait Anxiety Inventory, STAI-6 (78, 79); 6 items, range 6–24; *at the moment*], behavioral activation, rumination and functional impairment as measured by the Behavioral Activation for Depression Scale [BADS (80); 25 items; range 0–150], and worrying [Academic Worrying Questionnaire; AWQ (81); 10 items; range 0–40]. Emotional exhaustion will be assessed using the emotional exhaustion subscale of the Maslach Burnout Inventory student version [MBI-S (82); five items, range 5–30].

Academic outcomes. To evaluate presenteeism and loss of productivity, the Presenteeism Scale for Students' [PSS (83)]

TABLE 2 | Psychoeducation modules in the control group.

Session	Name	Content
1	Introduction	Prevalence and types of stress; biological response to stress; effects of stress on emotions, thought, somatic symptoms
2	Causes of stress	Common stressors among students; Lazarus' transactional model of stress
3	Does stress have the same effect on all individuals?	Short and long-term consequences of stress; inter-individual differences in stress response
4	What effect does stress have on the body?	Physiological response to stressors; evolutionary background of stress reactions; stress and performance
5	Cognitive appraisal	Common dysfunctional thoughts contributing to perceived stress; 5 steps for cognitive reappraisal
6	Coping and resources	Typical resources and coping mechanisms for stress
7	Health	Definition of health and sense of coherence
8	Booster session	Recap of previous material

TABLE 3 | Overview of instruments and assessment points.

Variable	Instrument	T0	T1	T2	Putative moderator
Screening					
Depression	CES-D	X	–	–	–
Suicidal ideation	BDI-II (Item 9)	X	–	–	–
Demographic data	–	X	–	–	–
Self-reported history of psychosis/dissociative symptoms	–	X	–	–	–
Primary outcome					
Depression	CES-D	X	X	X	–
Secondary outcomes					
Mental health					
Perceived stress	PSS-10	X	X	X	–
Anxiety	STAI-6	X	X	X	–
Worrying	AWQ	X	X	X	–
Emotional exhaustion	MBI-S	X	X	X	–
Behavioral activation, rumination	BADS	X	X	X	–
Academic outcomes					
Work impairment, productivity	PSS	X	X	X	–
College self-efficacy	CSEI	X	X	X	X
Risk and protective factors					
Emotion regulation skills	SEK-27	X	X	X	X
Resilience	CD-RISC	X	X	X	–
Self-compassion	SCS	X	X	X	–
Locus of control	IE-4	X	–	–	X
Self-esteem	RSES	X	X	X	–
Beliefs about stress	BASS	X	X	X	X
Health economic measures					
Indirect costs	TiC-P	X	X	X	–
Health literacy and help-seeking behavior					
Help-seeking intentions	GHSQ	X	–	–	–
Internet therapy experience	–	X	–	–	–
E-Health literacy	eHEALS	X	–	–	–
Reasons for participation	–	X	–	–	–
Additional measures					
Client satisfaction	CSQ-8	–	X	–	–
Intervention credibility and expectations	CEQ	X	–	–	–
Sociodemographic characteristics	–	X	–	–	X
Personality traits	BFI-10	X	–	–	X

subscale for work impairment (Work Impairment Scale; WIS; 10 items; range 10–50) will be administered. The WIS is based on the Stanford Presenteeism Scale [SPS-6 (84, 85)] and allows to assess work-related outcomes in non-occupational samples (86, 87). Productivity losses will be assessed by an adaption of the PSS' work output scale (WOS) investigating the percentage to which participants are able to reach their usual academic productivity. Productivity will be rated on a visual analog scale ranging from 0% = *completely unproductive* to 100% = *full productivity*. College self-efficacy will be assessed by the College Self-Efficacy Inventory [CSEI (88); 13 items; range 13–65].

Modifiable risk and protective factors. Risk and protective factors for mental illness include resilience as measured by the Connor-Davidson Resilience Scale short form [CD-RISC (89); 2 items; range 0–8], emotion regulation competencies [German version of the Assessment of Emotion Regulation Skills; SEK-27; State Version (90); 27 items; range 27–108], self-compassion [Self-Compassion Scale; SCS-D (91); 12 items; range 12–60], self-esteem as measured by the Rosenberg Self-Esteem Scale [RSES (92); 10 items; range 10–40], and locus of control as measured by the Short Scale for the Assessment of Locus of Control [IE-4 (93)]. The IE-4 consists of two subscales for internal and external locus of control, each consisting of two items (range 2–10). Personal beliefs about the controllability and the harmful and positive nature of stress will be assessed using the Beliefs about Stress Scales' [BASS (94)] subscales for positive (four items; range 4–16), negative (eight items; range 8–32), and controllability beliefs (three items; range 3–12).

Health economic measures. Indirect costs due to presenteeism and absenteeism will be assessed using the productivity loss subscale of the Trimbos/iMTA questionnaire for costs associated with psychiatric illness [TiC-P (95)], which was adapted to the context of distant-learning students in tertiary education. With this questionnaire, participants register approximations of their working hours at university, household work, and monthly salaries when holding a job besides their studies. Indirect costs, such as the number of "work loss" days (absenteeism from work) or the number of "work cut-back" days (reduced productivity at work), can be assessed.

Health literacy and help-seeking intentions. To assess the help-seeking preferences of participants, the General Help-Seeking Questionnaire for personal–emotional problems

[GHSQ-Per-Emot (96); seven items; range 7–77] will be administered at baseline. E-Health literacy will be assessed at baseline using the German E-Health Literacy Scale [eHEALS (97); eight items; range 8–40]. Online counseling experiences and awareness will be assessed by two items extracted from the SOEP-IS module "Internet-based psychotherapy" (98) ("have you ever utilized psychosocial or psychotherapeutic online counselling before?"; "have you ever heard of or read about Internet(-based) psychotherapies?"; yes/no). A self-constructed questionnaire will be used to assess the reasons for participating in the intervention, following the help-seeking behavior model by Rickwood, Thomas & Bradford (99).

Additional measures. Additional questionnaires will assess demographic variables and client satisfaction with the intervention [German version of the Client Satisfaction Questionnaire, adapted to the online context; CSQ-8; (100, 101); eight items]. Personality traits will be assessed at baseline using the 10-item Big Five Inventory [BFI-10 (102); 10 items; range 2–10 per dimension]. Treatment credibility and expectancies will be measured at baseline by administering the Credibility and Expectancy Questionnaire [CEQ (103); six items]; results for each subscale incorporated in this questionnaire will be transformed into a 100-point overall score for each participant. Participants in the IG will have the opportunity to suggest intervention improvements after every session and give feedback on each modules' usefulness (0 = *not useful at all*, 4 = *very useful*), complexity (0 = *very complex*, 4 = *very easy*), and duration until termination (0 = *less than ½ hour*, 4 = *more than 1½ hours*) on a five-point Likert scale.

Moderator variables. Following variables mentioned above will be analyzed in explorative analysis of putative moderators: i) emotion regulation skills as measured by the SEK-27, ii) personality traits as assessed by the BFI-10, iii) locus of control as measured by the IE-4, iv) academic self-efficacy (CSEI), v) beliefs about stress (BASS), and vi) demographic variables. These variables were selected based on a hypothesis-generating approach, using a broad variety of possible moderators at baseline in order to detect putative moderators for sufficiently powered future studies (104).

Statistical Analyses

Clinical evaluation. Analyses based on the ITT principle will be conducted, with missing data imputed using a Markov chain Monte Carlo multivariate imputation algorithm with 100 estimations per missing.

The hypothesized superiority of the Internet-based stress intervention will be tested with regard to i) change in participants' scores of depression and secondary outcomes from baseline (T0) to post-intervention (T1) and 3-month follow-up (T2), ii) the amount of participants with treatment response, iii) the amount of participants who experienced symptom deterioration throughout the trial, and iv) the number of individuals who achieved clinically relevant amelioration of symptoms in the IG compared to the CG.

Differences in the change of symptoms between study arms will be assessed using univariate analysis of covariance with scores at baseline used as covariate. Changes in within-group scores between baseline, T2, and T3 will be explored. Effect sizes (Cohen's d) will be calculated based on the imputed data set for between- and within-group changes with 95% CIs (105). To mitigate the risk of type I error inflation due to multiple testing, p-values will be adjusted using Holm's method (106).

To ascertain the number of participants attaining a reliable improvement in depressive symptomatology, participants will be coded as responders or non-responders according to the widely used *Reliable Change Index* [RCI (107, 108)]. To assess the clinically relevant impact on depression for the IG compared to control, we will calculate and compare the number of participants who achieved a reduction of >50% in depressive symptoms compared to baseline at both T1 and T2.

Negative effects of the intervention will be evaluated by the number of participants with reliable deterioration concerning depression scores through the RCI.

Moderators of treatment effects. To assess the effect of putative moderators on changes in outcomes (i.e., T0 − T1), an ordinary least squares (OLS) regression-based framework for estimating interactions in moderation models will be used, along with simple slopes for probing interactions. In order to test the robustness of our findings and to examine differences between imputed data and complete cases, separate sensitivity analyses (109, 110) will be conducted. Moreover, to assess relevant subgroup effects, follow-up simple slope analyses for possible significant interaction effects will be conducted. The slope and significance of the intervention main effect will be evaluated for conditional values (one standard deviation below and one standard deviation above the mean) of the moderator (111). For more precise information on conditional effects of the moderators, the Johnson–Neyman technique will be applied (112).

Cost–benefit evaluation. According with common practice, a probabilistic approach will be used to make health-economic inferences (113). The total benefit of the intervention will be derived by subtracting productivity loss costs assessed by the TiC-P of the CG from the ones of the IG. The cost–benefit relationship will be reported by calculating the three most frequently used metrics: i) the net benefits (NB), the net monetary gain of the intervention; ii) the benefit–cost ratio (BCR), the money saved for one monetary unit invested; and iii) the return-on-investment (ROI), indicating the percentage of profit with every monetary unit invested. Bootstrapped 0.95% CIs with 2,500 replications will be estimated around these metrics.

Sensitivity analyses will be conducted to assess the robustness of the findings and to account for uncertainty regarding the actual prize of implementing the intervention into health care. Further health economic analyses will be conducted if feasible.

Help-seeking behavior analysis. To make assertions on the help-seeking intentions and behaviors of participants, baseline data of all participants from the GHSQ-Per-Emot (96), eHEALS (97), "awareness of online counseling," and "reasons for participation" questionnaires will be analyzed using descriptive statistics.

Process evaluation. Descriptive statistics will be used for process evaluation. To assess overall user satisfaction across various domains, CSQ-8 item data will be examined. Acceptance of intervention modules will be analyzed using the module feedback of the IG. Adherence will be assessed by analyzing intervention completion rates tracked within the intervention platform.

DISCUSSION

This protocol describes the rationale and design of a two-armed RCT evaluating the effectiveness, moderators, and health economic outcomes of an Internet- and App-based stress intervention for distance-learning students. We hypothesize the intervention to be more effective in reducing symptoms of depression and improving other mental health-related outcomes when compared to a CG receiving Internet-based psychoeducation.

The relevance of early intervention in mental health promotion and prevention has become increasingly evident in recent years (42, 114). Easily accessible and acceptable instruments are urgently needed when facing discouragingly low utilization rates found for conventional health promotion approaches directed at the general public (115). This trial will contribute to the ongoing investigation into the potential of Internet-based interventions to reach out to individuals who would not otherwise seek treatment due to psychological barriers. Furthermore, this study will explore moderators of intervention effects and assess the intervention's health economic potential when implemented into routine care. Help-seeking behavior will be assessed to attain more knowledge on the causes and motivation of distance-learning students when seeking help *via* the Internet.

This trial will employ a cutoff for elevated symptoms of depression, although not restricting eligibility to individuals showing symptoms of full-blown depression only. Although in its content, the intervention at hand focuses on academic stress, we did not decide for a cutoff for perceived stress, as this trial is aimed at evaluating the intervention's effectiveness as an intervention instrument in individuals with an indicated risk for depression and in individuals potentially suffering from major depression. Perceived stress has been associated with the development (33) and worse trajectories (34, 35) of clinical depression. The potential of Internet-based stress interventions as an early intervention and treatment instrument in depressive target groups, however, has not yet been evaluated. Mental health stigma, a known barrier to treatment utilization, has been shown to be greatest among highly distressed individuals with low depression literacy (116). If the intervention evaluated in this trial is found to be effective, Internet-based stress interventions could be investigated as a potential mean to address depression in individuals for whom a conventional mental health disorder treatment would not be an option.

We will compare the effects of the intervention to an Internet-based psychoeducation program of similar length. Meta-analytic evidence suggests that Internet-based interventions for college students show moderate to large effect sizes when compared to a waiting CG. This superiority, however, could not be ascertained when compared to active CGs (117). Treatment expectancies have been discussed as an artifact in clinical evaluation studies utilizing waitlist CGs. Participants waiting for treatment may be less motivated to initiate health-related behavior changes (118–120), which could over-accentuate effects attributed to an intervention (120, 121). Findings in this trial will provide the opportunity to investigate the effects of an Internet-based intervention employing evidence-based cognitive–behavioral techniques compared to a CG in which participants are also actively engaged.

Findings of this trial will have some limitations. First, an open recruitment strategy is employed, in which potential participants are actively recruited from the student population. Therefore, we cannot rule out selection bias, with more motivated individuals attaining access to the study. Second, due to feasibility reasons, this trial is somewhat underpowered to reliably detect significant treatment moderators. This might impede finding statistically significant factors contributing to this interventions' effectiveness that would have been detected in a larger study sample (122, 123). Same applies to health-economic inferences, for which a probabilistic approach will be applied in this study. Third, due to logistic reasons, this trial will only use self-administered questionnaires and will not assess diagnostic status or physiological measures.

There is a growing number of studies investigating the efficacy of Internet-based interventions in reducing various symptoms of mental illness (124, 125). Much less is known, however, on the potential of such interventions in distance-learning student samples, and their impact on academic functioning, for which this study will provide tangible empirical results. Results will also provide the opportunity to investigate the practicability of Internet-based stress interventions as an approach to address mental health issues in individuals with subthreshold or full-blown symptoms of depression and increase their use of health services.

Trial Status

Recruitment started in April 2017. Follow-up assessments for the last participant are expected to be completed by March 2019.

ETHICS STATEMENT

All procedures involved in the study are consistent with the generally accepted standards of ethical practice. All potential participants have to provide written informed consent to be eligible for study inclusion. The study was approved by the University of Erlangen-Nuremberg ethics committee (Erlangen, Germany; 33_17 Bc).

AUTHOR CONTRIBUTIONS

DE and JA-H initiated the study. MH, LF, MD, LK, KB, CS, A-CZ, HB, and DL made relevant contributions to the study design and procedure. MH wrote the initial draft of the manuscript. All authors read and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2019.00361/full#supplementary-material

TABLE S1 | SPIRIT Checklist.

FIGURE S1 | SPIRIT Figure.

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Smooth Sailing: A Pilot Study of an Online, School-Based, Mental Health Service for Depression and Anxiety

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Background: Schools play an important role in supporting young people's mental health, but face challenges identifying and responding to students in need of care. To assist secondary schools, the Black Dog Institute has developed an online, school-based, mental health service (Smooth Sailing). Delivered in the classroom, Smooth Sailing uses a website to screen, assess, allocate, and deliver care for depression and anxiety. The service is based on the principles of stepped care, offering treatments with varied intensity and follow-up by a school counselor when necessary. The current study aimed to evaluate the feasibility, acceptability, and safety of this new type of service among secondary school students.

Methods: Between February and June 2017, a single-arm, pre-post, pilot study was conducted among students from four NSW secondary schools. Schools were given access to the service for 6 weeks. Feasibility measures (consent rates and step allocations), acceptability measures (service use and satisfaction) and safety measures (deterioration in help-seeking intention scores and mental health symptoms) were assessed at baseline and completion of the 6-week trial period.

Results: A total of 59 students took part in the service pilot (mean age, 14.57 years; SD, 0.89 years; range, 13-16 years). At baseline, 18.64% of students were found to require follow-up from the school counselor, and 80% of these were new cases. Although completion of the online modules was low, service satisfaction was high. At 6 weeks, the mean scores for help-seeking, depression, and anxiety remained relatively stable or improved.

Conclusions: The current study presents important findings for the development and implementation of an online mental health service that screens students' mental health and allocates care accordingly, all within the school setting. Although the findings provide some support for the feasibility, acceptability, and safety, service improvements are needed. The modifications outlined are likely to improve the quality of the service and its effectiveness.

Trial Registration: Australian New Zealand Clinical Trials Registry (ANZCTR): ACTRN12617000977370

Keywords: school, student, mental health, stepped care, online, help-seeking, depression, anxiety

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INTRODUCTION

Given that half of all mental disorders emerge between the ages of 12 and 18 years (1), secondary schools play an important role in supporting the mental health of young people. Delivering mental health services in schools has the potential to address barriers to care, including accessibility, costs, and stigma (2). Many secondary schools employ counselors or psychologists to address student mental health, but up to one third report that their workload is unmanageable (3). A meta-analysis of face-to-face mental health services delivered to students found that targeted, selective, and universal programs were all effective for reducing mental health problems among students (4). Other initiatives, such as classroom-based online cognitive behavioral therapy (5–7) and curriculum-embedded mental health content (8) were also effective for improving symptoms and mental health literacy. However, wide-scale uptake is challenged by low levels of awareness of the effective mental health programs, competing priorities, time constraints, and limited resources (9). Despite the potential, schools remain underutilized, under resourced, and lack the capacity to appropriately manage students' mental health needs.

Stepped care has been proposed as a service model for the treatment of depression and anxiety (10) that may increase engagement with care, reduce symptoms, and allow for better distribution of resources (11). Stepped care is considered well suited to depression and anxiety as these disorders are highly prevalent, have varied degrees of severity, are responsive to light-touch interventions, and the shortage of trained clinicians and specialist services hinders access to face-to-face care (12). Although there is no consistent definition of stepped care, it typically involves a process of screening and assessment to determine individuals' symptoms and treatment needs (13). In some models, initial treatment is matched to the severity of symptoms whereas in others, all individuals begin at the same "step" of intervention, regardless of symptom severity. Individuals who fail to respond to their allocated treatment in the set time are then stepped up to the subsequent level of care (14). Most models do not incorporate stepping down. In accordance with clinical guidelines (15), stepped care for depression may involve several components including psychoeducation, self-directed online therapy, individual face-to-face therapy, medication, and monitoring. It has been argued that when fully realized, stepped care could maximize clinical outcomes while minimizing provider costs (13).

While the cost-effectiveness of stepped care has been supported (16–18), there is only emerging evidence of treatment effectiveness. A meta-analysis of 10 randomized trials among depressed adults found moderate treatment effects for stepped care, but limited evidence to support its use as the dominant treatment model (19). In a review of primary care trials, stepped care for depression was found to be as effective as treatment as usual (20); however, its clinical superiority was undetermined. Few formal evaluations of stepped care have been conducted among youth. When comparing standard care to stepped care for the treatment of clinical anxiety, no significant difference in symptom reduction was found (17). In contrast, young adults living with HIV who received stepped care for depression had significantly greater improvements in symptoms compared to those receiving treatment as usual (21). This is consistent with Mufson et al. (22) who found stepped care to be more effective for reducing depression among adolescents in primary care when compared to treatment-as-usual. This suggests that the superiority of stepped care may be dependent on the degree of intervention provided by the treatment comparator. As such, stepped care may be ideal for school settings where treatment as usual is minimal.

In Australia and other high-income countries, most schools operate on a wait-to-act model in which school staff instigate referral to mental health support only after observing certain behaviors or students' self-disclosures (23). As help-seeking is low among youth, and teachers are not always trained to identify those in need (24), a proactive model like stepped care which detects symptoms and stratifies care accordingly may assist schools in caring for students. Components of stepped care have already been implemented in schools with some success. School based screening has been found to identify a significantly greater proportion of students to be in need of mental health services than would have been identified without screening (25). School based screening has also resulted in increased rates of referral, improved help-seeking behavior, and greater access to services for students (26). Australian schools are well-placed to provide professional follow-up due to the availability and employment of school counselors and school psychologists. Although other components of stepped care, such as triage and brief intervention, have been tested in school settings with promising results (27), it remains unknown whether Australian schools have the capacity to integrate a stepped care model for depression and anxiety. Given the emergence of mental illness in adolescence, the low levels of help-seeking, and limited school resources, evaluating stepped care and its promise is timely.

The Smooth Sailing Service

The Black Dog Institute has developed an online, schools-based, mental health service called Smooth Sailing. Based on the principles of stepped care, Smooth Sailing uses a website to screen, assess, allocate, and deliver psychological interventions to improve help-seeking for mental health problems and reduce depressive and anxiety symptoms among secondary school youth. Brief, validated, self-report measures of depression and anxiety (28, 29) are used to accurately determine students' symptoms and required level of care. The service has three degrees of treatment intensity which are matched to students' initial symptom severity categorization (i.e. nil-mild, moderate, moderately severe to severe). The model is consistent with Australian Clinical Practice Guidelines (30) and conservative due to the novelty of the service. Self-directed, web-based, psycho-education is provided

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Abbreviations: (CBT), Cognitive Behavioral Therapy; (PHQ-9), Patient Health Questionnaire-9; (GAD-7), Generalized Anxiety Disorder 7-item; (UNSW), University of New South Wales; (GHSQ), General Attitudes to Help-Seeking Questionnaire; (AHSQ), Actual Help-Seeking Questionnaire; (LGBTI), Lesbian, Gay, Bisexual, Transsexual or Intersex; (ATSI), Aboriginal and Torres Strait Islander.

for students with nil to mild symptoms. Self-directed, web-based, cognitive behavioral therapy (CBT) is provided for students with moderate symptoms (5, 7). A direct link to face-to-face care with a school counselor is provided for students with moderately severe to severe symptoms or thoughts of death/harming one's self. School counselors are instructed to provide their usual care, consistent with school guidelines and policies. Students' symptoms are monitored fortnightly by an email or SMS check-in, which also includes a reminder to use the service and an automated login link. Every 6 weeks, students complete a step assessment from which care is reallocated based on their results.

The Smooth Sailing service is based on Rickwood et al. (31) help-seeking model. As outlined in **Figure 1**, Smooth Sailing directly targets each of the stages of help seeking through varied content and features. Smooth Sailing utilizes the Internet to address resource shortages and provide young people with evidence-based information and resources (32, 33). A major strength of the current service is that it links directly to face-to-face care, improving the likelihood of actual and future help-seeking (34).

The Smooth Sailing service was designed in partnership with students, school counselors (3), teachers, General Practitioners (GPs; 35), and parents (36). These stakeholders strongly endorsed the service due to perceptions of its usefulness in detecting symptoms and providing care, the suitability of the school setting for reaching youth, and young people's preferences for digital technology. However, key concerns also emerged including the privacy and confidentiality of students' information, Internet accessibility, and the availability of face-to-face care. School counselors felt students may try to avoid follow-up by answering the screening questions dishonestly and that students may forget or lack motivation to complete the online modules. School staff felt that gaining parental consent would be a potential barrier, although conversely, parents endorsed the service due to the prevalence and impacts of poor mental health among youth. While these concerns have been raised in similar studies of school-based computerized programs for mental health (37–41), broad uptake and successful implementation of the service is unlikely unless issues related to feasibility and acceptability are addressed.

Aims

The current study aimed to evaluate the feasibility, acceptability, and safety of the Smooth Sailing service among secondary school students. Feasibility was determined by the willingness of students to take part and the capacity of school counselors to initiate and manage follow-ups. Acceptability was determined by the extent to which students used the service, barriers to service use, and students' perceptions of service satisfaction (42, 43). The safety profile of the service was determined based on the deterioration in students' help-seeking intentions and symptoms after using the service. Although the study was not powered to detect significance (44, 45), measuring the change in these scores determined whether the service was likely to have an effect in an appropriately powered trial. The current study enabled service improvements to be defined and actioned, including important resource considerations. It also provided the initial data needed to develop future trial protocols, including sample size calculations and recruitment targets. Given the limited number of studies on school-based mental health services, and the lack of evaluation of stepped care for adolescent mental health, the current pilot may help researchers and clinicians to design more effective and integrative school-based service models.

METHOD

Study Design

A single-arm, pre-post, 6-week uncontrolled pilot trial was conducted. The study was approved by UNSW Human Research Ethics Committee (#167424), the NSW State Education Research Application Process (#2016471), and the necessary Catholic Education Offices. The study was undertaken in NSW, Australia, between February and June 2017. The recruitment target was set at a minimum of 50 students in total from 4

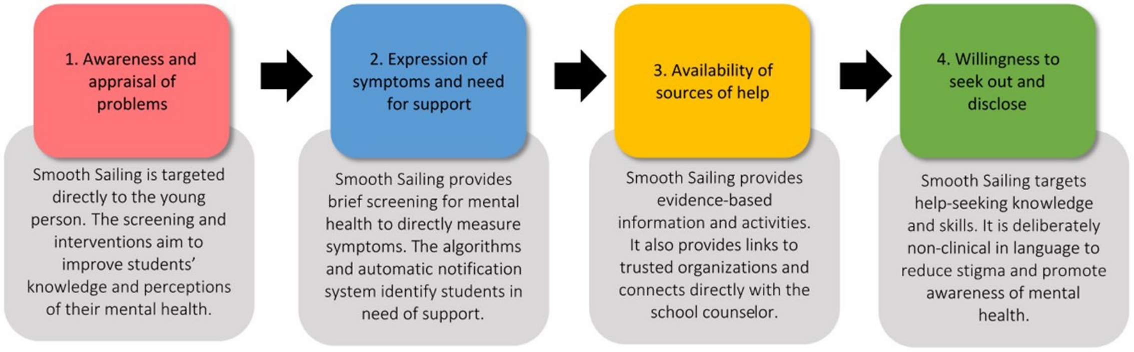

FIGURE 1 | Rickwood et al.'s (31) help-seeking model applied to the Smooth Sailing service.

schools. This target was based on recommendations for pilot research (46, 47) and was conservative to minimize the number of notifications and potential overburden on the participating school counselors. A convenience sample of schools who had expressed interest in the service during the design phase was used. School principals were emailed an information letter inviting the school counselor and two class groups from each school to participate. For school consent, schools were asked to provide a signed letter of support from the school principal. This letter was then forwarded to the governing ethics bodies to confirm school participation. Upon receipt of the signed school letter of support, student information and consent forms were mailed to each school. These forms were then distributed to the selected class groups by school staff. Interested students were required to return their consent form with signed parental consent by the day of the first school researcher visit. There were no other exclusion criteria. The study information sheet and consent form informed the students that taking part was completely voluntary, and that they were free to withdraw from the study at any time, without penalty, and without having to give a reason. Students could withdraw by emailing the research team or notifying the researchers at the school visits. Parents could also withdraw their child at any time using the same methods or by contacting their child's school.

Implementing the Service

At baseline, researchers visited the school to deliver the service in class time. Researchers reviewed students' consent forms and provided them with instructions to register to the service. Registration involved visiting the service website (https://smoothsailing.blackdoghealth.org.au) and completing an online Gillick Competency measure—six multiple choice questions to test students' capacity to provide informed consent and their understanding of the service. During registration, students provided their name, study code, email, mobile phone number, gender, and date of birth. They were asked to report their current employment status (part-time/casual, nil), whether they identified as lesbian, gay, bisexual, trans, or intersex (LGBTI) (answered yes, no, I'd rather not say) or as Aboriginal or Torres Strait Islander (ATSI) (answered yes, no, I'd rather not say). They were also asked to report whether they knew someone with a mental illness; cared for someone with a mental illness; had a mental illness themselves; or had used the Internet to find information about a mental health problem (all answered yes, no). This information was collected to determine the demographics of the sample alongside their experience and exposure to mental health problems.

The self-report mental health screener consisted of two validated measures: the nine-item Patient Health Questionnaire (PHQ-9; 28) for depressive symptoms and the seven-item self-report Generalized Anxiety Disorder Scale (GAD-7; 29) for generalized anxiety symptoms. Each of these questionnaires listed symptoms, and students were asked to rate how frequently they had experienced these, in the past 2 weeks, using a four-point Likert scale ranging from not at all (0) to nearly every day (4). The service automatically calculated a total score for each scale. Using whichever total score was the highest, students' symptoms were classified as "nil-mild" (i.e. total score on PHQ-9 or GAD-7 equaling 0-9), "moderate" (i.e., total score of PHQ-9 or GAD-7 between 10 and 14), or "moderately severe to severe" (i.e., total score of PHQ-9 or GAD-7 between 15 and 27). To measure the impact of their symptoms on overall functioning, one additional item asked students to rate how difficult their symptoms had made their daily life and relationships. Participants answered using a four-point Likert scale ranging from not at all (0) to very (4).

After completing the screener, the service automatically allocated students to a step of care that matched their symptom severity (see **Table 1**). The Smooth Sailing service produced a personalized dashboard which provided students with an overview of the recommended modules to complete in their own time (see **Table 2**). The online psycho-education consisted of five 10-minute modules which provided information about anxiety, depression, and help-seeking. The modules were created specifically for the Smooth Sailing service and were reviewed in the co-design process by young people as well as a clinical psychologist. The content was also edited by a copywriter to ensure it was written at an appropriate reading level. The modules are complemented by animations and illustrations as well as hyperlinks to other credible youth

TABLE 1 | Smooth Sailing Model: Criteria for steps and intervention provided.

	Step 0 to 1	Step 2	Steps 3 to 4
Total scores on PHQ-9 or GAD-7	0-9	10-14	15+
Symptom severity	Nil-Mild	Moderate	Moderately-severe to Severe
Self-directed online psycho-education	Yes	Yes	Yes
Self-directed online cognitive behavioral therapy (CBT)	No	Yes	Yes
Face-to-face session with School Counselor	No	No	Yes

TABLE 2 | Overview of the Smooth Sailing modules.

Title	Content overview
What is mental health?	Information about mental health issues common among youth and when it might be time to seek help.
Feeling on edge	Information on anxiety, how to identify it, potential causes, where to seek help and practical tips for managing it.
Waves of sadness	Information on depression, differences between sadness and depression, potential causes, how and where to seek help, and practical tips to cope.
When it's time to tell someone	Information about when to seek help, how to talk to friends and parents, seek help from a GP, and the roles of different health professionals.
When a mate needs a hand	Ways to help others including having a private chat, seeking help together, respecting the treatment process, and the importance of looking after yourself.
Don't fret, help is here	This module offers access to two evidence-based free online CBT programs, produced by Australian universities. Young people can select which program they prefer. This module is only offered to those at steps 2 and above.

mental health services and websites. All modules are designed to be self-directed, self-paced, and can be completed in any order. Module 6 includes referral to two web-based, publicly available, free, evidence-based CBT programs for depression and anxiety (5, 48, 49). MoodGym (5) comprises of five modules in which young people learn strategies to identify and manage unhelpful patterns of thinking, connect their thoughts and feelings, improve self-esteem and interpersonal relationships, and relaxation exercises to de-stress. The BRAVE Program (48, 49) includes ten 1-hour self-directed sessions that are usually completed over 10 weeks, that teach young people to identify anxiety and stress, develop relaxation and problem-solving skills, and reframe negative thinking. Before ending the visit, researchers advised students to use the website as much as they wished for the next 6 weeks.

Students who were allocated to steps 3 and 4 (i.e. moderately severe to severe symptoms) and/or reported thoughts of that they would be better off dead or of harming themselves in the past two weeks (i.e. score ≥ 1 on item-9 of the PHQ-9) automatically triggered a notification to the school counselor for follow-up through a secure, deidentified, email. Using the study ID codes, this email outlined that a student required follow-up from the school counselor within two days. School counselors were provided with a paper list of student names and matching study ID codes to ensure follow-up could be facilitated. The screening was only conducted on days when the school counselors were onsite. After conducting the student session, researchers met with the school counselor to review the email notifications. This took no more than 30 minutes. School counselors were provided with a list of local mental health services to support their follow-up. Two days after the school visit, the research team contacted the school counselor to confirm that all students had been followed up and to monitor any adverse events. This procedure was repeated at 6 weeks. All data were collected *via* the Smooth Sailing service e-platform which is hosted on university servers at the Black Dog Institute, University of New South Wales, Sydney, Australia.

Outcome Measures

Table 3 presents the key outcome measures and the criterion used to determine whether service modifications and improvements to procedure were needed.

Feasibility

Consent rate: This was measured by the percentage of students who gained parental consent to participate and determined the likelihood of service uptake among students. The service was deemed feasible if >50% of invited students took part, based on the uptake of previous Australian school-based mental health programs (50, 51). Non-consenting students were asked to complete a short anonymous questionnaire outlining their reasons and to indicate whether an incentive would encourage participation.

Step allocations and follow-up notifications: This was the percentage of students who were allocated to each step and the percentage who required follow-up from the school counselor. This was measured to provide an estimate of the prevalence of mental health issues among students and the capacity required of school counselors. Based on prior recommendations for school-based screening, the service was deemed feasible if no more than 20% of students triggered a follow-up notification (52).

Acceptability

Service use: Based on a recent review of uptake and use of digital health interventions (53), service modifications were needed if the majority of students (>50%) were minimal users (i.e. completed one or less of the prescribed modules).

Barriers to service use: Service barriers were identified using an 18-item list delivered at 6-weeks. Students were asked to report whether they experienced any of the listed service barriers throughout the pilot (e.g. "I forgot how to access Smooth Sailing," answered yes or no). If >20% of students reported experiencing the same barrier, service modifications were needed.

Service satisfaction: Satisfaction was measured using service dropout - the percentage of students who withdrew from the service throughout the pilot period. Based on dropout rates for mental health treatment, service modifications were needed if dropout was >20% (54). Satisfaction was also measured using students' responses to an 11-item questionnaire delivered at 6 weeks. Students were asked to agree or disagree with a list of statements about the service (e.g. "Smooth Sailing was easy to understand"). Service modifications were needed if <60% of students agreed with each of the statements.

TABLE 3 | Outcome measures.

Domain	Construct	Measured by	Criteria for service modifications
Feasibility	Willingness of students to take part	Percentage of students who gained parental consent	<50%
Feasibility	The school counselor workload	Percentage of students that triggered a follow-up notification	>20%
Acceptability	Service use	Percentage of students who were "minimal users" i.e. completed ≤ one module	>50%
Acceptability	Service satisfaction	Percentage of students who withdrew from the service	>20%
		Percentage of students who reported barriers to service use	>20%
		Percentage of students who agreed with the service satisfaction items	<60%
Safety	Incidence	Percentage of identified cases that were new i.e. students who reported current symptoms but did not have a prior history of mental illness	<50%
Safety	Likely effectiveness	Help-seeking scores and mental health symptoms at baseline and 6 weeks	Deterioration at 6-weeks

Safety

Incidence: This was the number of new cases identified by the service i.e. the percentage of students who required follow-up but had no history of mental health problems or illness. Service modifications would be needed if <50% of the identified cases were new.

Likely effectiveness: This was determined based on the deterioration in help seeking and symptom scores at 6 weeks. Help-seeking intentions for mental health were assessed at baseline and 6 weeks using an adapted version of the General Attitudes to Help-Seeking Questionnaire (GHSQ; 55). Students were asked to rate how likely they were to seek help when faced with a mental health problem from 12 different sources including informal (e.g. parents, friends, other adults), formal (e.g. GP, mental health professional), school-based (e.g. teacher, school counselor), and technology (e.g. mental health websites, telephone helplines, Internet activities). Each item was answered using a 5-point scale ranging from "extremely unlikely" to "extremely likely." Answers were summed to create a total score with higher scores indicating a greater likelihood of seeking help. As outlined, the service also measured students' depression and anxiety symptoms at baseline and 6 weeks using the Patient Health Questionnaire (PHQ-9; 28) and the Generalized Anxiety Disorder Scale (GAD-7; 29). Higher scores indicated greater symptom severity.

RESULTS

Feasibility

Consent rate: **Figure 2** outlines the participant recruitment and flow.

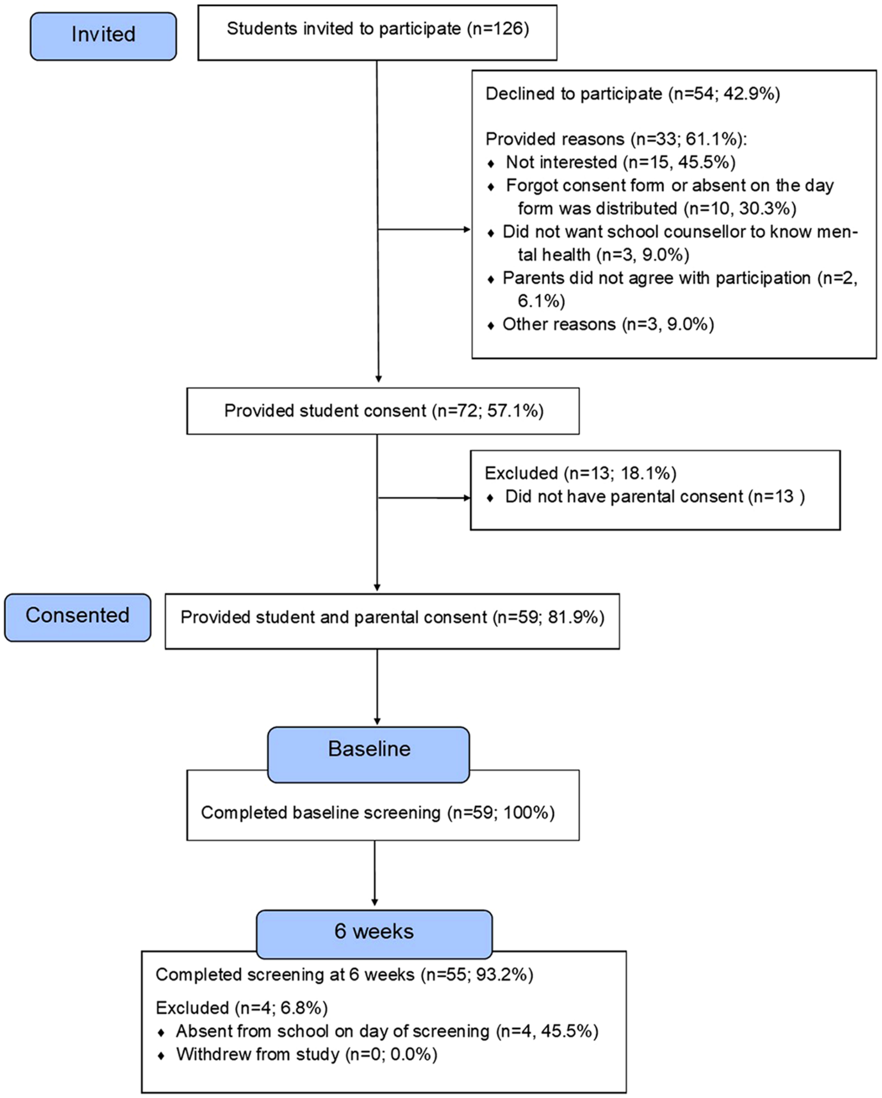

FIGURE 2 | The CONSORT flowchart outlining recruitment and service participation.

A total of 126 students from the 4 participating schools were invited to take part in the service and 72 provided their consent (57.14%, *n* = 72/126). Of these, 59 gained parental permission. This gave an overall consent rate of 46.83% (*n* = 59/126). A total of 33 non-consenting students completed the feedback form. Of these, half were male (*n* = 18/33, 54.54%) and over half reported feeling sad, worried, or stressed for more than two weeks at a time (54.54%, *n* = 18/33). **Figure 2** outlines the reasons for non-participation. When asked about the use of an incentive for future participation, 24.24% (*n* = 8/33) said they would not participate regardless, 39.39% (*n* = 13/33) preferred a gift voucher, and 36.36% (*n* = 12/33) gave no response. Participant characteristics of the final sample are presented in **Table 4**, stratified according to baseline step allocation.

Step allocations and follow-up notifications: Displayed in **Figure 3**, two thirds (66.10%, *n* = 39) of the sample reported nil to mild symptoms at baseline and were allocated to steps 0 and 1; 16.94% (*n* = 10) reported moderate symptoms and were allocated to step 2; and a further 16.94% (*n* = 10) reported moderately severe to severe symptoms and were allocated to steps 3 and 4. A total of 18.64% of the sample (*n* = 11/59, 7 female) triggered a follow-up notification at baseline. There was a downward shift in symptom severity at 6-weeks with reductions in the number of students at the highest steps. However, there was no change in the total number of students who required follow-up at 6 weeks because five students with nil-mild symptoms reported thoughts of death and/or self-harm.

Acceptability

Service use: Although module completion was higher among the students with more severe symptoms at baseline, the majority were minimal users (range: 50.00-74.35%, see **Table 5**).

TABLE 4 | Participant characteristics at baseline stratified by step allocation (N = 59).

	Steps 0 to 1 (n = 39)		Step 2 (n = 10)		Steps 3 to 4 (n = 10)	
	n	%	n	%	n	%
Female	23	58.97	6	60.00	6	60.00
Employed	7	17.95	3	30.00	0	0.00
Provided mobile number	20	51.28	7	70.00	3	30.00
Lesbian, gay, bisexual, trans, queer, intersex	1	2.56	0	0.00	1	10.00
Aboriginal or Torres Strait Islander	6	15.38	1	10.00	0	0.00
Knew someone with a mental illness	21	53.85	9	90.00	9	90.00
Cared for someone with a mental illness	13	33.33	8	80.00	5	50.00
Reported having a mental illness	6	15.38	1	10.00	3	30.00
Used Internet to find information about a mental health problem	5	12.82	2	20.00	5	50.00

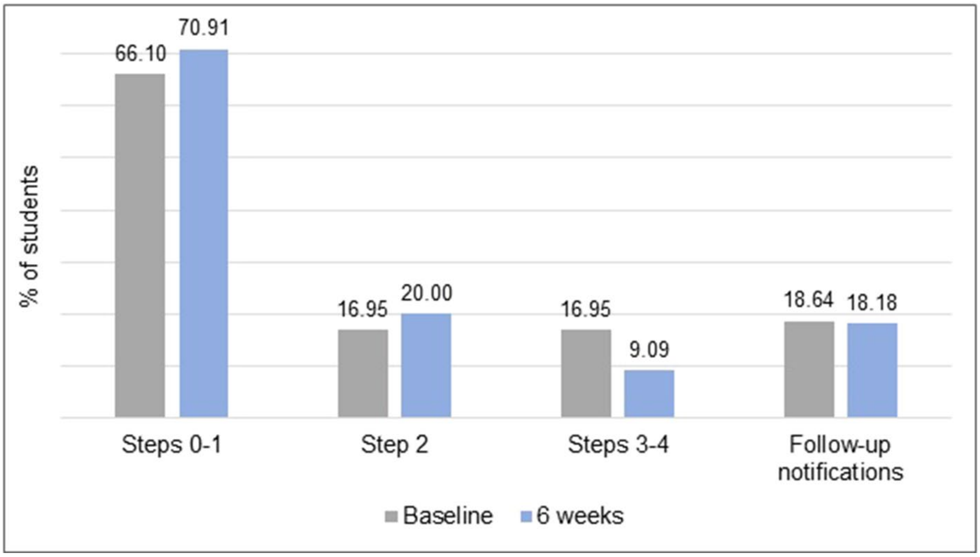

FIGURE 3 | The frequencies of the step allocations and follow-up notifications at baseline and 6 weeks.

TABLE 5 | Service use among students throughout the pilot (N = 59).

	Steps 0 to 1 (*n* = 39)		Step 2 (*n* = 10)		Steps 3 to 4 (*n* = 10)	
	n	%	n	%	n	%
Nil modules completed	16	41.02	2	20.00	2	20.00
Only 1 module completed	13	33.33	4	40.00	3	30.00
2 or more modules completed	10	25.64	4	40.00	5	50.00

Barriers to service use: Outlined in **Table 6**, service barriers differed according to baseline step allocation. Students at step 2 experienced more barriers than others, reporting problems with Internet connectivity, lack of time, forgetfulness, low motivation, worry about the privacy of data, content taking too long to read and complete, using too much phone data, not trusting the service, feeling too worried or down to use the service, and not wanting the school counselor to know their feelings.

Service satisfaction: There were no active withdrawals during the service pilot and 55 of the 59 students were present for the 6-week assessment (93.22% retention). As outlined in **Table 7**, most of the students (range: 60–100%) felt that Smooth Sailing was easy to understand, easy to use, interesting and enjoyable, regardless of their baseline step allocation. The majority also felt comfortable providing their mobile phone number, agreed that they would tell a friend to use the service, and would use the service again in the future. The students allocated to steps 3 and 4 were comfortable with school counselor follow-up but less comfortable providing their email address. There was also disparity in students' responses to whether Smooth sailing helped them "feel in control of their feelings" and "helped them a lot in everyday life," with lower levels of agreeance among those allocated to the higher steps.

TABLE 6 | Barriers to service use reported at 6 weeks (N = 55).

	Step 0 to 1 (*n* = 37)	Step 2 (*n* = 9)	Step 3 to 4 (*n* = 9)
My Internet connection didn't work	Yes	Yes	NA
I didn't have time to use Smooth Sailing	Yes	Yes	Yes
I forgot about Smooth Sailing	Yes	Yes	Yes
I couldn't be bothered using Smooth Sailing	Yes	Yes	Yes
Smooth Sailing wasn't what I needed	Yes	Yes	Yes
I forgot how to access Smooth Sailing	Yes	Yes	No
I was worried about privacy of my data	No	Yes	No
I didn't want school counselor to know my feelings	No	Yes	Yes
I had trouble logging into the website	Yes	Yes	No
I felt too worried or down to use Smooth Sailing	No	Yes	No
The check-ins took too long to complete	No	Yes	No
Smooth Sailing took too long to read	No	Yes	No
Smooth Sailing used too much phone data	No	Yes	No
I didn't trust Smooth Sailing	No	Yes	No
The text was too hard to read on phone	No	No	No
Smooth Sailing took too long to load	No	No	No
I didn't have a phone or computer to use	No	No	No
Smooth Sailing made me feel worse	No	No	No

Yes indicates that the barrier was experienced by >20% of students and that service modifications are needed. No indicates that the barrier was experienced by <20% of students.

TABLE 7 | Service satisfaction reported at 6-weeks (N = 55).

	Steps 0 to 1 (*n* = 37)	Step 2 (*n* = 9)	Steps 3 to 4 (*n* = 9)
Smooth Sailing was easy to understand	Yes	Yes	Yes
I found Smooth Sailing easy to use	Yes	Yes	Yes
I enjoyed using Smooth Sailing	Yes	Yes	Yes
I would tell a friend to use Smooth Sailing	Yes	Yes	Yes
I thought Smooth Sailing was interesting	Yes	Yes	Yes
I felt comfortable providing my mobile phone number	Yes	Yes	Yes
I would use Smooth Sailing again in the future	Yes	Yes	Yes
I felt comfortable providing my email address	Yes	Yes	No
I was comfortable being followed-up by the school counselor	Yes	No	Yes
Smooth Sailing helped me to feel in control of my feelings	Yes	No	No
The skills I learned helped me a lot in everyday life	No	No	No

Yes indicates that >60% of students agreed. No indicates that >60% disagreed and that service modifications are needed.

Safety

Incidence: Sixteen of the 20 (80%) students who required follow-up did not report a history of mental health problems or mental illness.

Likely effectiveness: The mean scores for help-seeking intentions, depression, and anxiety appeared stable or improved throughout the pilot, across all levels of symptom severity (see **Table 8**).

DISCUSSION

This study aimed to determine the feasibility, acceptability, and initial safety profile of an online mental health service for improving help seeking and mental health symptoms in NSW secondary school students. The findings revealed that some modifications to the service and its procedure are needed if a future controlled trial is to be successful.

Feasibility

Uptake of the service among students was low with less than half consenting to take part. Importantly however, the main barrier to consent appeared to be administrative: one quarter of the non-participating students had forgotten their consent forms and others were absent on the day forms were distributed. A more streamlined approach such as using passive "opt out" consent for parents and

TABLE 8 | Help-seeking intentions (GHSQ), depression (PHQ-9), and anxiety (GAD-7) scores at baseline and 6 weeks (N = 55).

	Steps 0 to 1 (n = 37)		Step 2 (n = 9)		Steps 3 to 4 (n = 9)	
	Baseline	6 weeks	Baseline	6 weeks	Baseline	6 weeks
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Help-seeking intentions (GHSQ)	34.36 (6.88)	35.38 (7.74)	29.30 (11.07)	36.00 (9.67)	24.60 (6.50)	24.22 (0.36)
Depression (PHQ-9)	2.82 (2.59)	2.59 (3.27)	10.30 (2.63)	10.80 (3.33)	15.10 (3.38)	11.22 (5.26)
Anxiety (GAD-7)	2.36 (2.50)	2.20 (2.72)	9.60 (3.53)	10.00 (4.03)	12.70 (5.96)	9.44 (7.21)

collecting student consent on the day of registration may improve uptake. This is likely to be supported by school communities as only a small proportion of parents did not want their child to participate in the service, although this would need to be evaluated further. Other strategies to increase uptake of the service among students may include broader promotion and marketing, utilizing school champions (56), increasing teacher awareness and support, and using incentives (57, 58). To better understand reasons for non-participation, future trials would benefit from implementing a consent form which all students are required to return, regardless of whether they choose to participate. This would allow more accurate rates of uptake to be measured and to better capture the reasons for non-participation. This is particularly important to address any concerns students have about using the service, the potential follow-up from the school counselor, and privacy protection.

This pilot also confirmed that the feasibility of the service is significantly impacted by the availability of school counselors to conduct the student follow-ups. In the initial screening, the service found that nearly one in four students experienced symptoms of depression and anxiety that warranted being seen by the school counselor. These rates are likely to increase the workload of school counselors. Based on the current study, school counselors would be required to initiate consultations with approximately 20% of all students screened. This has implications for delivering the service to larger samples, which would be needed for an effectiveness trial. In preparation for service implementation, schools would need to increase school counseling resources during the screening periods to ensure that all students requiring follow-up are seen in a timely manner. This would allay the concerns that students would not have access to face-to-face care if needed (3, 36). The service may lead to fewer follow-ups in the future; however, this would need to be investigated. Implementing the service over a longer period would enable researchers to evaluate the preventative and early intervention effects of the proposed stepped care model. As school counselors have already reported feeling time poor and vulnerable to burnout (3), future studies would need to monitor the impact of the increased workload on school counselors' well-being and job stress.

Acceptability

There was no drop-out throughout the pilot, signifying the support for this type of service among the participating youth. However, service use was low with most students failing to complete more than one module. This is problematic, particularly for the students allocated to step 2 (i.e. moderate symptoms) as they were symptomatic but failed to engage with the therapeutic content. Students at step 2 also faced more barriers to service use, such as poor Internet connectivity, failure to remember passwords, and forgetfulness. Time constraints also impacted students' use. Although email and SMS reminders were used, these did not appear to increase engagement. While SMS reminders are more likely than emails to be actioned (59), only half of the students chose to provide their mobile phone number. Service use may be improved by schools allocating class time for module completion as Neil et al. (60) found this resulted in a threefold increase. Other strategies could include publishing promotional material throughout the schools, inserting a web link to the Smooth Sailing service on schools' websites and students' desktops, introducing multiple options for restoring access and password retrieval (e.g. one-time pin codes, email verification links, use of secret questions) and utilizing student leaders to promote the service. A future trial may also benefit from using multi-modal methods of reminders including ones that are classroom-based, as well as customizable electronic reminders *via* SMS and email. Highlighting the brief time commitment required to work through the online modules may also increase module completion. Engagement is a challenge for many Internet programs and interventions, with the relationship between adherence and effect still unclear (61). However, as greater adherence can lead to stronger effects (62), modifications to the service may be necessary to increase acceptability and effectiveness.

Service satisfaction was high. Most students reported that they enjoyed using the service and found it easy to use. The online delivery mode may have contributed to this, with young people commonly reporting positive experiences with Internet activities for mental health (63). However, for stepped care models to be effective, participants need to be motivated and engaged with their allocated treatment (64, 65). The findings suggest that the current service model may need to be modified to include additional support or interaction, particularly for those at step 2 because motivation and capacity to engage with the self-directed content was low. This confirms school counselors' prior concerns that symptomatic students may have difficulties engaging with this type of delivery (3). In studies among adults, adherence to online therapies has been greater when external support or guidance was provided (66). The current service model may be improved by the addition of human contact for youth allocated to step 2. Further, many students reported that the service was not what they needed, despite many having symptoms. Students' lack of awareness of their mental health may have negatively impacted their engagement with the service. This is supported by Gould et al. (67) who found that students' perceptions about their need for treatment impacted their service use. The service may benefit from improving the registration process to better educate students about its purpose and include symptom feedback to help students understand their needs. Providing more information about the effectiveness of e-mental health programs to students (68) and utilizing parents or peers for support (69) may help increase service use and satisfaction. In addition, redefining the expectations of students who have nil-minimal symptoms and implementing a curriculum-embedded mental health program (8) may help to supplement the online modules and increase overall acceptability.

Safety

A key question of this study was to establish the initial safety profile of a service which overtly identified students in need, provided care, and referred them to the school counselor when appropriate. The service was successful at detecting new cases of mental health problems, with four of five of the students identified not having a history of mental illness. Prior concerns about Internet-delivered screening and programs for school students have been related to them being untruthful or joking with their responses (3, 36). This study found no evidence of this behavior in students. On the contrary, it appeared that the service was perceived as trustworthy, encouraging honest disclosures of mental health history, symptoms, and help-seeking behavior. However, future studies would benefit from measuring the outcomes of student follow-ups, to determine whether the positively identified cases were genuine and whether referrals to other mental health services were made. The mean scores at baseline and 6 weeks suggested that the service did not worsen students' intentions or symptoms, and positive significance may be found with a larger sample. Importantly, most students were comfortable being followed up by the school counselor, and even those who were not remained in the service. These findings provide some initial support for the effectiveness of the proposed model, but the low rates of module completion suggest improvements are needed before effects can be confirmed in a larger clinical trial. Future studies would benefit from increasing the sample size, using a control group, and implementing the service over a longer period. This would help determine genuine improvements in help-seeking behavior and symptoms.

CONCLUSION

The current study presents important findings for the development and implementation of an online mental health service that screens students' mental health and allocates care accordingly, all within the school setting. Although the findings provide some support for the feasibility, acceptability, and safety, service improvements are needed. Modifying consent procedures, ensuring school counselor availability, improving completion of modules, and removing service barriers related to accessibility will significantly improve the quality of the service and its likely effectiveness. The current study confirms the potential of this new type of service model for identifying new cases of mental health problems in students, which may halt symptom progression and prevent the onset of serious mental illness. A randomized controlled trial comparing this service to school as usual would determine the genuine effects and benefits for students. Future studies should also examine the impact of the service on school counselors, school culture, and parents. This would help to understand the broader implications of this new type of service delivery model.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the National Health and Medical Research Council's National Statement on Human Research with written informed consent from all subjects in accordance with the Declaration of Helsinki. The protocol was approved by UNSW Human Research Ethics Committee (#167424), the NSW State Education Research Application Process (#2016471), and the necessary Catholic Education Offices. Written consent was obtained from participants and their parents

AUTHOR CONTRIBUTIONS

BO'D and HC conceived the study. BO'D prepared the protocol and initiated the trial. HC and NC approved protocol and supervised trial activities. BO'D, CK, and MS-K contributed to the coordination of the trial. BO'D and CK contributed to data analysis. BO'D led the authorship of the paper alongside all co-authors. MA completed formatting and referencing. All authors read and approved the final manuscript.

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A Pilot Digital Intervention Targeting Loneliness in Youth Mental Health

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Background: Loneliness is an emerging issue for young people, but yet many interventions to address loneliness in this group focus on providing social opportunities. While these sorts of interventions may appear to increase social connections, loneliness is more related to quality rather than quantity of social relationships. Thus, interventions addressing loneliness should focus on maximizing the quality of current relationships. Together with youth consumers both with mental ill health and those without, we developed a digital smartphone application (app) called +Connect. The 6-week program delivers positive psychology content designed to improve relationship quality. We tested the acceptability, feasibility, and safety of the program in lonely young people with or without a mental health diagnosis of social anxiety disorder. We used a mixed method study design to triangulate pilot quantitative and qualitative data in young people with and without social anxiety disorder (SAD).

Method: Nine participants with a diagnosis of social anxiety disorder ($M_{age} = 21.00$; $SD = 1.41$) and 11 participants with no mental health conditions ($M_{age} = 20.36$; $SD = 2.16$) completed the +Connect digital intervention.

Results: Those with social anxiety disorder reported less acceptable ratings on outcomes. Feasibility ratings, measured by uptake and app completion, met *a priori* threshold criteria in both groups. Those with social anxiety disorder yielded more attrition, with almost double the attrition rate compared with those without the disorder. There were no safety issues elicited during the pilot study. In terms of outcomes, exploratory analyses indicated that the app itself is likely to be beneficial rather than cause harm. Our qualitative data indicated both groups reported no negative outcomes and noted that positive outcomes were driven by three processes: reflection, learning, and real-life application. Further exploratory data on usability indicated room for improvement in terms of giving more support for different components of the app (i.e., challenges).

Conclusion: The pilot findings of this proof-of-concept app indicates some promise in terms of a second iterative version of +Connect.

Keywords: loneliness, social anxiety disorder, positive psychology intervention, digital intervention, youth mental health

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INTRODUCTION

Loneliness is a subjective experience of social isolation (1), and although such aversive feelings occur across the lifespan (2), young adults (18–29), together with older adults (65–79) are the most vulnerable to loneliness, reporting the highest prevalence compared to other age groups (3). Forming meaningful relationships with others is critical to our survival, and the lethality of loneliness is well established. Future poor health and increased risk of death is predicted by loneliness (4, 5). In addition, deleterious effects have been observed on various physical health conditions, including decreased immunity (6), increased inflammatory response (7), elevated blood pressure (8), decreased cognitive health (9), and faster progress of Alzheimer's disease (10), to name a few.

The challenge of loneliness is magnified by its effects on mental health in addition to its effects on physical health. Loneliness is well known to be associated with increased mental health symptoms in both clinical (11, 12) and nonclinical populations (13–15). In longitudinal studies that examined older adults aged 50–68, loneliness predicted depressive symptomatology over and above potential confounding variables (e.g., demographics, stress, and social support) (16). Similarly, in a large-scale general population study of people aged 18 to 87 years old (N = 1,010), loneliness predicted more severe social anxiety, depression, and paranoia across a 6-month period (17). Given these results, targeting loneliness has the potential to prevent the development of more severe psychiatric symptoms.

Focusing interventions on youth might have the largest impact because loneliness and psychiatric symptoms are common in this age group and because of the potential for secondary prevention. In a large Danish study of adolescents and young people aged between 16 and 29 years old (n = 5,324), being female, having low levels of education, and living in a deprived area were risk factors for loneliness (18). Young people aged 12 to 25 are also at high risk of developing emerging mental illnesses (19). In the 2007 Australian National Survey of Mental Health and Wellbeing, young people aged 16–24 years have the highest prevalence of mental disorders, but the lowest rate of receiving services in the past 12 months (20, 21). Young adulthood is further marked with significant life changes from leaving school or home, to facing new social challenges such as higher education or work (22). Such social transitions mean that young adults may be more reliant than ever on their social networks for support (23). Having high-quality relationships can improve the young adult's ability to adjust to new social environments (24, 25), buffering the effects of loneliness (26).

Interventions aimed at fostering social inclusion and enhancing social relationships can promote psychological well-being or promote recovery from problematic mental health symptoms (27). However, because loneliness is more related to the quality of social relationships than to the quantity (28, 29), interventions that focus solely on providing more social opportunities to the "lonely" individual have shown minimal benefit (30). This is because loneliness is not the same as being alone or physically isolated and is not strongly correlated with time spent alone (31). Hence, simply asking a "lonely" individual to join a group or interact with others provides either transient or minimal relief from loneliness. Cognitive models of loneliness elaborate on the distinction between loneliness and being objectively alone. Proponents of such models contend that while the adverse nature of loneliness motivates "lonely" individuals to connect with others, they are also hypervigilant to social threats, causing them to find evidence that people are not trustworthy or accepting (32, 33). In response, the "lonely" individual shows less prosocial behaviors toward others in an attempt to protect him or herself from rejection thereby eliciting rejection from others (32, 33).

The cycle outlined above suggests that a key target in reducing loneliness is to maximize the experience of social connection within *existing* relationships by helping the "lonely" individual to show more prosocial behaviors toward others. A positive psychology-based intervention provides a useful framework when addressing loneliness as it is designed to increase the meaningfulness of existing relationships, promote positive emotions, and focus on thriving during adversity (34–36). Positive psychology is the scientific study about what is right about the individual (as opposed to what is wrong), and it involves identifying positive characteristics, strengths, and psychological assets, which are inherent in a person irrespective of societal status (37).

Young people are well known to use digital tools extensively to connect with others, but existing social media apps may favor a large number of brief social interactions, as opposed to fewer and more meaningful relationships or designed to increase social support (38). Existing social media platforms carry a risk of alienation and cyberbullying (39, 40), which might contribute to more loneliness (41). This situation suggests the possibility of using a more positive app to build on strengths and reduce loneliness. This possibility comports well with the increase in digital platforms to either augment face-to-face mental health interventions or to simply engage young people who would otherwise not engage in mental health intervention (42). Although a digital health intervention that can deliver evidence-based health information is highly valuable and preferred by young people (43, 44), significant resources for development and testing are required.

We developed a proof-of-concept digital tool to address loneliness in young people. +Connect is a 6-week smartphone intervention using a strengths-based positive psychology framework. It is gamified and engaging. It delivers videos and posts daily in an attempt to convey evidence-based concepts known to strengthen relationships and increase social connections. Over 2015–2017, young people aged 18 to 25 participated in a series of focus groups. The groups included members that ranged from young people with no mental ill health, to those with a history of high prevalence disorders (e.g., depression, social anxiety) to those with psychotic disorders. Feedback from initial focus groups also recommended that content should be delivered in short but frequent bursts (as opposed to longer and dedicated time) (45). We opted to develop a smartphone app over other digital platforms because of its mobility and accessibility (46–48). The group then provided feedback on design (i.e., fonts, colors, layout), functionality (e.g., task completion and gamification), and language (e.g., written task and video content).

In a pilot study, we employed a mixed methods approach using both quantitative and qualitative data in order to deepen our understanding of how young people experience +Connect. The primary study aim was to examine the acceptability, feasibility, and safety of +Connect in young people with or without social anxiety disorder. First, we anticipated that +Connect would be acceptable to both groups of young people. This would be demonstrated by participants reporting higher than *somewhat* in their satisfactory and helpfulness ratings across a series of criteria, including understanding, enjoyment, and content helpfulness.

Second, we anticipated that +Connect would be feasible across three key factors: uptake, attrition, and app completion. For uptake, we anticipated that at least 50% of people who were interested would attend a baseline assessment. For attrition, we anticipated no more than 30% attrition rate for both groups. We further considered a participant to be a drop out if he or she ceased using the app for >3 consecutive days, and the researchers were unable to contact the participant. For app completion, we hypothesized that participants would complete at least 70% of the program (equivalent to 30 of the 42 days of content). We explored other possible feasibility factors *via* the qualitative interview. Third, we anticipated that +Connect would be safe to use for lonely young people and to assess safety, we measured the number of adverse events that occurred during the course of the study.

Fourth, in an exploratory analysis, in order to determine if the intervention reduces loneliness severity, we estimated the plausible effect size of +Connect on loneliness ratings *via* a latent trajectory model in an exploratory analysis. We included measures of mental health such as social anxiety and depression symptom severity that could influence loneliness severity. Last, in a second exploratory analysis, we measured the usability of the app (e.g., functionality, navigation) and acceptability ratings around the app design, concepts, and delivery components.

MATERIALS AND METHODS

+Connect Application Information

We opted to relay socially oriented content *via* video material wherever possible. We developed three types of videos: 1) shared experience videos (SEVs) using young people with lived experiences of loneliness (49); 2) expert videos (EVs) featuring academics (50), or 3) actor[1] videos (AVs) demonstrating concepts *via* modeling (51), all of which have already been utilized in previous digital interventions.

Key concepts relayed *via* a smartphone app means that content had to be concise and frequent as opposed to other internet delivered interventions, which may require longer but more infrequent discrete blocks. +Connect's program was designed to be delivered in less than 5 min over 42 days (6 weeks). Participants are shown a home screen when they opened the app. They were asked to log their mood states using a mood evaluation tracker. They are then directed to a task which was delivered either: 1) *via* text and images (e.g., an Instagram format); 2) SEVs featuring young people with lived experiences; 3) EVs featuring academics introducing core concepts; or 4) AVs featuring actors who would model interactions within specific social contexts.

Videos were designed to be brief (i.e., 1.21 to 4.38 min). AV scripts were written by a scriptwriter (under 25 years of age) and reviewed in a series of focus groups with young people (students, those with a history of high prevalence and serious mental illness). Two coders unrelated to this study (graduate students under clinical training) rated the content of each SEV on whether it achieved the aims of the modules (e.g., gratitude video: to relay that expressing gratitude can feel awkward at first, and it is more than saying thank you). These processes meant that material was checked and refined to ensure that concepts were simple to understand, youth friendly, and relatable. Participants completed daily tasks and were asked to answer a series questions related to the post or video, using a multiple choice or True/False format. Daily tasks did not exceed past 5 min. The gamification processes include winning points and badges through task completion, mood monitoring logins, progress through the app, and winning challenges (52–54). **Supplementary Table 1** outlines what was delivered within +Connect app. The content was developed by ML, JG, TR, and DP. There are different tasks (e.g., the gratitude exercise, showing gratitude) that can sit under one general module (e.g., Gratitude).

Participants

Twenty participants aged 18 to 23 years old were recruited for the study. Nine participants with social anxiety disorder (*M* = 21.00, *SD* = 1.41) were recruited from a local youth health service, while 11 participants with no diagnosable mental health disorder (*M* = 20.36, *SD* = 0.52) were recruited through convenience sampling from an Australian university. See **Table 1** for more participant demographic information.

Materials

Participants attended three assessments: Time 1 (T1), baseline; Time 2 (T2), post-treatment (after completing at least 33 days of +Connect); and Time 3 (T3), 3-month follow up (conducted 3 months after the T2 assessment). All measures were administered at all timepoints except for a) the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders (SCID-5-RV; 55), which was only administered at baseline, and b) the qualitative interview, which was conducted only at T2.

The Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders (SCID-5-RV; 55)

The SCID-5-RV depression and social anxiety modules were administered at baseline to determine the study eligibility and clinical diagnosis for the SAD group. Thirty percent amount of the assessments was randomly selected and independently rated by another coder with 100% agreement on diagnosis.

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[1] Actors in videos were under 25 years old at time of filming.

TABLE 1 | Demographics of participants across groups.

Demographic Variable *M(SD) or %*	**SAD**	**Students**
% Female	44.44%	45.45%
Age	21.00 (1.41)	20.36 (2.16)
Ethnicity		
Asian Australian or Asian	22.22%	36.36%
White (including Caucasian, European, Australian)	78.78%	45.45%
African Australian	0%	0%
Multi-Racial	0%	9.09%
Other	0%	9.09%
Relationship status (% Single)	89.89%	81.81%
Living status		
Living alone	11.11%	0.00%
Residing with housemates	33.33%	54.54%
Residing at home with immediate family	44.44%	36.36%
Residing with relatives	0.00%	0.00%
Residing in college	11.11%	9.09%
If residing with others, number of people in household		
One other person	12.50%	27.27%
Two other people	25.00%	0%
Three other people	37.50%	36.36%
Four other people	0.00%	18.18%
Five or more other people	25.00%	18.18%
Completed education (in years)	13.67 (1.50)	14.00 (2.24)

SAD refers to social anxiety disorder.

The Revised UCLA Loneliness Scale (UCLA-LS; 34)

The UCLA-LS, a 20-item self-report scale, was used as a measure of loneliness severity. It uses a 1 (Never) to 4 (Always) Likert-type scale. The measure consists of both positively and negatively worded items that assess loneliness (e.g., How often do you feel that you are no longer close to anyone)? The UCLA-LS has been shown to correlate negatively with life satisfaction and perceived social support, thus supporting its convergent validity with related constructs (56). Internal consistencies αs ranged from 0.90 to 0.95 across time.

The Social Interaction Anxiety Scale (SIAS; 56)

The original SIAS is a 20-item self-report questionnaire that measures anxiety-related reactions to different social interactions (e.g., *I get nervous if I have to speak with someone in authority*). The 17 *straightforwardly-worded* items (S-SIAS) were found to be more valid indicators of social interaction anxiety than the reverse-scored items across different samples (57). For this reason, we used the straightforward items. Internal consistencies ranged between αs = 0.91 and 0.94 across time.

Centre for Epidemiological Studies – Depression (CES-D; 58)

The CES-D is a 20-self-report measure of depressive symptoms, which employs a 0 (rare or none of the time) to 3 (most or all of the time) Likert-type scale. Scores are summed to create a total score indicative of depression symptomatology, where higher scores indicate the presence of more symptomatology. The CES-D has strong internal reliability (58). Internal consistencies for the CES-D ranged from αs = 0.88 to 0.90 across time.

Semi-Structured Qualitative Interview

Participants were invited to complete a semi-structured interview regarding their experiences using +Connect at T2. The questions are provided in **Table 2**. The interview was transcribed verbatim prior to analysis.

Design and Procedures

Human research ethics approval was obtained from the university ethics board, and written informed consent was obtained from participants. We recruited young people who were assessed to be lonely. There were two groups: 1) young people with social anxiety disorder and young people with no current mental health disorder. Participants with social anxiety disorder were recruited *via* their case manager at the local youth mental health service. A student group was recruited *via* print media placed around the local university. All potential participants were first screened *via* telephone to assess their eligibility for the study. See **Table 3** for inclusion–exclusion criteria for each group.

The research assistant administered the UCLA Loneliness three-item scale (59) over the telephone; those who scored 5 or more and did not meet the exclusion criteria were invited to a face-to-face baseline assessment, during which they completed the remaining measures. At the baseline assessment, participants provided consent to the study and complete the UCLA-LS. The research assistant scored the scale and proceeded with the SCID-5-RV if the score is above 38. The SCID-5 was audio recorded in order to conduct inter-rater reliability on the clinical diagnosis. Participants were excluded at this point if they met any of the exclusion criteria. Participants who were assessed to be eligible then completed the remaining assessments.

TABLE 2 | Study inclusion and exclusion criteria for social anxiety disorder and student groups.

Inclusion Criteria	**Exclusion Criteria**
1. Aged 18–25 years[a]	1. Presence of moderate or severe risk issues, i.e., deliberate self-harm and suicidality in the past month[a]
2. Engaged with a current mental health service, general practitioner (or was engaged at time of assessment)[a,b]	2. Psychiatric hospitalization in the past month[a]
3. Provided consent to contact current/previous mental health worker or general practitioner should risk issues arise[a,b]	3. Substance abuse or dependence in the past month[a]
4. Own a smartphone (Android or iOS)[a]	4. Known diagnosis of an Axis II personality disorder[a]
5. Identified a desire to connect with others[a]	
6. Current DSM V of SAD assessed by the SCID-5[b,c]	
7. UCLA Loneliness Scale score >38[d]	

[a] *Items checked at the initial telephone screen.*
[b] *Only applicable to those with social anxiety disorder.*
[c] *Students were accepted only if they did not meet criteria for social anxiety disorder as assessed by the SCID-V.*
[d] *There is no known threshold for problematic or severe loneliness, but a score of 38 and above was used to indicate above the median score across different samples (Russell, 1996).*

TABLE 3 | Semi-structured interview script.

Question Type	Question
Experience of the app	How did you feel after finishing +Connect? What was it like to go through all the 42 days? What did you think about the different types of videos (Probe: SEV vs AV vs Expert)? What was it like doing the challenges (Probe: applying +Connect to daily life)? What would have encouraged you to do the challenges more? What was it like to do all the tasks? (Probe: What could have encouraged you to complete them)?
Benefits and challenges of the app	What part of +Connect was the most helpful, and why? What part of +Connect did you find the most fun, and why? What did you find challenging about +Connect and why? What was it like to focus on your strengths and positive things?
Functionality of the app	How did using the app fit in with your daily life? Where and what time did you usually use the app? Research tells us that people like apps to be interactive – are there any interactive features that you would have liked to have seen in the app? Were all the sections in +Connect relevant to you? Why or why not? Finally, do you have suggestions that can help us improve the app for other people that use it?

Once participants completed the baseline assessment, research assistants introduced and oriented the participant to the app (i.e., completing the first day with the participant). The participant was briefed on the purpose, design, and functionality of the app, and shown how to navigate the different components. Researchers were able to monitor the progress of the participants *via* a webpage. Participants were contacted weekly for brief check in (either *via* text or a phone call). This was conducted to ensure technical issues were reported swiftly and to identify and address emerging risk issues during the course of the study. Participants were reimbursed for the completion of each assessment ($15/h). If they completed every day of the app, they were reimbursed up to $1.90 per day. This was done to offset the cost of data use outside WIFI zones.

Data Analytic Plan

A mixed methods approach included both descriptive statistics and qualitative analysis. Specifically, participant interviews and qualitative survey responses were analyzed using content and thematic analysis. These data were used to support quantitative data. An exploratory analysis using a latent trajectory model of the UCLA-LS was also used to estimate the effects of the intervention on young people. Bayesian estimation was used in Mplus (60) to provide a credible interval for the intervention's effect over time, assuming a linear slope across reporting periods. We consider these analyses exploratory because they were clearly underpowered to detect anything but a large effect size given the sample size. We also reported Cohen's *d* for effect size. Consistent with all pilot interventions, acceptability, feasibility, and safety are the primary outcomes. *Acceptability* was assessed at post-intervention using satisfaction ratings on questionnaires, content helpfulness ratings, and qualitative interview data that support these measures. Feasibility was assessed by considering four key factors: uptake, attrition, retention, app completion, and *engagement*. *Uptake* was defined as the number of potentially eligible young people who attended the baseline assessment. *Attrition* was defined as the number of participants who attended the baseline assessment but failed to log into the app for more than three consecutive days and where researchers were unable to contact the participant. *App completion* was defined as accessing and completing at least 70% of the app (30 out of 42 days). Consistent with most pilot interventions and recommendations (61), we also measured *Safety*, which was operationalized as the incidence of serious adverse events (e.g., hospitalization and self-harm) during the course of the study (62).

RESULTS

Acceptability

App Satisfaction Ratings

We set *a priori* threshold of outcome satisfaction ratings of more than 70% of participants in each group would rate higher than *somewhat satisfied* in their satisfactory ratings (that ranged from *very satisfied*, *somewhat satisfied*, *not at all satisfied*) across a set of criteria relating to different outcome ratings regarding ease of understanding, enjoyment in life, and content helpfulness. **Student app satisfaction ratings.** Around 72.73% of participants in the student group said that they were somewhat or very satisfied with each outcome criterion (see **Table 4**). Furthermore, all participants found +Connect easy to understand; however, 18.18% to 27.27% reported being not at all satisfied with several components of +Connect, including increasing social confidence and creating new relationships. See **Table 4** for details of the outcome satisfaction ratings. **Social anxiety group app satisfaction ratings.** As shown in **Table 5**, at least 50% of participants in the social anxiety group rated themselves as either somewhat or very satisfied with each of the outcome criterions. Similar to students, all of the participants with SAD reported that +Connect was easy to understand and helped them accept their mental health symptoms. However, 25.00% to 50.00% reported being not at all satisfied with several components of the app, including creating new relationships and increasing social confidence.

TABLE 4 | Post-intervention outcome satisfaction ratings of the +Connect for the student group.

Question	Very satisfied		Somewhat		Not at all satisfied	
	n	%	*n*	%	*n*	%
Ease of understanding	9	81.81%	2	18.18%	0	0%
Look forward being with people	4	36.36%	5	45.45%	2	18.18%
+Connect helped me enjoy life	6	54.54%	3	27.27%	2	18.18%
+Connect helped me feel connected with others	2	18.18%	7	63.63%	2	18.18%
+Connect helped increase social confidence	5	45.45%	3	27.27%	3	27.27%
Helped create new relationships	3	27.27%	5	45.45%	3	27.27%
Helped accept mental health symptoms	5	45.45%	4	36.36%	2	18.18%

App Content Helpfulness

Additional acceptability questions related to how helpful the content was. **Student group content helpfulness.** Overall, students tended to find the modules of +Connect helpful, with 27.27% to 81.81% reporting the modules to be either *helpful* or *very helpful*. If we extend positive ratings to include *somewhat helpful*, we see that 91.01% to 100% of the participants reported +Connect to be helpful. In interviews, student participants reported Three Good Things as their favorite module (*n* = 7), e.g., *"I found the ones that were about how to make you feel better about yourself. So ones like three good things, for example.…those bits I found most helpful."* Those modules that students reported most as not relevant in their lives were self-disclosure (*n* = 2) and balanced relationships (*n* = 2). This was primarily because they felt they were "already aware of all that stuff" or had not experienced a situation in which the information would be relevant, i.e., *"Balanced relationships … I really didn't relate to myself because I never had like that kind of relationship where it was always imbalanced or one-sided."*

All students found the shared experience and expert videos *somewhat* or *very much* useful and enjoyable, while 81.81% of students found the actor videos were useful and 72.72% rating them as enjoyable (see **Supplementary Table 2** for details). This differed somewhat from the qualitative findings; while four students reported preferring the shared experience videos, one student found them boring and hard to relate to, *"Because when people actually shared their experiences, they are feeling that emotion, but you can't feel that."* Three students instead reported a preference for the actor videos. However, a further two student participants reported finding the actor videos *"kind of forced," "kind of creepy,"* and *"fake."* Three participants reported the expert videos as their favorite type of video.

Social anxiety group content helpfulness. Overall, participants with SAD tended to find the modules of +Connect helpful with 25% to 100% reporting modules to be either helpful or very helpful (see **Supplementary Table 3** for details). If we include somewhat helpful as a positive rating, we see that 75.00% to 100% of the participants with SAD reported +Connect to be helpful. In interviews, participants with SAD also reported Three Good Things as their favorite module (*n* = 3). Two participants with SAD reported that the savoring module was not relevant in their lives as *"It felt a bit wishy washy and I didn't really know how to relate that too much of my life."*

Participants with SAD reported a different pattern of preference for the video types in comparison to the student, in that 87.50% reported shared experience videos as being *somewhat* or *very much* useful, while 75.00% reported them being *somewhat* or *very much* enjoyable. This was supported, in part, by the qualitative results; five participants with SAD endorsed the shared experience videos as "*genuine,*" "*inspiring,*" and *"easy to relate to,"* while two participants with SAD felt that the content was sometimes *"fake"* or *"not relevant to [their] own experience."* For the expert and actor videos, 75.00% of the participants with SAD rated the videos as *somewhat* or *very much* useful, while

TABLE 5 | Post-intervention outcome ratings of the +Connect for the SAD group.

Question	Very satisfied		Somewhat		Not at all satisfied	
	n	%	*n*	%	*n*	%
Ease of understanding	7	87.50%	1	12.50%	0	0%
Look forward being with people	1	12.50%	5	62.50%	2	25.00%
+Connect helped me enjoy life	1	12.50%	5	62.50%	2	25.00%
+Connect helped me feel connected with others	3	37.50%	3	37.50%	2	25.00%
+Connect helped increase social confidence	1	12.50%	5	62.50%	2	25.00%
Helped create new relationships	1	12.50%	3	37.50%	4	50.00%
Helped accept mental health symptoms	5	62.50%	3	37.50%	0	0%

SAD refers to Social Anxiety Disorder.

only 50.00% rated the expert videos as either *somewhat* or *very much* enjoyable and 62.50% rated the actor videos as *somewhat* or *very much* enjoyable. This difference in the rating of actor video usefulness and enjoyable was reflected in the qualitative findings. Four participants with SAD reported preferring the actor videos over the shared experience videos as *"you actually see how they are feeling and you understand how things are."* However, two participants with SAD agreed with the student participants who found the actor videos *"a bit cheesy."*

Feasibility

Uptake

We set *a priori* threshold of at least 50% of people who were eligible would attend a baseline assessment. **Student uptake:** One hundred and one participants initially expressed interest in participating in the project over a 10-month period. Fifty-one students did not want to participate in the context of a research project but were given access outside the trial. Of the remaining 50 students, 22 were found to be potentially eligible after the initial phone screen; the remaining 28 were screened out primarily for not identifying as lonely or needing to connect, exceeding the age requirements, or having a mental illness. Of the 22 people who were potentially eligible for the study, we were unable to contact two participants for a baseline assessment, leaving only 20 participants who were invited to a baseline assessment. Hence, the uptake was around 90% with 2 out of 22 participants (around 91% uptake). **Social anxiety group uptake.** Nineteen young people were presented as potential participants from a local health service over a 12-month period. Two of these people were non-responsive to telephone attempts, while two people were ruled ineligible for the study during the phone screen for substance abuse (one participant) and increased risk to safety (one participant). The remaining 15 people were eligible to complete the baseline assessment, and of these, two people did not attend the baseline or did not finish the baseline assessment. The remaining 13 participants were enrolled in +Connect. Therefore, the uptake for social anxiety is around 13 out of 15 participants (around 87% uptake).

Attrition

We set *a priori* threshold of a 30% attrition rate for both groups. **Student group attrition.** There was a rate of 15.38% with two participants dropping out of the study citing no reason. **Social anxiety group attrition.** There was an attrition rate of 30.76% with 4 participants out of 13 dropping out of the study, and the only reason cited was time commitment.

App Completion

We set *a priori* app completion rate of 70% (30 out of 42 days) for both groups. **Student group app completion.** Participants completed 90.26% of the app (M = 37.91 days, SD = 5.09) exceeding the *a priori* requirement of 30 out of 42 days. **Social anxiety group app completion.** Participants (n = 9) completed approximately 84.66% of +Connect (M = 35.56 days, SD = 7.78), exceeding our *a priori* requirement of 30 days out of 42.

Other Feasibility Factors

There were additional feasibility factors relating to time burden, and difficulties with app components that were elicited. **Time burden.** Around 78.95% of the participants (15/19) found that the app did not create a significant time burden, reporting they used the app for 3 or more minutes per day, while the remaining 21.05% (4/19) reported using the app less than 3 min per day[2]. In interviews, one SAD and one student participant reported difficulties with the length of the strength challenge, and one SAD participant reported difficulties with the longer videos, i.e., *"When they started becoming four minutes and such, they got really really difficult to concentrate on them, or just like, find the time to actually do that."* **Maintaining engagement.** The greatest difficulty participants with SAD reported during interviews was remembering to complete the challenges and tasks (n = 5), e.g., *"It was quite difficult to remember for me. Cos you know, even though like occasionally it would give me like a notification say I'll forget to do it because I might have like gone to work or you know, I've got uni work I'm doing or whatever. I tried at one point to make it like a daily thing where I'd wake up and I'd do it. But that didn't really work out. So it was hard to keep consistent."* Conversely, only two student participants reported difficulties remembering to complete the app. It seemed that for student participants, it became part of their routine more easily, i.e., *"doing the app was just a daily task and then I think because there were some coming around it was just making interest to like continue on with the app."* This may partly be due to more control participants (n = 4) reporting being motivated by the app gamification than clinical participants (n = 1). **Difficulties with app components.** Three participants with SAD also reported difficulties completing the challenges. This seemed to be primarily due to social anxiety severity levels, i.e., *"these kind of challenges I thought would take a lot of confidence in me. I just procrastinated on them a bit."* Participants suggested breaking down the challenges into smaller and shorter components to make completion easier, i.e., *"maybe simple, easy challenges like 'today, compliment a stranger's outfit' or something. I think if I did those kind of exercises each day, it will help me a lot in my social anxiety."*

Safety

No participant in either group reported any adverse event during the program.

Health and Wellbeing Outcomes

First, we report the descriptive scores, means, and standard deviations across the two groups across time (see **Table 6** for descriptive statistics). Because our intent was to be descriptive, we do not provide tests of between-group differences, but we do describe changes over time within group. Next, we used a latent trajectory model of the UCLA-LS to estimate the effects of the intervention on young people. Bayesian estimation was used in Mplus (60) to provide a credible interval for the intervention's effect over time, assuming a linear slope across reporting periods.

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[2] Due to a technical issue with the survey, one participant did not contribute to the feasibility, acceptability, and usability ratings of the +Connect App.

TABLE 6 | Descriptive statistics for student and SAD groups across loneliness and secondary outcomes.

Measure	Students (n = 11)			SAD (n = 9)		
	Baseline *M(SD)*	Post-treatment *M(SD)*	3-month Follow-up *M(SD)*	Baseline *M(SD)*	Post-treatment *M(SD)*	3-month Follow-up *M(SD)*
UCLA-LS	48.18(7.85)	42.70(11.61)*	40.40(11.82)*	57.00(5.61)	51.67(6.89)	49.56(7.07)
S-SIAS	29.18(12.34)	21.64(14.00)	22.00(11.96)	43.22(7.56)	37.22(10.49)	34.89(13.80)
CES-D	11.55(7.10)	8.45(7.37)	8.45(6.93)	21.89(7.75)	14.00(5.51)	15.56 (8.88)

**n = 10 because one participant had missing data on item. SAD refers to Social Anxiety Disorder. UCLA-LS refers to University of California Loneliness Scale. S-SIAS refers to straightforward items from Social Anxiety Interaction Scale. CES-D refers to Centre for Epidemiological Studies Depression.*

Student Group Descriptives

The UCLA-LS, S-SIAS, and CES-D scores decreased from baseline to post-intervention and 3 months post intervention.

Social Anxiety Group Descriptives

The UCLA-LS and S-SIAS scores decreased in a linear trend from baseline to 3 months post-intervention for the SAD group. However, CES-D scores decreased from baseline to post-treatment, but scores appeared to regress toward their baseline at the 3-month post-intervention period.

Combined Exploratory Quantitative Outcomes

Across the entire group of participants, loneliness showed a mean negative slope (M = −3.82, 95% Credible Interval [CI] −5.54 – −2.17). On the average, participants' UCLA-LS scores decreased by 7.64 points (where the standard deviation at baseline was 8.11) by follow-up, suggesting a large effect (Cohen's d = 0.94). If anything, results were stronger for students than the group overall (M = −4.38, 95% CI −8.45 – −0.66, d = 1.12, based on an SD of 7.84). The effect appeared similar in size, although it had a wider confidence interval for the group of participants with SAD (M = −3.39, 95% CI −7.61 – 0.41, d = 1.20, based on an SD of 5.61). In each analysis, the slope had a significant variance, indicating meaningful variation in how participants responded to the intervention.

Qualitative App Outcomes

In interviews, 75% of the participants reported at least one positive outcome from using the app. These primarily included increased positive affect (e.g., "*When I was using it more regularly … I felt a lot more happy with myself*") and improved social interactions (e.g., "*I know more friends and can talk with them more.*"). Four participants (n_{clin} = 2, n_{control} = 2) reported no positive outcomes from using the app, (e.g., "*it only takes up such a small part of your day that it's not like it changed my lifestyle in any big dramatic way*"). No participants reported negative outcomes from using the app. Positive outcomes seemed to be driven by three main processes induced by the app: 1) reflection (n_{clin} = 5, n_{control} = 5); 2) learning (n_{clin} = 6, n_{control} = 8); and 3) real-life application (n_{clin} = 4, n_{control} = 5).

Reflection

This factor seemed to be the primary process underlying the increase in positive affect reported by participants, e.g., "*I don't really tend to reflect on stuff that much and it helped me to go 'oh, I could do that, and it would be productive'.*" Participants reported using the challenges, video content, and mood logs as ways of stimulating reflection.

Learning

In terms of learning processes, while videos were the main source of psychoeducational information, several participants (n_{clin} = 4, n_{control} = 3) highlighted the key role of the after-video questions in their learning process, i.e., "*The questions were definitely good. They were definitely smart because they made you, made you watch the video. You wanted to get them right because you learnt something.*"

Real Life Application

While some participants (n_{clin} = 2, n_{control} = 2) found that the app provided little new knowledge, they nonetheless valued how it provided revision of existing or commonsense knowledge, e.g., "*this stuff you just rarely notice, but it's just a little bit reminder that you should be doing this to people around you.*" This revision often led participants to attempt to apply the lessons in real life, either informally, or more often, through the challenges: "*the challenges … just meant that it became a lot more … like oh 'I can actually take it out into the world and do some of the things it suggested'.*" Participants reported finding this real-life application both rewarding and challenging, i.e., "*I feel like I've, there was a lot of information that at first seemed like common sense, to me, but although it may seem like common sense, it's actually like important that we know those things because once we actually implement it, it actually makes a difference in our lives,*" "*Challenging? Trying to put it into real life context. And actually do it.*"

Three clinical participants reported an intent to apply +Connect skills in future social interactions, primarily due to a lack of current opportunities to apply the skills, e.g., "*because I don't really have any friends or relationships [the app is] not relevant to me right now … But I feel like if I got a relationship it would be helpful. I definitely learned a lot, and I did take quite a bit of stuff from it.*"

Usability

We measured variables related to functionality, design, and delivery of concepts in order to better design a second iterative version of +Connect. **Student group usability.** Overall, students found +Connect to be a usable smartphone application with 72.72% to 100% of participants rating that they *agree* or *extremely agree* that +Connect was easy to navigate, the format made sense, and that the language was easy to understand. Similarly, 72.72% to 100% rated that they *agree* or *extremely agree* that they liked the color scheme, fonts, photos, and videos. This was only partially supported by student participants' qualitative feedback, with the majority of suggestions for app improvement relation to app navigation and design ($n = 8$)[3]. Student participants also reported finding the app questions were too easy ($n = 6$) and reporting being able to answer them correctly without watching the videos. They suggested increasing the difficulty of the questions in future versions. Around 27% of students did not enjoy challenges within the app, indicating that some work is required to improve the challenges (see **Table 7** for more details). **Social anxiety group usability.** Participants with SAD found +Connect to be a usable smartphone application as indicated by 100% of participants rating that they *agree* or *extremely agree* that +Connect was easy to navigate, the format made sense, and that the language was easy to understand. Furthermore, 62.50% to 87.50% of the participants rated that they *agree* or *extremely agree* that they liked the color scheme, fonts, photos, and videos. The qualitative feedback of the participants with SAD mirrored that of the student participants in conflicting with the quantitative results; five participants with SAD suggested improvements in app navigation and design, and five reported that the app questions were too easy. Similar to students, those with SAD did not find challenges particularly enjoyable. Furthermore, almost 50% of those with SAD reported that they did not find the badge reward scheduling system encourage participation, suggesting that a different reward schedule either by item or reward schedules will need to be revised (see **Table 8** for more details).

DISCUSSION

Key Findings

+Connect is a digital intervention designed to target loneliness in young people. Because loneliness is more related to the quality of relationships as opposed to quantity, we employed a positive psychology approach to help young people identify their strengths, increase their positive affect, and focus on building the intimacy within existing relationships. We piloted the tool in both lonely young people with and without social anxiety disorder.

Overall, we found higher acceptability ratings across different ratings (e.g., ease of understanding, enjoyment in life) in a nonclinical lonely student group compared with those with SAD, i.e., > 70% in the student group vs 50% in the SAD group reported higher than somewhat in their satisfaction ratings. Specifically, those with SAD reported that they did not feel that +Connect helped them create new relationships or increase social confidence. While +Connect was not intended to create new relationships (rather the focus is on increasing the quality of existing relationships), it is important to consider modifying the app to assist young people with SAD because social interactions, including those suggested within the app, are likely to be significantly more difficult for them.

In the qualitative interview, at least four participants with SAD reported that they preferred actor videos over shared experience videos even though 87.5% of the group rated the shared experience videos as somewhat useful (see **Supplementary Table 4** for more details). All students found the shared experience videos more than somewhat useful and enjoyable. While previous studies that have found that content featuring people with lived experiences is highly acceptable to mental health consumers with similar experiences (49, 63), our findings also indicate that shared experience videos may also be useful for those without a mental illness, as long as the experience being portrayed is shared (in this case, loneliness). Expert videos (i.e., academics speaking to the audience) were the least enjoyable, which suggest that videos that provided either background or summary information should be relayed in a more youth-friendly format. Focus groups with young people with or without a mental disorder have already been engaged in the next iteration and have given feedback on how to relay seemingly useful but mundane information within animated videos instead of messages from video-recorded experts.

One strength of this study was the ability to triangulate qualitative and quantitative data to deepen our understanding of participants' experiences using the app. For example, while satisfaction ratings for different video types would suggest that, overall, both participant groups preferred the shared experience videos, the in-depth interview data suggests that participants with SAD were split almost equally on their preference for shared experience or actor videos, while student participants were split almost equally between shared experience, actor, and expert videos. Further, their feedback provided a more nuanced understanding of the differences in video scores for "useful" versus "enjoyable." Participants seemed to prefer actor videos based on the quality of the learning experience (i.e., usefulness), despite reporting them as less enjoyable. This suggests that useful content is more important to users than enjoyable content.

Uptake of the app was 91% and 87%, respectively, for students and those with SAD. While uptake was high for both groups, the SAD group had a higher attrition rate of 30.76% compared with half of that with those with no mental health disorders at 15.38%. However, for those who were retained, both groups completed more than 70% of the program. While the consumer-focused guidance within its development phase may have contributed to both acceptability and feasibility ratings, these findings suggest that clinicians and researchers have to think more deeply about how to engage those with SAD in digital interventions. Fortunately, +Connect was assessed to be safe for young people with or without SAD. While the study was underpowered to determine any meaningful difference pre-post, the evidence of a generally positive effect in quantitative ratings was consistent with qualitative data. No participant reported negative outcomes, and positive outcomes were driven by reflection, learning, and real-life application processes. In our exploratory analyses, we found that +Connect was more likely to benefit, or at least not cause any harm, to young people.

In order to ensure that feedback from this proof-of-concept trial can enhance the participant's experience in future versions, we assessed its usability, and results indicated that participants

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[3] Further app design feedback primarily focused on app design and navigation, additional content, additional notifications, increased login flexibility, gamification, and additional opportunities for social interaction. A list of participant improvement suggestions is provided in **Supplementary Table 4**.

TABLE 7 | Ratings related to functionality, design, and delivery of concepts for the student group.

Question	Extremely Disagree		Disagree		Neutral		Agree		Extremely Agree	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Acceptability										
Enjoyed using +Connect	0	0%	0	0%	2	18.18%	6	54.55%	3	27.27%
+Connect was useful	0	0%	0	0%	2	18.18%	5	45.45%	4	36.36%
Enjoyed content	0	0%	0	0%	2	18.18%	5	45.45%	4	36.36%
Understand the ideas	0	0%	0	0%	1	9.09%	2	18.18%	8	72.73%
Gained a lot	0	0%	0	0%	3	27.27%	6	54.55%	2	18.18%
Could relate to content	0	0%	0	0%	1	9.09%	5	45.45%	5	45.45%
Relate to characters	0	0%	0	0%	0	0%	9	81.82%	2	18.18%
Videos helped with content	0	0%	0	0%	0	0%	7	63.64%	4	36.37%
Videos were entertaining	0	0%	0	0%	2	18.18%	6	54.55%	3	27.27%
Questions helped with content	0	0%	0	0%	2	18.18%	6	54.55%	3	27.27%
Questions were the right level of difficulty	1	9.09%	0	0%	1	9.09%	4	36.37%	5	45.45%
Enjoyed challenges	1	9.09%	2	18.18%	0	0%	4	36.37%	4	36.37%
Badges encouraged participation	1	9.09%	0	0%	3	27.27%	3	27.27%	4	36.36%
Usability										
Easy to Navigate	–	–	1	9.09%	0	0%	7	63.63%	3	27.27%
Format made sense	–	–	1	9.09%	1	9.09%	6	54.54%	3	27.27%
Language is easy to understand	–	–	–	–	0	0%	6	54.54%	5	45.45%
Liked color scheme	–	–	–	–	3	27.27%	5	45.45%	3	27.27%
Liked Fonts	–	–	–	–	3	27.27%	6	54.54%	2	18.18%
Liked Photos	–	–	–	–	3	27.27%	6	54.54%	2	18.18%
Content is interesting	–	–	–	–	3	27.27%	5	45.45%	3	27.27%
Liked Videos	–	–	–	–	0	0%	10	90.91%	1	9.09%

found its format easy to navigate and the language easy to understand. Challenges presented in the app, however, may appear overwhelming for both groups, in that challenges were perceived as either time consuming or effortful. Furthermore, the current badge gamification system may require further revision, to encourage participation, with a participant with SAD suggesting changing reward schedules and a student noting that it was not motivating enough.

TABLE 8 | Ratings related to functionality, design, and delivery of concepts for the SAD group.

Question	Extremely Disagree		Disagree		Neutral		Agree		Extremely Agree	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Acceptability										
Enjoyed using +Connect	0	0%	0	0%	2	25.00%	5	62.50%	1	12.50%
+Connect was useful	0	0%	0	0%	0	0%	6	75.00%	2	25.00%
Enjoyed content	0	0%	0	0%	1	12.50%	5	62.50%	2	25.00%
Understand the ideas	0	0%	0	0%	1	12.50%	3	37.50%	4	50.00%
Gained a lot[a]	0	0%	1	12.50%	1	12.50%	5	62.50%	0	0%
Could relate to content	0	0%	0	0%	0	0%	8	100.00%	0	0%
Relate to characters	0	0%	0	0%	0	0%	6	75.00%	2	25.00%
Videos helped with content	0	0%	0	0%	0	0%	6	75.00%	2	25.00%
Videos were entertaining	0	0%	2	25.00%	2	25.00%	3	37.50%	1	12.50%
Questions helped with content	0	0%	0	0%	0	0%	7	87.50%	1	12.50%
Questions were the right level of difficulty	1	12.50%	1	12.50%	1	12.50	3	37.50%	2	25.00%
Enjoyed challenges	0	0%	1	12.50%	4	50.00	3	37.50%	0	0%
Badges encouraged participation	3	37.50%	1	12.50%	0	0%	4	50.00%	0	0%
Usability										
Easy to navigate	0	0%	0	0%	0	0%	4	50.00%	4	50.00%
Format made sense	0	0%	0	0%	0	0%	5	62.50%	3	37.50%
Language is easy to understand	0	0%	0	0%	0	0%	3	37.50%	5	62.50%
Liked color scheme	0	0%	0	0%	2	25.00%	5	62.50%	1	12.50%
Liked fonts	0	0%	1	12.50%	2	25.00%	2	25.00%	3	37.50%
Liked photos	0	0%	0	0%	1	12.50%	5	62.50%	2	25.00%
Content is interesting	0	0%	0	0%	2	25.00%	4	50.00%	2	25.00%
Liked videos	0	0%	0	0%	1	12.50%	4	50.00%	3	37.50%

SAD refers to Social Anxiety Disorder.

Study Limitations and Future Directions

First, this study is statistically underpowered to determine the significant effects of pre-post intervention. However, our findings are supported by qualitative data that will assist in revising the app for use in a well-powered randomized control trial. There were several reasons related to the small *N*, which contributed to poor recruitment of young people with SAD: 1) there was change in management and clinician turnover at the recruitment site; 2) young people with SAD were particularly difficult to recruit, plausibly due to a high social avoidance of services.

Second, it is important to take into account that many research studies offer reimbursement to offset any potential costs the participant may incur during the study. In this case, participants were reimbursed to offset potential costs when logging into the app outside WIFI networks. While the completion of this program (84.66% to 90.26%) was high, it is unclear whether engagement with +Connect would be different in “real-world” settings.

Last, +Connect is merely a tool to deliver information to young people. A more tailored approach to assist young people to translate these skills to real life may be required for at least some young people. Such an approach may involve more clinician or peer interaction within safe and moderated chatrooms. Alternatively, the app might ask users for feedback about challenges, leading to a more titrated, multi-step approach for participants who rate challenges as unachievable for them. A more tailored approach may be especially helpful for young people who are lonely, with co-occurring mental ill health or clinical mental disorders. Feedback taken from this proof-of-concept app can be used to develop a second iterative version, with a focus on increasing therapeutic outcomes and improving engagement.

Conclusion

Our proof-of-concept app +Connect was developed with an aim of addressing loneliness severity in young people. The development involved consumers aged 18 to 25 with or without a mental health disorder. In this pilot mixed methods study, we focused on pilot primary outcomes such as acceptability, feasibility, and safety; next, we explored the potential outcomes of the pilot. Our findings suggest that those with SAD may benefit from such interventions but may require more tailored support within the app in order to address attrition. Together with quantitative and qualitative data, there is a rationale to do further work such as modifying +Connect and examining its effectiveness within a pilot randomized controlled trial.

DATA AVAILABILITY

The datasets generated for this study are available on request to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors made a significant contribution to this manuscript. ML holds all chief investigator duties, including app development, study design, and write-up of this manuscript. TR contributed to the development of the app content, statistical analyses, and the write-up of this manuscript. RE was the postdoctoral research fellow in charge of the recruitment, contributed to the statistical analyses, and the write-up of this manuscript. KL contributed to the qualitative analysis. DP contributed to the development of the app content and the write-up of this manuscript. JG contributed to the development of the app content and the write-up of this manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2019.00604/full#supplementary-material

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What Would Digital Early Intervention for Bipolar Disorder Look Like? Theoretical and Translational Considerations for Future Therapies

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There are growing calls for the development of early intervention/preventive interventions for young people identified to be at risk of bipolar disorder (BD), and digital delivery appears to be a strong candidate delivery method. To date, no such interventions exist, and the aim of this perspective paper is to advance the literature by reviewing theoretical issues related to early intervention in BD and introducing a framework for design of feasible, acceptable, and effective online psychosocial interventions for this population. It is concluded that, by adopting an appropriate transdiagnostic and humanistic framework, and recognizing emerging tenets of digital psychotherapy development, testable online interventions for young people at risk of BD are within reach.

Keywords: engagement, agency, transdiagnostic, online, smartphone, staging, co-design, resilience

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Bipolar disorder (BD) is a serious mental illness affecting half a million Australians (1) and 2–3% of the world's population (2). Prominent commentators are calling for the development of early intervention/preventive approaches to mitigate the significant morbidity and mortality associated with BD [e.g., Refs. (3–5)].[1] Digital delivery platforms are receiving growing attention for established BD [e.g., Refs. (6–10)] but have not yet been applied in the early intervention domain. The aim of this paper is to take the next step toward online early intervention for BD by doing some prerequisite conceptual work. Firstly, existing data relevant to the potential of digital early intervention in BD are briefly summarized. Secondly, theoretical considerations for early intervention in BD are introduced, leading to three assertions about the optimal approach for those at elevated risk of BD. Finally, translational considerations are canvassed in a novel intervention design framework, the final stage of which is a co-design process with consumers.

DIGITAL EARLY INTERVENTION FOR BIPOLAR DISORDER: SOME RELEVANT DATA

To date, no digital early interventions have been developed for populations at risk of BD. However, triangulated findings from three cognate literatures suggest that digital platforms have potential as a modality for early psychological intervention in BD. Firstly, there is meta-analytic evidence that effective psychological treatments for young people *with, and at risk for, major depressive disorder* can

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[1] For the present purposes, the phrase "early intervention" is preferred over "prevention" because a) from a staging perspective, people with elevated risk of a future diagnosis of BD (through, e.g., family history and nonspecific symptoms) can be viewed as being on the developmental spectrum of BD, and b) the goals of optimal intervention in this population are much broader than prevention of a future specific BD diagnosis.

be effectively and safely delivered digitally [see Refs. (11–13)]. In a recent review, Hollis and colleagues note that many questions remain in this nascent literature but conclude that digital health interventions hold "huge potential for widening access, increasing efficiency and improving healthcare outcomes" (14, p. 498). Secondly, a recent systematic review of early intervention for BD identified seven studies of *face-to-face psychological treatments* (15), with broadly positive findings for a range of outcomes. The existing literature has significant limitations, however: only two randomized controlled trials have been published, and the majority of studies have simply translated treatments for established BD, rather than testing bespoke interventions for early intervention in young adults (the emphasis here). Finally, online therapy as an adjunctive psychosocial treatment for *established BD* has been tested in a small number of trials, with generally positive findings on at least some outcome measures [e.g., Refs. (8, 9, 16, 17)]. Critically, our group has completed an international online trial of mindfulness-based therapy in late-stage BD with no reportable adverse events, providing some confidence about the safety of remote psychotherapy delivery in BD (18).

Arguments for the potential utility of digital delivery of mental health interventions include evidence for comparable effect sizes to face-to-face for many conditions, cost, and access (6, 19). Access considerations are particularly compelling in BD because less than half of people on the BD spectrum worldwide currently receive treatment of any kind (2). In combination with the empirical literature reviewed here, then, it can be concluded that there are strong *a priori* grounds for developing and testing digital early interventions for BD.

THEORETICAL CONTEXT OF EARLY INTERVENTION IN BIPOLAR DISORDER

Early Intervention and Stage-Tailoring

The rationale for early intervention in mental health is well accepted. As reviewed by Arango and colleagues (20), for example, existing research supports two major conclusions: there is increasing evidence for the benefits of universal and selective preventive interventions; and interventions targeting subthreshold presentations (indicated prevention) have potential to improve trajectories. In the domain of BD specifically, Vieta and colleagues recently proposed that early phases of the disorder may be more responsive to treatment and require less aggressive intervention, that there is an "at-risk" mental state for BD that can be used for indicated prevention, and that specific biological, environmental, and dimensional risk factors may be modifiable during this critical window (5).

The call for early intervention in BD overlaps conceptually with interest in stage-tailoring of treatments for BD. Several (largely compatible) clinical staging models have been described to capture the key features of BD within putative stages. These refer to an initial asymptomatic at-risk stage, followed by a stage characterized by nonspecific symptoms, and then a stage with more specific mood disorder-related, but subsyndromal symptoms. A syndromal stage, usually referred to as clinical stage 2, then follows, wherein mood episodes meet recognized diagnostic criteria and functional impacts begin to emerge followed by stage 3, where a repeated pattern of recurrences and relapses is common. The final or end stage (stage 4) is characterized by chronicity manifested by treatment refractoriness and progressively more severe functional impacts. Berk and colleagues (21) highlight the role of accumulating mood episodes and associated functional impairments. A related model proposed by Kapczinski and colleagues (22) prioritizes interepisodic functional and cognitive decrements as BD progresses.

Like the push for early intervention, enthusiasm for the staging approach in BD must be tempered by limited understanding of BD trajectories [see Ref. (23)]. Indeed, the notion that BD can be understood as a staged disorder is contentious [see Refs. (24, 25)]. Concerns about the staging heuristic include the potential for unproductive medication use [(26); see also Ref. (27)] and promulgation of the potentially demoralizing neuroprogression hypothesis [see Ref. (28)].[2] Such concerns are particularly relevant to those "stages" falling early in the life course, given our incomplete understanding of the long-term effects of mood stabilizers on the developing brain [see Ref. (29)] and the potential to iatrogenically reinforce self-stigma and passivity (30–32).

A consequence of our imperfect developmental understanding of BD is lack of consensus on the best target population(s) for early intervention (33). Many studies to date have included family history as a risk factor (15), but the positive and negative predictive value of this criterion is limited, and so samples have often been "clinically enriched" by the presence of symptoms. Some research has focused on young people who are already presenting with hypo/manic symptomatology [e.g., Ref. (34)] or a less severe BD diagnosis (35). Research is ongoing to determine which clinical, social, and environmental factors may be associated with the development of BD for those at high familial risk [e.g., Ref. (36)]. The question of to whom should early intervention be offered (and consequently the specific targets of such intervention) has also been influenced by emerging transdiagnostic approaches (discussion later).

Three Principles of Early Intervention: Minimize Harm, Attend to Transdiagnostic and Diagnostic Concerns, and Embrace Teleology

A tension therefore exists between two face-valid propositions about early intervention in BD—prompt attention to early signs could improve clinical outcomes, but without solid biopsychosocial understandings of disorder trajectories and treatment impacts, we are in danger of causing harm. I believe we can progress by acknowledging three principles of early intervention in BD.

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[2] I have previously highlighted the dispiriting and unwarranted (cancer-related) terminology currently used in BD staging research (28). As an alternative to 'stage', we have proposed the term, 'experience with BD'(ranging from limited to substantial) which is both less dispiriting, and avoids unsupported connotations about the nature of BD's trajectory.

First and foremost, early intervention attempts must attend to harm/benefit ratios. Given their more benign side-effect profiles, there is a consensus that any early intervention attempts should therefore privilege psychotherapies over pharmacotherapies [e.g., Ref. (37)]. Pragmatically, it has also been noted that young people are reticent to take medications for even diagnosed mental disorders, and clinicians are reticent to prescribe them (3). On the other hand, there is evidence that delay in instantiating first-line pharmacological treatments for BD is associated with negative outcomes (38). Taken together, these arguments suggest that interventions with stepped/sequential components may be optimal, with *adjunctive medication treatment* reserved for those who deteriorate or experience a diagnosable BD episode [for an example of one trial based around these principles, see Ref. (39)]. The focus of the present paper is the first, psychosocial step in this approach.

Secondly, it is useful to recognize a spectrum of specificity of problems/symptoms in populations at risk for BD, ranging for example, from nonspecific anxiety, through sleep/circadian problems, to relatively specific subsyndromal hypomania. In this vein, McGorry and colleagues argue that prevention/early intervention efforts must recognize pervasive pluripotence in psychopathology and so be organized around a broad range of inputs and outputs [e.g., Ref. (33)]. According to the Clinical High At Risk Mental State (CHARMS) (33) paradigm, inputs requiring attention are both disorder specific (family history of diagnosis, subsyndromal states, etc.) and transdiagnostic (e.g., functional decline). Similarly, outputs warranting attention should cover a range of target syndromes and problems. In translation, this paradigm would involve identifying distressed and help-seeking young people and targeting their presenting symptomatology (rather than any particular syndrome or proto-syndrome). The term "resilience" does useful work here (40, 41)—such transdiagnostic interventions are designed to address current issues and concomitantly build resilience against a range of negative health outcomes, including onset of frank BD.[3]

Finally, it is critical to expand our thinking beyond a medical paradigm, to explicitly recognize young people as motivated agents. The positive psychology [e.g., Ref. (42)] and recovery paradigms [e.g., Ref. (43)] remind us that a medical focus is only one side of the mental health coin. Complementary priorities are more explicitly teleological [explaining behavior by the outcomes it is intended to achieve, see Ref. (44)] and humanistic [prioritizing positive motivations and agency rather than abnormality and illness, see Ref. (45)] and, as such, will be particularly relevant in engaging young people with early intervention. Developmental psychopathology reminds us that young people at risk of BD are in a particular developmental window, working to optimize their well-being through completion of common developmental tasks [see, e.g., Refs. (46, 47)]. These theoretical observations have a very pragmatic implication—overlooking young people's subjective quality of life (QoL) and meaning-making motivations will threaten engagement with any intervention we offer (46, 48, 49). Beyond the aim of improved resilience, then, early intervention can and should support young people building richness into their lives.

In sum, three principles can help navigate tensions between threats and opportunities in early intervention for BD. As we will see later, the various therapeutic targets implied by these principles can be addressed by a hybrid digital intervention drawing from existing evidence-informed psychosocial interventions.

CONSIDERATIONS IN DEVELOPING AN ONLINE INTERVENTION FOR YOUNG PEOPLE AT RISK OF BD

There is clearly room for innovation in the space of digital early psychosocial intervention for BD. To support the translation of these principles, this section introduces an intervention design framework for future online interventions (**Figure 1**). It was noted earlier that a variety of subpopulations could be targeted as at risk for BD: To simplify the present exposition, "at risk" is defined as family history of BD, plus the presence of distress (with or without help-seeking behavior).[4]

Following best practice, the design framework identifies specific, malleable causal factors (see **Figure 2**), a change mechanism (individual therapies with a recovery focus), and mode of delivery (email-supported web-delivery with social network components). The framework is evidence-informed, insomuch as it synthesises existing BD research into novel adjunctive psychotherapies (6, 28, 52, 53), technological delivery (18, 54), stage-tailoring (9), QoL outcomes (55–57), strengths (49, 58–60), co-design, and community-based participatory research (61). Note that the final level in the framework of **Figure 1** is co-design with consumers: the aim here is not to present a completed intervention, but to present a framework that can form the foundation of a future co-design process to develop such an intervention.[5]

Personalised Content

The theoretical review presented above suggests that early intervention for young people at risk of BD should have hybrid targets including symptoms and syndromes linked specifically to BD, common nonspecific distress and problems of stage 1 BD, and also positive goals of QoL, and personally meaningful developmental goals. Summarized in **Figure 2** are approaches to achieving these diverse ends using modularized web-based delivery of evidence-based therapy components.

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[3] From a strong transdiagnostic perspective, it might be argued that the population of interest in this paper (young people at risk of BD) does not warrant delineation at all. However, existing literature provides grounds for a hybrid transdiagnostic/diagnostic approach, and we would be needlessly ignoring (relatively) BD-specific information (the importance of sleep and circadian stability, the ambiguity of elevated mood states, family history of BD diagnosis, etc.) if we adopted a fully diagnosis-blind approach.

[4] The design of an early intervention for BD will depend on the nature and definition of the risk population to which it is offered. The clinical aim of, specifically, preventing transition to BD in high-risk young people has generated a small literature on quantifying this particular risk [see Refs. (50, 51)].

[5] The co-design process could lead to refinement of the considerations presented here, and different co-design processes could lead to different testable interventions.

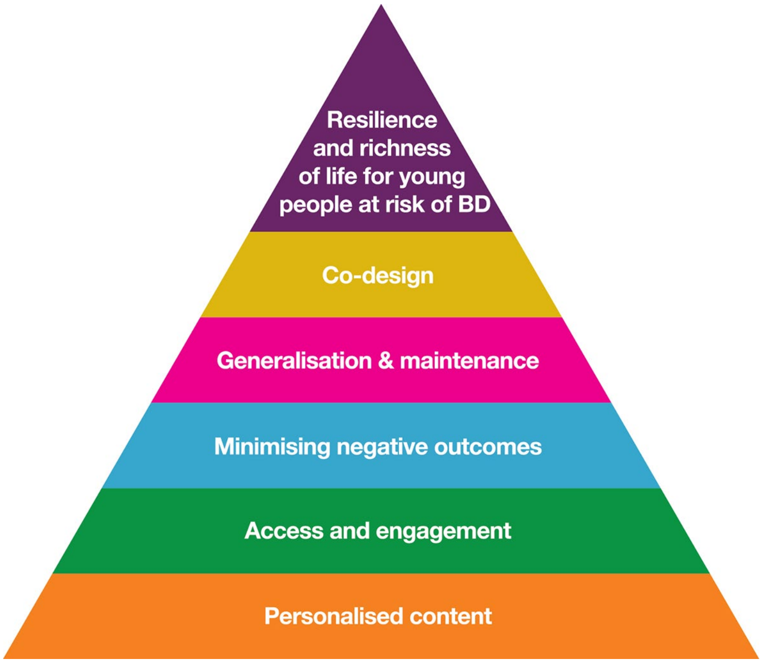

FIGURE 1 | Intervention design framework for feasible, acceptable, and effective online intervention for young people at risk of BD.

A critical target of early intervention attempts is prevention of hypomanic and manic episodes.[6] Evidence-based therapies for established BD include development of knowledge and skills around personal relapse triggers and responding early to signs of impending relapse into a mood episode (62, 63). In early intervention, this "relapse prevention training" could be repurposed as "hypo/mania onset prevention training" through an interactive psychoeducation online module. Web delivery can also facilitate daily mood monitoring [e.g., *via* automatic generation of mood charts, see for example, Ref. (18)]. An exciting potential addition to monitoring self-reported mood is the integration of passive objective monitoring of activity *via* actigraphy (64–66), a technology that will likely be ready for clinical use in the near future. Key to objective monitoring as a clinical tool will be consideration of the human–technology interface: what type of information, in what form, and with what training, is most likely to encourage productive action?

Just as the epidemiology of staging in BD is unclear, the transdiagnostic symptoms and problems likely to be prevalent in this stage 1 population are not well characterized and differ depending on the operationalization of "at risk." Possible transdiagnostic modules would include psychoeducation related to sleep, drugs and alcohol, physical activity and diet, and mental health stigma. Following the CHARMS approach, we note that this population of young people is heterogeneous, and engagement and efficacy demand the inclusion of optional online modules based on the young person's experience (orange circles in **Figure 1**). Existing literature suggests that emotion regulation, anxiety, irritability, subsyndromal hypomanic, depression, and emotion regulation are likely to warrant attention as optional foci of work.

While diagnostic and transdiagnostic content can be addressed didactically through psychoeducation and cognitive-behavioral therapy, strengths-based content could be addressed through online versions of "third wave psychotherapies" (28, 67), with mindfulness and self-compassion strategies having untapped potential for improving QoL in BD (28). The values-based action principles from acceptance and commitment therapy (ACT) (68, 69) would be face-valid for encouraging young people to progress through developmental tasks [some of this content can be directed toward the likely strengths in this population, including creativity and a romantic aesthetic, see Ref. (49)].

Access and Engagement

The great strength, of course, of online intervention is access: the web provides economical access to tailored psychological interventions and can overcome many barriers to accessing psychological assistance for BD, including cost, time, and trust in professionals (6). Online therapies are acceptable to people with established BD (70, 71), and the strengths of digital delivery are particularly pronounced in young adult populations (72).

Contemporary online interventions maximize engagement *via* best practice persuasive system design [see Refs. (54, 73, 74)], including: 1) dialogue support (praise from coach, email reminders, etc.), 2) social support (e.g., moderated forums), and 3) primary task support (modularization of content, personalisation/monitoring of progress, etc.). We have found that presenting content *via* brief (2–3 min) "consumer documentary videos" is a powerful engagement strategy [see Ref. (75)]. Other mature

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[6] The most common trajectory in BD is one or more early depressive episodes, followed by an episode of hypomania or mania that then supports a BD diagnosis.

approaches to digital intervention elevate social network features for their engagement and therapeutic benefits [e.g., Refs. (72, 76)].

A major determinant of engagement is duration, and online therapy designers must juggle the desire for comprehensive topic coverage, attrition risk, and patients' preference not to be hurried through content (9). The co-design process is critical for these decisions, with patients' intuitions complemented by their participation in multiple prototype versions. For example, co-design of our intervention for late stage BD (54) led to a structure in which an initial "active phase" with email coaching support lasting 5 weeks; participants then retained access to the site (without coaching support) for the 6 months of follow-up. Based on our retention rates in that trial, we believe that a slightly longer active phase (e.g., the nine weekly content modules proposed in **Figure 2**) would be feasible and acceptable, but consumer input may modify this prediction.

Finally, intervention design must be sensitive to the fact that the Internet is now most commonly accessed by smartphone, with this device being particularly popular among young people (77, 78). Little is known about how engagement with online therapy content varies by device (79), but not only are smartphones the platform du jour, but they also offer engagement/intervention opportunities not available by website (think ecological momentary assessment and intervention, passive monitoring, etc.). There is reason to think these app-based technologies may be particularly impactful for engagement in young people (14).

Minimizing Risk of and Responding to Clinical Events

The flexibility and reach of online interventions bring with them concerns about risk management (18, 80). We have reported on one successful approach to risk management in online intervention for late-stage BD. Our approach (again, strongly informed by consumer input) explicitly emphasizes patient autonomy and devolution of clinical care to local clinical services (18). A complexity in this strategy is that clinicians overseeing the online therapy may inadvertently come to know about increased risk, requiring some response: we have developed a decision-tree procedure (involving automated and manual components) to address this challenge (54).

Online intervention alone will be insufficient to optimize outcomes for some young people. Stepped care approaches are common in public health [e.g., Refs. (81, 82)], with progression from low- to high-intensity intervention triggered by deterioration/failure to improve. Stepped care has been considered for established BD [see Ref. (83)] and likely has particular relevance in the early intervention context. "Stepping

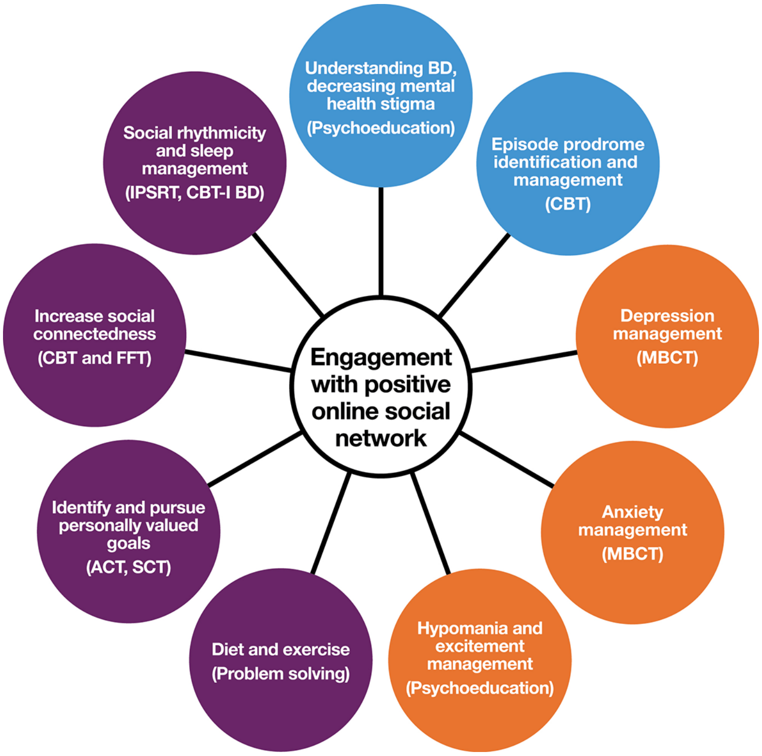

FIGURE 2 | Possible elements of therapeutic content for online early intervention for young people at risk of BD. Blue (BD-specific) and purple (strengths-based targets) are core modules; Orange are optional modules based on young person's current concerns (derived from empirical literature on prevalent problems in high-risk populations, or symptoms elevating risk). CBT, cognitive behavioral therapy; IPSRT, interpersonal and social rhythm therapy; MBCT, mindfulness-based cognitive therapy; ACT, acceptance and commitment therapy; SCT, self-compassion therapy; FFT, family-focused therapy; CBT-I BD, cognitive behavioral therapy for insomnia, modified for BD.

up" for those not benefiting from digitally delivered psychotherapy could include intensive face-to-face psychotherapy and/or introduction of adjunctive pharmacotherapy (84).

Generalization and Maintenance of Treatment Effects

A recognized challenge in psychotherapy delivery (whether face-to-face or digital) is generalization of new skills and insights into everyday life. The potential of smartphones to bridge this gap is significant, and a number of groups are investigating apps (either stand-alone or integrated with web-based modules) as part of mobile monitoring and therapy delivery (85–87). It would be unwise to ignore this technological trend in any future early intervention for BD.

Adopting the "active phase"/"follow-up phase" structure described in the section *Access and Engagement* previously, the follow-up phase, could include periodic booster modules to help maintain therapeutic benefits. Booster modules could provide 1 week of new content, with topics personalized for the individual (based on their preferences, symptoms, and problems remaining at the end of the active phase, etc.).

Co-Design

Research by our group [e.g., Ref. (61)] confirms the common-sense intuition that participatory research methods (involving end-users in all stages of intervention development) not only circumvents translational barriers but helps accelerate novel treatments by testing theoretical and empirically derived ideas against lived experience (88). Here, the systematic co-design phase would complete pieces of work around therapeutic content (refining **Figure 2**) and trial and provide feedback on technology prototypes, participate in design of social networking components, etc.

CONCLUSIONS

I have previously argued that the task of developing online interventions in mental health has little in common with developing face-to-face psychotherapy manuals: Engagement is the sine qua non of digital interventions, and designing an online intervention has much in common with producing a series for Netflix (89). The engagement challenge is particularly pointed in the case of digital natives at risk of, but not diagnosed with, BD. In this population, we cannot assume that "need" is a sufficient driver of engagement, and we must speak to the positive motivations that might lead people to stick with our therapeutic offer. The present perspective paper posits that these engagement-related considerations align neatly with theoretical considerations about early intervention in BD: People at elevated risk of BD must be viewed through a teleological lens that includes their developmental tasks and opportunities, their current psychological challenges, and their risk of future problems (including diagnosable BD). An evidence-informed intervention design framework is offered as a translational tool to support further work in this important domain.

AUTHOR CONTRIBUTIONS

GM conceived and wrote the article.

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PERSPECTIVE
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A Digital Platform Designed for Youth Mental Health Services to Deliver Personalized and Measurement-Based Care

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Mental disorders that commonly emerge during adolescence and young adulthood are associated with substantial immediate burden and risks, as well as potentially imparting lifetime morbidity and premature mortality. While the development of health services that are youth focused and prioritize early intervention has been a critical step forward, an ongoing challenge is the heterogeneous nature of symptom profiles and illness trajectories. Consequently, it is often difficult to provide quality mental health care, at scale, that addresses the broad range of health, social, and functional needs of young people. Here, we describe a new digital platform designed to deliver personalized and measurement-based care. It provides health services and clinicians with the tools to directly address the multidimensional needs of young people. The term "personalized" describes the notion that the assessment of, and the sequence of interventions for, mental disorders are tailored to the young person—and their changing needs over time, while "measurement-based" describes the use of systematic and continuing assessment of a young person's outcomes over the entire course of clinical care. Together, these concepts support a framework for care that transcends a narrow focus on symptom reduction or risk reduction. Instead, it prioritizes a broader focus on enhancing social, health, and physical outcomes for young people and a commitment to tracking these outcomes throughout this key developmental period. Now, with twenty-first century technologies, it is possible to provide health services with the tools needed to deliver quality mental health care.

Keywords: youth, transdiagnostic, mental health care, technology, ehealth, mental disorders, routine outcome monitoring

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INTRODUCTION

Mental disorders present one of the most serious public health challenges in the twenty-first century. Young people (i.e., adolescents and young adults) are particularly vulnerable with over 75% of adult mental disorders emerging before the age of 25 years (1, 2) and over 45% of the total burden of disease for those aged 10–24 years being attributed to mental ill-health (3). The high prevalence of mental disorders during adolescence and young adulthood poses a risk for future health and well-being outcomes precisely due to the timing at which they emerge (4–8). These are the chronic illnesses of young people, and if not adequately addressed, their impact can have effects that endure a lifetime (9, 10).

Consequently, we have seen major revolutions in youth mental health care, which is now set to collide with the technology boom sweeping the health sector where we have already seen a major increase in the number of mobile applications, internet-based resources, and platforms that target mental health problems (11, 12). Many of these promise to transform the way mental health care is delivered and have the potential to overcome many of the traditional barriers to conventional clinic-based care (13, 14). Here, we describe one of these solutions, a digital platform which has been codesigned with lived experience, health professionals, and services to facilitate the delivery of quality mental health care by utilizing two clinical innovations: "personalized" and "measurement-based" care.

PERSONALIZED AND MEASUREMENT-BASED CARE

The past decade has seen a major shift towards early intervention services and preemptive psychiatry. This shift has largely been driven by the recognition that delayed access to care and longer periods of untreated illness contribute to the complexity of treatment, development of chronic mental health problems, and secondary risks, such as function impairment and comorbid alcohol and/or other substance misuse (1, 15–20). Research to date demonstrates that young people presenting to early intervention services typically exhibit a clear need for clinical care, either due to psychological symptoms, functional impairment, or suicidal thoughts and/or behaviors, even when they do not meet traditional criteria for a mental disorder (21–26). This means that effective interventions during this time may prevent or delay the development of mental health disorders and poorer outcomes since trajectories of mental disorders and impairment are often not fixed, but instead malleable to change (27–31).

This challenge has largely driven the development of new personalized approaches (see **Box 1**) for identifying and treating common mental disorders. These approaches aim to be consistent with developmental epidemiology and neurobiology and be useful when applied in everyday clinical practice (32– 35). The World Health Organizations' mental health plan (2017–2020) emphasizes the need for mental health care to transcend the prevailing narrow medical model to address the social determinants of mental health, educational and employment opportunities, and psychosocial disability so that people can achieve their potential for health and participate fully in society. This approach reiterates that, for truly personalized mental health care in young people, a move away from categorically defined disorders toward a focus on clinically meaningful differentiations that improve outcomes are urgently needed (32, 36–38). The importance placed on diverse but related outcomes aligns with the substantial burden associated with these disorders and the needs reported by young people and their families (39, 40).

BOX 1 | The nomenclature of "personalized."

Current uses of the term "personalized" vary depending on the medical discipline and context. A primarily biological and genetic perspective limits its use to describe unique interventions, which have been customized to an individual (e.g., personalized vaccines) (41). In psychiatry, the term personalized has been replaced with terms such as "stratified," to subtype illnesses on the basis of salient treatment-relevant characteristics (36) or "precision" medicine to place greater emphasis on the exactness of measurement (42). A broader, yet related, concept is "person-centered" medicine, which is commonly used to describe a holistic view of the individual with an emphasis on the role of the person in treatment (43). The term "personalized" in this paper aims to encompass various facets from the definitions described above to describe broadly the notion that the assessment of, and the sequence of interventions for, mental disorders are tailored to the individual, and their changing needs over time.

Similarly, measurement-based care as a health service quality improvement strategy may be particularly suited to mental health care. Measurement-based care involves the systematic and continued assessment of an individual's outcomes over the entire course of clinical care. It supports better-informed and highly personalized clinical decisions about treatment throughout the entire episode of illness (44, 45). Many reviews have demonstrated the effectiveness of these approaches including faster symptom improvement and lower likelihood of deterioration during care (46–50). Namely, monitoring an individual's progress during care can reduce deterioration and improve treatment effects by notifying individuals and clinicians of positive and negative changes following a particular treatment (51, 52). This facilitates the opportunity to alter the treatment plan accordingly and actively engage young people (and their families) who may have disengaged or are not adhering to treatment.

When combined with the concept of personalized mental health care, the use of measurement-based care has the potential to improve outcomes in real-world settings (45). This framework differs from manual-based approaches and interventions by moving away from clinical decisions based on the "average" patient to a focus on the individual by routinely monitoring their outcomes. The measurement-based feedback helps to detect unmet care needs and enables the earlier identification of other markers of need. This begins with a broad assessment to get a complete and personalized overview of the young person's health and well-being, avoiding a narrow focus on symptom reduction or risk identification. Secondly, these measurements are repeated overtime across these broad domains to determine specific personalized changes over the course of treatment. Identifying these personalized changes in response to an intervention can help determine whether an intervention should be adapted or whether a change in the outcome focus is needed.

A DIGITAL SOLUTION—THE INNOWELL PLATFORM

The Innowell Platform is a configurable digital tool that aims to facilitate personalized and measurement-based care within a mental health service. It is one of the first platforms developed that puts into practice many of the innovative and emerging models of mental health care discussed internationally (34, 38, 40, 53). While here we focus specifically on young people, the Platform has been designed for, and is used in, a range of other service populations (e.g., children and families, veteran community, and older adults), and many of the concepts discussed below also generalize to these other populations. Importantly, the Platforms design has been informed through an ongoing process of participatory design with lived experience, health professionals, and service staff (including administration and management) across different service populations (e.g., headspace services, Opens Arms veterans and families counseling service) (54), and is the current focus of a clinical trial across these different service settings (55).

The Platform assists with the assessment, feedback, management, and monitoring of their mental ill health and maintenance of well-being by collecting personal and health information from a young person, their clinician(s), and supportive others. This information is stored, scored, and reported back to the young person, their clinicians, and the service provider to promote genuine collaborative care (56, 57). The clinical content is determined by the health service who invites the young person to use the Platform. The Innowell Platform does not provide stand-alone medical or health advice, risk assessment, clinical diagnosis, or treatment. Instead, it guides and supports (but does not direct) young people and their clinicians to decide what may be suitable care options. Importantly, all care aligns with the existing clinical governance (e.g., policies and procedures) of the service provider.

The Platform facilitates personalized and measurement-based care within a mental health service by enhancing key processes, which themselves may not be new, but their combined use and integration with face-to-face services is. Specifically;

Assessment

The assessment uses a multidimensional outcomes framework to cover domains of social and occupational function, self-harm and suicidal thoughts and/or behaviors, physical health and concurrent alcohol and/or other substance misuse, as well as illness type, stage, and trajectory (e.g., symptoms, diagnoses, treatment history) (58). The Platform can present a set of assessments; however, the exact content or makeup of these assessments are configured by the service using the Platform so that the content can be modified to address the needs of any population or setting. The Platform currently contains a library of evidence-based questionnaires for services to choose from, which are commonly used in youth mental health studies and clinical practice (e.g., Overall Anxiety Severity and Impairment Scale, and Kessler Psychological Distress Scale); however, this library will continue to expand as additional questionnaires are added. Also, developmental considerations have been made for younger populations, whereby it is possible to use age appropriate stimuli (e.g., pictures) for assessments.

To achieve a greater level of personalization, these assessments can also be tailored to individuals by demographic (e.g., age, gender) or clinical information (e.g., endorsement of self-harm, depression score). The Platform also facilitates the integration of information collected for other sources; namely, health professionals who might be seeing the young person in face-to-face care, a supportive other(s) (e.g., parent or guardian) who the young person can invite to fill out information about them, or devices (e.g., activity monitors such as Fitbit) to provide a more detailed understanding about underlying pathophysiology and multidimensional outcomes.

Feedback

The dashboard is used to feedback results to the young person, support persons (e.g., family members), clinical services, and clinicians (**Figure 1**). The Platform automatically processes assessment results using a set of algorithms that score and interpret the responses and data. These results are presented on a single page using a set of "cards," which are presented using either gauges (panel **A**) or text (panel **B**). Each card (gauge or text) contains the same type of information (see **Figure 1**); i) "a header" indicating the domain (e.g., depressed mood); ii) "color," which is used to communicate whether a result is good (green) or poor (red); iii) "a descriptor," which provides feedback about the result (e.g., anxiety is high); iv) "a time stamp," which indicates when a domain was last updated (e.g. 5M = 5 months); and v) "a change status" to compare the current result to the previous result (e.g., "no change" or "improvement"). Each "card" aims to summarize a young person's current outcome within a domain, and together, these cards provide an overall view of the totality of needs across each domain within the multidimensional outcomes framework. The use of color and presenting these cards altogether facilitates the ease and efficiency of quickly understanding where the areas of high or low concern might be. These cards can be reordered by the young person to reflect their preferences regarding which domains are particularly important to them versus those that are less important (see **Figure 1**, panel **B**). This is an important feature that indicates how the Platform can be used to facilitate communication between the young person and health professional for the management of their mental ill-health and well-being.

Management

The Platform also provides the capacity for shared decision-making between the young person and their support person(s), and health professionals to facilitate the management of mental ill-health. The Platform presents specific care options that are available for the entire range of domains assessed by the assessments and presented on each card on the dashboard. These care options are divided into two categories; "what I can do now," which presents apps or etools that are accessible immediately to a young people; and "what I can do with my clinician," which presents the range of clinical interventions provided by a service that require a clinician or services support to do (**Figure 2**). Each care option is accompanied by a set of actions that facilitate communication between the young person and their clinician(s). For example, these actions may be used by the young person to indicate they are interested in a particular care option

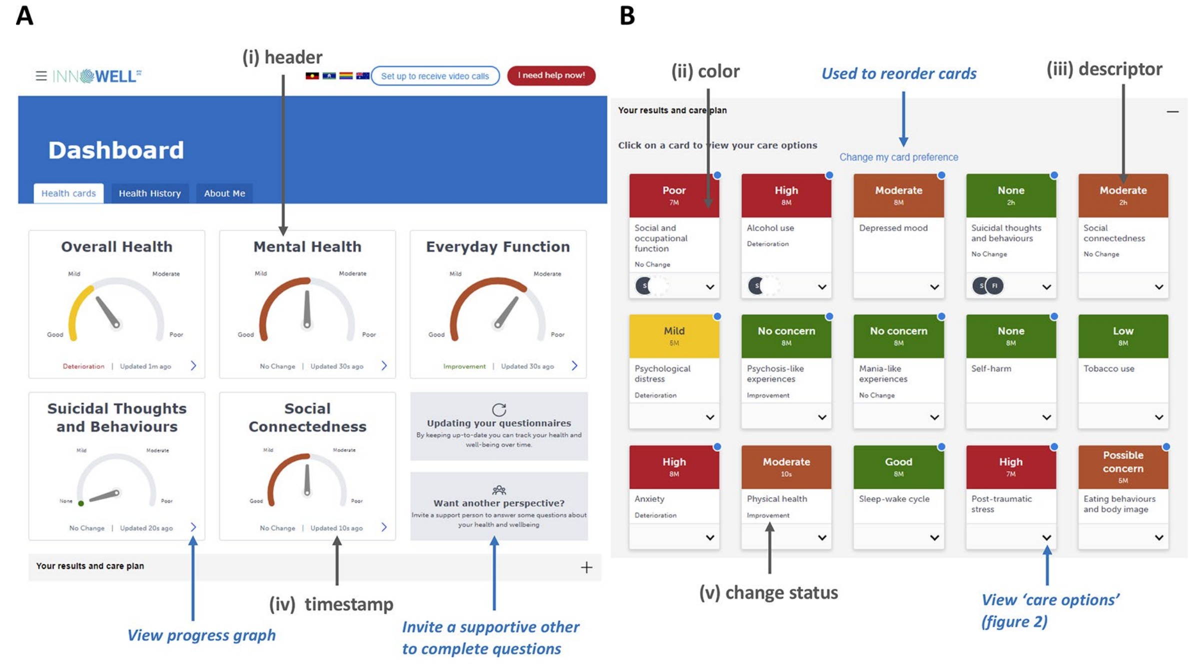


FIGURE 1 | The dashboard of results for the Innowell Platform. Panel **(A)** shows the summary dashboard which provides a broad overview of the young person's results for key health domains. Panel **(B)** shows the more detailed dashboard (i.e., "your results and care plan" section expanded), whereby all of the results from the broad assessment are displayed on different "health cards." Each domain is accompanied by a scale, the current result (represented using color and a dial), and an indication of personalized change. The Platform allows for the customization of specific domains, questions, and algorithms for this section. The use of color here is to make it easier for young people and clinicians to figure out what might be tracking well or not so well. The color is accompanied by a text description (e.g., high) as well as a timing (e.g., 3M, equal to "3 months"), which is used to indicate how recent the current result is. The middle of the health card presents the title and includes the personalized change status in text (e.g., improvement). The circles presented on the "suicidal thoughts and behaviors" health card provides an example of how the Platform communicates whether or not an intervention is currently active for a particular domain. Here, the initials of the treating clinician are displayed along with the young persons initials to indicate they are working on this together. Gray text and arrows highlight key components described the feedback section of this paper; blue text and arrows highlight other key components. Please note that the image presented here displays the Platform as it exists at the date of this publication, and is subject to further development and refinement.

offered by the service [e.g., cognitive behavior therapy (CBT) for depression]. This increases the transparency about who is working with the young person, what the target for intervention is, and how the young person and clinician(s) will work together to address it.

Specific triggers can be set up based on the responses provided during the assessment to help a service manage specific concerns. For example, if a young person reports current suicidal thoughts and/or behaviors, the Platform will present an immediate pop-up that notifies the young person that they can get immediate help from specific helplines or services, and a notification will also be sent to a health professional at the service so that they can respond in an appropriate way (e.g., telephone follow-up, safety planning, schedule a sooner face-to-face appointment). This notification will remain active (e.g., flagged in the Platform) until a response is made by the service. The types of triggers, their thresholds, and service responses to manage them can be configured to meet the specific needs of a service population or setting.

Monitoring

The multidimensional assessment is repeated over time to track changes across multiple domains, and the results for each domain over time are presented in two ways to communicate change. The first is through the use of text (i.e., "improvement," "no change," "deterioration") and color (green text for positive results, red text for negative results) on each card of the dashboard (see **Figure 1**), and the second is through a graphical display, which plots the outcomes for each domain over time. The assessments can be repeated at regular intervals (e.g., every month), whereas there are summary questions (see **Figure 1**, panel A) that can be completed at more regular intervals (e.g., daily) to provide a more fine-grained summary of changes in mental health and functioning.

APPLIED USE WITHIN A MENTAL HEALTH SERVICE

The Innowell Platform enables the delivery of enhanced care that builds on the usual processes provided by the services by facilitating systematic assessment and the promotion of clinical care within multidisciplinary team environments. The application and use of the Innowell Platform within a mental health service will vary depending on the setting and population. Each service has distinct pathways into and out

Care Options

Here are some care options for this health card.
These care options are arranged from those you can do on your own at the top to those you can do with your service provider.
Your service provider will work with you to determine the type of care that is best suited to your needs.

What I can do now...

In progress ✕ Visit

Smiling Mind

An app for practicing guided mindfulness and meditation, to help reduce your anxiety and create a sense of calm. (FREE)

FI You have started

Get started Visit

ReachOut WorryTime

ReachOut WorryTime interrupts repetitive thinking by setting aside your worries to one time of the day, so you don't get caught up in them and can get on with your day. (FREE)

Get started Visit

MindShift

MindShift is an app designed to help teens and young adults shift their anxiety. Rather than trying to avoid anxiety, you can make an important shift and face it. (FREE)

What I can do with my clinician...

Requested ✕

Group therapy for social anxiety

This care option requires your clinician's support

Group-based Cognitive Behavioural Therapy (CBT) that can help you manage the symptoms of social anxiety.

FI Waiting for your clinician

Request this

Psychological therapy for anxiety

This care option requires your clinician's support

Psychological therapy, such as Cognitive Behavioural Therapy (CBT) or Acceptance and Commitment Therapy (ACT) that can help you better manage the thoughts, feelings and behaviours associated with anxiety.

Request this

Medical treatment for anxiety

This care option requires your clinician's support

Medications that can help you manage the symptoms associated with anxiety.

Used to communicate that a young person is using this care option

A direct link to download the app or access the webpage

This care option requires a clinician to assist/arrange

Used to communicate that a young person is interested in this care option

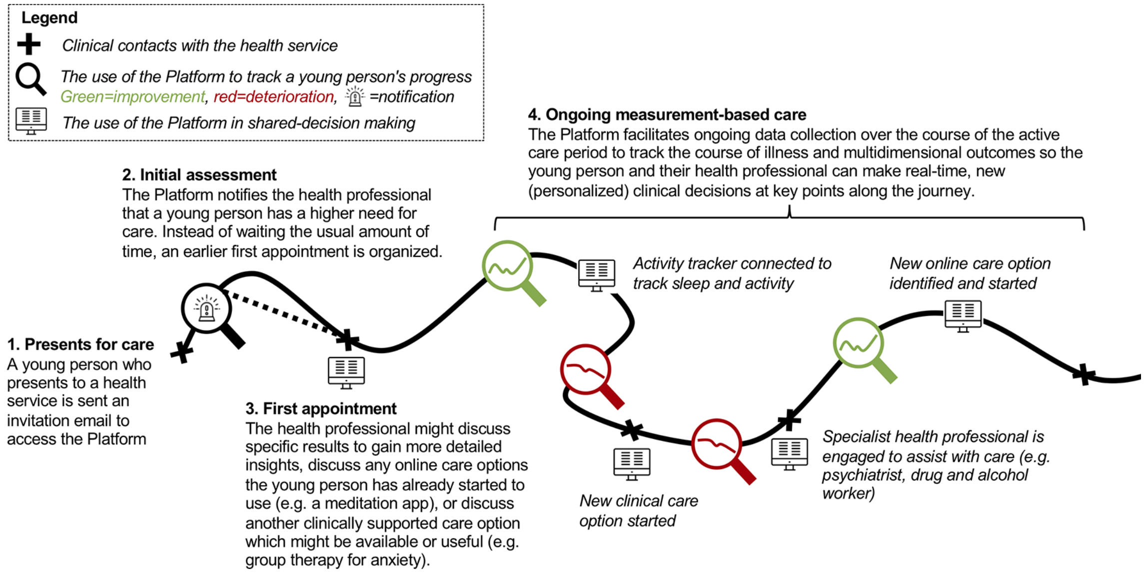
FIGURE 2 | The more detailed view of the dashboard of results, which facilitates shared-care planning and the management of mental ill-health. The figure presents the care options that are available for this particular domain and shows how the blue buttons can be used to facilitate shared decision-making. These care options are customized according the health service using the Platform, so that it accurately reflects their clinical offering. Each care option is accompanied by a title, a description, an action button, and a status icon on the bottom left. Specific actions can be performed for these care options using the buttons on the right of each care option. In this example, the circle with an "FI" on the "smiling mind" care option is used to indicate that this young person has started to use the app to address their anxiety. The circle with an "FI" and dotted circle on the "group therapy for social anxiety" care option is used to indicate that the young person is interested in this intervention and would like to speak to their clinician about it. Please note that the image presented here displays the Platform as it exists at the date of this publication, and is subject to further development and refinement.

of care and will vary in terms of their service offering. This means that how the Platform is specifically used by a service is determined on a case-by-case basis through an ongoing process of implementation, which involves understanding and mapping the care pathways for a mental health service and asking the critical question: how can each of the components (i.e., assessment, feedback, management, and monitoring) be used to enhance those pathways? For illustration purposes, a commonly used model for how the Platform is used by young people and health professionals is provided in **Figure 3**. The figure shows how technology can be used to enable typical care pathways and processes by improving the personalization and use of measurements to guide clinical decision-making.

Since young people are more likely to present with multidimensional needs (59), health service strategies should be in place to identify and respond to a range of health, educational, employment, and social issues (60). Here, services can make use of the Platforms assessments at initial presentation and over time to identify known predictors of outcomes or subgroups of individuals who have differential care needs. A higher severity of needs tends to be associated with poorer outcomes over time, and so strategies that address these problems may be able to improve long-term outcomes (61). A recent systematic review demonstrated that of the few studies that assessed multiple health domains (e.g., mental health, alcohol use, sleep) in primary care, screening facilitated the opportunity to provide targeted interventions and led to better health outcomes (62, 63).

Previous prototypic work demonstrates the utility of the Platform, integrated with a youth mental health service, to enable an appropriate and timely response for young people reporting higher levels of suicidality (64). The use of the Platform meant that clinicians could utilize the clinical details from the multidimensional assessment, such as the presence of comorbid issues, and a history of suicide plans and attempts to make informed clinical decisions. Further prototypic work also demonstrated how it can also be used to more broadly assess the totality of a young person's needs before a one-on-one assessment (face-to-face or video visit) and enable clinicians to move away from traditional evaluations towards more detailed data-driven assessments (65).

The Platform facilitates the development and evaluation of specific, integrated care packages across multiple domains, which may be needed to reduce the morbidity and mortality due to mental disorders (66, 67). Inherent in these approaches is moving beyond symptom and risk management to an emphasis on improving outcomes and reduce secondary risks. These approaches are particularly suitable for young people with many co-occurring conditions since interventions can be effectively coordinated in a way that addresses their complex needs (68). This also facilitates the use of integrated or conceptual unified approaches that incorporate multiple sources of information about causal or maintaining factors to develop interventions that target these processes (69, 70). Some patients do deteriorate during treatment, and some require long-term care, so being able to identify an individual's



1. Presents for care
A young person who presents to a health service is sent an invitation email to access the Platform

2. Initial assessment
The Platform notifies the health professional that a young person has a higher need for care. Instead of waiting the usual amount of time, an earlier first appointment is organized.

3. First appointment
The health professional might discuss specific results to gain more detailed insights, discuss any online care options the young person has already started to use (e.g. a meditation app), or discuss another clinically supported care option which might be available or useful (e.g. group therapy for anxiety).

4. Ongoing measurement-based care
The Platform facilitates ongoing data collection over the course of the active care period to track the course of illness and multidimensional outcomes so the young person and their health professional can make real-time, new (personalized) clinical decisions at key points along the journey.

FIGURE 3 | Illustrative example of a young person's journey through care. The figure shows how the Platform can be used at different points along the care journey to facilitate measurement-based care to drive personalized treatment decisions. Specifically, in this example, the Platform is being used at entry to care to identify young people reporting higher levels of suicidality, who may need to "skip" the waitlist. The first appointment (much like proceeding clinical contacts) can be used to engage in usual face-to-face clinical care or enhanced by the Platform enhanced by the Platform (as described in point 3 above). As care progresses, ongoing data collection and tracking are used to make personalized treatment decisions, such as connecting to an activity tracker to better understand a young person's sleep wake cycle in relation to their mood, start a new clinical intervention or engage a specialist due to a deterioration in outcomes, or engage in an online intervention when outcomes start to improve. "Computer" by Nikita Kozin from the Noun Project; "Alarm" icon made by Freepik from www.flaticon.com.

progress during treatment may facilitate decisions about the effectiveness of current interventions and the timing of new ones (71). We have previously shown that young people with complex needs often leave care too early, before they have improved (72, 73). As services do not routinely track clinical or functional outcomes, individuals may end up being overtreated, undertreated, or not treated at all. Practically, this can result in a worsening of the underlying syndrome (74), acute presentations to emergency departments, overutilization of crisis services, greater physical health comorbidity, ongoing functional impairment (73), as well as alcohol and/or other substance misuse (75).

CONCLUSION

The youth mental health landscape has undergone dramatic transitions over the past decade, particularly in terms of awareness, access, and resource allocation. These advances are a crucial step in the right direction for addressing mental disorders and their associated burden in young people. The next important step in this revolution is to ensure that young people who access services receive quality, personalized, and measurement-based mental health care that addresses their multitude of needs early in life so that they can lead fulfilling and contributing lives later in adulthood. With major mental health reform on the global agenda, here, we present a digital platform that provides health services with the essential tools needed to deliver quality mental health care.

AUTHOR CONTRIBUTIONS

All authors discussed the evidence and contributed to the writing of this manuscript. FI drafted the manuscript. All authors contributed to and have approved the final manuscript.

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Figure 3 icon acknowledgment: “Computer” by Nikita Kozin from the Noun Project; “Alarm” icon made by Freepik from www.flaticon.com.

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Conflict of Interest Statement: ES is the medical director of Young Adult Mental Health Unit, St Vincent's Hospital Darlinghurst; discipline leader of Adult Mental Health, School of Medicine, University of Notre Dame; research affiliate at The University of Sydney; and a consultant psychiatrist. She has received honoraria for educational seminars related to the clinical management of depressive disorders supported by Servier and Eli-Lilly pharmaceuticals. She has participated in a national advisory board for the antidepressant compound Pristiq, manufactured by Pfizer. She was the National Coordinator of an antidepressant trial sponsored by Servier. IH was a commissioner in Australia's National Mental Health Commission from 2012 to 2018. He is a co-director of the Health and Policy at the Brain and Mind Centre (BMC) University of Sydney. The BMC operates an early-intervention youth services at Camperdown under contract to headspace. IH has previously led community-based and pharmaceutical industry-supported (Wyeth, Eli Lily, Servier, Pfizer, AstraZeneca) projects focused on the identification and better management of anxiety and depression. He is a board member of Psychosis Australia Trust and a member of Veterans Mental Health Clinical Reference group. He is the chief scientific advisor to, and an equity shareholder in, InnoWell. InnoWell has been formed by the University of Sydney and PwC to administer the $30M Australian Government Funded Project Synergy. Project Synergy is a 3-year program for the transformation of mental health services through the use of innovative technologies.

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Can an Emoji a Day Keep the Doctor Away? An Explorative Mixed-Methods Feasibility Study to Develop a Self-Help App for Youth With Mental Health Problems

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Today's smartphones allow for a wide range of "big data" measurement, for example, ecological momentary assessment (EMA), whereby behaviours are repeatedly assessed within a person's natural environment. With this type of data, we can better understand – and predict – risk for behavioral and health issues and opportunities for (self-monitoring) interventions. In this mixed-methods feasibility study, through convenience sampling we collected data from 32 participants (aged 16–24) over a period of three months. To gain more insight into the app experiences of youth with mental health problems, we interviewed a subsample of 10 adolescents who received psycthological treatment. The results from this feasibility study indicate that emojis) can be used to identify positive and negative feelings, and individual pattern analyses of emojis may be useful for clinical purposes. While adolescents receiving mental health care are positive about future applications, these findings also highlight some caveats, such as possible drawback of inaccurate representation and incorrect predictions of emotional states. Therefore, at this stage, the app should always be combined with professional counseling. Results from this small pilot study warrant replication with studies of substantially larger sample size.

Keywords: ecological momentary assessment, youth at risk, emojis, mobile health interventions, adolescence

INTRODUCTION

In today's society, mobile technology allows people to be in and out of contact with each other seamlessly and continuously. Currently, in the Netherlands, 98.2% of the young people between 12 and 24 years of age have a mobile phone to access the Internet (1). With this being such an important medium for young people, even partially substituting in-person contact with the technology (2) in youth mental health care might be an effective intervention or contribute to the effectiveness of youth psychological treatment (2–5). A recent meta-analysis on the effectiveness of mobile health as a supplement to mental health interventions for youth suggests that the mobile phone may enrich youth therapy (6). Mobile supported therapy of shorter lengths yielded larger effects for treatment adherence and weight-management.

Weisz et al. (7) conducted a multi-level meta-analysis on youth psychological treatment outcomes over the past five decades. Significant positive treatment effects were found for anxiety (medium effect) and depression (small effect) but not for youth with multiple problems (7). To enhance therapeutic effects for those with complex needs, the authors propose extending treatment to youth's everyday lives and personalize treatment through the implementation of add-ons, such as an additional drug therapy, wireless devices, and/or more traditional supplemental interventions (7, 8).

In this explorative mixed-methods feasibility study, we describe the development of G-Moji, an mHealth intervention in which "the technology aims to enhance treatment or assessment, increase dissemination of interventions, or provide clinicians and clients with greater choice for accessing treatment materials or activities" (9, p. 1). Advantages of technologically enriched treatments are the possibility of reducing costs, giving the clients an active role in their treatment process, and making greater impact.

A new way to assess mental health problems is by using a technological form of measurement, designated as ecological momentary assessment (EMA), whereby behaviours are repeatedly assessed within a person's natural environment (10). This form of measurement is promising because it enables more accurate daily measurements compared to questionnaires administered intermittently, it makes it feasible to provide personal advice, and it may detect mental health problems at an early stage. The latter makes it possible to shift the focus more from treatment to prevention and aims to help empower youth through self-monitoring.

Communicating mental health issues can be very challenging, especially for teenagers and early adolescents (11). Emojis, from the Japanese *e* [picture] + *moji* [character] are graphic symbols, such as 😊. They offer a new way of communication about emotions, mood, and physical state, with the benefit that these emojis are already well integrated into the daily lives of individuals through the ubiquitous use of digital devices and social media. Emojis are the innovative form of emoticons (a portmanteau of "emotion" and "icon", that use punctuation to depict emotions, i.e., :-)), and they use vivid pictographs of faces, objects, and symbols. However, studies warrant caution interpreting emoticons and emojis, especially given that cultural differences might lead to different interpretations of similar emojis (12). There also exist gender differences. Girls prefer using emojis more than boys (13). Despite these differences, however, emojis could prove to be helpful with youth by allowing them to communicate their mental health state and better understand the challenges with managing their health (14). To our knowledge, however, differences between youth with and without mental health problems and their interpretation or use of emojis have not yet been explored.

Our pilot study combines questionnaires, ecological momentary assessment, and interviews to explore the feasibility of a new mHealth self-monitoring tool as an intervention to empower youth with mental health problems. To conduct this study, a new app called "G-Moji" was developed.

The present study first explored the frequency of emoji use and whether these emojis were perceived as negative and positive emotions by the participants. Second, we aimed to identify differences in self-report of negative and positive emojis between a group of adolescents receiving youth care and a non-clinical comparison group of adolescents from the general population. Third, we examined whether report of negative and positive emojis were associated with mental health problems (i.e., psycho-neuroticism) and resilience. After these group level analyses, we conducted individual pattern analysis in order to examine if patterns of emoji use over a three-month period were different in two participants from the "clinical" youth care group and the comparison group. Different patterns would support the use of emojis for clinical purposes in order to be able to fine-tune interventions from the perspective of personalized treatment. We also interviewed a subsample of the participants receiving treatment to explore their experiences and perspectives on the potential advantages and disadvantages of the emoji-driven app. Results of this study will contribute to the current knowledge of mHealth interventions, since this is the first study that examines this type of intervention for youth with complex needs.

METHOD

Participants

The study included 32 participants between 16 and 24 years of age ($M = 20.06$, $SD = 2.54$), 78% were female and 84.4% of Dutch ethnicity. Of the participants, 41% ($n = 13$) received mental health care from a municipality service, mental health care ranging from mild (e.g. psychological counselling) to severe (e.g. residential treatment). Within this specific group, the average age was 19 ($M = 18.85$, $SD = 2.51$), 78% were female, 77% of Dutch ethnicity, and 55% had education beyond high school. The average age within the group not receiving youth care ($n = 19$) was 21 ($M = 20.89$, $SD = 2.26$), 79% female, 90% of Dutch ethnicity, and 71% with education beyond high school.

A subsample of $n = 10$ participated in the qualitative study, aged between 16 and 22 ($M = 18.5$, $SD = 1.86$). Of this subsample, 70% were female 76.9% of Dutch ethnicity, and they all received some type of psychological support ranging from mild (psychological counselling) to severe (residential treatment).

Procedure and Exclusion Criteria

Convenience sampling was used to recruit participants: healthy participants were recruited through snowball sampling, and youth receiving mental health care were recruited from de Bascule, a child and adolescent psychiatric facility. Participants were met in person at a location of their choice. The goal of the study was explained and questions answered. To make certain that every participant was aware of their rights and our privacy statement, they all signed an informed consent. Participation was voluntary and termination was possible at all times. As a reward, the participants received a power bank for their wireless devices along with € 5 for each month of participation. Inclusion and exclusion criteria were based on the type of smartphone operating system, residence of the participant, and whether their smartphone use was work-related or for personal use. The G-Moji app is only available for Android, so participants with other operating systems (e.g., iOS) were excluded. For practical reasons, it was decided to exclude the participants with a work phone, because they would not be able to answer the questions daily, and data could only be collected five days a week during day-time hours. The data collection lasted three months. Since the app is developed for youth with mental health problems, we randomly selected a subsample of the clinical population to gain more insight in their experiences through in-depth interviews. After the completion of the three months, participants decided if they wanted to keep using the app or uninstall it from their phones.

MEASURES

Data Collection Through Smartphone — Continuously Throughout the Three-Month Period

Participants used the G-Moji app (**Figure 1**), which is currently in its developmental stage. Feedback from the participants will be used to further develop the app. At the beginning of the evening, the "G-Moji" app asked one daily short survey question: "How are you feeling today?". Participants responded by selecting one out of fourteen emoji icons to describe the following feelings: anxious, confident, confused, down, ecstatic, funny, happy, hopeless, love, mad, peaceful, sad, sick, or tired. Emoji icons were used, because this is a natural, attractive and easy way for adolescents to respond. Moreover, the G-Moji app also collects socio-behavioral passive data (e.g., call logs, Bluetooth devices in proximity, cell tower IDs, application usage, and phone status, such as charging and idle) to infer a) activity levels, b) social interactions (how frequently they interact with whom in their network), c) sleep and d) general routineness. Because of the scope of this study, these data are not taken into account yet.

Questionnaires — Pre- and Post-Measurement

Physical and psychological symptoms. The Symptom Checklist (SCL-90, Dutch version) was used to assess if the participants had any physical or mental health issues. The self-report checklist contains 90 statements based on a five-point Likert-scale of distress, ranging from "not at all" (1) to "extremely" (5). The checklist contains eight subscales; agoraphobia (AGO), anxiety (ANX), depression (DEP), somatization (SOM), inadequacy of thinking and acting (IN), interpersonal sensitivity (SEN), hostility (HOS) and sleep issues (SLE) (15). Next to these scales are nine non-scaled items with questions about eating disorders and psychoticism, which contribute to the total score of psycho-neuroticism (PSNEUR). The General Severity Index (GSI) displays the average score and provides an overall measure of psychiatric distress (15). The total score of psycho-neuroticism ranges from 90 to 450; individuals with a score equal to or higher than 224 are highly likely to experience some kind of psychopathology.

The SCL-90 is widely used as an assessment instrument for the screening of mental health problems and evaluation of treatment results. The psychometric properties have been widely investigated and were found to be satisfactory. The internal consistency of the scales range from .77 to .90 (16), which means

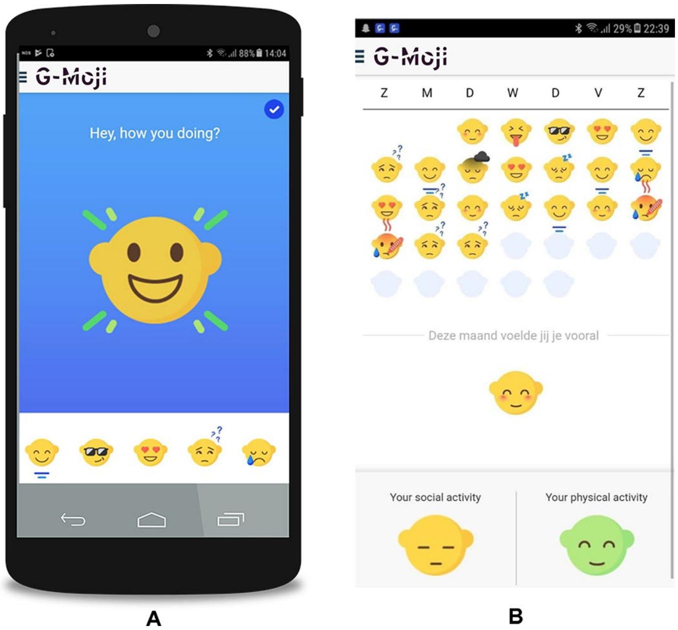

FIGURE 1 | Screenshots of G-Moji app used for collecting self-reported feelings. **(A)** Daily question to answer with a emoji (ecstatic). **(B)** Monthly overview of selected emojis which also gives an overall feeling of the month and shows the social and physical activity level of the participant.

that all scales can be qualified as excellent according to the margins of Cicchetti (17). The test–retest reliability ranges from .68 to .90 (18, 19).

In this study, the Cronbach's alpha reliabilities were .97 at pre-test and .99 at post-test. The pre- and post-test scores were significantly correlated (r = .83, p < .001). Based on this correlation, and because participants reported their emotional states by means of emojis between pre- and post-test, we decided to compute an average psycho-neuroticism score. This was not normally distributed and it showed a substantial positive skewness. As a result, we log-transformed the overall score to obtain normality. We did not find outliers, based on criteria formulated by Tabachnick and Fidell: −3.29 < z < 3.29 (2013).

Resilience. The Child and Youth Resilience Measure (CYRM-12) was used to assess the resilience of the participants. The questionnaire consists of 13 basic questions about education and residency, and contains 12 items based on a five point Likert scale, ranging from "not at all" (1) to "extremely" (5). These items measure individual capacities, relationships with primary caregivers, a sense of social support, and account for diverse social contexts across cultures.

The validation of the CYRM has been investigated in different countries for both English and translated versions. The reliability of this questionnaire is sufficient (α = .84) (20). The Dutch version has not been extensively validated, but the questionnaire has been designed to be culturally sensitive. It showed positive psychometric properties in a recent general population study among youth from Curaçao in that the original factor structure was replicated and proved to be measurement invariant across Dutch and Papiamento speaking youth, age, and gender, while reliability proved to be satisfactory (21).

In the present study, Cronbach's alpha reliabilities were .76 at pre-test and .74 at post-test. The pre- and post-test scores were significantly correlated (r = .65, p < .001). Based on this correlation, and because participants reported their emotional states by means of emojis between pre- and post-test, we decided to compute an average resilience score, which proved to be normally distributed. We did not find outliers, based on criteria formulated by Tabachnick and Fidell (22). Because no valid cut-off scores are available in order to establish which score represents the boundary between the "normal" and "clinical" range, we created (pre-test and post-test) percentile scores for the present sample in order to facilitate comparisons at the individual level.

Interviews — During Participation

In addition to questions about their experiences with the app, participants were also asked to reflect on the growing trend of "datafication of health": the representation of many aspects of life as quantified data (23). They were asked about the potential risks of this development (e.g., a situation involving elevated odds of undesirable outcomes), and resilient factors (e.g., the process of harnessing key resources to sustain well-being) (2015). Interviews were conducted using an semi-structured interview approach based on a pre-formulated topic list.

Quantitative Analysis

Analyses were conducted without data imputation to compensate for missing values. First, a descriptive analysis to examine the frequencies of the 14 emojis was conducted. This led to the exclusion of the emoji "hopeless", since it was never chosen. Subsequently, we conducted a principal component analysis with oblimin rotation for correlated factors, with a forced two-dimensional solution, in order to establish whether a distinction could be made between a negative and positive dimension in experiencing emotional states by means of self-report through emojis, using absolute instead of relative frequencies. Next, we examined whether youth receiving care experience more negative emotions and less positive emotions, less resilience and more psycho-neuroticism than youth from the comparison group by means of a series of t-tests. Finally, we examined correlations between the negative and positive emojis and also psycho-neuroticism and resilience by computing simple Pearson's correlation coefficients.

Qualitative Analysis

In-depth readings of the complete interview transcripts were conducted. The qualitative data analysis software program NVivo was used to develop a codebook, based on the two thematic areas of the topic list: (a) risks and (b) resilience. Initial themes were identified by the third author and verified by the first author, using the iterative thematic approach from Boeije (2005), following guidelines as formulated by Tong et al. (24) to secure the validity and reliability of qualitative study findings. During the initial coding phase (Step 1), we reviewed the transcripts to identify emerging themes, based on the initial codebook. Next, we noted possible relations between codes and groups and developed descriptive codes and categories (Step 2). We then conducted our final analyses by reviewing the code clustering (Step 3). The first author served as master coder, reviewing the work of and providing feedback to the coder to ensure consistency in coding across cases. Transcription and data analysis were in Dutch, with key quotes translated into English. Further details about the design and method of the study can be obtained with the first author.

RESULTS

Quantitative Study

In total, the participants reported 2,217 emojis during the 3 months (90 days) of data collection. The number of times a given participant selected an emoji varied from 1 to 146, the average response rate was 67%, while the median was 77%. The app was most intensively used during the first 30 days (42% of all responses), with a gradual decline in the second 30 days (33% of all responses), and the lowest response rate in the final 30 days (25% of all responses). A total of 63% of the participants did use the app during the whole 3-month period, with short time lapses of 1 or 2 days. Two participants stopped using the app after the first day. Survival analysis showed that the average time until premature termination of the emoji application was 72 days, with only marginal differences for age, gender and clinical status, which did not reach significance. **Table 1** describes the variation in the frequency of the different emojis. Upon inspection, **Table 1** shows that happy, peaceful, and tired had the highest frequencies, whereas funny, love and mad had the lowest. In addition, the participants reported more positive (60%) than negative (40%) emotions.

A principal component analyses (PCA) within-subject selected emojis over time, with oblimin rotation and factor loadings of .40 as a cut-off criterion, yielded a positive and negative dimension, which was consistent with our expectations. The emoji "sick" did not meet the .40 cut-off criterion and was therefore removed from the PC-analysis, loading .20 on both dimensions. Notably, "sick" might not be perceived subjectively as a negative psychological state (i.e., negative emotion) given the presence of a thermometer in the emoji but as an objective negative physical state instead. The two dimensions, which consisted of six items each, accounted for 50% of the total variance (**Table 2**). Internal consistency analyses revealed that the scale for positive emotions was only marginally reliable, showing a low standardized Cronbach's alpha of .53 (Guttman's Lambda 2 was .55), whereas the scale for positive emojis proved to be reliable, with a standardized Cronbach's alpha of .87 (Guttman's Lambda 2 was .88). The scale for positive emojis showed a normal distribution, without outliers. Also, the scale for negative emojis did not have outliers, but it showed a moderate positive skewness and was therefore changed to normal by means of a quadratic transformation.

Unexpectedly, the two dimensions were positively correlated ($r = .35$, $p = .05$), showing a trend to indicate that participants who select more negative emojis also select more positive emojis and vice versa. However, if corrected for the frequency of selecting emojis, the dimensions showed a negative and significant correlation ($r = -0.66$, $p = < .001$), indicating that participants who select more negative emoji's also select less positive emojis.

Participants receiving youth care had significantly higher scores on psycho-neuroticism ($t = -4.494$, $df = 30$, $p < .001$ and Cohen's $d = 1.70$) and lower scores on resilience ($t = 1.762$, $df = 30$, $p = .044$ and Cohen's $d = 0.63$) than participants from the comparison group, indicating that participants with youth care reported substantially more psychological dysfunction and less resilience. No differences were found with positive or negative emotions, although the results for the positive emojis were in the expected direction (Cohen's $d = 0.24$), which was not true for the negative emojis, but again the difference proved to be small (Cohen's $d = 0.24$), indicating participants with youth care reported less positive emotions (expected direction), but also less negative emotions (not in the expected direction). No different results were obtained when the analyses were repeated with the 13 separate emojis, even without correction for multiple testing.

TABLE 1 | Frequencies of emojis (*N* = 32).

	Maximum	M	SD
Happy	38	13.62	12.52
Peaceful	36	12.31	8.18
Tired	33	11.09	9.10
Ecstatic	47	6.31	9.22
Confused	19	5.44	5.32
Down	22	4.60	6.42
Confident	26	4.13	6.19
Sad	11	3.03	3.34
Anxious	17	2.56	3.77
Sick	10	2.22	2.99
Love	10	1.72	2,16
Funny	19	1.16	3.42
Mad	10	1.09	1.94

TABLE 2 | Principal component analysis of emojis.

	Component	
	1	2
Down	.844	
Confused	.822	
Mad	.792	
Anxious	.791	
Sad	.742	
Tired	.602	
Ecstatic		.605
Confident		.590
Happy		.559
Peaceful		.491
Love		.490
Funny		.479

Extraction method; principal component analysis; Rotation method; Oblimin with Kaiser normalization.

Finally, the correlations between negative and positive emotions and also between psycho-neuroticism and resilience on the other hand ranged between $r = -0.003$ ($p = .985$) and $r = -0.076$ ($p = .678$), respectively. Repeating the analyses with the 13 separate emoji's, with and without chance correction, did not yield significant results either ($p > .10$, without chance correction). However, correlations were higher now ($-0.012 < r < -0.295$), but still small or even very small, and not always in the expected direction.

Notably, all analyses were conducted on the frequencies of emoji use. We repeated all analyses by using the proportions of emoji of each participant (i.e., the number of times an emoji is selected as a proportion of the total frequency of emoji selection), which did not yield an interpretable factor solution in the PC-analyses. In addition, analyses based on proportions showed similar (non-significant) results when comparing youth with and without youth care and in the correlational analyses on single emoji use if compared with results from the analyses that were based on frequencies of emojis.

An individual case comparison was made to identify possible different patterns between two participants with an almost similar frequency of emojis, one from the youth care group (participant 1006; 61 emoticons) who attempted a suicide at the beginning of June and one from the "healthy" comparison group (participant 1009; 65 emoticons). **Figure 2** shows the reported

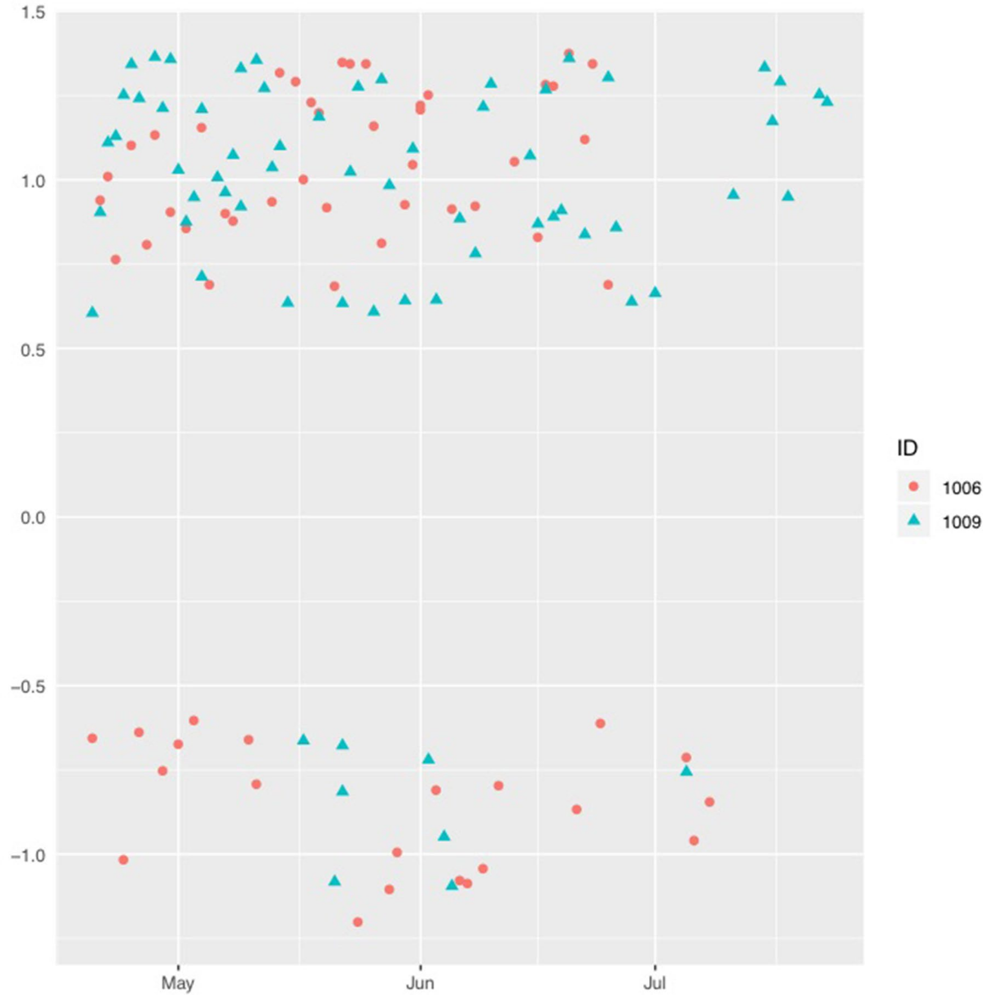

FIGURE 2 | Reported positive (0.5–1.5) and negative (–0.5– −1.0) emojis during the study.

positive and negative emojis over the three month period (May until July) for the participant from the youth care group (SCL total scores of 369 at pre-test and 395 at post-test, representing the clinical range, and a CYRM total score of 51 at pre-test and 43 at post-test, which is at the 72nd and 38th percentile, respectively) and for the participant from the comparison group (SCL total score of 107 at pre-test and 95 at post-test, representing the normal range, and a CYRM total score of 48 at pre-test and 46 at post-test, which scores are both at the 50th percentile). The data was not transformed, but visualization was improved by adding some minor random error through jittering.

During May and June, the participant receiving youth care (1,006) consistently reported positive and negative emotions, whereas in July only negative emotions were reported. The participant without youth care (1,009) reported several negative emotions at the end of May and the beginning of July, whereas positive emojis were reported during the whole study period. Both participants reported more positive emotions than negative emotions.

Qualitative Study

In this part, we describe the findings in detail regarding the two thematic topics: a) resilience and b) risks. The results are organized in **Table 3** to give an integrative image, after which they are described in more detail.

Three resilient factors were identified: 1) increase of self-awareness, 2) personalized care, and 3) autonomy. For self-awareness, all participants argued that mobile health technologies have the potential to increase awareness about their behavioral patterns and motivate them to change their lifestyle in favor of their wellbeing. They stress that this type of app could give them a sense of control, and has the potential to confront them with how they are really feeling. *"Most of the times I do not pay attention to how I was feeling over the month, but now you can do something about it, because the app shows you the overview"*(James, #16) However, for youth with severe mental health problems, for example struggling with self-harm, this is difficult. Kim (20) explains that she feels empty if she has a hard time identifying her current emotion, at such moments *"it*

TABLE 3 | Key themes of the qualitative study.

Resilience	*Increase of self-awareness:* increased awareness about behavioral patterns that motivate to change lifestyle positively, giving a sense of control.	*Personalized care:* receive tailored information from the app, based on the predictive function.	*Autonomy:* flexibility in blending face-to-face meetings with online support.
Risk	*Inaccuracy in prediction:* concerns about the accuracy and reliability of the prediction of mood.	*Privacy:* data is unsafe on the Internet, this app would not be less safe than other apps.	*Being controlled by an app:* these mobile health technologies might result in youth relying on apps instead of their own feelings.

The results should be interpreted with caution, because it is based on a small number of participants who may not be representative for the population of youth using similar apps with the same purpose.

might be helpful if the app could give me a suggestion with how I'm feeling, such as you could be sad or angry". During the pilot, Kim's self-harm problems became so intense, that she was referred to a residential crisis facility. In her crisis, she stated: *"I quit choosing emojis, because my head is too full with different emotions".* Most youngsters replied that they did not consider their feelings more than usual by tracking their emotions in the research.

Regarding personalized care, all youngsters prefer to receive tailored information from the future version of the app, and most stress that besides the predictive function, the app should also be able to provide personalized advice. Julia (19), for example, illustrates that the app might help her with putting her fears into perspective, because she finds this difficult to do on her own. *"Normally I ask my friends if my fear is qualified in a certain situation. However, they are not always available, and I feel like a burden if I'm always talking about my problems. Asking an app for advice would be great".* Many youngsters stress that the next version of the app could help them reach their goals. All youngsters considered it important to customize the evolved app according to their wishes.

Concerning autonomy, youngsters mostly mentioned flexibility in blending face-to-face meetings with online support. They did not think mobile health applications should substitute social workers completely; they prefer blended therapy. Jade (20) stated: *"You can ask SIRI, but then you get weird answers, not a real conversation. Furthermore, a social worker can help you with self-reflection, an app can't do that of course. A social worker can meet your needs, an app can't. Or it becomes really scary. No, let's not do that".* However, they are convinced that an app could offer support, especially during the waiting list period. Fleur (22), for example, was put on a waiting list for intensive trauma therapy and needed to wait another ten weeks. *"I need a crisis time out, but now I need to wait for another two months. You wait and survive. An app is at least something if you don't have any support at all. It is not much, definitely not a human, but it might help."*

Additionally, three risk factors were identified: 1) inaccuracy in prediction, 2) privacy and 3) being controlled by an app. Regarding prediction inaccuracy, some participants expressed concern about the reliability of a future version of the app by speaking about the inaccuracy of other devices and applications they had used. For example, Fleur (22) used two apps simultaneously to track her steps and discovered a big difference in the results of both apps. The perceived unreliability of apps raises questions about accuracy of the prediction of feelings. Therefore, the future app must be scientifically validated in order to be sure that the prediction of mood is correct, because an inaccurate prediction could result in bad feelings. As Jade (20) explains: *"if an app says you are sad or you are going to be sad, you might interpret this feedback as the feeling that you should have and as a result you will feel sad, even though the prediction might be wrong".* However, it also depends on your current mood for how negatively a wrong prediction is perceived, as Julia (19) illustrates: *"I wouldn't mind a wrong prediction much if I'm feeling really happy, but if I'm on the edge it might make me feel a bit sadder because it makes me doubt my happy mood".* David (18) thinks this could also work in the other direction: *"if you are depressed and your phone says that you are super happy, then it will actually go worse".* Therefore, youngsters stress that in some cases an inaccurate prediction could become very risky, and they worry that it might even become fatal for youngsters with suicidal thoughts. Consequently, some participants stressed that the future version of the app should not become completely predictive. Instead, the user should be given the possibility to fill in the right emoji themselves if the application predicts their mood wrongly. Two participants, Carmen (23) and Fleur (22), had neurotic symptoms (assessed with the SCL-90) and suggested that giving user input might become another compulsion for youngsters with neurotic tendencies.

Considering privacy, these youngsters believe that their data is unsafe anyway on the Internet, and that the research and future app would not be less safe than other apps. Therefore, these youngsters did not care much whether their data was being sold to third parties. David (18) for example, was not worried about his privacy on a self-tracking app, *"since the app only has unimportant information like my profile picture, weight, length and heartbeat".* Julia (19) shares art on Instagram and follows tattoo artists. *"I think it is really innocent, so I wouldn't be scared if my information would be shared [with third parties] or something like that, because there isn't something interesting anyways".* Most participants thought their collected data would not be important enough or that could be used in a harmful way by thirds parties.

As for being controlled by an app, youngsters stressed the controlling effects of mobile health technologies. Fleur (22), for example, was concerned that users of mobile health applications might only listen to their app instead of their own feelings: *"it is certainly a danger that emojis generated by the computer might determine our real-life emotions".* David (18) was firmly opposed to the a future version of the app: *"it annoys me that a computer would tell me how I'm feeling, of course I know this better than an app. Emotions are what distinguishes a human from a robot* *and if an app is acting like he is the boss about your emotions by predicting your mood, you are no more than a robot".*

Apart from these possible advantages and disadvantages, the desirability of interaction through a chat function in the app with other app-users was investigated. All participants, apart from James (17), would not use this chat function that would connect them with other (at-risk) youth, because they were not interested in meeting new people. However, they thought that other youth would like to have the ability to share their story with other users. Therefore, this chat function should be optional, so that youth experiencing similar issues might support each other. However, they indicated that this could also go wrong, since adolescents might assist each other in planning dangerous activities, such as suicide attempts.

DISCUSSION

The aim of our mixed-method study was to investigate whether the use of emojis is feasible for research purposes, providing a new assessment method for acquiring knowledge on the aetiology of mental health problems of adolescents with complex needs receiving youth care, and as a clinical tool that can be used for self-monitoring, in particular as an add-on to regular treatment.

Although two emojis were excluded (hopeless and sick), the other 12 emojis represented negative and positive emotional states, with overall more positive (60%) than negative (40%) feelings. No differences were found in self-report of negative and positive emojis between youth from the "clinical" group and comparison group, while negative and positive emojis were not associated with mental problems and resilience. However, individual case analyses did reveal (clinically meaningful) different patterns of emoji use over a three-month period between a participant from the youth care group, scoring in the clinical range on psycho-neuroticism and showing a sharp decrease in resilience from pre-test to post-test, and a participant from the comparison group scoring in the normal range on psycho-neuroticism and average resilience. Given that principal component analyses of the 12 emojis yielded two well-interpretable dimensions of negative and positive emotions and the clinically meaningful individual differences in patterns of emoji use, further research on the emoji app in clinical practice seems warranted.

The qualitative part of our study revealed that through this type of mHealth intervention, youth experienced an increase of self-awareness and autonomy and see opportunities for personalized care. Nevertheless, they are concerned about inaccurate representation and prediction of emotional states, privacy, and the idea of being controlled by an app. Connecting youth with mental health problems with each other through a chat function on the app may facilitate mutual support, but was also evaluated as risky by the participants, since this could lead to planning harmful activities together, such as suicide attempts.

The fact that the principal component analysis of the emojis yielded two well-interpretable dimensions seems important, especially because emojis are relatively independent from technology developments. Current touch screens, for example, might soon be replaced by eye-tracking or gesture based interfaces, each technology development requiring new studies to interpret this new type of data (25). Emojis, on the other hand, might offer a relatively stable part of smartphone usage. Although studies warrant caution interpreting emojis, especially since cultural differences might lead to different interpretations of similar ones (12), none to date have investigated differences in interpretation of emojis between youth with and without mental health problems. Therefore, our results from the principal component analysis warrant replication with a substantially larger sample in order to be able to conduct multi-group confirmatory factor analysis, examining measurement invariance between the clinical and non-clinical group, different ethnic groups, sex and age.

The emojis "sick" and "hopeless" should be excluded in future studies. The emoji "sick" might not be perceived as a subjective negative psychological state (i.e., negative emotion) given the presence of a thermometer in the emojis, but as an objective negative physical state. The emoji "hopeless" was not reported. Future studies could enrich their emojis with the Lisbon Emoji and Emoticon Database, which divided 153 emoji in seven dimensions for emojis from iOS, Android, Facebook, and Emojipedia (26).

The SCL-90 has been developed for valid and reliable assessment of psycho-neuroticism at both the individual and group level, with high levels of specificity and sensitivity; and, thus, low chance of false positives and false negatives. Notably, there is an ongoing discussion about the validity, reliability, and usefulness of group level research, because of large individual differences among youth receiving treatment for complex needs. Nevertheless, our data show that the SCL-90 has great predictive power with regard to the discrimination between the clinical and non-clinical comparison group, both at the group and individual level. As we are conducting a feasibility study, it seems important to use the SCL-90 in subsequent research on the G-Moji. The combination of different assessment methods, such as retrospective evaluations by means of questionnaire self-report (SCL-90) and daily (momentary) self-perception of emotional states through a mobile device (G-Moji), lead to a more elaborate and integrated assessment of adolescents' mental health (27).

Our study has several limitations, which are primarily associated with the explorative character of our feasibility study, such as convenience sampling and a small sample size, resulting in little statistical power and limited external validity. Most participants did not use the app every day, which made it difficult to compare patterns of emoji use at the group level. Our individual comparison is for illustrative purposes and needs further statistical elaboration in future research, statistically testing profiles after cluster analyses. In doing so, future research may reveal clinically meaningful differences in patterns of emoji use between groups of adolescents with and without mental problems over longer periods of time by using Generalized Linear Mixed Models and Cluster analysis. We could not reliably distinguish between youth receiving psychological treatment and youth from the normal comparison group on the basis of frequencies of emoji use at the group level. Notably, the emoji app has been designed to assess the dynamics of daily changes in emotional states over a longer period of time, and it is therefore plausible to suggest that future group level analyses of such individual differences might reveal that different patterns of emotional states shed more light on the aetiology of mental problems in youth with special needs, providing new tools for effective personalized treatment. Time-of-day effects should be taken into account in future studies, since previous studies indicate differences in responses result from the moment during the day in which a question is asked (28). Future studies should compare the use of emojis on communication platforms youth already use on a daily basis (e.g., Instagram, Whatsapp, etc.) and how this relates to emoji selection in the G-Moji app. The continuous use of emojis throughout the day on platforms youth are already familiar with might reflect youths' range of experienced emotions (e.g., moment by moment'), whereas the once a day selection of an emoji within G-Moji might rather capture youths' reflective emotions (e.g., overall feeling).

In line with recent development in the field and to get a more accurate view on youth's emotional state, future studies should, besides ecological momentary assessment (EMA), include digital phenotyping from mobile phone data collection, which shows a representation of a person's digital patterns, that can help understand their mental health problems (29, 30). Passive data collection from personal digital devices, such as the smartphone, combined with daily measurement with emojis, may shift the focus from treatment to real-time prevention of (recurring) mental health problems.

ETHICS STATEMENT

This study was approved by the Ethics Review Board of the University of Amsterdam, 2018-CDE-8836, ID 8836.

AUTHOR CONTRIBUTIONS

LV was the leading author. He designed the study, conducted the acquisition, and did the interpretation of the data. SR and EV supported with data collection and interpretation of the data. GS, MM, RV and conducted the analysis, whereby GS also helped with the interpretation and conceptualization of the total study. APo helped with the design. ES helped with the data-storage and data output. APe helped with the design of the study and the analyses. TR supported LV with the supervision of the study.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX 1: EMOJIS

	Description	Emojis
Positive emojis		
1.	Funny, e.g. feeling yourself a little playful, childish in a positive way	
2.	Ecstatic, "super happy"	
3.	Happy	
4.	Peaceful, relaxed,	
5.	Confident,	
6.	In love, as in "in love with these shoes/person, etc"	
Negative		
7.	Confused	
8.	Sad	
9.	Depressed	
10.	Tired, exhausted	
11.	Anxiety, scared	
12.	Mad, angry	
Excluded		
13.	Hopeless	
14.	Sick	

(*Continued*)

Continued

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ORIGINAL RESEARCH
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Using a Smartphone App to Identify Clinically Relevant Behavior Trends *via* Symptom Report, Cognition Scores, and Exercise Levels: A Case Series

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The use of smartphone apps for research and clinical care in mental health has become increasingly popular, especially within youth mental health. In particular, digital phenotyping, the monitoring of data streams from a smartphone to identify proxies for functional outcomes like steps, sleep, and sociability, is of interest due to the ability to monitor these multiple relevant indications of clinically symptomatic behavior. However, scientific progress in this field has been slow due to high heterogeneity among smartphone apps and lack of reproducibility. In this paper, we discuss how our division utilized a smartphone app to retrospectively identify clinically relevant behaviors in individuals with psychosis by measuring survey scores (symptom report), games (cognition scores), and step count (exercise levels). Further, we present specific cases of individuals and how the relevance of these data streams varied between them. We found that there was high variability between participants and that each individual's relevant behavior patterns relied heavily on unique data streams. This suggests that digital phenotyping has high potential to augment clinical care, as it could provide an efficient and individualized mechanism of identifying relevant clinical implications even if population-level models are not yet possible.

Keywords: smartphone, apps, schizophrenia, digital health, psychiatry, digital phenotyping, mental health

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INTRODUCTION

Interest in smartphone apps for both research and use in clinical care of psychiatric disorders continues to rise. While there is evidence to support the feasibility of apps across all mental health disease states and all ages, there is a focus on youth mental health because of the high prevalence of ownership and access to smartphones in this demographic. Yet being a "digital native" does not necessitate wanting to use apps and technology towards mental health. Indeed, one recent survey study of college students found that only 26% reported being open to using a mental health app and 81% noted that they would prefer to talk to a person than use an app (1). In this paper, we explore a possible solution to this dichotomy between app and clinicians by discussing case examples of efforts to integrate apps into clinical settings. Focusing on monitoring versus intervention, this paper explores how smartphone apps, digital phenotyping, and real-time mobile data can augment, not replace, face-to-face care for youth.

The potential of smartphones for youth mental health can be understood in part through the concept of digital phenotyping. This refers to "moment-by-moment quantification of the individual-level human phenotype in-situ using data from smartphones and other personal digital devices" (2). In essence, this involves the creation of a digital fingerprint for a user that exhibits the pattern by which they use their mobile device. Common data streams that have been utilized previously in digital phenotyping include geolocation, accelerometer, voice and speech, human–computer interaction, and call/text logs (2, 3). Many of these data streams can serve as proxies for behavior (e.g., accelerometer for activity) or environment (e.g., geolocation data for locations visited) and thus could help provide context to patients' lived experience of mental illness. For example, in a case series report, Dror Ben-Zeev noted sensor data changes including physical activity, geolocation, phone unlock duration, and speech frequency and duration in participants prior to relapse (4). However, the relevant data streams that indicated a change in clinical status of Ben-Zeev's participants varied in each of the cases presented, suggesting that the most efficient method of identifying relevant behavior changes may be on an individual level. Thus, we present case reports of our participants based on relevant behavior changes as indicated by a smartphone app.

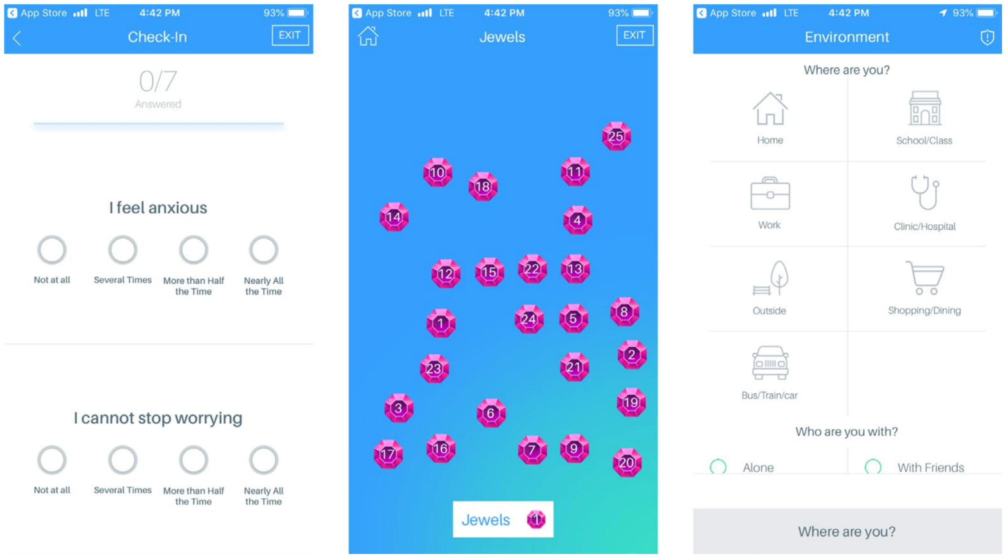
While this potential of smartphones to improve youth mental health and offer more personalized care is impressive, it is important to note that much of this research and early efforts using smartphones in mental health have not yet be scientifically reproduced. This is in part due to the numerous apps studied, heterogeneity in statistical methods applied to the data, and diversity of patient populations assessed. Given the nascency of digital psychiatry as a field, this current state of affairs is understandable, although the need to now move towards reproducible research is paramount. In that light, the case reports we present here are offered with an online Appendix that includes links to the code repository for others to be able to use the app we used and also the analysis pipelines that generated the below figures.

Another reason for slower progress in digital mental health than may be expected by the prevalence of smartphone and apps existing today is that the optimal use cases for apps in care has not yet been realized. On the one hand, apps may serve as population-level tools capable of screening youth for risk and aiding in prevention. While such population models offer immediate generalizability, there is more evidence to date that these apps may serve as better individual tools designed to assess risk for each person based on their unique situation. But digital tools yielding individual results will require more interpretation, which in turn requires more input and partnerships with clinicians. While many apps today are being built with patient-centered design principles, fewer are created with relationship-centered design in mind—tools to augment the therapeutic alliance between clinicians and patients and advance clinical care. Thus, it is no surprise that a top research priority, as voted by both patients and clinicians, included "What is the optimal way to inclusively implement and combine digital mental health with current clinical care?" (5). While answers to these important questions will take concerted efforts, in this series of case reports, we hope to outline potential directions and next steps.

METHODS

The Lamp Platform

The LAMP app (see **Figure 1**) is a mobile application that can be accessed from both the Apple App store and the Google Play store and is compatible with both Android and iOS operating systems. Currently, to access LAMP, patients must be enrolled



I feel anxious

○ Not at all ○ Several Times ○ More than Half the Time ○ Nearly All the Time

I cannot stop worrying

○ Not at all ○ Several Times ○ More than Half the Time ○ Nearly All the Time

Where are you?

Who are you with?

○ Alone ○ With Friends

FIGURE 1 | Screenshots of select features of LAMP, including symptom surveys, Jewels A cognitive assessment, and environment and social tagging.

in several ongoing research studies across different universities at this time. LAMP collects both active and passive data. Active data include all information collected when the participants are actively using the app (e.g., survey scores, cognitive test scores, and environment and social tagging), whereas passive data include all information collected in the background (GPS location and HealthKit information). LAMP collects several data streams within each of these categories including self-report surveys, cognitive abilities *via* "games" that are modified neuropsychological tests, GPS location, environment and social context tagging, and HealthKit integration from a smartwatch (which includes step count and heart rate).

Surveys

LAMP allows the users to take surveys that are customized by clinicians or researchers on the LAMP portal; that is, surveys that have been implemented in the LAMP study aim to assess anxiety, depression, and psychotic symptoms, as well as sociability and sleep quality. LAMP also allows for the customization of survey schedules, which can also be set by the researchers and will send the users a push notification when the researchers want the participants to take a survey. LAMP also records the time taken to answer each question individually, as well as the time taken to complete the entire survey.

Cognition Tests

The LAMP app consists of several "games," which are simplified neuropsychological cognition tests, to provide a basic assessment of the users' cognitive abilities. Each cognition test provides the researchers with information specific to that test. For example, Jewels A and B, a modified version of the Trails A and B tests, provides the researchers with the time taken to touch each jewel, the number of correct and incorrect answers, and how long the game took in total. Currently, the majority of the cognition tests assess the users' memory and attention (see **Figure 2**). A clinician or researcher is able to schedule a notification for a cognition test with the same customization options as surveys. Currently used cognition tests include Jewels A and B, which are modified versions of the trails tasks to assess the users' attention, and spatial span forwards and backwards to assess the users' memory.

GPS

LAMP collects the users' GPS location when they complete a game or a survey. In addition, the users are prompted to tag where they are and whom they are with. For example, the users could say they are at home alone. This information allows the researchers to identify any potential trends regarding symptoms/cognition in specific places or with specific people. For example, a participant with agoraphobia may tend to have higher anxiety symptoms while they are at home alone, than in busy public places, which could potentially be useful information to the users in identifying this trend and starting exposure therapy. If the users complete more than one activity in a row, they are not prompted to complete a location tag after every activity, as it is assumed that they are in the same place with the same people. After 30 min, the users are then prompted to tag their location again when completing an activity.

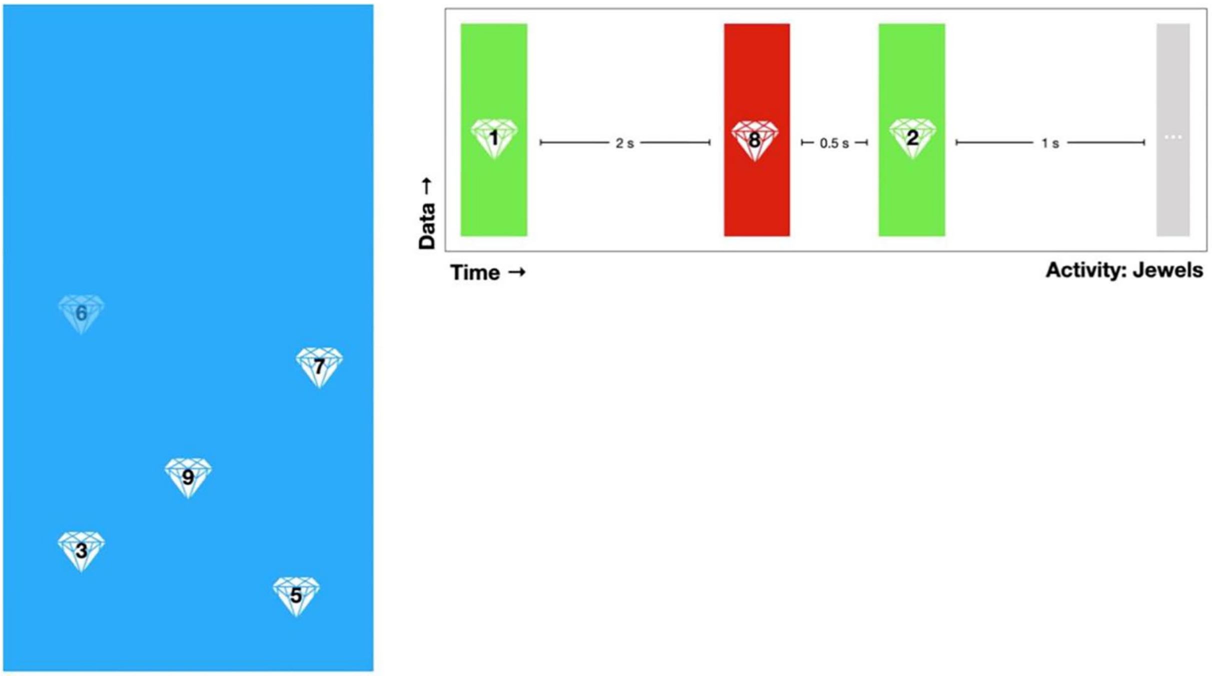


FIGURE 2 | A demonstration of Jewels A. A user is shown numbered jewels on a screen and instructed to tap the jewels in increasing chronological order. The researchers are shown a summary of the user's taps including time taken and correct/incorrect value.

Watch and Healthkit Integration

The users are given an Apple Watch or an Android Ticwatch E, depending on their smartphone operating system, to collect exercise and HealthKit data. These include number of steps taken, heart rate, flights of stairs climbed, and miles walked.

Dashboard

Researchers or clinicians can access participants' data through the LAMP Dashboard, which provides visualizations of survey response correlations, average cognition test accuracy, mean cognition test response time, mean survey response time, survey scores, and cognition test standard deviation. The dashboard also provides a summary of each LAMP "event." A LAMP event marks anytime participants complete a LAMP activity and provide relevant information, including what their scores were on the survey or game, where they took the survey or game, who they were with, and what their HealthKit information was. The dashboard provides a comprehensive summary of the participants' clinical state.

Procedure

The study was approved by the Beth Israel Deaconess Medical Center (BIDMC) institutional review board (IRB), and all participants signed written informed consent. Participants come in for an initial study visit, where they first complete informed consent and are informed of all the data streams that LAMP collects. Then, they complete a battery of paper and pencil assessments, including the Patient Health Questionnaire (PHQ-9) (6), Generalized Anxiety Disorder 7-item (GAD-7) (7), Social Functioning Scale (8), the Positive and Negative Symptom Scale (PANSS) (9), and the Brief Assessment of Cognition in Schizophrenia (BACS) (10). Participants are given a smartwatch (either Ticwatch E or Apple Watch Series 3, depending on their operating system) to collect HealthKit information. The patients are fully informed as to how the LAMP app and the smartwatch work at visit 1. After completion of visit 1, the participants may use the app and the smartwatch as much or as little as they would like for 3 months. After 3 months have passed, the participants then return for a second study visit, where they complete the same assessments as they did at visit 1. The data streams examined for this case report included depression, anxiety, psychosis, sleep, sociability, and medication adherence (survey scores), cognitive abilities (Jewels A/B and Spatial Span Forwards/Backwards), and steps (HealthKit). All participants are given an overview of their collected data at visit 2.

During the 3 months between visits 1 and 2, participants are prompted to take surveys 10 times *per* week (twice *per* day, Mondays to Fridays) and prompted to play games five times *per* week (two games at the same time, once *per* day, Mondays to Fridays). On Monday, Wednesday, and Friday, participants were asked to complete surveys assessing depression, sleep, and sociability and to play Jewels B and Spatial Span Forwards. On Tuesday and Thursday, participants were asked to complete surveys assessing anxiety, psychosis, and sociability and to play Jewels A and Spatial Span Backwards. Participants were not compensated for using LAMP or engaging with it so as to better understand real-world use of the app.

Results

Upon examination of overall activities completed by age group within the first 2 weeks of enrollment in the LAMP study, we found that participants under 25 years of age completed less activities (number of games and surveys completed) than did participants above 45 years of age who completed more than the prompts by the app (see **Figure 3**). Participants between 25 and 45 years of age completed approximately the same amount of average activities as those under 25, but with a greater degree of variability.

Participant 1

Participant 1 demonstrated a high adherence rate with her scheduled surveys in accordance with the scheduled notifications and presents as relatively clinically stable. Thus, Participant 1 is an example of how we are able to map her symptoms and show her overall clinical presentation for monitoring. Interestingly, Participant 1 did not take any sleep surveys within the first month of the LAMP study.

Participant 2

Participant 2 reported high levels of paranoia, anxiety, and depression and had a relatively stable clinical presentation.

However, when Participant 2 answered survey questions, he, on average, took a longer amount of time answering "Today I feel depressed" compared with any other survey question (see **Figure 4**). In this figure, the height of the bar indicates the answer on a scale of 0–3, and the width of the bar indicates the time taken. This suggests that he continually thought longer about this question when answering it, perhaps indicating uncertainty or high investment in the question. The time taken to complete each question provided by LAMP creates a new data stream that is not accessible when taking these surveys on pencil and paper, underscoring the potential of novel data streams gathered with this method.

Further, Participant 2 showed strong correlations with his psychotic symptoms in depression, anxiety, steps, and cognition scores (see **Figure 5**). Psychotic symptoms positively correlated with depression and anxiety scores, which is expected and a fairly common presentation among many of the LAMP study participants. Additionally, steps and cognition negatively correlated with psychotic levels, suggesting that when Participant 2 experiences more psychotic symptoms, he exercises less, is less mobile, and has worsened cognition relative to his baseline.

Participant 3

Participant 3 had been unemployed for 4 months upon enrolling in the study. She reported that has led to a high presence of depressive symptoms (PHQ-9 score of 24). After 2 months of enrollment in the LAMP study, she wished to terminate her participation as she had received a full-time job and would not be able to attend further study visits once her employment started.

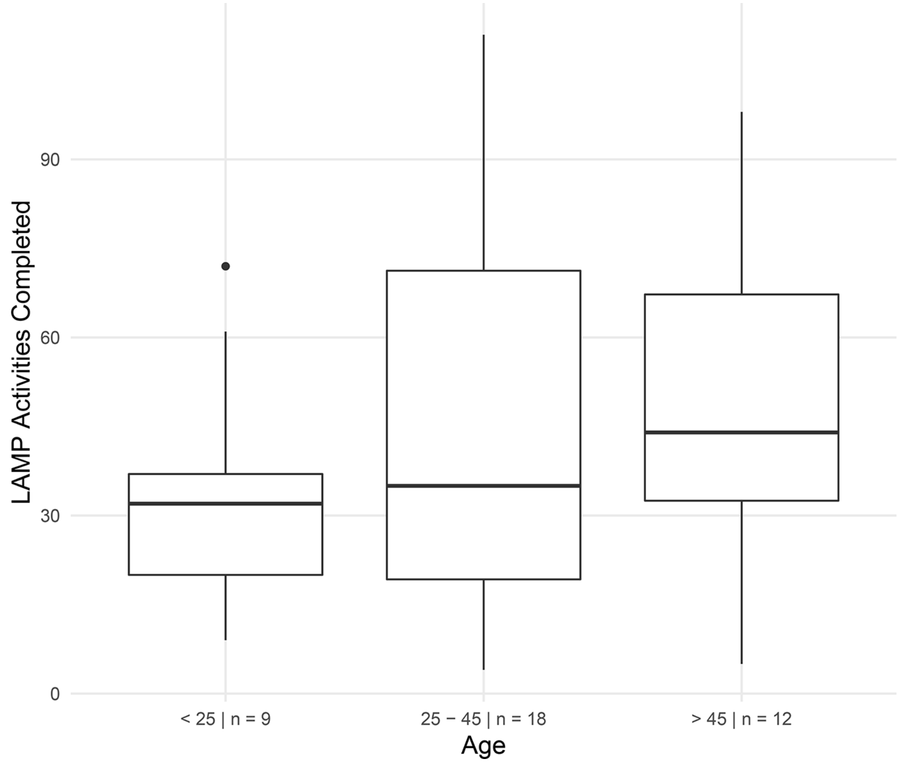


FIGURE 3 | Adherence rate within the first 2 weeks of enrollment in the LAMP study in participants by age. Subjects could complete up to four schedule LAMP activities (surveys and cognitive assessments) per weekday for a total of 20 *per* week and 40 in 2 weeks. Subjects were free to take as many additional tasks as they desired.

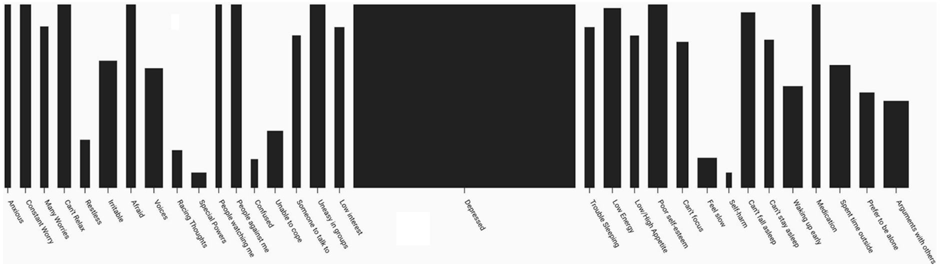


FIGURE 4 | A summary of Participant 2's average survey scores and time taken to answer survey questions. Height of the bar indicates average survey score, and width of the bar indicates average time taken to respond.

At her second visit, Participant 3 indicated that her depressive symptoms had improved since receiving a job offer. She denied hospitalization during the duration of her study enrollment. However, upon examination of her survey scores, there was a significant increase in both anxiety and depression scores between days 30 and 45 (see **Figure 6**). Upon inquiry, she indicated that during these days, her symptoms reached what she termed "an all-time high" and discussed hospitalization with her therapist. On approximately day 45, Participant 3 received her job offer. Although her PHQ-9 score was 23 at visit 2, survey scores from LAMP indicated that her symptoms were immediately alleviated upon receiving her job offer. After day 45, her anxiety, depression, and psychosis scores were on average lower than in days 1–30. This provides an example of how digital phenotyping is beneficial in identifying trends for discussion in clinical visits that can help patients share new information that they might have otherwise overlooked.

Participant 4

Participant 4 reported very high anxiety and depression scores, with low medication adherence. However, at approximately 15 days into study enrollment, survey scores for depression, anxiety, and psychotic symptoms began to steadily decrease, while medication adherence increased (see **Figure 7**). As seen in the below figure, we detected changes in symptom report, but we were also able to detect a negative correlation between Participant 4's medication adherence and her anxiety and depression symptoms.

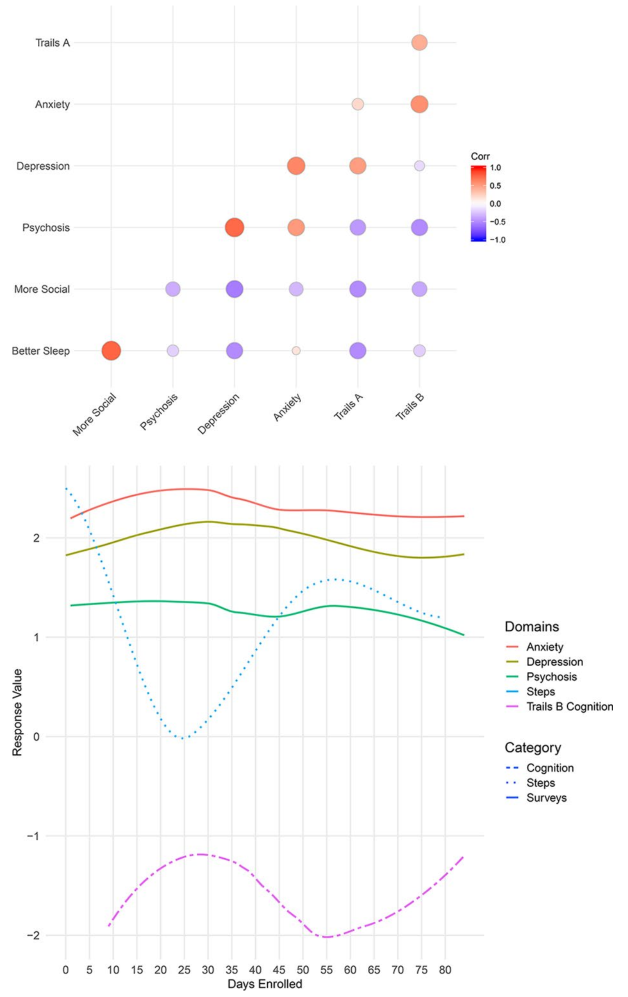


FIGURE 5 | Two views of Participant 2's data. Correlation between Participant 2's survey scores and cognition levels (top), and a summary of Participant 2's anxiety, depression, psychosis, steps, and cognition over time (bottom).

Participant 5

Participant 5 reported issues with sleep. Her smartphone data, shown in the **Figure 8**, reveal significant negative correlations between sleep quality and psychosis, anxiety, and depression, suggesting that these symptoms are improved when she sleeps better at night. While correlation does not equal causation, with these data, it is possible to help the patients understand why a trial insomnia cognitive behavioral therapy (CBT) or at least improving sleep hygiene may offer numerous benefits. By using the app, it would also be possible to assess her response to these interventions and help monitor her progress in real time.

DISCUSSION

In this case report series, we explored diverse clinical use cases around digital phenotyping data for patients with psychotic illness. Utilizing data streams from smartphone-based symptom report, cognition scores, fitness data, and physical and social environment of individuals with psychotic disorders, we investigated behavioral patterns with the goal of identifying potentially clinically relevant and actionable targets for lifestyle and clinical interventions. Our results suggest not only the feasibility of integrating digital phenotyping data in clinical visits but also the potential utility.

Our initial findings provide evidence that use of a smartphone application to monitor symptoms and behaviors produces an individual pattern for each person, indicating that this is a feasible means of monitoring and detecting patient status. Each of the individuals mentioned demonstrated different correlation patterns over time, which provided useful, relevant clinical indications for care. For example, whereas Participant 5's data showed that her symptoms are strongly correlated with sleep, Participant 4's data centered around her medication adherence. These correlations indicate that these two participants would benefit from different treatment plans. Because there is a large amount of heterogeneity in presentation among those with psychotic disorders, smartphone usage provides an easy and inexpensive way to monitor these behavior differences.

While identifying individual behavior trends to create personalized treatment plans has high potential to augment clinical care, the high heterogeneity between each of the users provided little ability to establish patterns on a population level. We were unable to find patterns suggesting that certain data streams tended to correlate strongly with others across the larger group of participants. Because of the very individualized nature of the results, further research would be necessary to examine whether or not there is potential for digital phenotyping to be useful on a population level. Additionally, further research is required to create algorithms capable of detecting relevant behavior changes without constant monitoring. This development would allow for less continual monitoring of a patient's incoming data in a clinical setting and provide an indication for when intervention is necessary based on the detection of clinically relevant behavior.

Our results also shed light on the challenge of finding universal use cases and durations of use for mental health app use. While the LAMP smartphone app is able to capture variable patterns among participants that did have clinical relevance, the value in this data was often elucidated though a conversation sparked by the data rather than the raw number or results. For example, Participant 3 had an important clinical finding that the app data suggested but did not reveal without discussing with her. On the other hand, Participant 1 appeared stable, and the data confirmed what was already the current clinical interpretation. Having Participant 1 record symptoms and capture digital data to potentially detect risk of relapse may thus not make sense but could prove useful if there was ever a dramatic change from the stability seen in that data present in **Figure 9**. This becomes a case where patient preference, clinician comfort, and clinical needs will determine use and duration. As seen in all five cases, the potential of LAMP to capture diversity in symptoms also likely requires there be equal flexibility in its clinical use. While our case report series is not able to answer why older participants used the app more than younger participants (**Figure**

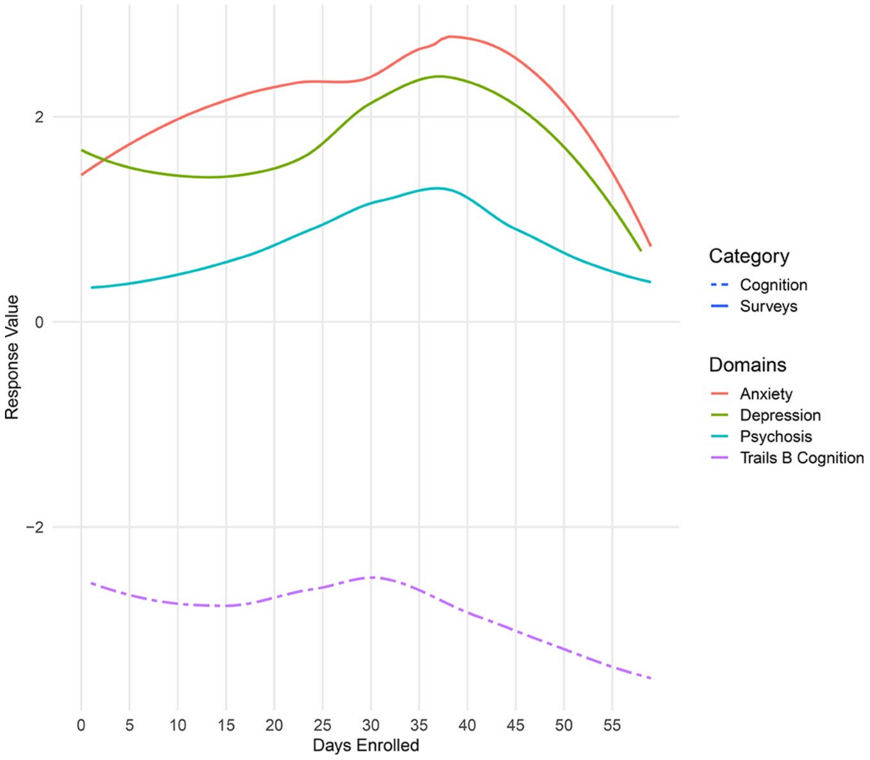


FIGURE 6 | Summary of Participant 3's survey scores over the duration of her enrollment in the LAMP study.

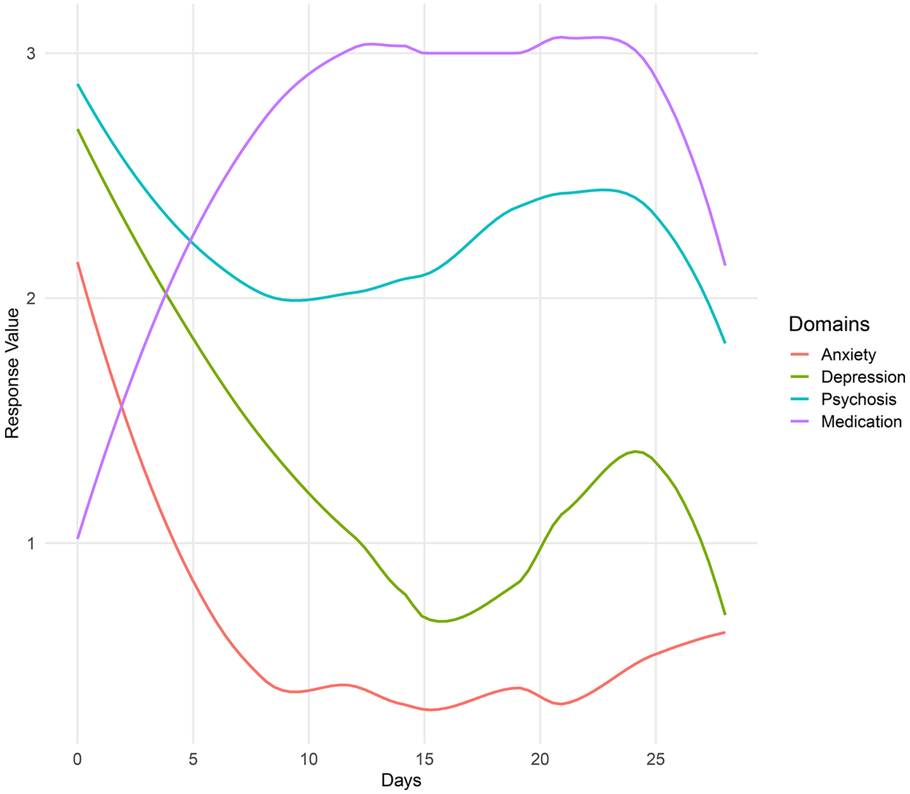


FIGURE 7 | Summary of Participant 4's survey scores over the duration of her time in the LAMP study.

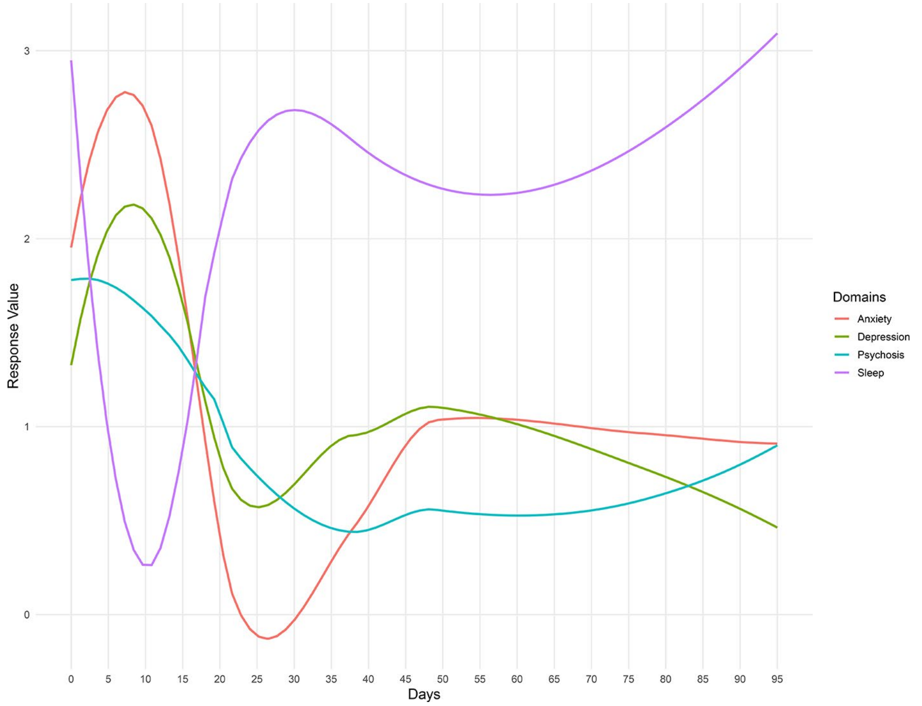


FIGURE 8 | Summary of Participant 5's survey scores over the duration of her enrollment in the LAMP Study.

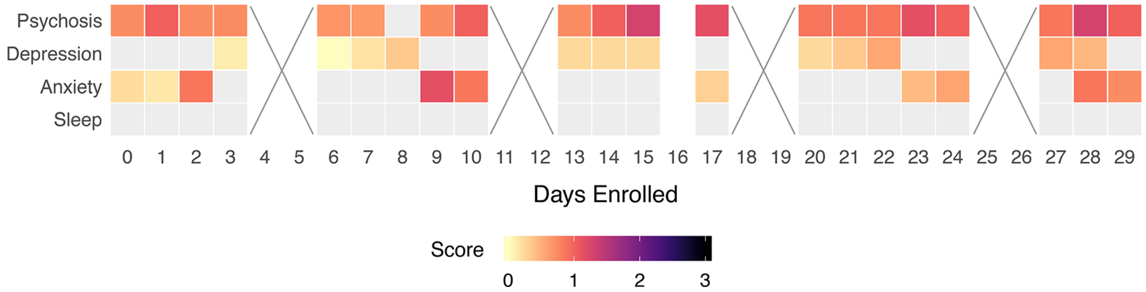


FIGURE 9 | Participant 1's survey adherence rate within their first 30 days of enrollment. Box color indicates symptom severity. Boxes marked with an "x" indicate a weekend, on which we did not ask participants to complete surveys.

3), these results do challenge the popular assumption that digital natives must want digital care.

Although the current study focused on retrospective examination of the data used in discussion with the participants as opposed to continual monitoring and prevention of behaviors, we found that there is potential for digital phenotyping in symptom monitoring and prediction. During discussion, all the users indicated that their observed clinical patterns made sense, and they were able to confirm patterns and stressful life events that warranted their observed change captured by their smartphones. All felt that while the app alone could not yet offer insights into their care, as a tool augmenting care, LAMP was useful.

To make the app more useful, we believe that a new type of mental health provider may be useful to help support its use and interpretation—a digital navigator. While the insights from the app should be discussed in clinical visits, monitoring the data in real time for safety (e.g., risk of suicide) and examining for relevant clinical trends in light of the patient's unique background and history can be time-consuming without any validated algorithm to help today. Thus, a digital navigator could serve the role of helping the patient set up and learn to use the app, monitoring the data, and highlighting potentially relevant areas for review during clinical visits. This same person could also help with unexpected issues such as the need to reset app passwords, replace smartwatch bands that break, and troubleshoot many other small issues that could arise.

Although our study offers promise that digital phenotyping can capture clinically relevant data, there are several limitations. First, as a case report series, it is difficult to generalize these results, although by making both the app and code to generate plots available, others can seek to replicate this work with their own patient populations.

Second, accurate data collection relies heavily on each individual user and how they use their phone (i.e., how often they engage with it and whether or not they carry it wherever they go). Digital phenotyping can only be an accurate proxy for behavior if participants keep their phone with them and use it. Therefore, this method is better suited for individuals who regularly engage with their smartphone and are able to use it with ease. Third, we only included those patients who already owned a smartphone, and so our results are also difficult to generalize to those patients who may use less technology.

CONCLUSION

This work demonstrates the feasibility of using smartphone apps to create a digital phenotype in mental health by monitoring symptom surveys, cognition scores, and physiological data. Furthermore, our study has shown that novel data may offer actionable clinical insights on the individual patient level. However, identification of these patterns is only the first step, and we recognize that to use these data in clinical care, there is a need for further replication of results, training of clinicians to use this data meaningfully, and even the creation of new roles for digital navigators to help facilitate the introduction of apps into the clinic.

DATA AVAILABILITY

The datasets for this study will not be made publicly available because others can use our app and code to generate their own datasets. Those we report on are of unique patients and thus identifiable if the full dataset is offered.

ETHICS STATEMENT

This study is approved by our hospital BIDMC full IRB board.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the design, data collection, writing, and editing of the paper.

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frontiers in Psychiatry

ORIGINAL RESEARCH
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Revising Computerized Therapy for Wider Appeal Among Adolescents: Youth Perspectives on a Revised Version of SPARX

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Background: The way in which computerized therapy is presented may be important for its uptake. We aimed to explore adolescents' views on the appeal of a tested computerized cognitive behavioral therapy (CCBT) for depression (SPARX), and a revised version (SPARX-R). The versions were similar but while SPARX is presented explicitly as a treatment for depression, SPARX-R is presented as providing skills that could be useful for young people for when they were depressed, down, angry, or stressed.

Methods: We held 9 focus groups with a total of 79 adolescents (13–19 years old; 47 females; 34 New Zealand European; 22 Māori or Pacific; 60 reported having experienced feeling down or low for at least several days in a row). Groups viewed the opening sequences of SPARX and SPARX-R (in random order), then took part in a semi-structured discussion and completed a brief questionnaire. Responses were analyzed using a general inductive approach.

Results: Participants considered both SPARX and SPARX-R useful and considered the stated purpose of the program to be important. Four themes contrasted the two approaches. The first, "naming depression is risky", referred to perceptions that an explicit focus on depression could be off-putting, including for adolescents with depression. The second theme of "universality" reflected preferences for a universal approach as young people might not recognize that they were depressed, and all would benefit from the program. In contrast, "validation" reflected the view of a significant minority that naming depression could be validating for some. Finally, the theme of "choice" reflected a near-unanimously expressed preference for both options to be offered, allowing user choice. In questionnaire responses, 40 (68%) of participants preferred SPARX-R, 13 (18%) preferred SPARX, while 10 (14%) "didn't mind". Responses were similar among participants who reported that they had experienced at least a few days of low mood and those who had not.

Conclusions: The way a CCBT program is presented may have implications for its appeal. The potential population impact of CCBT programs explicitly targeting depression and those targeting more universal feelings such as being stressed or feeling depressed should be explored for varied user groups.

Keywords: digital therapy, computerized cognitive behavior therapy, adolescent, depression, prevention, internet interventions

INTRODUCTION

Depression and sub-threshold depression are common and disabling, with up to 25% of young people experiencing depression by the end of adolescence (1). Cognitive behavioral therapy (CBT) is a first-line treatment (2), but the majority of adolescents do not use professional services despite significant symptoms (3, 4). Notably, many young people, particularly those from minority groups or cultures, report that they would prefer to access support from familiar people, use self-help or internet-based information, or that they would not seek any help (5–7).

Computerized cognitive behavior therapy (CCBT) has been demonstrated to be effective in alleviating depression in adolescents (8–10). Online approaches have the potential to reduce obstacles to therapy associated with location, cost, and convenience, and may reduce obstacles associated with stigma and limited help-seeking skills (11, 12). Our youth e-therapy team (SM, KS, TF, ML, MS) developed and tested SPARX (smart, positive, active, realistic, X-factor thoughts), an interactive CCBT program for adolescents with mild-to-moderate depression (13). SPARX comprises seven levels, which teach CBT skills such as relaxation, problem solving, and recognizing and challenging negative automatic thoughts *via* direct instruction and play-based learning in a fantasy environment. In a randomized controlled trial with 187 adolescents with symptoms of depression, SPARX was found to be non-inferior to treatment-as-usual (13). In smaller trials, it was found to be more effective than waitlist control for students excluded from mainstream education (14), appealing to indigenous Māori young people (15) and, in a "rainbow" version, promising for sexual minority youth (16). SPARX met with high approval from adolescents and providers (13, 17, 18).

However, analysis of data from our research highlighted some potential problems with targeting CCBT explicitly toward "youth with depression". First, some front-line workers who support young people were not confident about identifying depression and did not wish to do so (18). Consistent with social service providers (19), these helping professionals saw a diagnostic and treatment approach as inconsistent with their role, which they considered to be supportive, normalizing, and non-pathologizing. Many considered that identifying adolescents on the basis of their mental health problems might be unwanted and unhelpful. Second, adolescents themselves reported that they might not recognize that they were depressed or down. In addition, even if they did recognize this, they would not ask for help and would resist receiving help that differentiated them from their peers (12, 17). Third, in a pragmatic trial of SPARX CCBT in alternative education settings, a universal approach appeared advantageous. In this study, the recruitment and retention of participants (both with and without symptoms) was much higher in the five study sites that invited all students to participate than in the single site that used a targeted approach (14). Participating adolescents also reported that they found CCBT helpful, whether or not they had depressive symptoms at baseline (17).

There is promising evidence in support of CBT-based prevention programs, particularly with targeted or indicated groups. Meta-analyses show that psychological depression prevention programs for adolescents, many based on CBT principles, are promising for preventing depression compared with no intervention, with a number of studies showing a decrease in episodes of depressive illness during the year following intervention (20, 21). In addition, there is evidence that CCBT interventions can be effective in improving sub-threshold symptoms (22) and preventing mental disorders among adults (23).

Based on our findings and this evidence, we developed a revised version of SPARX, directed at preventing and treating sub-clinical symptoms as well as treating mild-to-moderate depression. TF, an experienced youth mental health clinician and SPARX co-developer, instigated the development of SPARX-R with the support of other SPARX co-developers SM, KS, ML, and MS (SM is a consultant child and adolescent psychiatrist and led the development of SPARX, ML and MS are experienced child and adolescent therapists and researchers, and KS is a research psychologist). All developers reviewed SPARX content and proposed changes and TF consulted adolescent advisors and an external clinical team on the proposed alterations and wording. SPARX developers reached consensus on the revised script in an iterative fashion. Key SPARX content is highlighted in **Table 1**. Almost all of this content was identified as appropriate or acceptable for SPARX-R, with the following alterations:

- SPARX begins with a "guide" character (a virtual therapist), who states that the purpose of the program is to help young people "who feel down or depressed". The term "depression" is thereafter used frequently, with the assumption that the user has depression.
- In SPARX-R, the guide states: "This version of SPARX was made to help young people who are having hassles and feeling down, stressed, or angry a lot of the time. Even if you are doing fine, SPARX can help strengthen your skills for dealing with problems when they do come along."

TABLE 1 | Revising SPARX.

Key SPARX content	Appropriate for SPARX-R	Acceptable for SPARX-R	Amended for SPARX-R
Welcome and virtual rapport building			Yes*
Psychoeducation regarding: depression being a common challenge that is amenable to change; methods of dealing with depression; linking thoughts, actions, and feelings			Yes**
Introducing a "shield against depression"			Yes***
Expression of hope		Yes	
Cognitive restructuring: recognizing and challenging negative automatic thoughts, identifying and promoting SPARX (smart, positive, active, realistic, X-factor thoughts)		Yes	
Relaxation skills: controlled breathing, progressive muscle relaxation	Yes		
Activity scheduling	Yes		
Interpersonal skills: social skills, listening skills, assertion and negotiation skills	Yes		
Dealing with strong emotions: anger and hurt feelings, distress tolerance	Yes		
Problem solving	Yes		
Keeping on trying, asking for help, overcoming barriers to change	Yes		

**Welcome amended as described in text.*

***Psychoeducation amended to feeling down, stressed, or depressed being a common challenge that is amenable to change; methods of dealing with these feelings when they become overwhelming or go on for a long time; linking thoughts, actions, and feelings.*

****Amended to a "shield against feeling down".*

- The term "depression" was replaced in SPARX-R by broader terminology, most often "feeling down, stressed, or angry a lot of the time".

To date SPARX-R has been tested in two small pilots and one cluster randomized controlled trial. The first prototype (SPARX-R 1.0) was piloted in two small studies using compact disc read-only memory (CD-ROMs) or memory sticks. The first pilot, in a New Zealand youth justice program, was unsuccessful. Few participants attended the program regularly, and even fewer began SPARX-R, with no effects reported (24). The second was held in Irish "Youthreach" alternative education centers. There were many technical problems with SPARX-R (e.g., downloads, saving progress). Despite these issues, there was an effect for emotion regulation, but no effect for depression was reported (25). In the next prototype (SPARX-R 1.1) the main technical issues were addressed and SPARX-R was delivered online in a cluster randomized controlled trial of 540 final year students in 10 Australian high schools. Participants in the SPARX-R arm of the study (n = 242) showed significantly reduced depressive symptoms relative to control participants (n = 298) at post-intervention (26). In contrast, a school based prevention trial in the Netherlands, found that a Dutch translation of SPARX was no more effective for reducing subclinical depressive symptoms among girls than a weekly detailed monitoring control condition or group-based CBT (27).

Despite these developments, adolescents' views on the relative relevance and appeal of SPARX and SPARX-R have not been explored. In this study we aimed to address this gap. In particular, we sought to understand whether framing the program as explicitly "for depression" or for youth more generally was salient to participants and implications for implementation of digital mental health tools for youth.

METHODS

As user preferences regarding the framing and focus of online therapy are relatively unexplored, we carried out a qualitative study using focus groups to explore adolescents' views. Focus groups are ideal for exploring people's experiences of health services and allow the researchers to investigate both convergent and individual views (28). To ensure that all participants' opinions were sufficiently captured, including points that they may not wish to raise in front of peers, participants completed a brief pen-and-paper questionnaire at the end of the focus group. Ethics approval was obtained from the University of Auckland Human Participants Ethics Committee (Reference 2015/014991).

Procedure

We approached 10 schools and 3 community organizations in ethnically and socio-economically diverse areas of Auckland, New Zealand. School principals and organization managers gave assent for adolescents to be invited to participate and were given material to disseminate to adolescents and their parents/caregivers through their standard communication channels. Interested students were given information and encouraged to take this home. Parents/caregivers of adolescents younger than 16 could opt to have their children excluded. On the day of the focus groups adolescents gave their own written consent to participate. Participants were offered a cinema voucher as an acknowledgement of their time and effort.

Focus groups were held in private spaces at the various organizations. All groups were facilitated by TF or EM and other co-authors and lasted between 40 and 60 min. Groups were audio-recorded and field notes were taken. In each group, participants viewed the opening sequences of SPARX and SPARX-R (in random order) and answered a schedule of open-ended questions (see **Table 2**). We used follow-up questions and reflective statements to explore and check understanding. Participants then completed a brief pen-and-paper questionnaire, which asked them 1) which program they thought they would prefer to use if they were feeling down, 2) which program they would prefer to use if they were not feeling down, and 3) whether they had ever felt down or low for

TABLE 2 | Questions used to guide focus group discussion.

1. Do you think people your age get depression? Have you seen it? Do people your age know/recognize if they are depressed?
2. How do young people usually cope? What do they do to cope? Do they get help?

First audio-visual excerpt shown (either SPARX or SPARX-R)

3. What do you think about this program? What did you like? Not like?
4. Do you think it would be relevant for young people?
5. Do you think it would be relevant for young people who were feeling okay? What about for young people who were feeling down? What about for young people who had depression?
6. How would you feel about being asked to do this program?

Second audio-visual excerpt shown (SPARX if shown SPARX-R previously or SPARX-R if shown SPARX previously)

7. What do you think about this program?
8. Did you notice a difference? What was the difference?
9. Which version do you think is better to use with young people? What about if you were feeling good/a little down/had depression and/or were feeling very down? What are the pros/cons about each?
10. Any other comments?

more than a few days in a row. The questionnaire also requested brief demographic information and included an open space for further comments. Once data saturation was reached (i.e. no new information was discovered in data analysis) no further focus groups were held.

Participants

In total, 79 young people aged between 13 and 19 years old, from eight schools and one youth community organization (focus group five) participated in nine focus groups, as shown in **Table 3**. Forty-seven (59.5%) were female, the majority were between 15 and 17 years old (13 years, n = 3; 14 years, n = 8; 15 years, n = 12; 16 years, n = 20; 17 years, n = 23; 18 years or older, n = 10). The sample was ethnically diverse (11 Māori; 11 Samoan, Tongan or other Pacific Island; 8 Asian; 37 New Zealand European; 4 "other ethnicity"). Most (75.9%, n = 60) reported that they had suffered from feeling down or low for more than a few days in a row. The number of participants as well as proportions of males and females, and proportions of participants who reported feeling down or low for more than a few days in a row, varied among the focus groups as shown in **Table 3**.

Analysis

We used a general inductive approach (28) to analyze transcripts and open-response questionnaire comments. This approach is appropriate for interpreting content regarding relatively specific research or service delivery questions. First, TF, EM, and EH-W familiarized themselves with the data through repeated reading of the transcripts. They identified basic units of information and developed initial codes, which were clustered with other similar codes to create potential themes. Second, themes were refined by assessing contradictory points, subtopics and reviewing the essence of each theme. The researchers independently viewed the data, and drafted themes using the same process. Identified themes were then discussed among the coders and reviewed with co-authors. Differences were resolved by consensus and quotes encapsulating the themes were selected. Throughout the analysis process, the scripts were re-read to ensure that the findings remained true to the data.

Questionnaire responses were imported into IBM SPSS (Version 19). Simple descriptive statistics were generated but statistical testing was not carried out due the exploratory aims of the study and the small sample size. The Consolidated Criteria for Reporting Qualitative Research (COREQ) (29) guidelines were used to guide the reporting of the study.

RESULTS

We identified four themes relating to the relative acceptability and appeal of CCBT explicitly "for depression" and CCBT with more general wording (i.e., SPARX compared with SPARX-R): 1) naming depression is risky, 2) universality, 3) validation, and 4) choice. Quotes illustrating each theme are presented in **Table 4**. In addition to these four themes, an overarching theme "computerized therapy is accessible" was identified, which reflected a high level of interest from adolescents in computer programs as an approach for accessing help.

TABLE 3 | Participant demographics by focus group.

Group	N	Gender		Age						Ethnicity					Feeling low[a]	
		Male	Female	13	14	15	16	17	18+	Māori	Pacific	NZE[b]	Asian	Other	Y	N
1	10	4	6				1	7	2	2	1	6	1		9	1
2	6	1	3			2		2				4			4	0
3	4	1	3		1	1		1	1	2			1		1	1[c]
4	11	2	9				4	6	1		6		3	1	10	1
5	13	6	7				3	4	6	3	2	7		1	12	1
6	10	5	5	3	4	3						5		2	5	2
7	7	2	5			2	4	1		1	1	3	2		7	0
8	7	4	1[d]			3	2	1				5	1		4	2
9	11	3	8		3	1	6	1		3	1	7			8	3
Total	**79**	**28**	**47**	**3**	**8**	**12**	**20**	**23**	**10**	**11**	**11**	**37**	**8**	**4**	**60**	**11**

[a]Affirmative response to "have you ever suffered from feeling down or low for more than a few days in a row?". [b]New Zealand European. [c], 1 individual responded "not sure", [d], 1 individual responded "prefer not to say".
Row totals may not match due to missing data.

TABLE 4 | Themes and example quotations.

Theme	Example quotes	Focus group
Computerized therapy is accessible	"You can just stay at home and relax with the computer."	FG1
	"It's good for [people] to not really have to leave their comfort zone to get help."	FG8
	"It's easier than [going to] talk to someone and sit down with them and go through all your problems with them."	FG6
Naming depression is risky	"'Depression' is off-putting."	FG4
	"I think [SPARX-R] is more on the safe side. You're less likely to take offence to it."	FG1
	"It kind of felt more belittling with (the guide) saying this game is to help people with depression. It made you feel worse about yourself for having this problem."	FG8
	"[SPARX-R] doesn't sound as severe … it's kind of like everyone goes through this sort of thing. You know you're not weird or having it labelled as [having] depression."	FG5
Universality	"I think [SPARX-R] will reach out to more people."	FG2
	"Even if they weren't depressed and were just feeling sad, you could aim the game at them too and make them feel better as well as the people that are dealing with depression."	FG4
	"It's like, even if you are doing fine, SPARX-R can strengthen the skills. And I think that's gonna appeal to everyone. Even if people are not completely depressed but just not feeling the best."	FG5
	"I like that [SPARX-R] didn't say 'depressed people', because not everyone comes to terms with the fact that they may be feeling depressed."	FG4
Validation	"When you're saying they've got hassles and stress and stuff, that's kind of putting them down in [terms of] what they're actually going through [if they are depressed]."	FG1
	"I know some people that are depressed and SPARX-R is like 'oh, you're stressed and stuff'. They take real offence to that because they know what they've got so they like people being straight up about it."	FG1
	"I liked SPARX more because of the way it acknowledges you're feeling depressed."	FG8[a]
Choice	"At the end of the day it all depends on the person and how they carry their depression."	FG4
	"You could make it that they answer questions before they get into it, that sort of tells you what space they're in and whether … they already sort of feel like they have depression so then it's okay to say it, or whether they're just feeling a bit down."	FG8

Computerized Therapy Is Accessible

This theme reflected participants' views that computerized therapy would be useful for adolescents as it is an easy way of getting help and does not require young people to speak with someone face-to-face. They considered the game-style interface of both versions (SPARX and SPARX-R) to be fun and much easier to access than other means of getting help for psychological issues. Speed and ability to get into "playing" quickly were noted as important. While participants considered both SPARX and SPARX-R to be somewhat "clunky" and "old school" they thought that they would still use it, as long as it was not too slow to play online.

Naming Depression Is Risky

Participants considered the "depression language" used in SPARX to be "a little bit scary" and some thought that the explicit assumption that users "had depression" could make users feel worse. Many considered this approach more confronting than the "toned down" language used in SPARX-R, suggesting that the "abrupt" use of depression language may be off-putting, or even offensive, to youth who may not want to be labeled as "having depression" or are unsure whether they are depressed.

Universality

Participants considered the language of SPARX-R more accessible than the "depression language" used in SPARX. They reported that the language used in SPARX-R was:

- Inviting for young people who were not depressed but were struggling with a range of issues (e.g., anger and stress);
- Inviting for those who might not realize they are depressed or, if they do realize, may want to keep this private; and
- Still relevant for those with depression.

Thus, participants reported that they would be more likely to recommend SPARX-R than SPARX to a friend, even if that friend had depression. Participants thought that "depression language" might "put [young people] off" getting the help they need. Counter to this, a minority of participants noted that, while SPARX-R was more accessible to a wider group, they enjoyed the direct approach and language used in SPARX, where the aim of helping people who might have depression is not hidden or couched in softer language. This ties in with the idea of validating young people's experiences of depression.

Validation

While it was generally agreed that SPARX-R was more appropriate for a wider audience, a minority of participants considered that the language in SPARX-R could be interpreted by some who had experienced clinical depression as belittling their experience. They thought that the direct language used in SPARX may confirm that this program was appropriate for them. However, provided with a scenario where only limited resources were available, participants considered SPARX-R to be a better option than SPARX.

Choice

Participants expressed the perspective that both approaches (i.e., depression-specific CCBT and a more general CCBT program) have positive and negative attributes. There was general agreement that both had value and users should be offered different versions depending on their preferences, the severity of their symptoms, and the route *via* which they had been offered the program (e.g., internet search *versus* recommendation by a clinician).

In questionnaire responses, the majority of participants preferred SPARX-R to SPARX, whether or not they had a history of feeling low for more than a few days in a row (see **Table 5**). The majority considered that if they were feeling down or depressed, they would still prefer SPARX-R or would like both versions equally.

TABLE 5 | Questionnaire responses.

	Which program did you like more/prefer?		
	SPARX	**Both equally/don't mind**	**SPARX-R**
Have you ever suffered from feeling low for more than a few days in a row?			
Yes	11 (19%)	8 (14%)	40 (68%)
Not Sure	0	0	1
No	2	2	7
Total[a]	13 (18%)	10 (14%)	48 (68%)
If I was feeling down or depressed I think I would prefer[b]…	25 (33%)	12 (16%)	38 (51%)
If I was NOT feeling down or depressed I think I would prefer[c]…	14 (19%)	14 (19%)	47 (63%)

[a]*Missing data n = 8;* [b]*Missing data n = 4;* [c]*Missing data n = 4.*

DISCUSSION

In this exploratory study we found that adolescents considered the way a CCBT program is presented and the language used is important for its appeal. While both SPARX computerized therapy "for depression" and SPARX-R computerized therapy "for young people generally" were received favorably, participants considered that the less clinical wording of SPARX-R would appeal to a broader range of adolescents. They suggested that this approach would hold greater appeal for those who 1) did not have depression, 2) did not recognize themselves as depressed, and 3) were uncomfortable identifying as depressed, while retaining relevance for those who did identify as depressed. Many participants expressed a preference for user choice between both options, as naming depression explicitly could be validating for some. However, should only one option be offered, they preferred the more broadly focused approach. Although these findings are from just one study and one comparison, they suggest that developers should give careful consideration to how CCBT for young people is presented.

Computerized therapies hold promise for reducing the large treatment gap for depression, but analyses suggest that such tools are yet to achieve their potential impact (8, 30–32). Systematic analyses highlight that clinical support can improve retention in CCBT (32). However, over half of young people with clinically significant symptoms do not seek professional help and clinically supported approaches will not address this. Gulliver, Griffiths, and Christensen (33) reviewed qualitative and quantitative studies, and found that adolescents identified the most significant barriers to help-seeking as: perceived stigma and embarrassment, difficulty recognizing symptoms (i.e., poor mental health literacy), and a preference for self-reliance. We have previously identified that even looking up a website "for depression" in private can be off putting for some adolescents (34). Computerized approaches that avoid the terminology linked to diagnostic categories may help to reduce the barriers associated with stigma and embarrassment, whether a young person is seeking help *via* a professional or on their own (e.g. *via* an internet search). It is noteworthy that many popular contemporary programs and apps focus on personal self-help or development and do so without naming specific psychiatric disorders. They instead highlight specific challenges (such as sleep), or aspirations, such as improved mood (35).

Universal or selective interventions have real potential in the face of limited help seeking amongst adolescents. To date, school- and education-setting-focused depression prevention interventions have shown promising results (20, 21). Ideally, users might choose a program (or, in computer science terms, a "skin" or pre-set appearance package) that appeals to them. As this option is not yet commonly available, interventions should be framed in a way that is welcoming and relevant for all, without minimizing disorder or causing other harms. In relation to prevention trials, it is useful to compare the two large high school-based studies of SPARX. One was a cluster RCT comparing SPARX-R with an online control program (26), and the other compared a Dutch translation of SPARX with a routine monitoring control condition and group-based CBT (27). The cluster RCT identified positive effects for SPARX-R for the prevention of depressive symptoms (26), while the Dutch trial did not find a greater reduction in subclinical symptoms in the SPARX condition than the other two conditions (27). There are a number of differences between these two trials that could account for their contrasting results. For instance, SPARX-R in Australia had a sample size of 540 students (63.1% female, mean age = 16.7 years) whereas the Dutch trial had a sample of 208 students (100% female, mean age = 13.4 years). Given the differences in prevalence of depression by age (36), the study in the Netherlands may have been underpowered. Differences in presentation between the two versions of SPARX may also have had an impact. For example, the professional voice actor who voiced the Guide in both SPARX and SPARX-R was carefully selected because of his warm empathic voice and young people have previously commented that they felt the guide cared for them (17). Different voice actors were used in the Dutch language version of SPARX. It is also possible that the contrasting findings regarding effectiveness could be due in part to the differences in language used to frame SPARX and SPARX-R, and resulting differences in user appeal. This hypothesis could be explored in further research. It would be valuable to directly contrast clinically and less clinically focused versions of programs in future studies.

Strengths and Limitations

We sampled a small, unique population group (young people living in urban parts of Auckland, New Zealand) and examined versions of one particular CCBT program (SPARX/SPARX-R). Other groups and other programs might yield different findings. However, our sample was diverse in terms of age, gender, and ethnicity. Co-designers of SPARX (TF, KS, and MS) carried out some of the focus groups, which may have led to a social desirability bias. To constrain this, honest and frank discussion was actively encouraged and participants completed anonymous questionnaires at the end of focus groups. Importantly, the sample was from a non-clinical population and depressive symptomatology was not assessed using a validated measure, although a large proportion of the participants reported having experienced periods of significant low mood. This is an important consideration, as preference between SPARX and SPARX-R can be expected to be influenced by experience with depression. Further research using a clinical sample or a validated depression measure would allow for comparisons of uptake, as well as adherence and effectiveness, between clinical (and potentially help-seeking) young people and youth from the general population.

Our focus groups varied in size from 4 to 13 persons and included differing proportions of males, females, and participants who had felt down or depressed. Guidance for focus group size often ranges from 4 to 12 participants (37), or more narrowly, for example from 6 to 10 participants (38). Our written feedback sheet did allow an opportunity for additional individual comments that might not have been made in groups; however, more standard sized groups might have allowed richer discussion.

CONCLUSIONS

This exploratory study suggests that the language used to frame the purpose of CCBT has implications for its appeal to adolescents. Some young people may perceive the term “depression” negatively, as well as stigmatizing and exclusionary to those struggling with less severe issues, whereas others may perceive it positively, as validating of a young person’s depressive experiences. Offering different terminology to meet diverse personal preferences is ideal, but where this is not possible and the therapy is designed for widespread use amongst youth more generally, our results suggest that adopting less clinically orientated or diagnostically focused language may broaden appeal.

DATA AVAILABILITY STATEMENT

The datasets for this study will not be made publicly available because data include statements made by individual young people and the ethics approval obtained by the University of Auckland Human Subjects Ethics Committee does not allow this to be shared.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the University of Auckland Human Participants Ethics Committee with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the University of Auckland Human Participants Ethics Committee (Reference 2015/014991).

AUTHOR CONTRIBUTIONS

SM, KS, MS, ML, and TF developed and tested SPARX. TF identified the possible need for SPARX-R and developed this with SM and KS and others. TF and EM planned the focus group study. TF and EM led the focus groups with input from EH-W, KS, and MS. TF, EM, and EH-W carried out the initial analyses of results and then refined these with all co-authors. TF, EM, EH-W, and LB drafted the paper. All authors contributed to the paper and confirmed the final content.

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Conflict of Interest: SM, KS, TF, MS, and ML are co-developers of SPARX. The intellectual property for SPARX is held by Uniservices at the University of Auckland and the co-developers could benefit financially from licensing or profit generated from SPARX outside of New Zealand.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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BRIEF RESEARCH REPORT
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Perspectives of Young Adults on Receiving Telepsychiatry Services in an Urban Early Intervention Program for First-Episode Psychosis: A Cross-Sectional, Descriptive Survey Study

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Background: Limited knowledge exists on telepsychiatry in specialized services for first-episode psychosis (FEP), despite its potential for improving service access and engagement.

Objective: To explore access and use of technology, obstacles to attending clinic appointments, and perspectives of young adults with FEP on using telepsychiatry as part of outpatient services.

Methods: A cross-sectional, descriptive survey study was conducted between July and October 2017 with young adults between the ages of 18 and 38 recruited from a specialized program for FEP in an urban Canadian setting. Data were analysed using descriptive statistics and content analysis.

Results: Among 51 participants (mean age = 26.1, SD = 4.2; 59% male; 20% experiencing housing instability), more than half (59%, n = 30) rarely or never used mainstream video chat (e.g., Facetime). The majority (78%, n = 40) reported obstacles to attending appointments, with several (37%, n = 19) identifying two or more. Almost half (49%, n = 25) were very favorable towards telepsychiatry and a quarter (25%, n = 13) were somewhat favorable. Participants expressed several concerns about telepsychiatry, including loss of human contact and confidentiality.

Conclusions: To our knowledge, this is a first study on the perspectives of individuals with FEP about telepsychiatry. Despite experiencing obstacles to attending appointments and expressing receptivity towards telepsychiatry, participants did not have access to these services. It is important to provide education to clinicians on the potential of telepsychiatry to improve service access. Also, more research is needed on when, where, and how telepsychiatry can be integrated into existing care while addressing patient and clinician concerns.

Keywords: information and communication technologies, mhealth, e-mental health, mental health services, psychiatry, telemedicine, homeless, video

INTRODUCTION

Young adults with first-episode psychosis (FEP) face individual, cultural, service, and system-level obstacles to engaging with mental health care (1). It can take half a day, or even more to attend a follow-up appointment (for example, after being discharged from the hospital, or after receiving an initial psychiatric evaluation as an outpatient), including time for transportation, waiting to be seen, and coping with other factors. Moreover, this process may need to be repeated on a weekly or bi-weekly basis at different time points during one's follow-up, which may not always be feasible due to competing priorities (e.g., caregiving, school/work schedules, financial resources for transportation).

To address these challenges, many early intervention programs for psychosis have adopted a community-based approach whereby clinicians deliver services outside clinic walls (2). However, this approach requires time for travel and the young person may not always be present or receptive to community visits. New models that are efficient and effective in sustaining engagement of young people are needed. Leveraging technology-supported services may help with service engagement (1, 3) and preliminary studies (4–7) conducted with the FEP population indicate that they have access to and use mainstream technologies (e.g., Internet, computers, mobile phones); however, limited attention has been given to the perceptions of young adults with FEP on use of telepsychiatry to receive mental health services.

Telepsychiatry (or tele-mental health) involves real-time communication with a mental health care professional through secure video conferencing solutions. Systematic reviews conducted with the general psychiatric population have shown that telepsychiatry is reliable for conducting assessments, equivalent in terms of producing treatment outcomes, and is cost-effective in comparison to face-to-face sessions [e.g., (8)]. However, as illustrated through Shore's review (9), most telepsychiatry studies have focused on rural and remote settings. Research is needed to better understand if individuals living in urban contexts face barriers in accessing services that could be addressed through telepsychiatry.

Moreover, very few studies have investigated the use of telepsychiatry with individuals diagnosed with FEP or schizophrenia-spectrum disorder. For example, Kaskow et al.'s (10) telepsychiatry review found only 6 studies conducted with participants diagnosed with schizophrenia and more recently, Santesteban-Echarri et al. (11) found 14 studies, though none were clearly focused on a population with FEP. Nonetheless, the results of these reviews provide preliminary evidence that telepsychiatry services for patients with schizophrenia-spectrum disorder is feasible and acceptable. However, limited, if any, research exists on telepsychiatry in urban and rural early intervention programs for psychosis, from the perspectives of patients, support networks, and service providers.

The purpose of this study was to better understand the perspectives of urban young adults with FEP on receiving telepsychiatry services as part of their follow-up (e.g., after being discharged from the hospital or following an initial outpatient psychiatric assessment). We also aimed to identify their access and use of technology, along with obstacles to attending clinic appointments, as these factors can influence feasibility of telepsychiatry and its perceived usefulness. This study is informed by the Technology Acceptance Model (TAM) (12), which has been used to assess acceptance towards technology in health care [e.g., (13)]. According to TAM, attitudes towards a technology (i.e., whether it is useful and easy to use) influence the future use of the technology (14). Understanding the acceptability of an innovation can help to inform strategies for improving adoption and actual use.

METHODS

This survey study is the first phase of a larger project evaluating the implementation of telepsychiatry services in an urban setting. The study received approval from the scientific and ethics review board of the University of Montreal Hospital Centre (CHUM) (#17.073), a general hospital located in downtown Montreal, Canada.

Study Design, Setting and Recruitment

Using a cross-sectional survey design and convenience sampling, participants were recruited from an early intervention program for FEP at CHUM: Clinique JAP—Jeunes Adultes Psychotiques, which also includes a sub-team EQIIP SOL—Équipe d'Intervention Intensive de Proximité, focused on delivering services to youth experiencing concurrent FEP and housing instability. Within this setting, up to 26% of patients with FEP experience homelessness either prior to receiving, or during, specialized services (15). At any given time, the Clinique JAP team provides services to approximately 260–300 youth, and EQIIP SOL has about 30 active patients.

Participants were recruited from the clinic's waiting room between July 11 and October 31st, 2017. Verbal informed consent was obtained by the research assistant based on the informed consent section at the beginning of the questionnaire; no personal identifiable information was recorded in this study. The anonymous questionnaire was administered by the research assistant in the waiting room or in a quiet room nearby based on participant preference. Respondents were provided with a gift card ($15 CAD) upon completing the questionnaire.

Data Collection

The paper-based questionnaire had 46 questions with multiple choice, Likert scale, and open-ended options. The questionnaire was adapted from a previously published study, the objectives of which were to better understand access and use of technology and preferences of using technology for a range of mental health services (6, 7). The sample from that study was recruited from a different clinical program for FEP, within the same city. We adapted the previous questionnaire as follows: 1) updated sections on access and use of technology and demographic questions, 2) replaced the rest of the questionnaire with sections on obstacles to attending appointments (e.g., finding time, financial, public transportation, physical limitations, etc.), satisfaction with services, attitudes towards technology, and perspectives on telepsychiatry. Topics were selected based on factors considered to influence perceived usefulness of, and intentions to use technology based on the TAM model. Items were developed through discussion with physician and non-physician clinicians working with this population and members of the research team. Before finalizing the questionnaire, we sought input from additional service providers and young adult patients for comprehensibility and relevance, and pilot tested it with two patients for duration. A copy of the questionnaire items is provided as **Supplementary Material**.

Data Management and Analysis

The data was entered into a password protected excel file and stored on a secure institutional server. Descriptive statistics were used to summarize the survey responses. Qualitative descriptive analysis was used to synthesize the responses to the open-ended questions pertaining to concerns and recommendations of using videoconferencing/telepsychiatry to communicate with treatment providers. Specifically, all responses were first entered into the excel file, then responses to each question were open-coded (inductively) by two members of the research team, and subsequently all codes were grouped into broader categories, which were discussed and finalized through team discussion. Then, we counted the number of times each of these categories were labelled to identify frequencies (e.g., number of times responses were labelled with the category of 'confidentiality').

RESULTS

Participants

In total, 83 individuals were approached to participate in the study, from which 51 (61%) consented to participate and completed the questionnaire, which took 16 min on average to complete. The mean age of the participants was 26.1 (sd = 4.2; age range 19–38), of which 59% (n = 30) identified as male; and, 75% (n = 38) had at least a high school diploma. **Table 1** presents the demographic details of the participants. Compared to the clinic's population, the sociodemographic characteristics of our sample was lower in terms of gender (e.g., 59% vs. 80%) (5), however, it is generally consistent with the broader literature to have more males than females diagnosed with FEP (16). In addition, our sample was generally consistent with the clinic population in terms of having a high school diploma (75% vs. 69%), and in terms of mean age—given that participants could be at any stage of their 5-year treatment in the program (5).

TABLE 1 | Demographic characteristics (n = 51).

Demographic characteristics (n = 51, Mean age = 26.1; Standard deviation = 4,2; Range = 19–38)	*N*	%
Sex		
Male	30	59%
Female	20	39%
Other	1	2%
Team		
Clinique JAP	41	80%
EQIIP SOL (youth with housing instability)	10	20%
Level of education*		
University, completed or no	18	36%
College, completed or no	9	18%
High school diploma	11	22%
High school, incomplete	11	22%
Elementary school	1	2%
Current situation/main activity		
Student	14	27%
Employed: Full-time	8	16%
Employed: Part-time	7	14%
I do not have a job/I do not go to school	13	25%
Other	6	12%
Volunteer	3	6%
Current living situation (more than one response possible)		
Alone in an autonomous apartment	16	31%
Apartment with roommates	12	24%
Supervised apartment	9	18%
Group home/Youth centre	7	14%
With family	7	14%
Hospitalized	7	14%
On the streets	1	2%
Shelter/dormitory	1	2%

**Data for the Level of education was only reported for 50 participants.*

Access and Use of Technology

As illustrated in **Table 2**, the majority of participants had a smartphone (84%, n = 43) and access to a personal computer in

TABLE 2 | Access to technology among young adults with first-episode psychosis treated in an urban early intervention service (n = 51).

Technology device	**Total***	**%**
Smartphone	43	84%
Public computer	31	61%
Personal laptop computer	28	55%
Laptop or desktop computer belonging to a friend, family member, etc.	19	37%
Personal desktop computer	17	33%
iPad/tablet	14	27%
Cell phone with no Internet connection	7	14%

**Multiple responses possible.*

terms of either a laptop (55%, n = 28) or a desktop (33%, n = 17). Many participants also reported access to a public computer (61%, n = 31) or a computer belonging to someone else (37%, n = 19). A smaller percentage reported access to an iPad/tablet (27%, n = 14) and a few reported having cell phones without any Internet connection (14%, n = 7).

The majority had access to a home Internet plan (76%, n = 39) and a little over half had access to a cellular data plan (55%, n = 28). Many reported accessing the Internet in public spaces (69%, n = 35), at school (27%, n = 14), or work (14%, n = 7). Several (43%, n = 22) reported having access to both a home Internet plan and a cellphone plan. In terms of frequency of Internet access, the majority reported daily use (78%; n = 40), the rest reported using it at least once per week (6%, n = 3), once per month (4%, n = 2), irregularly (10%, n = 5), or never (2%, n = 1). The majority of the homeless participants (80%, n = 8/10) reported accessing the Internet through public settings.

As illustrated in **Figure 1**, the majority reported listening to music/watching videos (89%, n = 45) and using social media (71%, n = 36) on a daily basis or at least once a week. More than half (59%, n = 30) rarely or never used video chat technologies (e.g., Skype, Google Hangouts, Facetime, others).

When asked about their use of technology to communicate with their treatment team, most reported never using text messaging (94%, n = 48), and the rest reported once a week (4%, n = 2) or once a year use (2%, n = 1). More than half reported never using email to communicate with their treatment team (69%, n = 35), and the rest reported use once a week (10%, n = 5), once a month (12%, n = 6), or once a year use (10%, n = 5). None reported using video chat or social media to communicate with their treatment team.

In terms of competency with video chatting, less than half reported feeling very competent with video chatting (43%, n = 22); the rest reported feeling somewhat competent (27%, n = 14), slightly incompetent (8%, n = 4), incompetent (18%, n = 9), and two did not provide an answer.

Obstacles to Attending Appointments

As illustrated in **Table 3**, several participants (37%, n = 19) identified two or more obstacles to attending their clinic appointments, many reported at least one obstacle (41%, n = 21), whereas a few (22%, n = 11) did not report any obstacles at all. The most common obstacles were symptom-related difficulties (e.g., anxiety; 43%, n = 22) and scheduling difficulties (e.g., in relation to work or school; 41%, n = 21). Other obstacles were financial difficulties pertaining transportation (20%, n = 10), access to public transportation (20%, n = 10), physical limitations (10%, n = 5), and not knowing how to get to the hospital (8%, n = 4).

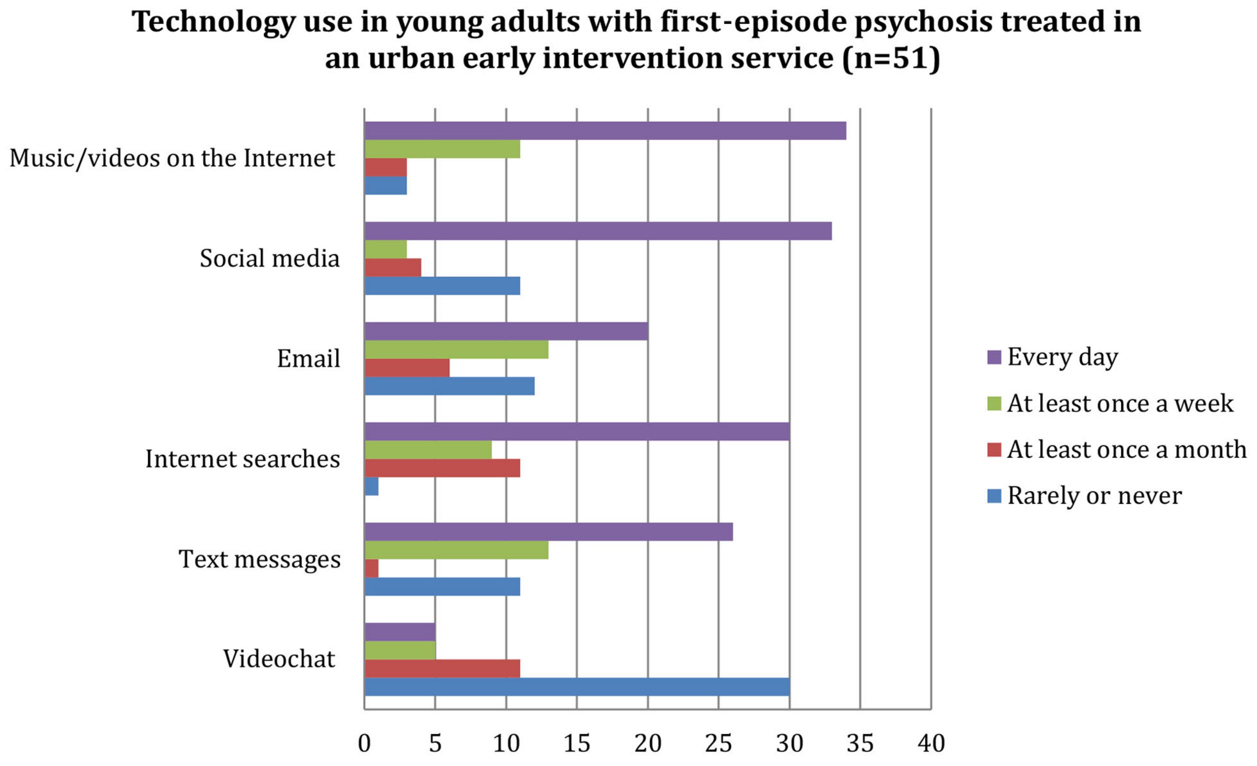

FIGURE 1 | Technology use among young adults with first-episode psychosis treated in an urban early intervention service (n = 51). Horizontal axis represents number of participants.

TABLE 3 | Obstacles to attending clinic appointments (n = 51).

Obstacles to attending clinic appointments	Total*	%
Symptoms (e.g., anxiety)	22	43%
Scheduling (e.g., in relation to work, school)	21	41%
No difficulties reported	11	22%
Finances for transportation	10	20%
Access to public transportation	10	20%
Physical limitations	5	10%
Not knowing how to get to the hospital	4	8%
Neutral/I do not wish to answer the question	0	0%

Multiple responses possible.

Perceptions of Telepsychiatry Services

As illustrated in **Table 4**, in terms of receptivity towards the idea of receiving telepsychiatry services (i.e., communicating with service providers using a secure videoconferencing platform), 49% (n = 25) said they were very favorable and 25% (n = 13) were somewhat favorable towards the idea. The rest indicated that they were somewhat unfavorable (14%, n = 7), very unfavorable (6%, n = 3), did not know (4%, n = 2), or preferred not to answer (2%, n = 1). When asked more directly whether they would like to attend a future clinic appointment *via* a secure videoconferencing platform, 55% (n = 28) indicated to be interested and 27% (n = 14) probably interested, with the rest stating no (18%, n = 9).

As illustrated in **Table 5**, the majority indicated that telepsychiatry services should be used in unforeseen or emergency situations (75%, n = 38) and as a last resort when face-to-face meetings are not possible (75%, n = 38). Similarly, 65% (n = 33) reported that this approach could be used to avoid traveling to the hospital (61%, n = 31), while 37% (n = 19) indicated that telepsychiatry services could be used to replace in-person meetings.

More than half identified ease of use (57%, n = 29), and confidentiality and security (57%, n = 29) as essential characteristics of a video conferencing platform. Some participants indicated cost (29%, n = 15), efficiency (24%, n = 12), quality of sound (18%, n = 9), and quality of image (14%, n = 7) as being essential.

TABLE 4 | Receptivity towards the idea of receiving telepsychiatry services (n = 51).

Receptivity towards the idea of receiving telepsychiatry services	Total	%
Very favorable	25	49%
Somewhat favorable	13	25%
Somewhat unfavorable	7	14%
Very unfavorable	3	6%
I don't know	2	4%
I do not wish to answer the question	1	2%

TABLE 5 | Situations in which telepsychiatry could be used (n = 51).

Situations in which telepsychiatry could be used	Total*	%
In the case of unexpected events or in an emergency	38	75%
As a last resort when in-person meetings are impossible	38	75%
To avoid travelling to the hospital	31	61%
To replace in-person meetings	19	37%
Other	4	8%

Multiple responses possible.

Concerns and Recommendations

Of the 51 participants, 30 provided responses to the open-ended question on whether they had any concerns about the use of videoconferencing/telepsychiatry with their treatment providers. Ten out of these 30 respondents stated that they did not have any concerns regarding telepsychiatry services. For the remainder 20, the most common concerns (i.e., mentioned by at least 4 participants or more) were about "loss of human contact." For example, one participant stated, "I do not want it to replace meetings in person" (P14), and another expressed concerns that telepsychiatry "will replace face-to-face consultations" (P21). Another common concern was confidentiality. For example, one participant expressed concerns about the "possibility that calls will be recorded" (P46), another stated, "I would not want it to be recorded" (P2), and another asked, "to what extent is it confidential?" (P30). Other concerns were: costs associated with the use of the service; quality of the transmission in terms of image and sound; not having access to the appropriate environment (e.g., sound-proof/noise free environment); not having the competency or skills to use the technology; reliability of video conferencing for making diagnoses; and "being disturbed in private life, feeling harassed" (P50).

Of the 51 participants, 29 participants provided responses to the open-ended question on recommendations. The most common recommendation pertained to ensuring confidentiality. For example, one participant stated, "confidentiality, zero on social media" (P1) and others stated, "ensure confidentiality" (P11) or "maintain confidentiality" (P45). Another common response pertained to ensuring quality of the technology and its transmission, for example to "test it before, be certain that it works well in terms of sound and image" (P2). Participant recommendations also pertained to accessibility; for example: ensuring there is no cost to users, making it available on multiple devices, using simple passwords, and having a color code for the type of calls (e.g., urgent, not urgent). They also highlighted the importance of training and orientation; for example, one participant recommended that there be a "tutorial on the platform" (P41). Others highlighted that it should be used as a complementary method as one participant stated, "it should not be obligatory" (P38) and another stated, "use it as a last resort, like during travel, or studying out of town" (P30).

DISCUSSION

Previous studies [e.g., (5–7, 17)] have examined access and use of technology in populations diagnosed with FEP, however to our knowledge, this is the first study that has a focus on the use of telepsychiatry to attend outpatient follow-up appointments. Telepsychiatry is a specific type of digital service that requires real-time presence of both parties, and as such differs quite significantly with other types of digital services, such as using websites or social media for information, or completing online psychoeducation modules autonomously. Our study focuses on patient perceptions regarding the use of videoconferencing solutions to attend a clinic appointment and considers how this might help to address barriers to engaging with their follow-up. In addition, 20% of our sample had a recent history of being homeless or were experiencing housing instability at the time of the study. With larger samples, future research could be focussed on more in-depth study of the potential role of telepsychiatry for this hard-to-reach population.

Our main findings were that the majority of the participants experienced obstacles (e.g., finding time, transportation) to attending their follow-up appointments, and more than a third faced multiple obstacles. Most had access to and used mainstream technologies (e.g., Internet, computers, smartphones) but did not use them to communicate with their treatment team. More than half expressed interest in telepsychiatry but had limited experience with video chat technologies. The most common concerns towards telepsychiatry were loss of human contact and confidentiality.

In-depth research is needed to better understand the obstacles young adults with FEP face in attending their follow-up appointments and whether ambivalence towards telepsychiatry is related to factors such as: limited social and productive opportunities to use videoconferencing technologies, cognitive difficulties, or residual symptoms of psychosis (e.g., emotional withdrawal, hallucinations, delusional thinking). Regarding the latter, symptoms could have influenced participant concerns (e.g., being recorded could be a delusional preoccupation); however, whether related to symptomology or not, our findings suggest that privacy and confidentiality issues are important to discuss with patients prior to providing telepsychiatry services.

In addition, the low levels of use and perceived competencies with mainstream video chat technologies in this study indicate the importance for providing training and technical support for patients when implementing telepsychiatry, even if the target population is young. Moreover, this training needs to account for cognitive difficulties and symptomatology found in the FEP population and provide reassurance that telepsychiatry is not meant to replace human contact. This study highlights the importance of integrating telepsychiatry into hybrid models of care, wherein telepsychiatry is offered as part of many contact possibilities, and as a complement to 'in person' contact when the latter is not feasible for patients. Furthermore, our findings indicate that ensuring patients have access to the Internet from a location that affords them quality of sound and image and privacy is a critical consideration for providing telepsychiatry services and may be particularly relevant for those living in unstable housing situations.

The limited use of technology in this population to communicate with healthcare providers could also be related to lack of clinician acceptance, which has been shown to be one of the most critical factors in determining telepsychiatry implementation (18). Research has shown that clinicians fear that videoconferencing could make contact "less personal" and challenging to establish trust (19). It is also possible that clinicians may lack the confidence and skills to use these technologies with patients. Clinician acceptance can be influenced by access to training, practice guidelines on the use of telepsychiatry in early intervention programs for psychosis, the latest technologies, and institutional support, all of which are key factors to consider for future research, policy, and practice.

Limitations

There are certain limitations of this study. The small sample size limits the representativeness of our sample and could have resulted in missing some perspectives. In addition, we used a non-validated questionnaire, which poses limitations on the consistency and accuracy of our results. Moreover, our instrument included mostly closed-ended questions, thus, we did not have access to detailed data on participant perspectives. Also, approximately 40% of the participants did not answer the open-ended questions which were at the end of the questionnaire, possibly due to fatigue. Qualitative research is needed to better understand the views of young adults regarding urban telepsychiatry, for example through interviews and focus groups. In addition, our recruitment occurred during summer and early fall months, which is relevant for a northern community where winter weather can influence patient perceptions of obstacles to attending appointments and receptivity towards telepsychiatry. For example, colder weather and snowy/icy conditions on the road can reduce motivation to leave the house and can also have an impact on the accessibility of public transportation. Furthermore, recruitment was done in the waiting room, among patients attending their appointments. The results could have been different if we surveyed individuals disengaging from care. For example, it is possible that receptivity to telepsychiatry could be different among individuals who wish to attend appointments but do not attend because of other commitments (such as school or work) versus those who are reluctant to engage with care due to other factors such as stigma. Research with large and representative samples is warranted to assess how these factors may influence acceptability towards telepsychiatry.

CONCLUSION

This study addresses an important gap in the literature on the use of telepsychiatry services for outpatient follow-up, from the perspectives of patients receiving treatment for FEP in an urban setting. While several participants faced multiple obstacles to attending their appointments and were receptive towards telepsychiatry, they did not have access to this service. It is important to provide education to clinicians working in urban settings on the potential for telepsychiatry in helping overcome obstacles to attending clinic appointments. Moreover, concerns regarding loss of human contact, confidentiality and privacy, costs, quality of sound and image, reliability for assessing, and perceived competencies in using videoconferencing technologies need to be addressed prior to offering telepsychiatry services. Finally, in the context of large scale, global implementation of early intervention for psychosis services, where distance, poor public transport, stigma, and competing priorities are an issue in accessing care, telepsychiatry can be a relevant add-on to current services and warrants further attention at the levels of research, policy, and practice.

DATA AVAILABILITY STATEMENT

The datasets for this article are not publicly available because participants recruited in this study did not give their consent to their raw data being publicly shared even if anonymised. Additional information regarding the datasets should be directed to Shalini Lal, shalini.lal@umontreal.ca.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the scientific and ethics review board of the University of Montreal Hospital Centre (CHUM) (#17.073) with informed consent from all subjects.

AUTHOR CONTRIBUTIONS

SL and AA-B contributed to the conception and design of the study. SL wrote the first draft of the study protocol and survey. AA-B, SS, FB, and IS contributed to revisions of the protocol, including survey development. SL led the study implementation, analysis, and reporting. FB contributed to recruitment and data collection. JW conducted data entry; JW and SS verified, analyzed, and reported the results. SL wrote the first draft of the manuscript. AA-B and SS contributed to revising the second draft. All authors reviewed and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.00117/full#supplementary-material

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The Effect of Eye-Feedback Training on Orienting Attention in Young Adults With Sluggish Cognitive Tempo

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Sluggish cognitive tempo (SCT) is a kind of attentional symptoms characterized by symptoms of slowness in behavior or in thinking. The aim of the present study was to develop a preliminary attention training program based on real-time eye-gaze feedback using an eye-tracker. A total of 38 participants with SCT were randomly assigned to one of following two conditions: eye-feedback ($N = 19$; Mean Age = 21.21; range 18–26) or control ($N = 19$; Mean Age = 20.68; range 18–25). The participants in the eye-feedback condition received three repeated trainings on the modified version of the Posner's spatial cueing test; we also used real-time constant eye-gaze feedback designed to lead the participants to quickly and accurately engage and to disengage, with pre- and post- measurement of eye-movements (overt attention) and the revised attention network test (ANT-R; covert attention). The participants in the control condition received three repeated same trainings without any feedback, with pre- and post-measurement of eye-movements measure and ANT-R. The results revealed that the eye-feedback group showed a greater improvement in engaging and disengaging attention through the overt attention measure than the control group. The eye-feedback group also showed a greater increase only in the orienting network related to disengaging attention in the covert attention measure compared to the control group. These results suggested that the eye-feedback can be meaningfully used in attention training to enhance the efficiency of attention in clinical settings.

Keywords: sluggish cognitive tempo (SCT), attention training, eye-feedback, eye-movements, attention network test (ANT)

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INTRODUCTION

SCT is a kind of attentional construct characterized by symptoms of slowness in behavior or in thinking, difficulty initiating and sustaining effort, hypoactivity, daydreaming, forgetfulness, and confusion in thinking (1, 2). Despite the growing body of research on the treatment for SCT symptoms using pharmacological and behavioral treatments (3, 4), there remains a need for research of intervention targeting attentional difficulties among individuals with SCT. Although the underlying mechanism in SCT remains unknown, it has been suggested that SCT is not primarily a disorder of executive functioning such as attention-deficit/hyperactivity disorder (ADHD); rather, it is associated with poor efficiency in orienting network (5, 6). Given that since the networks of attention are considered as skills that can be improved through practice (7, 8), attention training is not only a clinical intervention, but also an educational program. Previous research has demonstrated a brief training (e.g., 77 min) (9) has a significant effect on attention, and it appears that this effect can transfer to non-trained cognitive skills, such as academic performance (10, 11). In addition, attention training was found to be more effective for individuals with attentional problem such as ADHD, brain injury, and schizophrenia, when it was adaptive condition, and when it targeted the orienting networks (7, 12).

Deriving from the known ability of humans to change their behavior in order to adapt to the environment, known as behavioral plasticity (13, 14), the rationale for attention training is based on the assumption that efficiency of attention could be enhanced after repetitive practice (8, 15). The underlying mechanism of behavioral plasticity is that, if behavior changes, there should also be changes in organization or properties of the neuroanatomical networks in charge of producing the behavior (16). Similarly to any motor skill, oculomotor performance could be improved through practice of saccades, short and rapid eye-movements used to move the fovea to an object or place of interest for detailed visual exploration (17). The saccadic eye-movements (SEM) could be considered a cognitive parameter to evaluate visual attention, and can be divided according to two types of saccades. First, the pro-SEM is a redirection of the gaze to a visual stimulus in the environment related to the alerting and orienting networks; second, the anti-SEM is a voluntary gaze redirection in the opposite direction of a visual stimulus to inhibit automatic saccades related to executive control network (18). Several studies demonstrated that repetitive training of the SEM produces not only behavioral variations, such as decreasing in the latency of saccades and increasing in the saccadic accuracy, but also changes in the neural activity of the ocular motor network, such as supplementary eye field, frontal eye field, superior parietal lobe, cuneus, and superior colliculus (13, 19, 20). Furthermore, a significant post-training improvement in anti-SEM related to executive control was observed in individuals with ADHD who had difficulties in impulsivity control and goal achievement (21). Therefore, it is necessary to explore whether or not attention training using Pro-SEM related to orienting network can be beneficial for individuals with SCT with poor efficiency in that network.

According to the attentional network theory, there are three basic components of attention: alerting, orienting, and executive control (22, 23). The alerting network refers to the ability to prepare and maintain response readiness. The alerting functioning is critical for optimal performance in tasks involving higher cognitive functions. The executive control network accounts for the ability to control goal-directed behavior, detect target and errors, resolve conflicts, and inhibit automatic responses. The orienting network takes charge of the ability to selectively engage in specific information among various inputs and to disengage from what is currently focused on in order to attend another stimulus. Dysfunction of orienting network is related to not only attentional measures, but also SCT symptoms occurring in daily life such as slowness in behavior or in thinking, difficulty in initiating and sustaining effort, daydreaming, and confusion in thinking (5, 6). This makes it imperative to understand the underlying mechanism of orienting network and to repetitively use a task based on the theoretical evidence in order to enhance orientation network in individuals with SCT. One such method of estimating the orienting of attention is the Posner spatial cueing paradigm (24). This paradigm uses a covert attention task based on the RT (i.e., moving to a spatial location without eye-movements). However, the controversy remains as to whether covert shifts of attention are possible without eye-movements (25) and whether or not training covert attention could yield benefits for overt attention and vice versa (26). Also, there is an increasing necessity to directly assess each element of the orienting network. Therefore, in order to directly measure engagements, disengagements, and shifts of orienting network, in the present study, we used the modified the Posner spatial cueing paradigm and an overt attention task (i.e., moving to a spatial location with eye-movements) based on an eye-tracking system. Our primary goal was to establish whether repeated training of the modified task could enhance deficit of orienting network on covert and overt attention in individuals with SCT.

This study tested whether the effects of real-time constant eye-gaze feedback during repeated training of the modified the Posner spatial cueing task could improve orienting network in individuals with SCT. An adaptive attention training that provides performance feedback throughout the training is known to be more effective than a non-adaptive attention training where repetition of the same procedure without the feedback is conducted throughout training (7, 27). Previous research demonstrated that feedback could improve cognitive or behavior performances by reducing uncertainty and providing information to focus on correct response, incorrect response, or both (28, 29). In particular, given that individuals generally have poor metacognitive information of their own eye-movements, providing feedback on eye-movements could be helpful. Therefore, it may be effective to provide constant real-time feedback on eye-movements according to individuals' response in attention training. The results of previous studies highlighted that real-time constant feedback on eye-movements could modify the oculomotor behavior and reinforce intrinsic oculomotor perception (30). In addition, in the studies that used constant eye-gaze contingent feedback, training was found to lead to an efficient implementation of attentional control (31).

The aim of the present study was to investigate whether repeated attention training targeting orienting network could enhance dysfunction of a certain network in individuals with SCT. To this end, a modified Posner spatial cueing paradigm that provides real-time constant eye-gaze feedback was used. The task was designed for the participants to quickly and accurately respond to orienting network; thereafter, we compared the training effects after repetition of attention training between individuals with SCT who received real-time constant eye-gaze feedback (eye-feedback condition) and those who received no feedback (control condition). It was hypothesized that the SCT group in eye-feedback condition would show a greater improvement in orienting network on both covert and overt attention than the SCT group in control condition. Additionally, considering that attention training is generally dull and repetitive, which makes it an unpleasant and unengaging experience for the trainee, particularly if s/he has attentional difficulties (32, 33), we modified the task to a game so that to make it a more engaging experience for the participants.

MATERIALS AND METHODS

Participants

The sample size was calculated using G*power 3.1 (34). A total of 36 participants was required to demonstrate the medium effect size of Cohen's $f = 0.25$, a power ($1 - \beta$) of 95%, and an alpha of 0.05. On the basis of this estimate, a conservative goal of 42 participants was established allowing a drop out of 15%. Prior to the experiment, as an initial screening measure for SCT, a total of 1,098 adults completed the Barkley Adult ADHD Rating Scale IV (BAARS-IV) (35). Candidate participants were recruited through advertisements in psychiatric clinics, online communities of individuals with attentional problems, and an Internet bulletin board of several universities in Seoul, Korea. Based on the previous recommendations concerning the inclusion criteria (1, 35, 36), a threshold corresponding to the 95 percentiles of five or more symptoms was used to identify SCT or ADHD. A total of 90 participants completed the structured clinical interview for DSM-5 (SCID-5) (37) by clinical psychologists to determine diagnosis and their eligibility to participate. Exclusion criteria in the present study were as follows: (1) problems with intellectual ability; (2) history of head injury; (3) history of drug exposure; (4) diagnosis with ADHD; and (5) diagnosis with other neurological or psychiatric disorders. As a result, 22 individuals with SCT & ADHD (the SCT & ADHD group with at least five or more of symptoms of both SCT and ADHD), 23 individuals with ADHD only (the ADHD only group with at least five or more of symptoms of ADHD but not more than five symptoms of SCT) were excluded in the final sample of the present study. Finally, after controlling for ADHD symptoms, a total of 45 young adults who met inclusion criteria of SCT (SCT-only group with at least five or more symptoms of SCT but not more than five symptoms of ADHD) were asked to participate in the experiment. They were randomly assigned by simple randomization procedure to one of following conditions: the eye-feedback (EF) or the control condition. Randomization sequence was created using Microsoft Excel 2007 for windows (Microsoft, Redmond, WA, USA) with a ratio of 1:1 allocation by an independent research assistant who is not involved in the study. Of all participants, seven participants were excluded for the final data set: three because their eye-movements were not measured due to an eye-tracking device malfunction, two because half of the data was missing due to errors of the eye-feedback task, and two due to the drop-out. Finally, a total of 19 participants in the EF condition received three repeated training sessions with real-time constant eye-gaze feedback. Furthermore, a total of 19 participants in the control condition received three repeated attention training sessions without any feedback.

Questionnaires

The Barkley Adult ADHD Rating Scale IV (BAARS-IV)

The BAARS-IV, previously developed to assess the levels of ADHD and SCT (35) and validated (38), contains 18 items that are consistent with DSM-5 criteria for ADHD and 9 items that target the symptoms of SCT. Using a four-point scale (1 = not at all; 2 = sometimes; 3 = often; 4 = very often), the participants responded to each item with reference as to how often each statement best described their behavior in the past 6 months. Korean version of the BAARS-IV was used to classify young adults with clinically elevated SCT symptoms (39). In the present study, Cronbach's α values were 0.90, 0.80, and 0.90 for the ADHD inattention, ADHD hyperactive-impulse, and SCT, respectively.

The Adult Concentration Inventory (ACI)

The ACI, developed for a new adult self-report measure of SCT (40), includes 10 items identified in a recent meta-analysis as optimal for the assessment of SCT symptoms (2). Korean version of the ACI was used to measure the severity of SCT symptoms repeatedly (39). These items were rated on a four-point scale (0 = not at all; 1 = sometimes; 2 = often; 3 = very often) with reference to the past 6 months. In this study, Cronbach's α was 0.85.

The Beck Depression Inventory-Second Edition (BDI-II)

The BDI-II, which was developed to assess the levels of depression (41), includes 21 items associated with physical and cognitive symptoms of depression. These items were rated on a four-point scale (0 = not at all; 1 = mildly; 2 = moderately; 3 = severely) with reference to 1 week. Korean version of the BDI-II (42) was used in this study. In this study, Cronbach's α was 0.89.

The Beck Anxiety Inventory (BAI)

The BAI, developed to assess the levels of anxiety (43), includes 21 items related to physical and cognitive symptoms of anxiety. These items were rated on a four-point scale (0 = not at all; 1 = mildly; 2 = moderately; 3 = severely) with the reference to 1 week. Korean version of the BAI (44) was used in this study. In the present study, Cronbach's α was 0.89.

The Revised Attention Network Test (ANT-R)

The ANT-R was administered to measure the efficiency of three attentional networks: alerting, orienting, and executive control (45). The ANT-R is a computerized task consisting of three cue conditions (no-cue, double-cue, and spatial-cue) and two target conditions (congruent, incongruent). Further details on the ANT-R is provided in **Figure 1**.

Participants were asked to determine as quickly and accurately as possible the direction (left or right) of a central arrow (the target) located in the middle of a horizontal line presented either at the left or right of the screen. The target arrows appeared at one of two locations to the left and right sides of a central fixation cross for 500 ms, and either one or both of the boxes were flashed as a cue by briefly changing its color from black to white for 100 ms prior to the target arrow's appearance. There were three cue conditions: (1) no-cue (no flash before the target appeared; 12 trials); (2) double cue (both cue boxes flashed before the target appeared, so the cue provided temporal, but not spatial information for the target; 12 trials); and (3) spatial

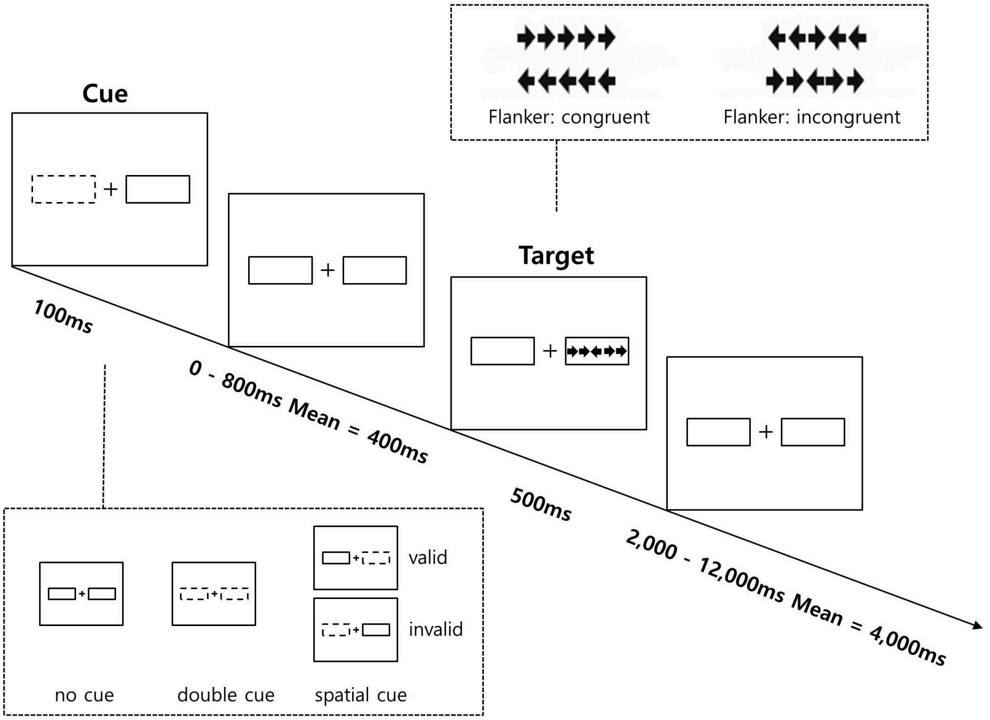

FIGURE 1 | Schematic of the Revised Attention Network Test (ANT-R). Participants make a response to the target's direction.

cue (one cue box flashed before the target appeared, so the cue provided temporal and spatial information for the target; 48 trials). Additionally, in order to estimate disengagement, shift, and engagement, 75% of the 48 spatial cues were valid (in the same location as the upcoming targets; 36 trials), while 25% were invalid (in the opposite location as the upcoming targets; 12 trials). After a variable duration (0, 400, or 800 ms), the participants were asked to identify the direction of the center target arrow flanked on each side by two flanker arrows pointing either in the same direction as the center target arrow (congruent), or in the opposite direction (incongruent) with same probability (50% each). They responded by pressing the corresponding button (left or right) on the keyboard. The duration between the offset of the target arrows and onset of the next trial varied systemically between 2,000 and 12,000 ms. The response time window was 1,700 ms after the onset of the target and flankers.

Prior to the analysis of the ANT-R, mean RT and error rate for each condition were calculated. Error trials and RTs below 200 ms and above 1,700 ms were excluded from the calculations of mean RT and attentional effects (45). Three networks of attention were considered for the ANT-R in the present data analysis. First, the alerting network represents the benefit of the target response speed by calculating the difference between the no cue and double cue conditions. Second, in the ANT-R, the orienting network could be separately measured as: (1) the engaging index (orienting network in the original ANT) represents the benefit of target response under valid cue condition because of orienting and engaging is measured by the difference between double cue and valid cue conditions; (2) the disengaging index represents the cost of disengaging from invalid cue and is measured by the difference between the invalid cue and double cue condition; (3) the validity index represents the cost of disengaging, and move operation is measured by difference between invalid cue and valid cue conditions. Third, the executive control network represents the flanker conflict effect measured by the difference between incongruent and congruent conditions.

The Eye-Feedback

The eye-feedback task was developed as a game-based task using Unity 3D game engine to enable users training continuously and repeatedly. The goal of the game was to provide appropriate feedback to the user and improve orienting of attention, based on the fundamental features of the Posner spatial cueing paradigm. The user's control over the game was done only through an eye-tracking device. It allows the user not only to see their own eye-gaze point in real time, but also to receive feedback on their response speed in relation to the movement of attention. The task is a simple form of car racing game: the car in the game acts as a fixation, and targets (blue or orange circles) and cues (red triangles) appear in colors and forms that are visually recognizable to users. Further detail about the task is provided in **Figures 2**, **3**.

The eye-feedback task is a computerized task consisting of two cue conditions (valid-cue, invalid-cue) and four locations (0°, 90°, 180°, 270°). Targets in blue or orange circles were displayed

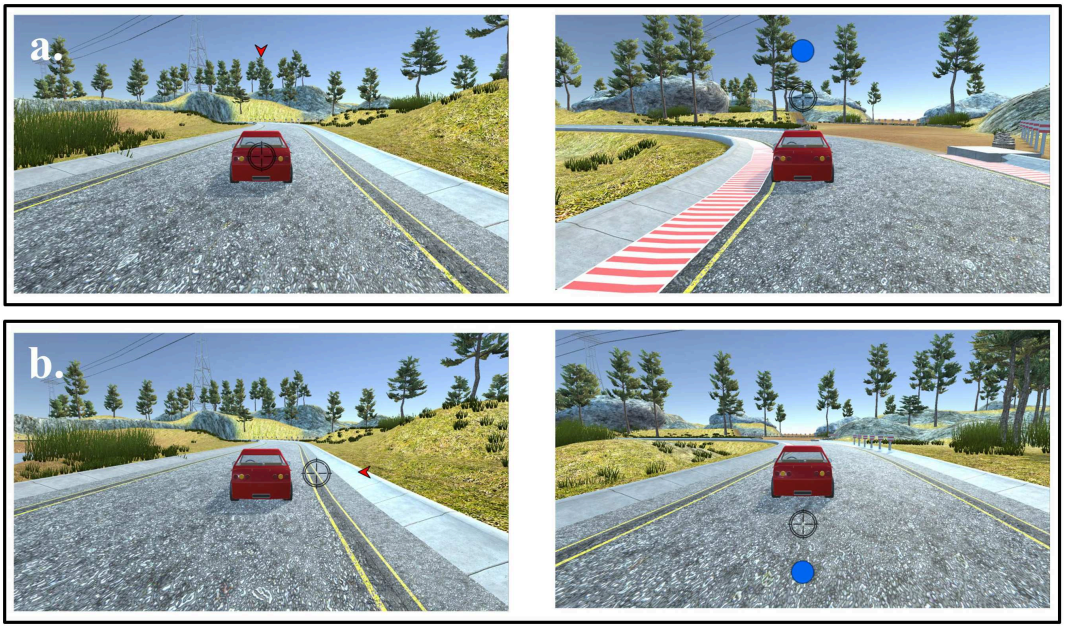

FIGURE 2 | Sample frames from a block of trials with eye-feedback condition. Stimuli (car, arrowhead cue, and circle target) and eye-gaze point used in eye-feedback condition: **(a)** Valid condition: cues were informative about where the target would appear. **(b)** Invalid condition: cues were uninformative about where the target would appear.

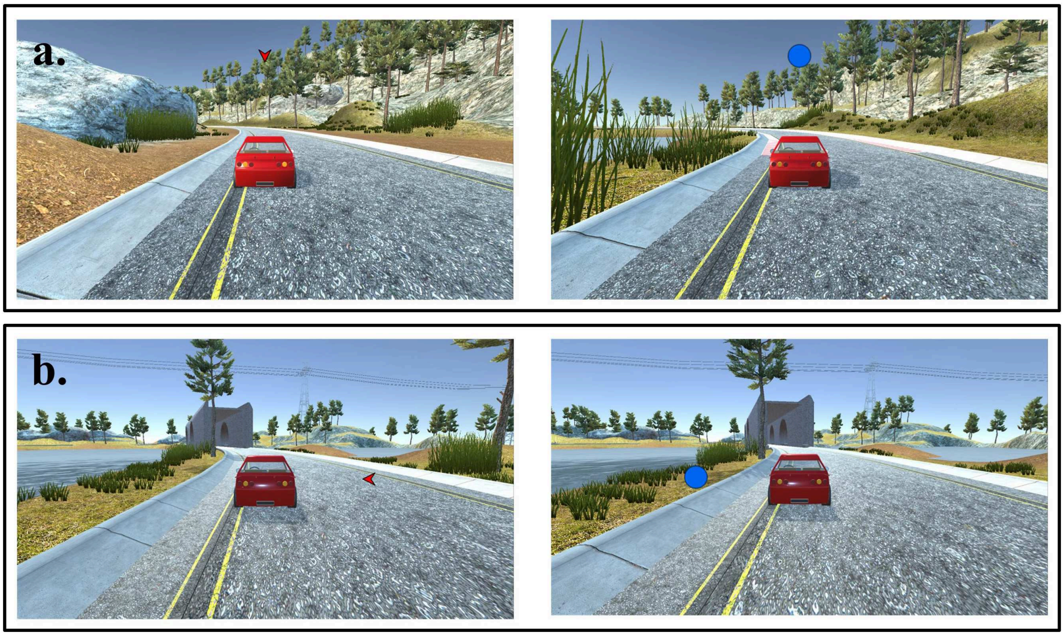

FIGURE 3 | Sample frames from a block of trials with control condition. Same stimuli as eye-feedback condition used in control condition except for eye-gaze point: **(a)** Valid condition: cues were informative about where the target would appear. **(b)** Invalid condition: cues were uninformative about where the target would appear.

at four possible locations (separated by 90°) for 500 ms, while cues in red inward pointing triangles were displayed for 500 ms prior to the target circle appearing. In order to estimate and improve both engagement and disengagement of attention, the eye-feedback task was made up of two cue conditions with the same probability: (1) 50% of valid cues (in the same location as the upcoming targets); and (2) 50% of invalid cues (in the opposite location as the upcoming targets). The cue-target onset asynchronies (CTOA) varied to 0, 400, or 800 ms, and the duration between the offset of the target circles and onset of the next trial (inter trial interval, ITI) varied randomly between 2,000 and 12,000 ms. The task consisted of 4 blocks of 48 test trials each. A total of 192 trials were composed with 96 trials for invalid-cue condition and 96 for valid-cue condition. During the task, eye-movements for all participants were recorded with an eye-tracking device as an overt attention measurement. The first block was the baseline phase with no feedback on both eye-feedback and the control conditions. Different formation of the blocks was used in the intervention phase (1st post-intervention) with feedback in the eye-feedback condition and without feedback in the control condition.

Prior to the game task, users were instructed that the fixation and movement of their gaze served as the click and move of the mouse, a traditional input device. The users were also asked to move their gaze when a target or cue appeared on the screen and make sure to return their gaze back to the car. The users received visual and auditory feedback throughout the game depending on the rate of gaze response recorded by the eye-tracking device. In other words, users were provided constant real-time feedback on the result whether each trial was faster or slower compared to baseline. When the gaze response was faster than the baseline, the screen flashed with the green color (visual feedback), a warning beep was played (auditory feedback), and the car speed increased. However, when the response was slower, a red flash appeared, a different warning beep was provided, and the car speed decreased. At the end of each block, the screen showed the response rate of participants' gaze movement compared to the baseline. In sum, participants in the feedback condition received feedback throughout the game, but participants in the control condition were not provided with two main feedback of the game: (1) real-time verification of the user's gaze position; (2) the response rate to gaze movement.

Apparatus

The ANT-R was presented on a desktop computer using E-Prime$^{\mathrm{TM}}$ 2.0 (Psychology Software Tools, Pittsburgh, PA) on a 23-inch wide monitor. RTs were collected and stored by the desktop computer using a keyboard.

Eye-movements for all participants were recorded with an eye-tracking device (Tobii TX300, Tobii Technology AB, Danderyd, Sweden) at the sampling rate of 300 Hz and the maximum total system latency of 10 ms. It integrates the infrared sensors and the camera. Each participant was seated 70 cm in front of a 23-inch wide monitor (1,920 × 1,080), and the eye tracker allowed the participants to naturally move their heads and eyes without any attached sensors. Eye-movements that were stable for at least 80 ms within the visual angle of 1.4° were defined as fixations (46). The eye-tracking equipment was calibrated for all participants by presenting five dots on the screen, and then the attention training task started. The software (Tobii studio, Tobii Technology AB, Danderyd, Sweden) provided a variety of gaze information, such as the participants' focus and latency to fixation, duration of fixated attention, and so on.

Procedure

As the participants arrived at the laboratory, they were given a brief instruction regarding the experiment and their rights as research participant; then they filled in the consent form that was approved by the institutional review board of Chung-Ang University (No. 1041078-202001-HR-009-01). The participants were then randomly assigned to either the eye-feedback or the control condition. The study involved three intervention visits. The first intervention visit was conducted to determine study eligibility and to collect baseline data before initiating the intervention period. Therefore, the participants were asked to administer the ANT-R as a covert attention measurement of the baseline phase. After a short break, the participants were instructed to engage with the attention training for ∼25 min. Prior to attention training, a total of 24 trials were administered as practice trials to ensure that the participants properly understood how to use the intervention. Then participants performed attention training according to each condition. After the task, the participants were asked to administer the ANT-R as a covert attention measurement after the 1st post-intervention. Also, they were asked to complete a clinical interview and to fill in questionnaires; finally, they also received instructions for the next intervention visits.

At the second intervention visit, the participants did attention training without the ANT-R in both conditions and were given instructions for the next intervention visit (2nd post-intervention). At the last and the third visit, the participants were asked to do attention training in each condition (3rd post-intervention). Afterwards, they performed the ANT-R as a covert attention measurement of last post-intervention. All three visits were organized within the minimum period of 3 days to the maximum period of seven days. Afterwards, participants were debriefed about the experiment and received 50,000 won (ca. 50 USD) as a reward. In addition, all participants were asked not to share any information with anyone who might participate in the experiment after them.

Data Analysis

For data analysis, a chi-square test and an independent t-test to analyze the differences in the characteristics between the eye-feedback and the control groups were performed. Prior to analyzing the ANT-R, mean RT and error rate for each condition were calculated. The attentional network index in RT and the error rate were computed using the definitions described above for **Table 1**. In the eye-feedback task, mean latency to fixation for each condition was collected using the eye-tracking system. Prior to the analysis of the task, error trials were excluded from the calculations of latency to fixation for attentional effects. The ability to attention engagement representing the selectively attend to specific information was measured by the latency to fixate the target from fixation in valid conditions. The ability to attention disengagement representing disengagement of focus from current target and shifts of focus to another target was measured by the latency to fixate target from fixation in invalid conditions.

In order to investigate the effects of the eye-feedback in individuals with SCT, we used a two-factor mixed design with

TABLE 1 | Demographic and clinical characteristic for eye-feedback and control group.

Measure	Group		
	Eye-feedback (*N* = 19)	**Control (*N* = 19)**	**Test statistics (t/χ2)**
Age (years)	21.21 (2.30)	20.68 (1.70)	0.80
Sex (male/female)	7/12	8/11	0.74
BAARS-IV			
ADHD IN	17.53 (2.10)	18.24 (2.39)	0.95
ADHD H-I	15.00 (2.73)	15.41 (3.06)	0.43
SCT	25.32 (2.73)	24.12 (1.65)	1.57
ACI	17.95 (3.96)	16.78 (3.89)	0.91
BDI-II	12.68 (8.51)	11.89 (9.10)	0.27
BAI	30.74 (8.51)	25.42 (15.19)	1.07

Mean (standard deviation); SCT, Sluggish Cognitive Tempo; ADHD, Attention-Deficit/Hyperactivity Disorder; Age, years, BAARS-IV, Barkley Adult Attention-deficit/Hyperactivity Disorder Rating Scale IV; IN, Inattentiveness; H-I, Hyperactivity and impulsivity; ACI, Adult Concentration Inventory; BDI-II, Beck Depression Inventory-II; BAI, Beck Anxiety Inventory.

group as the between-subject factor, and phase as the within-subjects factor. In order to investigate eye-movement data as an overt attention measurement, we conducted 2 (group: eye-feedback, control) × 4 (phase: baseline, 1st post-intervention, 2nd post-intervention, 3rd post-intervention) analysis. In order to examine the ANT-R as a covert attention measurement, we conducted 2 (group: eye-feedback, control) × 3 (phase: baseline, 1st post-intervention, 3rd post-intervention) analysis. Additionally, whenever there was a significant interaction effect, *post-hoc* tests were performed to examine interactions in more detail, and degrees of freedom were adjusted with the Greenhouse-Geisser epsilon to correct for violations of the sphericity assumption. All statistical data were analyzed using SPSS 17.0 for Windows.

RESULTS

Demographic and Clinical Characteristics

Table 1 shows the characteristics of the participants analyzed in the present study. There were non-significant differences in mean age [$t_{(36)} = 0.80$, *n.s.*], proportion of sex [$\chi^2_{(1)} = 0.74$, *n.s.*], ADHD inattention [$t_{(36)} = 0.95$, *n.s.*], ADHD hyperactive-impulse [$t_{(36)} = 0.43$, *n.s.*], SCT [$t_{(36)} = 0.1.57$, *n.s.*], ACI [$t_{(36)} = 0.91$, *n.s.*], BDI-II [$t_{(36)} = 0.27$, *n.s.*], and BAI [$t_{(36)} = 1.07$, *n.s.*] between the eye-feedback and the control groups. In addition, in order to investigate whether the BAARS-IV was associated with the ACI, a series of bivariate correlational analyses were conducted. Analyses revealed the ACI was positively correlated with SCT symptoms of the BAARS-IV [$r = 0.61, p < 0.05$]. There was non-significant correlation between the ACI and ADHD inattention of the BAARS-IV [$r = 0.25$, *n.s.*], the ACI and ADHD hyperactive-impulse of the BAARS-IV [$r = 0.11$, *n.s.*]

TABLE 2 | Results of eye-movements between eye-feedback and control group.

Phase	Group		
	Eye-feedback (*N* = 19)	**Control (*N* = 19)**	**Test statistics (F)**
ENGAGE ATTENTION			
Baseline	223.79 (107.06)	242.84 (156.21)	3.34*
1st post-intervention	216.65 (142.67)	271.07 (166.48)	
2nd post-intervention	196.28 (127.66)	359.82 (263.29)	
3rd post-intervention	173.81 (119.81)	311.74 (252.69)	
DISENGAGE ATTENTION			
Baseline	584.89 (108.45)	566.42 (63.78)	3.24*
1st post-intervention	539.11 (88.42)	533.75 (91.32)	
2nd post-intervention	523.16 (86.28)	595.53 (164.12)	
3rd post-intervention	504.04 (50.17)	585.05 (142.65)	

**p < 0.05; Mean (standard deviation) in milliseconds (ms); SCT, Sluggish Cognitive Tempo; ADHD, Attention-Deficit/Hyperactivity Disorder.*

Comparison of Eye-Movements Results Between Eye-Feedback and Control Group

Table 2 shows the changes in mean latency to fixation and standard deviation for each phase between the eye-feedback and the control group.

Comparison of the Attention Engagement Results Between Eye-Feedback and Control Group

Results of analyses in order to examine within group differences showed that there was a significant effect regarding the phase in the eye-feedback group [$F_{(3,\ 54)} = 3.06, p < 0.05, \eta^2 = 0.15$], while non-significant effect was shown in the control group [$F_{(3,\ 54)} = 2.11$, *n.s.*]. In a *post-hoc* test among phases, there were significant phase differences between the 3rd post-intervention and other two phases (baseline, 1st post-intervention). Results indicated that an increase in efficiency of attention engagement was shown only in the eye-feedback group, and this effect may become more prominent as the attention training repeats.

There was a significant interaction on the group and the phase [$F_{(2.45,\ 88.19)} = 3.34, p < 0.05, \eta^2 = 0.09$]. With a *post-hoc* test at each phase, non-significant group difference was observed at the baseline phase [$t_{(36)} = 0.44$, *n.s.*] and the 1st post-intervention phase [$t_{(36)} = 1.08$, *n.s.*]. However, there were significant group differences at the 2nd post-intervention phase [$t_{(36)} = 2.44, p < 0.05$] and 3rd post-intervention phase [$t_{(36)} = 2.15, p < 0.05$]. Results indicated that the attention engagement at the baseline did not differ between the eye-feedback and the control groups, and a similar result was obtained until the 1st post intervention phase. While at the 2nd post-intervention and the 3rd post-intervention phase, the attention engagement of the eye-feedback group was faster than the control group (see **Figure 4**). There was non-significant effect on the group [$F_{(1,\ 36)} = 3.96$, *n.s.*], indicating that statistically insignificant differences between the two groups were found. There was non-significant main effect on the phase [$F_{(2.45,\ 88.19)} = 1.11$, *n.s.*], indicating that statistically insignificant differences between the four phases were found.

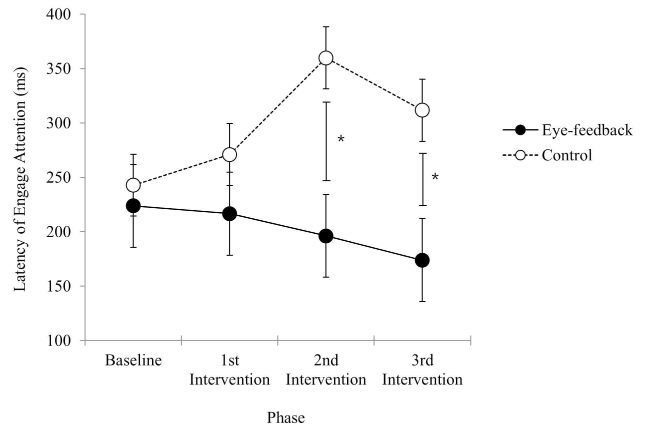

FIGURE 4 | Latency of engage attention. The figure shows change in the attention engagement results across sessions between the eye-feedback and the control group. The asterisk (*) indicates statistically significant difference at $p < 0.05$. Error bars indicate standard error of the mean.

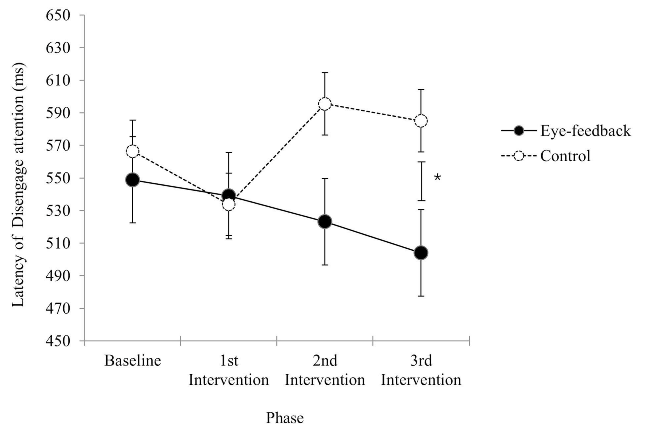

FIGURE 5 | Latency of disengage attention. The figure shows change in the attention disengagement results across sessions between the eye-feedback and the control group. The asterisk (*) indicates statistically significant difference at $p < 0.05$. Error bars indicate standard error of the mean.

Comparison of the Attention Disengagement Results Between Eye-Feedback and Control Group

Results of analyses in order to examine within group differences showed that there was a significant effect regarding the phase in the eye-feedback group [$F_{(3,\,54)} = 4.82$, $p < 0.01$, $\eta^2 = 0.21$], while non-significant effect was found in the control group [$F_{(3,\,54)} = 2.11$, *n.s.*]. With a *post-hoc* test among phases, there were significant phase differences between the baseline and the other three phases (1st post-intervention, 2nd post-intervention, 3rd post-intervention). Results indicated that an increase in efficiency of attention disengagement was shown only in the eye-feedback group, and this effect was consistent after the 1st post-intervention.

There was a significant interaction between the group and the phase [$F_{(2.45,\,87.06)} = 3.24$, $p < 0.05$, $\eta^2 = 0.08$]. With a *post-hoc* test at each phase, non-significant group differences were observed at the baseline phase [$t_{(36)} = 0.64$, *n.s.*], the 1st post-intervention phase [$t_{(36)} = 0.18$, *n.s.*], and the 2nd post-intervention phase [$t_{(36)} = 1.70$, *n.s.*]. However, there was a significant group differences at the 3rd post-intervention phase [$t_{(36)} = 2.34$, $p < 0.05$]. Results indicated that the attention disengagement at the baseline did not differ between the eye-feedback and the control groups, and a similar result was obtained until the 2nd post-intervention phase. While at the 3rd post-intervention phase, the attention disengagement of the eye-feedback group was faster than the control group (see **Figure 5**). There was non-significant main effect on the group [$F_{(1,\,36)} = 1.88$, *n.s.*], indicating that statistically non-significant differences between the two groups were found. There was non-significant main effect on the phase [$F_{(2.45,\,87.06)} = 1.46$, *n.s.*], indicating that statistically non-significant differences between the four phases were found.

TABLE 3 | Results of ANT-R between eye-feedback and control group.

Phase	Group		Test Statistics (F)
	Eye-feedback (*N* = 19)	**Control (*N* = 19)**	
ALERTING			
Baseline	58.74 (36.05)	*65.37 (35.14)*	0.50*
1st post-intervention	72.89 (31.56)	68.10 (33.55)	
3rd post-intervention	58.47 (34.65)	70.58 (40.89)	
VALIDITY			
Baseline	26.00 (45.02)	21.37 (26.64)	1.20*
1st post-intervention	16.84 (40.09)	9.37 (26.40)	
3rd post-intervention	−0.42 (18.46)	13.26 (30.86)	
ENGAGING			
Baseline	−24.16 (29.71)	−19.05 (21.47)	0.52*
1st post-intervention	−23.84 (27.48)	−22.05 (30.89)	
3rd post-intervention	−21.37 (19.13)	−27.74 (21.89)	
DISENGAGING			
Baseline	50.16 (39.41)	40.42 (28.94)	3.63*
1st post-intervention	41.11 (34.61)	31.00 (37.01)	
3rd post-intervention	20.95 (25.71)	44.16 (16.23)	
EXECUTIVE CONTROL			
Baseline	136.95 (53.65)	122.68 (32.57)	0.85*
1st post-intervention	125.89 (57.24)	119.26 (38.79)	
3rd post-intervention	107.37 (29.89)	113.26 (31.14)	

**$p < 0.05$; Mean (standard deviation) in milliseconds (ms); SCT, Sluggish Cognitive Tempo; ADHD, Attention-Deficit/Hyperactivity Disorder.*

Comparison of ANT-R Results Between Eye-Feedback and Control Group

Table 3 shows changes in attentional network index in RT for each phase between the eye-feedback and the control group.

Comparison of the Alerting Network Index Results Between Eye-Feedback and Control Group

There was non-significant interaction between the group and the phase [$F_{(2,\,72)} = 0.65$, *n.s.*], indicating that the two groups did not differ in the benefit of the target response speed because of alerting network at each phase. There was non-significant main effect on the group [$F_{(1,\,36)} = 0.66$, *n.s.*], indicating that statistically non-significant differences between the two groups were found. There was non-significant main effect on the phase [$F_{(2,\,72)} = 1.03$, *n.s.*], indicating that statistically non-significant differences between the three phases were found.

Comparison of the Engaging Index Results Between Eye-Feedback and Control Group

There was non-significant interaction between the group and the phase [$F_{(2,\,72)} = 0.57$, *n.s.*], indicating that the two groups did not differ in the benefit of target response because of engaging attention at each phase. There was non-significant main effect on the group [$F_{(1,\,36)} = 0.01$, *n.s.*], indicating that statistically non-significant differences between the two groups were found. There was non-significant main effect on the phase [$F_{(2,\,72)} = 0.14$, *n.s.*], indicating that statistically non-significant differences between the three phases were found.

Comparison of the Disengaging Index Results Between Eye-Feedback and Control Group

Results of analyses in order to examine within group differences showed that there was a significant effect regarding the phase in the eye-feedback group phase [$F_{(2,\,36)} = 4.01$, $p < 0.05$, $\eta^2 = 0.18$], while there was non-significant effect in the control group [$F_{(2,\,36)} = 1.02$, *n.s.*]. With a *post-hoc* test among phases, there were significant phase differences between the 3rd post-intervention and other two phases (baseline, 1st post-intervention). Results indicated that an increase in efficiency of orienting network related to disengaging attention was only shown in the eye-feedback group, and this effect may improve as the attention training repeats.

There was a significant interaction between the group and the phase [$F_{(2,\,72)} = 3.63, p < 0.05, \eta^2 = 0.09$]. With a *post-hoc* test at each phase, non-significant group difference was observed at the baseline phase [$t_{(36)} = 0.87$, *n.s.*] and the 1st post-intervention phase [$t_{(36)} = 0.87$, *n.s.*]. However, there were significant group differences at the 3rd post-intervention phase [$t_{(36)} = 3.33$, $p < 0.05$]. Results indicated that the disengaging index at the baseline did not differ between the eye-feedback and the control groups, and a similar result was obtained up until the 1st post intervention phase. While at the 3rd post-intervention phase, the disengaging index of the eye-feedback group was lower than the control group. There was a non-significant main effect on the group [$F_{(1,\,36)} = 0.04$, *n.s.*], indicating that statistically non-significant differences between the two groups were found. There was non-significant main effect on the phase [$F_{(2,\,72)} = 1.72$, *n.s.*], indicating that statistically non-significant differences between the three phases were found.

Comparison of the Executive Control Network Index Results Between Eye-Feedback and Control Group

There was a significant main effect on the phase [$F_{(2,\,72)} = 3.21$, $p < 0.05$, $\eta^2 = 0.08$]. With a *post-hoc* test among phases, there were significant phase differences between the 3rd post-intervention and the baseline phase. Results indicated that increases in efficiency of executive control network become better as the attention training repeats regardless of groups. There was non-significant interaction between the group and the phase [$F_{(2,\,72)} = 0.86$, *n.s.*], indicating that the two groups did not differ in the cost of target response because of the flanker conflict effect at each phase. There was non-significant main effect on the group [$F_{(1,\,36)} = 0.24$, *n.s.*], indicating that statistically non-significant differences between the two groups were found.

DISCUSSION

The present study developed and assessed a preliminary attention training program targeting the orienting network based on a real-time eye-gaze feedback using an eye-tracking system in order to improve dysfunction of attentional networks in individuals with SCT. As a result, those individuals with SCT who were assigned to the eye-feedback condition showed more improvement in engaging and disengaging their attention using the measurement of eye-movements than those in the control condition. In addition, the eye-feedback group showed more improvement than the control group only in the efficiency of orienting related to disengaging attention using the measurement of the ANT-R. Additionally, in both groups, there was an increase in efficiency of the executive control network after the repeated attention training.

The major finding of the present study is that attention training based on eye-feedback could enhance both engagement and disengagement of overt attention in individuals with SCT. In line with previous research (7, 8), this supports our hypothesis that efficiency of attention could be improved through repeated practice. There are three possible explanations of these results. First, the eye-feedback was developed to provide repeated attention training using Pro-SEM based on behavior plasticity. The task consisted of 4 blocks, each with 48 trials, for a total of 192 trials (∼25 min) and was designed to be repeated three times. The results of the present study indicated that increases in efficiency of attention engagement and disengagement may become better as attention training repeats. These results are in line with previous findings that repeated training of the SEM can produce changes in oculomotor performance, leading to an improvement in overt attention (13, 17, 20). Second, the eye-feedback was developed to improve specifically the orienting network. In order to directly and overtly measure attention engagement and disengagement using an eye-tracking system, a modified Posner spatial cueing paradigm previously used in a variety of attention orienting studies was used. Therefore, the eye-feedback could be used to not only assess the overt orienting on engagement and disengagement of attention, but also to improve these networks through repeated training. Finally, the eye-feedback was developed to provide real-time constant eye-gaze feedback during repeated training, and this was a distinctive characteristic of the task. In the present study, an increase in efficiency of engagement and disengagement on overt attention was observed in the eye-feedback group, but not in the control group. These results suggest that feedback could improve performance by reducing uncertainty and providing information to focus on correct, incorrect, or both (28). Also, these results are consistent with previous studies that suggested that an adaptive type of attention training (which can provide feedback during a task responsive performance) is more effective than a non-adaptive type of attention training. Therefore, in our study, a greater improvement among individuals was observed when feedback was given (7, 27). Eye-feedback is such a modified version of bio-feedback, similar to the neuro-feedback and fMRI-feedback, which is meaningful in that the task focused directly on improving visual attention.

Another meaningful result of the present study is that attention training based on eye-feedback could enhances only disengagements on covert attention in individuals with SCT. However, since an increase in efficiency of engagements on covert attention was not observed, hypotheses of the present study are partially supported. Therefore, the controversy about the relation between covert and overt attention remains. Several previous studies suggested that covert and overt shift of attention are independent of one another, which is known as the modular theory of attention (23, 47). By contrast, other studies results suggested that covert and overt attention cannot be independently changed, which is known as the premotor theory of attention (48). In the present study, since eye-feedback was overt attention training based on eye-feedback, it could improve efficiency of both engagement and disengagement on overt attention. There was also an increase in efficiency of disengagement on covert attention, but not in efficiency of engagement on covert attention. Although further studies are needed, there appears to be a link between covert shift of attention and eye-gaze process during disengagement, and these results support that training one might induce benefits of the other (26). Also, these results support the intermediate view of those theories that covert and overt attention may elicit both common and different regions of brain activation (49).

Interestingly, although attention training based on the eye-feedback did target the executive control network, increases in efficacy of the network become better as the attention training repeats regardless of groups. There are several possible explanations for this result. First, it is possible that the practice effect occurred in the executive control network only. This idea is consistent with previous reports of practice effects on the alerting and executive control networks in the ANT, as the difference of the scores changed significantly between sessions (32, 50). Second, it is possible that conducting repeated attention training might induce improvement in the executive control network. That is, although the cognitive load was low, the task requirement of focusing attention on any task for a substantial amount of time appeared to improve executive control (51), which is also supported by a previous finding that repetitive saccade execution can improve attention control (52).

The present study has several limitations. First, although we observed that eye-feedback can enhance attentional functions through three repeated practices, those three practices may not have been sufficient to confirm the practice effect. Our results suggest that, in both conditions, an increase in efficiency of the orienting network became larger after repetitive training, even if efficiency of the executive function improved. Second, we cannot investigate whether the attention training could transfer to SCT or ADHD symptoms because we did not measure SCT or ADHD symptoms after training. Thus, further research should examine the attention training based on eye-feedback in order to elucidate the improvement in not only the orienting network, but also other issues, such as SCT or ADHD symptoms, academic functioning, internalizing symptoms, and quality of life. Therefore, the study needs longitudinal follow-up and requires to examine other outcomes and functional impairment. Finally, the study needs to be replicated in better characterization of the clinical groups included—in relation to for instance comorbidities and intellectual abilities.

In summary, the results of the present study preliminary indicate that repeated attention training using the eye-feedback could improve orienting on both covert and overt attention in individuals with SCT. Our findings also provide a novel intervention targeting attentional difficulties among individuals with SCT. Specifically, the use of the eye-feedback as attention training in a promising means of improving efficiency of the orienting network in clinical settings.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The experiment was approved by the institutional review board in Chung-Ang University. All of the participants signed an informed consent that had been approved by the institutional review board in Chung-Ang University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR'S NOTE

This paper is a condensed version of KK's doctoral thesis.

AUTHOR CONTRIBUTIONS

KK, YL, and J-HL: conceived the experiment. KK: designed the experimental task. KK and YL: participants' data acquisition. KK and YL: data analysis. KK and J-HL: data interpretation. KK, YL, and J-HL: drafting of the manuscript. All the authors revised the manuscript critically and gave the final approval of the version to be published.

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A Feasibility and Acceptability Trial of Social Cognitive Therapy in Early Psychosis Delivered Through a Virtual World: The VEEP Study

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Background: Addressing specific social cognitive difficulties is an important target in early psychosis and may help address poor functional outcomes. However, structured interventions using standard therapy settings including groups suffer from difficulties in recruitment and retention.

Aims: To address these issues, we aimed to modify an existing group social cognitive intervention entitled 'Social Cognition and Interaction Training' (SCIT) to be delivered through a virtual world environment (Second Life ©).

Methods: A single arm nonrandomized proof-of-concept trial of SCIT-VR was conducted. Five groups of three to five individuals per group were recruited over 6 months. Eight sessions of SCIT-VR therapy were delivered through the virtual world platform Second Life© over a 5-week intervention window. Feasibility was examined using recruitment rates and retention. Acceptability was examined using qualitative methods. Secondary outcomes including social cognitive indices, functioning, and anxiety were measured pre- and postintervention.

Results: The SCIT-VR therapy delivered was feasible (36% consent rate and 73.3% intervention completion rate), acceptable (high overall postsession satisfaction scores) and safe (no serious adverse events), and had high levels of participant satisfaction. Users found the environment immersive. Prepost changes were found in emotion recognition scores and levels of anxiety. There were no signs of clinical deterioration on any of the secondary measures.

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Conclusion: This proof-of-concept pilot trial suggested that delivering SCIT-VR through a virtual world is feasible and acceptable. There were some changes in prepost outcome measures that suggest the intervention has face validity. There is sufficient evidence to support a larger powered randomized controlled trial.

Clinical Trial Registration: ISRCTN, identifier 41443166

Keywords: social cognition therapy, virtual environments, virtual world, first episode psychosis, psychosis, proof-of-concept trial

INTRODUCTION

Novel treatments targeted at functional outcome in early psychosis are important as functional recovery is less common than symptomatic recovery (1), and the two are not always intrinsically linked (2). Continued functional impairment has significant impact both personally and economically and is often rated as the most important treatment goal in people experiencing their first episode of psychosis (3). One treatment approach targeting functional outcomes broadly is social cognition remediation therapy. Social cognition, including the domains of emotion recognition, theory of mind, and attributional bias, is often poor in both established psychosis (4) and first episode psychosis (5), is strongly related to social functioning (6), and contributes unique variance in predicting functional outcome (7, 8). Although varied in approach, social cognitive remediation programs all appear to improve social cognition measures (9). Global approaches that deliver both social cognition skills training and real-world application of these skills also appear to improve functional outcome at least in established psychosis (9). In a previous study, we adapted one of these established global type social cognition programs, Social Cognition and Interaction Training (10), in an Australian sample of first episode psychosis patients (11). We found in a small pilot study that this group intervention was acceptable to young people, but feasibility was low as consent rate and maintaining attendance in the group was relatively poor (11). For some young people, the thought of attending traditional individual or group therapy provoked considerable anxiety (11). In this sense, we were aware that our intervention was not reaching a wider group who might benefit from social cognition training, especially as poor social cognition is associated with anxiety and negative symptoms (12).

Over the last few decades, technological approaches to delivering healthcare have developed rapidly. This is also the case in mental health problems where the use of apps and social media sites has been used to encourage engagement and widen the reach of interventions to other populations (13). Although emerging, the use of technology to deliver interventions has received relatively little attention in the psychosis field, perhaps due to concerns regarding young people with psychosis not using technology or that technology may be unhelpfully incorporated into their symptoms (14). However, there is no consistent evidence to suggest either of these concerns are the case (13, 15).

Virtual Reality (VR) interventions are showing promise in engaging and helping young people with psychosis often by providing safe exposure to challenging environments. Virtual world platforms are being used to deliver physical and psychological treatments to people with a range of health problems, including obesity, autism, intellectual disabilities, and diabetes (16–19). A virtual world is an online shared community environment where members can interact in a custom-built, simulated world. The community interacts in the simulated world using either text-based, 2-D and/or 3-D graphical models called avatars (20). Although under-researched, virtual world platforms have the potential to reduce communication barriers and improve access to support and treatment in people with mental health disorders (21).

One of most widely used virtual world environments is the online and freely available social world Second Life©. Second Life© has been used as a virtual world platform in healthcare education, delivery, and engagement and has considerable potential in delivering psychological therapies (21, 22). For example, Second Life© has been used to treat social anxiety and has been found to be feasible and acceptable with effects sizes potentially comparable to face-to-face Cognitive Behavior Therapy (CBT) for Seasonal Affective Disorder (23) and in treating social cognition problems in autism (24). However, we know of no other study that has used Second Life© in the treatment of psychosis. We adapted a traditionally face-to-face delivered social cognition and interactional training (SCIT) (25, 26) to a virtual world in Second Life© (SCIT-VR) using a codesign process involving young people, clinicians and web designers. This work is described in detail elsewhere (27). The title of this trial is "virtual reality as a method of delivering social cognitive therapy in early psychosis (VEEP)." Our aim was to test the feasibility and acceptability of the SCIT-VR intervention approach in a group of young people who were recovering from a first episode of psychosis.

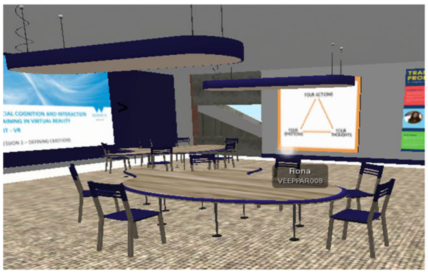
METHODS

Study Design

Single arm, nonrandomized, proof-of-concept study.

Development of SCIT-VR

We undertook a modified codesign process with 20 young service users in total, two carers, a virtual world designer, and the study team. The co-design process is described in detail elsewhere [(27); **Figure 1** displays screenshots of the environment].



Therapy room

Outside building Library

FIGURE 1 | Screenshots of the Second Life© environment adapted from (20).

SCIT-VR Structure

SCIT-VR consisted of 10 sessions (two individual and eight group sessions). The original SCIT (25) was delivered in 20 sessions but our adapted face-to-face version in early psychosis with young people living in Australia was delivered in 10 sessions (11). In the SCIT-VR version described in the current study, the group experience sessions at the end of the intervention were truncated based on our codesign feedback. We included two initial 30 minute sessions where the researcher helped the participant to set up and familiarize themselves with the technology in order to take part in the virtual group sessions. This included providing a headset, helping the participant through the login procedure, setting up their avatar, and helping to familiarize themselves with the Second Life© environment. The SCIT-VR content was then delivered over eight one-hour sessions. The basic structure of the intervention was the same as the original SCIT (25). The first three sessions focused primarily on emotion recognition, the next three sessions focused on attribution bias and paranoia as an emotion, and the last two sessions on "skills acquisition" using a CBT framework to discuss examples of social difficulties faced by the participant (see **Figure 2**). The intervention was manualized and delivered by a lead therapist and a cotherapist to groups of five participants.

Recruitment and Eligibility Criteria

Participants were recruited primarily from one National Health Service (NHS) early intervention in psychosis services in Coventry and Warwickshire, UK. These services provide a three year period of care to around 120 individuals experiencing their first episode of psychosis. Psychosis-specific interventions include antipsychotic medication, CBT, family interventions, and vocational interventions, plus individual case management. All young people aged between 18 and 45 years registered with the early intervention service and not in an acute phase of psychosis (*i.e.* not in hospital/in contact with the crisis team) were eligible. Exclusion criteria included a confirmed diagnosis of a learning disability or a neurological disorder.

Measures

Feasibility and Acceptability

Feasibility was assessed using consent rates in those eligible, levels of session completion and follow-up rates (28). Study completers were classified as individuals who attended at least six of the eight sessions (the two set-up sessions and at least four sessions). Acceptability was assessed immediately following each session by asking participants to complete a five-item feedback questionnaire completed online through the dedicated study website. Acceptability was also assessed using a semi-structured interview with participants post-intervention. We also completed a focus group with clinicians whose patients were involved in the study to access clinicians' views to real world applicability. These findings will be discussed in a future paper. Interview data was thematically organized.

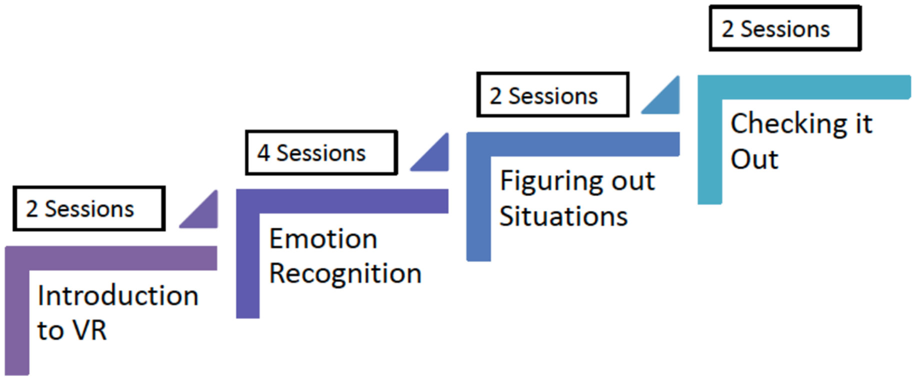


FIGURE 2 | SCIT-VR therapy structure.

Outcome Measures

Social Cognition

1) Social Cognition Screening Questionnaire (SCSQ)—comprises of 10 short vignettes, which presents an interaction between a fictional character and the participant. It has five subscales: verbal memory, schematic inference, theory of mind, metacognition, and hostility bias (29). 2) Bell Lysaker Emotion Recognition Task (BLERT)—this is a test of one's ability to correctly identify seven emotional states using facial emotion recognition (and body cues) endorsed by the preliminary reports of the SCOPE study (30). 3) Hinting task (31)—a theory of mind task where participants are required to identify verbal hints in a conversation. The social cognition measures were informed from the results of the ongoing Social Cognition Psychometric Evaluation (SCOPE) study (30, 32). 4) Cognitive Style Questionnaire-Short Form (CSQ-SF; (33)—focuses on 24 hypothetical positive and negative events relating to successes and failures in academic achievement, employment, and interpersonal relationships. This questionnaire assesses how an individual attributes the outcome of events.

Social Function

Personal and Social Performance Scale [PSP; (34, 35)]—clinician reported measure to assess the severity of social functioning in those with acute symptoms of schizophrenia.

Quality of Life

EuroQual 5-D (36) scale—a widely used scale assessing quality of life through five items and a visual analog health "thermometer" rating.

Behavioral Change Intention

1) Theoretical Domains Framework—Domain Four (TDF—D4)—used to develop questionnaires including 12 theoretical domains of potential behavioral determinants. Domain four is called *Beliefs about capabilities* and measures participants' self-efficacy, self-confidence, and perceived competence (37).

2) Theoretical Domains Framework—Domains Eight and Nine—these correspond to *Intentions* and *Goals* in the Framework. *Intentions* involves measuring participants' decision to undertake a behavior or resolution in a particular way. *Goals* involves assessing participants' goal priorities, targets, and their intention to implement such goals into their life (37).

Presence in the Virtual World

Presence (a VR concept employed to test the extent to which the participant was "immersed" in the virtual world) was tested using the presence questionnaire (38).

Psychopathology

Brief Psychiatric Rating Scale (BPRS) (39)—assesses participants' psychopathology and symptom severity. Researchers were trained on administering this scale to gold standard ratings.

Neurocognition

1) National Adult Reading Test (NART)—a commonly used method in clinical settings for estimating premorbid intelligence levels of English-speaking individuals (40). 2) Trail Making Test—a widely used neuropsychological test of visual attention and task switching (41).

Adverse Events

These were collected in line with the University of Warwick Clinical Trials operating procedure.

Procedure

Eligible individuals were identified by the treating team. Potential participants were approached for consent by the research assistant. Consented participants completed the baseline assessment over a maximum two weeks. When at least three but preferably five participants were consented and baseline assessment completed, therapy sessions commenced. The time between recruitment of the first and last participant was short (no longer than six weeks). The two initial individual sessions were arranged before the group sessions were scheduled at the convenience of the participants. To encourage attendance, participants were contacted by text prior to each session. Participants were aware that the secondary therapist was available *via* a study phone for an hour prior and after each session both for safety reasons and to help with technology queries.

The intervention was delivered to groups of three to five participants. The primary and secondary group facilitators were psychology trainees educated at masters level/above. The intervention was manualized. A number of PowerPoint presentations and videos were retained from the original SCIT intervention and delivered through Second Life© as part of the sessions. Immediately following each session, participants were taken to a 'virtual library' where they were invited to complete a session feedback sheet. Feedback was not available to the therapists until after the end of the intervention period. At the end of the 10 therapy sessions, participants completed the post-intervention assessments. They were also invited to complete a 30-minute interview with a research assistant to discuss views on the technology, the virtual world and the intervention itself. All interviews were topic-guide driven, audio-recorded and transcribed. Ethical approval for the study was obtained from the West Midlands—Solihull Research Ethics Committee.

Data Analysis

For the secondary outcome measures, pre- and post-test scores were compared using basic t tests. Demographic information on the participants was also collected and presented. Qualitative interviews were conducted post intervention, using a semi structured schedule. Interviews were conducted until data saturation was achieved (N = 15). A thematic analysis (42) method was used to analyze the data. Analyses were conducted using the software NVivo.

RESULTS

Sample Characteristics and Feasibility

Descriptive data for the participants who consented to take part in the study (*N* = 19) are displayed in **Table 1**. More males than females were recruited and the age was relatively young (mean 25.6 years). IQ estimates were slightly above normal and the level of psychopathology was relatively high. Of all the young adults with First Episode Psychosis (FEP) in the service who were deemed eligible by the care coordinators and approached (53 over a 6-month period), 19 participants (36%) agreed to take part. Four of those participants who consented (21%) then withdrew from the study before completing outcome measures, leaving outcome data for 15 individuals. Reasons for withdrawal from the study were: unable to commit the time (n = 2); experiencing a recent bereavement (n = 1); not able to contact (n = 1). If participants attended four or more of the total eight sessions, they were considered a completer. Eleven of the 15 participants were deemed completers (73.3%). The mean (SD) number of VEEP sessions attended by participants was 4.94 (2.64), which was a mean attendance rate of 61.8% of the total eight available sessions.

TABLE 1 | Participant demographics, psychopathology and neurocognitive measures at baseline.

Variable	Value	
Age	Mean	25.61
	SD	6.49
Gender	Male	14
	Female	5
Highest level of education	A level	3
	Trade or technical training (incomplete)	5
	Trade or technical training (complete)	6
	Tertiary diploma/certificate	2
	Undergraduate degree (incomplete)	1
	Undergraduate degree (complete)	2
Psychopathology (BPRS rating at baseline)	Mean	38.21
	SD	6.35
NART score (premorbid intelligence)	Mean	28.06
	SD	7.78
Trail making task (visual attention and task switching)	Trail A mean time (secs)	35.95
	SD	11.63
	Trail B mean time (secs)	113.58
	SD	74.28

Acceptability

Feedback Questionnaires

Participants gave ratings out of five for each of the five items assessing acceptability on a feedback questionnaire completed after every session. Acceptability was rated >3 out of five on every item. Descriptive data for ratings of each item of the questionnaire are presented in **Table 2**, while total ratings (0–25) for each intervention session are presented in **Table 3**.

Qualitative Interviews

Categories and illustrative quotes from the individual interviews are represented in **Table 4**. These were related to investigator's concerns on safety and immersion/realism in the environment. Participants did not have specific concerns regarding safety, liked the anonymity, and found the environment relatively immersive. There were some issues with the technology reported by the participants.

Secondary Outcome Measures

Treatment outcome was defined as change in social cognition, social function, quality of life, and behavioral change intention. Paired t-tests showed that there was a significant increase in emotion recognition (BLERT) scores from pre- to post-intervention, with a medium effect size (Hedges' g), t(14) = 3.21, p = .006, *g* = 0.58, (see **Figure 3**). There was also a significant decrease in the anxiety/depression subscale of the EuroQual-5D, indicating an improvement with a medium effect size, t(14) = 2.43, p = .029, *g* = 0.41 (see **Figure 4**) (43, 44). There were no other significant differences from pre- to post-treatment on any of the other measures (p > .1). See **Table 5** for pre- and post-intervention analyses. Presence was measured in the last nine consecutive participants (due to an omission in the interview schedule). The results showed that the participants had a reasonable degree of presence in the virtual world (average score on the presence questionnaire (38) 154.2, SD 18.8 see **Supplementary Figure 1**).

TABLE 2 | Acceptability ratings (0–5) for each item of the feedback questionnaire.

Questionnaire item	Mean	SD	Min	Max
Q1:Suitable level of content (*e.g.* easy to understand)	4.40	0.54	3	5
Q2:Relevance and value of the content	4.16	0.56	3	5
Q3:Guidance from the therapist	4.69	0.51	4	5
Q4:Encouragement to participate and interact	4.57	0.67	3	5
Q5:Safety of the VR world	4.70	0.61	2	5

TABLE 3 | Total acceptability ratings (0–25) for each session of VEEP.

Session	Mean	SD	Min	Max
1: SCIT-VR and social cognition definition	22.11	1.62	19	25
2: Defining emotions	21.71	2.06	19	24
3: Guessing people's emotions	22.33	1.94	19	25
4: Suspicious feelings	22.25	2.63	20	25
5: Jumping to conclusions	22.6	2.88	19	25
6: Separate facts from guesses & gathering more information	23.75	1.26	22	25
7: Checking it out—part I	22.6	2.3	19	25
8: Checking it out—part II	24	0	24	24

Participants were also given the opportunity to provide a written feedback response on the questionnaire. Written responses are presented in ***Supplementary Table 1****.*

TABLE 4 | Feedback and illustrative quotes.

Nature of the Feedback	Illustrative Quotation
Feedback on the virtual world	
Privacy and Safety	"I think it was safe yeah no I don't think erm I had any concerns of like you know people listening in who shouldn't be or people able to access..." (Participant 017)
Anonymity	"Cause I didn't know them, I didn't think it would be too much of an issue. So I said some certain things about like my psychosis." (Participant 005)
Second Life Environments	"I thought that was pretty good with the different rooms, the different therapy rooms." (Participant 015)
Sense of Realism	"you know the graphics could've been a bit better? " "it may-may have made me feel like I was in more of a real life setting and which would've been oh-okay because it would've got me out of my comfort zone." (Participant 005)
Feedback on the treatment	
Treatment content and delivery	"I think the content was delivered...comprehensively during the presentations, during the sessions, I didn't feel I needed to go back and re-read anything." (Participant 017)
Impact of treatment on wellbeing	"About...you know...what people, what you think they might mean and what they actually mean. You know like with facial expressions, you-you can come up and say, 'Oh were they were they giving me a dirty look?' When actually if you think about it they may be having a bad day or there maybe other reasons so...yeah I found that useful." (Participant 007)
Support during the treatment	"Not much. Literally not much. Everything (Research Associate's name) set up perfectly. Like she put it on and all I had to do 'cause she even saved my login details so I didn't even have to put them in once." (Participant 005)
Ideas for improvement	
Technological Difficulties	"I would log in five minutes before the session, my computer would crash, and I would spend the next ten minutes trying to login, and I'll be five minutes late" (Participant 016)
Duration and timing of treatment	"Cause the times they were aren't ermm like you said yeah I think evenings maybe better for some people. Depending on you know, I suppose age and whether they work or not. " (Participant 007)

DISCUSSION

We conducted a proof-of-concept nonrandomized study of an established group social cognition intervention (SCIT) adapted for delivery through a virtual world (Second Life©), SCIT-VR. We found that the intervention was generally feasible as the intervention completion rate was reasonable, and the delivery of the intervention by relatively inexperienced clinicians in an NHS setting was possible. Our completion rate is similar to that of the trial conducted by Bartholomeusz et al. (11) where 75% of participants completed the intervention. The intervention was mostly considered acceptable as measured by attendance rate, post-session feedback questionnaires and qualitative interviews. There were no concerns about safety either from adverse events or from individual participant interviews. There was a suggestion that the intervention had face validity as pre-post changes were observed on measures of social cognition and anxiety. There was no change in participants' intention to change or self-efficacy scores. The intervention was not primarily aimed at improving intention to engage in further therapy or social activities but we anticipated this might be a beneficial effect of the approach. Further studies might want to consider the use of virtual worlds as interventions aimed more directly at engagement and self-efficacy as part of a pathway to accessing more structured and face-to-face interventions.

The small scale pilot face-to-face version of this study was conducted by Bartholomeusz et al. (11). The average effect size score in their trial was d = 0.29, compared to our g = 0.22. Similarly this trial also found significant improvements on emotion recognition. This is not completely unexpected as we believe the virtual world is a mechanism to provide the SCIT intervention to those who might find it difficult to attend face-to-face therapy. The findings in the current study across a number of measures indicate that the virtual world intervention we have developed has the potential to improve social cognitive domains in those people with early psychosis. However, this is a small pilot study with a small sample size. Therefore, a large randomized controlled trial is required to determine whether providing SCIT in a virtual world can lead to significant improvements in this population.

This is the first study to our knowledge using a virtual world to deliver a structured group therapy in early psychosis. It was relatively ambitious, as a number of social cognition skills would appear to rely on face-to-face social contact to achieve mastery. However, there have been previous studies that have used Second Life© successfully with the aim of improving social cognition skills in those with high functioning autism (24). We believe that the didactic teaching approach that was delivered in Second Life© was possibly more successful than more group-focused sessions as measured by higher levels of feedback on the individual sessions that were more didactic in nature. The sessions with more specific teaching content were rated more highly by the participants than the sessions that involved group work. No participants highlighted that they enjoyed the group or specifically felt part of the group. Future studies using this approach may want to consider whether the intervention needs to be delivered in a group setting. Others, for example, have

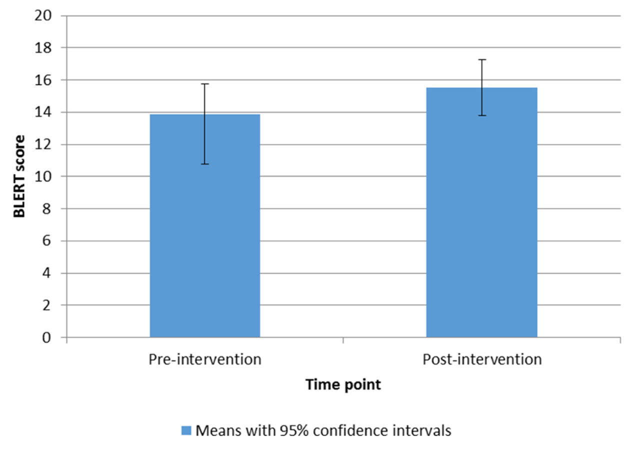


FIGURE 3 | Bar chart to show means and 95% confidence intervals of BLERT scores from pre- to post-intervention.

successfully used an individual approach when using virtual worlds to treat social anxiety (23).

Participants reported a high degree of presence in the virtual environment, which was surprising as the interaction with Second Life© is purely through a computer monitor and headset and not using a head mounted display or more traditional immersive technology and the interview themes also highlighted that people felt high levels of presence in the virtual world. However, the presence questionnaire was completed by a minority of participants. Previous research has attempted to assess the sense of presence using Second Life©; for example, nursing students reported relatively high degree of presence in Second Life©, which was related to attitude towards using the environment (45). We have considered whether a more immersive environment such as traditional VR or using 360 videos might lead to a greater acquisition of social cognition skills as they more approximate real-life situations.

These findings support the growing number of VR interventions for people who experience psychosis. According to a recent literature review, there are a distinct lack of studies examining the potential impact of VR interventions for early psychosis (46) Therefore, our trial is timely. The key advantage of VR is that real-time behavior can be observed when interacting in the VR world. Furthermore, the environment can be modified and controlled to elicit certain responses (47).

There are a number of limitations of the study. Firstly, there was no control group and therefore we cannot be sure that any improvements are due to the intervention. There were challenges in recruiting patients, which impacted on the feasibility of the study, with only 36% of eligible patients consenting to take part in the intervention. This differs from previous research, which showed that two thirds of patients with psychosis were willing to be contacted about taking part in research (48). However consent rates for those eligible participants diagnosed with psychosis differ between trials. For example, while Wood et al. (49) reported a 67% consent rate (30/45), Kanniston et al. (50) reported a 33% consent rate (1139/3417), and Schrank et al. (51) reported a mean consent rate of 40.0%. One possible reason for our recruitment rate is that some potential participants may not have had access to the internet or may have had limited digital skills, reflecting an ongoing concern around digital exclusion for some people. This issue is a concern more generally in digital mental health studies and requires further consideration in finding ways to reduce digital inequalities (52). More frequent contact between clinicians and researchers has been shown to improve recruitment. Therefore this should be reviewed in future research (53).

Whilst we had a reasonable retention rate, we had problems keeping people engaged in the study. There were some problems with the technology during some of the sessions which required the secondary therapist to rectify; on two occasions this was not possible. This was highlighted in the qualitative interviews. One of the limitations of using Second Life © was that it was not functional on tablets or hand-held devices and it could not be streamed through a gaming console. A number of participants did not own a laptop or desktop computer. We were able to loan a computer to participants who did not have access to one, but for those who do not own or have access to a computer participation in an intervention delivered on a platform such as Second Life© is compromised.

Given the results of this small proof-of-concept study, there is sufficient evidence to consider a full-scale efficacy trial in this population. Challenges in designing such a trial are whether to consider adjunctive experiences that might be more immersive such as combining other VR approaches. Based on the feedback, we would also need to consider whether all parts of the intervention need to be delivered in a group setting and how we might be able to overcome technical problems and access to those without a computer. The delivery of evidence based psychological therapies to this group continues to prove challenging, and the use of technologies such as Second Life© shows promise in widening access and engagement for this hard to reach group.

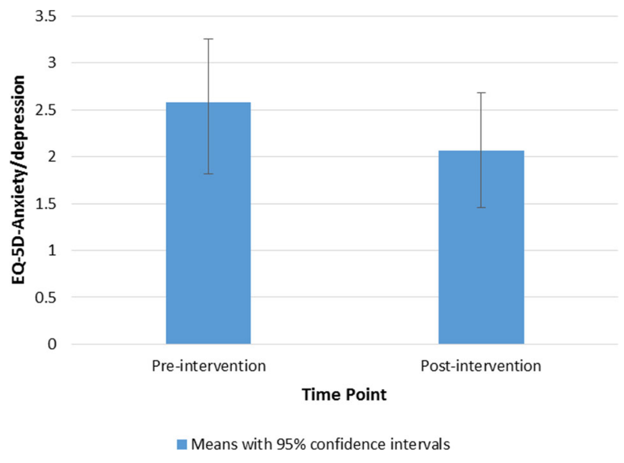


FIGURE 4 | Bar chart to show means and 95% confidence intervals of EuroQual-5D-Anxiety/depression subscale ratings from pre- to post-intervention.

TABLE 5 | Pre- and post-intervention means and SDs for secondary outcomes.

Variable		Pre-intervention		Post-intervention		p value	Hedges' g
		Mean	SD	Mean	SD		
BPRS	Total	38.21	6.35	36.4	9.16	0.348	0.23
	Anxiety	2.16	1.26	2.33	1.35	0.843	0.13
	Depression	2	0.94	2.13	1.19	0.818	0.12
SCSQ	Total SCSQ	31.13	3.52	33.29	3.4	0.253	0.61
	Theory of mind	7.05	2.2	8	1.56	0.173	0.49
	Schematic Inference	6.95	1.27	7.67	1.23	0.126	0.56
	Verbal memory	7.89	1.15	8.33	1.23	0.164	0.36
	Metacognition	9.24	0.77	9.29	0.64	0.823	0.07
	Hostility bias	1.68	1.25	1.47	1.36	0.855	0.16
BLERT		13.84	4.36	15.53	3.16	0.006	0.58
Hinting task		17.84	2.39	18.67	1.72	0.344	0.39
CSQ-SF	CSQ-SF-Total	195.16	27.4	191.53	24.2	0.13	0.14
	Internality subscale	47.32	5.7	49.53	4.87	0.337	0.41
	Globality	43.21	8.16	43.2	7.1	0.453	0
	Stability	42.58	6.55	39.67	6.95	0.098	0.42
	Negative Consequences	21.32	4.73	20.13	4.63	0.219	0.25
	Self-worth implications	40.47	9.32	38.67	8.93	0.067	0.19
PSP		66.74	15.65	67.87	14.03	0.773	0.07
EuroQual-5D	Total	8.74	3.81	8.6	3.79	0.187	0.04
	Anxiety/depression	2.58	1.3	2.07	1.1	0.029	0.41
EuroQual-VAS		71	16.92	70	21.04	0.669	0.05
TDF-4 (Beliefs about capabilities)	Total	2.57	0.55	2.38	0.56	0.486	0.33
	Group	2.64	0.73	2.55	0.75	0.673	0.12
	Individual	2.51	0.48	2.33	0.57	0.331	0.33
TDF-8 (intentions)	Total	2.48	0.82	2.21	0.61	0.576	0.37
	Group	2.56	0.8	2.24	0.68	0.454	0.45
	Individual	2.4	0.88	2.18	0.63	0.777	0.28
TDF-9 (Goals)	Total	2.98	0.73	2.72	0.56	0.399	0.39
	Group	3.03	0.7	2.68	0.68	0.274	0.49
	Individual	2.93	0.81	2.76	0.52	0.772	0.25

The pre- and post-intervention means (SD), t values, p values, and effect sizes (Hedges's g) for level of psychopathology (total Brief Psychiatric Rating Scale—BPRS), anxiety and depression subscales of the BPRS, total and each subscale of the Social Cognitive Screening Questionnaire (SCSQ), Bell Lysaker Emotion Recognition Task (BLERT), hinting task, total and each subscale of the Cognitive Screening Questionnaire-Short Form (CSQ-SF), Personal and Social Performance scale (PSP), Euro-Qual-5D Quality of life Scale (EuroQual-5D) -total and anxiety/depression subscale, EuroQual-Visual Analogue Scale (EuroQual-VAS), Theoretical Domains Framework (TDF) 4, 8, & 9 totals, group and individual ratings are presented.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the 'West Midlands – Solihull Research Ethics Committee' with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the 'West Midlands – Solihull Research Ethics Committee'.

AUTHOR CONTRIBUTIONS

AT, SB, MB, IV, and DT wrote the grant application for this feasibility and pilot trial. AT, AR, DT, and FE were responsible for coordinating the design of the virtual world. AT, AR, and FE conducted the co-design workshops. AT, FE, FL, and AR undertook the trial. AT drafted the manuscript. All investigators have been involved in revising the report, and all authors have seen and approved the final version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.00219/full#supplementary-material

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Conflict of Interest: SB is a director of a not-for-profit company aimed at commercialising mental health apps.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Development of a Lived Experience-Based Digital Resource for a Digitally-Assisted Peer Support Program for Young People Experiencing Psychosis

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This paper describes the creation of a web-based digital resource designed for tablet computer use during peer work sessions to structure discussion about recovery in early psychosis. The resource consisted of a series of videos featuring young people who have used early psychosis services discussing how they navigated issues in their own recovery. A participatory process was used to create the resource. Researchers held a series of collaborative development workshops with early psychosis service users, peer workers, other mental health practitioners, and academics. These were used to derive a framework of recovery processes relevant to young people experiencing psychosis, which was considered as useful areas of discussion within a peer work relationship. A semi-structured interview guide based on this framework was then used in video-recorded interviews with young people in recovery from psychosis. Footage was edited into 14 videos and organized into six final themes: My Journey, Self-Care, Connections, My Identity, Life, and Mental Health. The combined expertise of young mental health service users, peer support workers, mental health practitioners, and digital mental health researchers throughout the development process enabled the creation of tailored digital resource for peer work in an early psychosis service.

Keywords: peer support, first episode psychosis, personal recovery, digital mental health, early intervention mental health services

INTRODUCTION

Early intervention for young people experiencing psychosis has become a key focus of mental health services worldwide (1). Policies such as the Australian Government's National Youth Mental Health Initiative have led to widespread implementation of specialized early intervention mental health services for young people experiencing or at risk of psychosis (1–3). Engaging young people with psychosis into mental health services earlier in their mental health journey has been reported to improve clinical and psychosocial outcomes and reduce the long-term burden of mental illness (4–6).

Mental health services have been shifting towards a recovery-oriented approach to mental health treatment. This has been heavily influenced by a broader consumer movement in mental health advocating for mental health services to prioritize personally meaningful goals of consumers, rather than narrowly focussing on symptom remission (7, 8). This focus of services is often referred to as *personal recovery* to distinguish it from traditional clinical (symptom remission) and functional (return to work or study) conceptualizations of recovery. This concept of personal recovery emphasizes a process whereby individuals live a hopeful, rewarding, and satisfying life, sometimes in the presence of ongoing symptoms (7, 9, 10). In a synthesis of the existing literature, Leamy et al. (11) proposed a framework of five personal recovery themes, highlighted from mental health consumer accounts of their own recovery from severe mental illness. These include: social connectedness; hope and optimism about the future; transforming identity; finding meaning and purpose; and empowerment in mental health self-management (CHIME) (11). CHIME has been cited as a model for defining and examining personal recovery in mental health, and may have benefits in providing an evidence-based approach to help inform clinical and research programs (12–15). Although, criticisms have been raised in regard to the model having an optimistic perspective on recovery and under-emphasising the difficulties associated with mental illness (16–19). The CHIME model was also conceptualized from long-term service users lived experiences, in which the relatedness of the model to younger populations, including those experiencing early psychosis is uncertain.

In supporting the notion of recovery, an emerging feature of recovery-oriented mental health services is engaging people with lived experience of mental health difficulties into service delivery (7, 20, 21). Peer Support Workers (PSWs) are employed by mental health services and often use their personal experiences of mental illness, "along with relevant training and supervision to facilitate, guide, and mentor another person's recovery journey by instilling hope, modeling recovery, and supporting people in their own efforts to reclaim meaningful and gratifying lives in the communities of their choice" [p. 4, (22)]. The shared lived experience of mental illness can help create a sense of authenticity, trust, understanding, acceptance and support in developing adaptive self-management strategies, counteracting negative stereotypes of mental illness, and making it evident that recovery is possible (21, 23–26).

To date, resources to facilitate the delivery of peer work have most commonly been created in the form of paper workbooks [e.g., Wellness Recovery Action Planning; (27)]. There may be benefit in using digital tools in sessions to help structure the peer work process, particularly in young people experiencing psychosis (28–30). The Self-Management and Recovery Technology (SMART) research program in Victoria, Australia has been examining the use of digital lived experience material on tablet computers (31–33). Given that recovery concepts have arisen from mental health consumer narratives of recovery, the resource developed in the SMART research program makes use of lived experience videos as a means of communicating content. Videos relate to a series of recovery topics, each feature a number of "peers" discussing how that issue has affected them and/or how they have navigated it (31, 32). Initial findings confirm that use of lived experience video material is a feasible and acceptable means of structuring one-to-one sessions (31, 34). Participants described the videos providing a sense of hope and connection, encouraged participants to talk about their own mental health, and gained a sense of ownership over the conversations discussed (34). These findings draw similarities with naturalistic explorations of peer videos on social media and digital storytelling (35–37).

This novel form of working has potential synergies with a peer work context. Peer workers may be better placed than non-peer workers to discuss the lived experience-based material. Meanwhile, the lived experience video material may be useful both in providing a reference point for the PSW sharing parts of their own lived experience, and in providing a broader range of lived experience material to discuss than their own alone to promote recovery-oriented discussions. The increased availability and diversity of peer lived-experience through videos may also help improve participant feelings of normalization, validation, and hope.

Preliminary investigations indicate that young people with psychosis have expressed interest in digital resources including videos being used as part of their mental health service support (28, 29, 38). Bucci et al. (38) explored the views of young people with psychosis on digital health interventions, finding that digital interventions were seen as an acceptable resource that could aid in destigmatizing access to mental health services. Current examples of digital mental health interventions for young people experiencing psychosis include HORYZONS—an online program that contains a series of interactive psychosocial interventions and an expert and peer social networking platform (39). Investigations into HORYZONS have found the intervention was feasible, with participants viewing the online intervention as being positive and useful, and feeling more empowered and connected (39). Bucci and colleagues (40) trial of a digital smartphone application (i.e., Actissist) designed to target key areas of concern for early psychosis was found to be a feasible, acceptable, and safe digital intervention. Further research has provided support for the feasibility and acceptability of digital programs in this population (41–46), with a few randomized control trials currently under-investigation (47, 48).

However, the development of digital resources to promote personal recovery in young people experiencing psychosis, and their use in a peer work context are yet to be examined. In developing such a resource, the limited available literature on personal recovery and individual face-to-face peer support work in this population emphasizes the key role that participatory processes can have. Consumer expertise has been increasingly encouraged within health research by government funders such as the US National Institute of Mental Health (49), Australian National Health and Medical Research Council (50), and UK National Institute of Health Research (51). Likewise, participatory design processes are increasingly becoming the standard in digital intervention development (52–54), and in mental health service design (55).

Meaningfully integrating expertise from consumers and mental health service professionals including PSWs *via* a participatory process is needed to create resources that are more likely to align with the needs and preferences of those involved in delivering and receiving the program (56–59). It may also assist in understanding how digital technology can be integrated into peer work and help break down some of the barriers often associated with implementing peer-based programs (29, 60, 61). In this paper, we describe the participatory development process we used for making personal recovery lived experience video resources for use in peer support work, and detail the resultant web-based resource. The strengths and difficulties associated with this process will also be discussed.

METHODS

Development Process

Service Context

The project took place in collaboration with Alfred headspace Youth Early Psychosis Program (hYEPP) clinicians, PSWs, and consumers. This service forms part of a nationally-implemented model of services designed for young people aged 12 to 25 years old who are experiencing or at risk of developing psychosis. hYEPP provides the opportunity for young people and their network to receive a holistic approach towards treatment that includes addressing concerns related to psychosis, whilst also supporting young people in key developmental areas such as physical health, education, employment, and relationships (2, 3). The collaboration coincided with the service exploring options for their newly developed peer workforce. This led to the aim of exploring a novel digitally assisted peer support program influenced by work on developing a tablet computer-based recovery-oriented intervention within adult mental health services (31–34). The project was approved by The Alfred (526/16) and Swinburne University of Technology (2018/164) Human Research Ethics Committees. All participants provided informed consent prior to participation.

Overview of the Development Process

The creation of the resource content followed a sequential development process, involving participatory development of an initial content framework of themes, which was used to develop a semi-structured interview guide, conducting filmed interviews on the basis of this guide, and then editing video material with reference to the initial content framework into final themes (**Figure 1**). In this way, the content was shaped by both participatory development of an initial lived experience-based framework, and then the emergence of lived experience-based material during interviews.

Co-Development of Content Framework

Step 1. Collaborative planning

Initially, a steering group was formed of academics with experience in digital resource development, hYEPP service managers and PSWs to consider the potential use of a tablet-based lived experience video resource within a peer work context.

Discussion over a number of planning sessions involved thinking about the type of peer-resource that could be developed and exploring the principles and experiential nature of peer work and meaning of personal recovery for young people. These discussions highlighted the need to identify the personal recovery priorities that may be relevant for young people with psychosis. They also highlighted the potential for facilitating participatory engagement *via* the "Discovery College" program, a youth-oriented version of the recovery college model, an innovation in recovery-oriented practice with an emphasis on collaborative learning processes in mental health self-management (62).

Step 2. Participatory Content Development Workshops

Four, 3 h consumer workshops were co-designed, developed, and conducted in 2016. The workshops were facilitated by two members of the hYEPP Discovery College team, with members of the steering group present. Use of independent facilitators helped to reduce the potential biasing of the emergent content framework towards a replication of SMART or CHIME. Any PSW or service user engaged with the service was eligible to participate in the content development workshops. Two PSWs (both female) and ten hYEPP service users (3 males and 7 females) participated.

In the first workshop, participants were oriented to the type of digitally assisted peer program that could be created and discussions explored young people's perspectives on the relevance of content and videos (e.g., lived experience and professional videos) from the SMART resources developed for a mainstream adult population (31). Discussion initially involved an introduction to participatory research and peer support work to help orient participants to the purpose of the workshops. The group was then asked to consider a young person who experiences mental health challenges and may have started to use mental health services like this one for the first time and using a digital resource with a peer worker. They were asked questions such as "what is important to know and understand about their mental health and wellbeing?", "what is important to

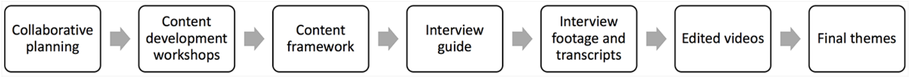


FIGURE 1 | Outline of the development process.

have in their lives?", "what is important to do to stay well?", and "what is important to include in a digital resource for young people experiencing mental health challenges?". From these discussions, overall themes emerged. The second and third workshops focussed on determining the specific information to include within each of the themes identified and creating interview questions for the lived-experience filming in order to capture the central target of each theme. In the workshops, participants also decided on a name for each area that they felt was relevant to a youth population and discussed their perspectives on the development of a website to host the program (e.g., use of color and youth-friendly language).

Initial Themes From the Content Development Workshops

Themes elicited revealed several areas within the individual and their environment as being important to their recovery. For example, participants expressed a preference for hearing other young people's perspectives on family pressures or difficult parent situations and how these situations were navigated. Participants also advocated for content focussing on de-mystifying the mental health sector and navigating engagement with mental health services, such as how to break down barriers around diagnosis and medications and discuss concerns with workers. Environmental factors such as conversations about managing school, driving, and finances were reported, as well as making conscious choices around social media use. A key theme that arose across each of the personal recovery areas was the importance of creating authentic and genuine lived experience accounts that capture hopeful stories of people doing well but also include "not all good stories" to normalize the challenges experienced.

Six personal recovery themes were summarized; 1) recovery, 2) relationships, 3) self-management, 4) basic needs/environment, 5) identity, and 6) resources/stigma. The themes were renamed following a detailed discussion of each area to capture the overall content and to create titles that would be in appropriate language for a youth population. For instance, basic needs/environment was re-titled "Life" to encompass the different life challenges identified by young people. Recovery was re-titled "My Journey" because participants expressed dislike for the term "recovery", as it implied there is an end-point to when someone has "recovered"' from mental illness.

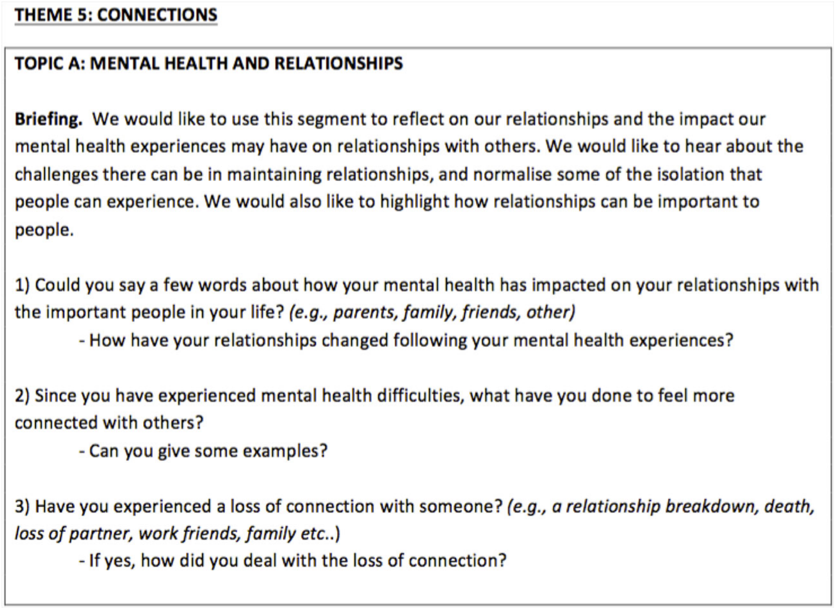
Conducting the Lived Experience Filming

Step 3. Development of Semi-Structured Interview Schedule

In the next step, a semi-structured interview schedule was developed based on the list of interview questions suggested by participants for each theme in the content development workshops by CP, FF, and NT. Open questions were developed to elicit the interviewees' experiences of each of the themes. An example of the interview schedule is shown in **Figure 2**.

Step 4. Recruitment and Briefing of Interviewees

Advertisements were co-designed and created with the service to identify young people aged 18 to 25 years old who had an experience of psychosis and were willing to share their lived experience of mental health on film. Recruitment involved distributing flyers at the service, liaison with mental health clinicians, and discussions with service users who were involved in analogous events. Interested individuals were contacted to discuss the nature of their participation and potential implications of the filming. A pool of interviewees



THEME 5: CONNECTIONS

TOPIC A: MENTAL HEALTH AND RELATIONSHIPS

Briefing. We would like to use this segment to reflect on our relationships and the impact our mental health experiences may have on relationships with others. We would like to hear about the challenges there can be in maintaining relationships, and normalise some of the isolation that people can experience. We would also like to highlight how relationships can be important to people.

1) Could you say a few words about how your mental health has impacted on your relationships with the important people in your life? *(e.g., parents, family, friends, other)*
- How have your relationships changed following your mental health experiences?

2) Since you have experienced mental health difficulties, what have you done to feel more connected with others?
- Can you give some examples?

3) Have you experienced a loss of connection with someone? *(e.g., a relationship breakdown, death, loss of partner, work friends, family etc..)*
- If yes, how did you deal with the loss of connection?

FIGURE 2 | Example of the lived experience filming interview schedule.

was sought to capture diversity in gender, age, sexuality, and ethnicity.

Ten young adults (4 females, 6 males) aged 18 to 31 years old ($M = 23.10$, $SD = 3.84$) with an experience of psychosis were recruited to be filmed and interviewed about their recovery. Two of the 10 young adults' footage was included from another resource [i.e., (31)] due to difficulty experienced in recruitment. Participants were emailed the consent form and interview questions one week prior to the scheduled filming. This allowed for the participant to review the consent form and the interview questions and inform the researchers of any areas they would not like to discuss during the filming. This was revisited on the day of the filming to confirm the participant would only be asked questions they were comfortable with.

Step 5. Interviewing and Filming

Interviews with young people were then conducted by CP, NT, FF, and/or ML across a total of four days in 2016 and 2017, using a professional videographer team to film the interviews. NT, FF, and ML had experience in conducting lived experience interviews. A two-camera set up was used, with the interviewee in frame of both cameras, and the interviewer outside the camera's field of view. The use of two cameras allowed for switching view from one camera view to another when material need to be edited out to create a seamless edit. Furniture and other styling items were brought to the filming to create diverse background scenes. Audio was recorded using a lapel microphone.

During the interview, the interviewer asked open questions focused on participants experiences and explored how they navigated various challenges, based on the semi-structured interview schedule. The format allowed for the interviewer to deviate from the schedule, where it appeared useful to explore additional emerging content. Interviewees were briefed to discuss their own experiences and encouraged to use a first-person perspective (e.g. "something I experienced has been…", "I've found…", or "for me…", rather than "people with psychosis experience…" or "if you use mental health services you should…"). This approach was used to fit with the theme of lived experience and capture the uniqueness of individuals' experiences and perspectives. Participants were asked to re-film their response to improve delivery or align with the first-person perspective, if required. Each interview went for approximately 1–1.5 h and participants were financially reimbursed with $200 (AUD). The interviews were professionally transcribed, and a two-week cooling off-period was provided for participants to review the video transcripts and inform researchers of any material they wished not to be included in the final videos.

Step 6. Editing

An extensive editing process was employed to create the lived experience videos. The video transcripts were initially reviewed by CP and coded into the personal recovery themes identified in the consumer content development workshops. Comments were made on the transcripts to highlight content that: i) conveyed a meaningful or powerful message, ii) was relevant to the personal recovery themes, and iii) aligned with the intended purpose of the video. Participant transcripts were cross-checked with the video material to ensure content maintained a similar meaning when visually-presented. Each participant video was then reviewed to identify any visually-presented material that conveyed a meaningful message but may not have appeared important when looking at the participant transcript independently. These steps were completed a total of three times for a thorough review of the material.

Following this, 16 draft videos were created using Camtasia Version 2.10.8 software program (63). The *a priori* parameters for each video were to be less than 4 min in duration (ideally between 2 and 3 min), and to feature at least three interviewees in order to provide diversity in perspectives (important given the highly individual nature of personal recovery) (11). To generate these videos, excerpts from each interviewee's highlighted content were combined into a video compilation to compare, contrast, and review to determine which material should be retained for the final videos. In reviewing the draft videos, the meaning, significance and range of content, diversity of demographics, and duration of the video were considered to decide on the final content. This was an iterative process reviewed initially by CP, FF, ML, and NT and then with hYEPP PSWs and other team members for feedback and modifications. The final videos were developed by a professional film team. After the videos were created, interviewees involved in the filming were given the option of attending a session to view the finished videos at the mental health service (which two participants took up).

RESULTS

Developed Resource

The methodological descriptions outlined the processes involved in creating a lived experienced-based resource for PSWs to use in individual face-to-face sessions with young people engaged in an early intervention mental health service. The results section will commence by detailing the final personal recovery themes developed, then the lived experience videos and website created and, end with describing the resultant digitally assisted peer support program, namely, Peer Plus.

Final Themes Developed

Through reviewing the content obtained from the lived experience filming, the initial six themes were refined. The filmed interviews were able to elicit material for each of these six themes, but slight modifications were made, where necessary, to ensure each personal recovery theme reflected relevant experiences. For example, the Mental Health theme had been initially designed to have a single video focused on experiences and difficulties associated with medication, but this was incorporated into a video on people's experiences navigating challenges with mental health services, allowing for a separate video to be created that focussed on people's experiences with mental health services (both positive and negative).

Overall, six themes emerged from the consultation with the existing literature, lived experience expertise from the content development workshops and film content, and mental health service including PSWs. In the digitally assisted peer program, each personal recovery theme includes one to three lived experience videos and represents a single module within the program. A summary of the six modules is detailed below:

1. *My Journey*, provides an overview of the lived experience speaker's mental health journey and their view on the meaning of recovery.
2. *Self-Care*, explores how stress affects people including the types of things that cause people stress, how to recognize the signs of being under stress, and strategies to cope with stress.
3. *My Identity,* explores people's sense of self and how personal identity may be affected by mental illness and the stigma that can be attached to mental health. It includes discussions about how to navigate changes to our personal identity and coping with stigma or discrimination in order to lead a more meaningful and satisfying life.
4. *Connections,* explores the impact of mental health on relationships with friends, family, people in the community and on social media. This includes how these relationships can be challenged during hard times, and ways to nurture these relationships and form new connections with others.
5. *Life*, explores the different challenges people may experience during their late adolescence and young adulthood, and the ways people can navigate these challenges (e.g., getting a driver's license whilst on medication). Life also covers people's experiences with disclosing their mental health to others, or factors considered when deciding not to disclose their mental health.
6. *Mental Health,* explores people's experiences with mental health services and how people could navigate difficulties (e.g., conversations about medication) to make the most of their mental health service.

Content of Lived Experience Videos

Although initially aiming to produce 16 videos on the basis of funding and content derived from the workshops, a decision was made to have a total of 14 videos (see **Table 1**). There was insufficient content obtained for the My Journey theme, which resulted in one of the videos being removed that focused on participants current situation and future plans. A second video was removed from the Life theme, with two of the planned videos collapsing into a single video to provide an overall perspective on people's experiences and navigation of difficulties. The final videos are from 1.30 to 3.53 min (M = 2.70 min) in duration and aim to capture diversity in the young people's experiences and navigation of various mental health related difficulties. Each of the videos have between three to seven lived experience speakers. To illustrate the type of lived experience videos created, one example of a participant transcript from an overall video compilation for each of the personal recovery themes will be described.

My Journey

The My Journey theme involves three participants briefly talking about some of their mental health experiences including a point in their journey where things started to get better. Two of the young people also describe their view on what "personal recovery" means to them to highlight the individualized nature

TABLE 1 | Summary of the lived experience videos developed.

Module theme	Video title	Number of speakers	Content areas discussed
My Journey	My Journey	3	Brief overview of the speaker's mental health experiences and meaning of "recovery".
Self-Care	What is stress?	7	Things that can cause people stress (e.g., crowded places, financial instability, expectations from others).
	Impact of stress	6	The effect of stress including physiological responses, racing thoughts, or psychotic symptoms (e.g., increased voices).
	Managing stress	6	Strategies used to cope with stress such as distractive (e.g., exercise, meditation) and cognitive processing techniques.
My Identity	Who am I?	4	Sense of self and personal strengths (e.g., fitness, humour, religious beliefs, art).
	How my sense of self has changed	4	Impact of mental health on personal identity and coping with changes (e.g., acceptance, values identification, re-engaging with past interests).
	Stigma and discrimination	4	Experiences with stigma (e.g., societal and self-stigma) and how these situations were managed.
Connections	Relationships	4	The impact of mental health on relationships and navigating challenging relationships or loss of friendships, as well as how to form new reciprocal connections.
	Family	5	The impact of mental health on family systems (e.g., supportive responses, and navigating difficulties).
	Social media	5	Positive experiences with social media as a means of connecting and navigating the negativity that can arise.
Life	Challenges	3	Navigating different challenges in life (e.g., employment, finances, getting a driver's license).
	Disclosure	5	Experiences with disclosing mental health to others (e.g., romantic partner, employment) and deciding when not to disclose.
Mental health	Experiences with mental health services	5	Experiences and difficulties with mental health services (e.g., engaging in service programs or relationship concerns with workers).
	Navigating difficulties with mental health services	5	Managing difficult situations such as conversations about medications, power imbalances or having multiple workers.

of recovery. This was covered in a single video titled "My Journey".

> "How I started my mental health journey. At first, I did it by myself. I tried my luck so to speak. I used to get waves of depression, where six months I'd be feeling really depressed. Six months I'd be feeling fine, so I think, oh, that's okay. But it did come back. I kept pushing through, gradually getting worse and worse each time, until I guess I reached a bit of a breaking point and I reached out and saw someone, which I regret taking so long to do. But kinda switched my views there. Started the long journey and now I feel like I'm the best possible me I can be at the moment. When I first got diagnosed, my view on recovery is a lot different to what my view is now. My view back then was this massive, I guess task, I had to do. I didn't know if I was ever gonna reach recovery, it was quite blank and vague, the information given didn't favour a recovery. But now my view has changed to seeing that recovery is about taking a lot of little small steps." Interviewee 1.

Self-Care

The Self-Care theme involves young people talking about the various things that cause them stress, the impact of stress and the different ways in which they manage stress. The content covered in this theme was divided into three videos; what makes you stressed, the impact of stress, and managing stress. In the what makes you stressed video, seven participants spoke about the things or situations that can lead to them feeling stressed such as social situations, family relationships, studying, financial constraints, expectations from society, and a negative internal voice (i.e., "you're not good enough").

> "The main thing I stress about is that I worry a lot. I worry about myself, how I'm going in life, how my friends are going in life, if anyone's okay, if anyone's ill. I worry a lot about my mental health." Interviewee 2.

The second video focused on six participants describing the impact of stress on themselves. This included physiological, behavioral, and cognitive effects of stressors such as experiencing bodily pains, heart palpitations, shakes, and sweats, as well as changes to emotional reactions (e.g., feeling depressed or paranoid), or hearing increased voices.

> "I get a lot of heart palpitations. My heart races, I get shakes and sweats. I get a bit queasy in the stomach and then I have thoughts racing that, you know "Why am I in this situations?" And you know it's stressing me out, I need to get out of those situations because I don't feel comfortable in those situations." Interviewee 3.

The last video in the Self-Care theme involved six participants describing the different ways in which they manage stressors, and how these strategies are helpful for them. This included distraction-based strategies such as physical activity (i.e., going for a walk), practicing meditation or yoga, listening to music, as well as more cognitive-based strategies. These included time-management skills and exploring the nature of the stressor.

> "I find that music can be therapeutic. Every time I'm stressed, I chuck some music on or chuck a beat on and I'll write how I'm feeling or a big cure for me I turn to my faith and I pray." Interviewee 4.

My Identity

The My Identity theme involves young people reflecting on their sense of self and how their view of themselves may have changed throughout their mental health experiences. My Identity also explores young people's experiences with stigma and discrimination, and how they may have navigated such difficulties throughout their journey. The content covered in this theme was divided into three videos: who I am?, how my sense of self has changed, and navigating stigma and discrimination.

In the first video, four participants described their perspective on what makes them who they are and their personal strengths. There were differences across the perspectives, with one participant talking about the importance of religion and two participants describing the value of listening to and playing music, whilst another participant spoke about having strengths in socializing with others and humor. One participant recognized their sense of self encompasses a range of things including creativity and their mental health experiences.

> "The things that make up who I am as a person? Oh, man. There are so many different things. I love color, flowers, art is the biggest one in there, though. I've been an artist ever since I was young, and it is every aspect of my life. Everything is a piece of art, and I love that. My mental health is actually a very big part of me, as well, I've come to realize. Obviously, when I was younger, I didn't want it to be there at all, but I've come to realize that it's a very, it makes me who I am, and without it, I wouldn't be the stronger person I am today." Interviewee 2.

The second video on how my sense of self has changed aimed to highlight four participants experiences associated with changes to their identity, whether that involved reconnecting with their sense of self before experiencing mental illness or forming a new sense of self following mental illness. The video captures what participants did to reconnect or shape their personal identity, such as embracing acceptance, identifying values, or re-engaging with prior interests or hobbies.

> "After receiving the diagnosis, it definitely changed the way I thought of myself. I felt like I wasn't me anymore. Currently, I feel a lot better. I feel that after a period of time, I definitely feel like I've better myself, more than anything. But at the time it was quite big and scary. The kind of things I did to find out who I am again after the diagnosis was just try to

> reconnect with what I was passionate with, before I started getting lost so to speak. Before I started throwing it all away. I started exercising, was one. Just really taking the time to think about what I wanted to do in life. Trial and error really. I did a lot of different courses to find out what I wanted to do. Did a lot of different jobs, and yeah, just really reconnected with my passions and let them blossom again." Interviewee 1.

The navigating stigma and discrimination video covered both societal stigma and self-stigma. Capturing both aspects of stigma was important in being able to highlight the different types of stigma that can occur and obtain diversity in young people's experiences. Two participants talked about experiencing societal stigma from people in the community or workplace, and two other participants described their experiences with self-stigma, and how they navigated these difficulties.

> "The discrimination at work that was a real difficult one. A lot of the times in the workplace I felt like I wasn't good enough or I'm off with the fairies. I'm just not normal. How I used to cope with discrimination of the people around me and my friends and everyone who didn't want to be around me really. I didn't cope at first but for a long time I was by myself. I didn't know how to deal with what I was going through. I would turn to God a lot of the times. Having a new church to go to helped me cope with losing all my friends really but the discrimination at work that was a real difficult one. It didn't get resolved. It got to the point where I had to walk away. I found that it was for the best to have a long break from everyone who was putting me down and not helping to then go off and find people that genuinely care." Interviewee 4.

Connections

The Connections theme involves young people talking about the impact of mental health on their relationships with others in their physical and online environment, and how these relationships can be challenged. It also explores how people formed new relationships. The content covered in this theme was divided into three videos; relationships, family, and social media. In the relationships video, participants spoke about how their relationships with friends and the community might have changed throughout their mental health experiences, and how some people navigated losing friendships and forming new reciprocal connections with others.

> "My mental health has impacted my family and it's been difficult with friends as well, not understanding mental health or why someone does those type of things. They're not sure how to help you or even talk to you sometimes about those situations or what you've dealt with. But over time people generally get a bit better. What I've done to feel more connected is basically I met a lot of people through the mental health sector and we kind of used mental health as a kind of, as grouping each other, that we all went through these different situations and we've all come together and we all mutually help each other. So, through that I've gained a lot of friendships and relationships and met a lot of great people just because we can all relate to each other." Interviewee 3.

Another key area for young people was the impact of mental health on their family system. In the family video, participants described the difficulties experienced in feeling pressure from their parents to do well. Other participants spoke about a lack of understanding about mental illness from their parents, and how they navigated these difficulties. Positive experiences with family members were also described in the video.

> "I remember when I started experiencing mental health difficulties, I remember quite a strong response which was a bit surprising for me. A strong response in that two of my older siblings lived back at home for a period of time to support my parents and everyone within the family and I found that really positive. When I was within the hospital system just my family making an effort in that my mother made sure that she came and saw me every day which was really important to know that I was getting that constant support and care." Interviewee 5.

Social media was the third video within the Connections theme. The topic of social media was highlighted in the content development workshops as a key concern for young people beyond those discussed for relationships more broadly. In the video, participants shared both positive and negative experiences associated with various social media uses. Some participants spoke positively about social media in providing a sense of connectedness with others and sharing their own story, whilst other participants acknowledged the negativity that can occur from making a post online. One participant believed in the importance of communicating with others *via* traditional means of face-to-face or phone contact relative to social media.

> "My view of social media is I don't believe it has to be the only way to communicate with someone. The old way of phoning someone is still a prevalent way to talk to people and I have close friends myself, we keep in contact by phone and things like that. And face to face, as well instead of just through Facebook feeds and seeing what's going on." Interviewee *3*.

Life

The Life theme involves participants talking about the various challenges they have experienced in their life to date, and how their mental illness may have impacted on these challenges. This theme also involves participants talking about their experiences with disclosing their mental health to others, as well as participants describing situations where they decided not to disclose their mental illness. The content covered in this theme was divided into two videos; challenges and disclosure.

In the challenges video, three participants describe the different difficulties they have experienced and how they navigated these challenges. One participant spoke about the trouble experienced in obtaining a driver's license whilst being on certain medications, and how they were able to overcome this issue through seeking support from their mental health worker. Another participant described feeling removed from society after experiencing their mental illness, and how they were able to navigate this difficulty through slowly re-connecting with activities. The third participant described difficulties associated with feeling scared about the possibility of relapse and finding the motivation to pursue employment.

> "Some of the challenges I've had with mental health illnesses and I guess pushing forward in life is, the motivation to try to find work was hard, because it wasn't quite there. I was very close off and I didn't want to push forward. You know, don't have any money from not working is quite stressful. You can't go out and enjoy the time with your friends. You can't do this, so you end up sitting at home, just being alone with your own thoughts. So, I was afraid to push forward, because I was afraid that I could relapse. I guess it took me a long time to get comfortable with pushing myself a little bit to find employment, to reach out for education, and to I guess help myself." Interviewee 1.

The second video in the Life theme involved five participants talking about their positive and negative experiences with disclosing their mental illness to others such as with a romantic partner, friends, mental health professionals, and at work. It was important to capture both normalize and validate young people's experiences in this area and highlight the difficulties that can occur. One participant spoke more broadly about only disclosing their mental health to people they trust and believe care about them.

> "When I disclosed to my previous work about my mental health, it wasn't very good that I felt like I was suddenly isolated by some people, and I found it very hard to connect with people, because the place that I worked, it was just, everyone talked to everyone, and everyone knew about everyone. The fact, I felt like people thought I'd been hiding something from them. That was pretty isolating, but I kind of realized that, although that had happened, it was okay, because my whole life wasn't work, or wasn't that work. Although, I'm not working there anymore, and I still have friends from there, I know that the people who didn't quite like it, I guess, don't matter because they are not a major part of my life". Interviewee 2.

Mental Health

The Mental Health theme focuses on young people's experiences with mental health services. This theme appeared to be vital in covering both the helpful and positive experiences some individuals have when engaging with mental health services, particularly for the first time, but also capturing content that highlights some of the difficulties faced by young people engaging in services such as navigating various key workers or power imbalances. The content for this theme is divided into two videos: experiences with mental health services and navigating difficulties with mental health services.

In the first video, five participants described their experiences with mental health services. Two participants described a positive and supportive experience, whilst another participant spoke about initially being frustrated but later finding value in receiving support form a professional who had specialized expertise. Another participant expressed wishing they had known more about mental health and the services available when they were unwell but described the opportunities now available for them such as group activities associated with the service. One participant highlighted the difficulty experienced when they first engaged with mental health services and spoke about how they managed the situation at the time, and in hindsight what they would do differently based on their experience.

> "My first contact with mental health services wasn't the best. But I've had a lot of positive views, like, overtime, I've had a lot of positive experiences with mental health services as well. From my experience, the first person I saw wasn't the best fit for me, but I wasn't sure there was any other option out there, so I thought that was all I had. I was given this, could only do this. I was stuck at that for a while. What I wish I had have done was voiced my opinion and said, look, I don't know if there are any other services that I could be seeing. Because I didn't agree on some of his views, but I thought I was just stuck with that. It's important to not just feel, be turned off your first experience, but to keep working, finding the one that fits you. It's a bit of trial and error, but that's with everyone." Interviewee 1.

The second video of the Mental Health theme is navigating difficulties with mental health services. This video captured five participants experiences with mental health services including two participants experiences with understanding medication and talking about medication with their treating team, whilst another participant reflected on how they managed a power imbalance and a different participant spoke about managing having multiple workers from different organizations involved in their care. One participant described the value of having someone advocate for their treatment and support.

> "When I first started using mental health services, I found that the most confusing part of it all was the medication. There were lots of different medications

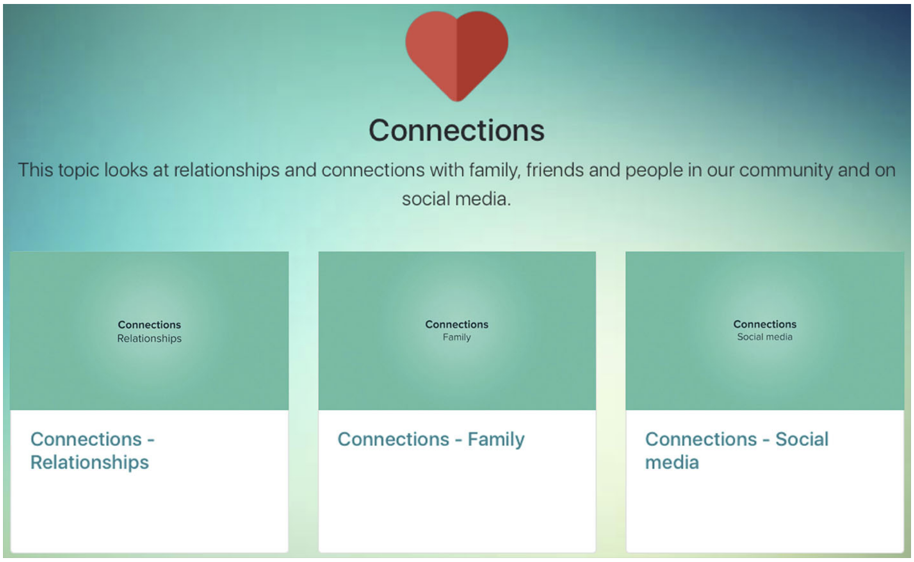
> for different things, but I found that sometimes I was prescribed a medication that wasn't mainly used for my illness, but was used for another illness, but I was being prescribed it, because apparently, sometimes it can help my illness. It all got a bit confusing and talking to mental health professionals or counsellors, workers, any sort of mental health person, about my medication has always been kind of hard for me" Interviewee 2

Website Design

A simple website hosting the videos was professionally created in accordance to preferences expressed in the workshops (i.e., youth-friendly, engaging, easy to understand, and incorporate colors), PSWs preferences, and recommendations from the literature (64). The website employs a single page design optimized for a tablet computer (e.g., iPad), with simplified navigation by organising the content in the same format for all modules. Each module has an icon, heading, brief description, and easily accessible links to the lived experience videos (see **Figure 3**). By having the content on a single webpage, participants can easily scroll through the website to the personal recovery theme they would like to explore. Whilst the modules are presented in an order to allow for a single page format, participants are encouraged to choose the module themes and videos they would like to explore in the session. Discussion prompts are included with each video to help facilitate conversations, if required (see **Figure 4**). The website is accessed *via* a private account issued to the PSW before the individual face-to-face peer support work sessions. Considering the planned usage as a tool to stimulate discussion during peer work, rather than as a tool to be used outside sessions, young people were not issued with log-ons.

Peer Plus Program

The development process resulted in the creation of a digitally-assisted personal recovery and self-management program for peer support work, namely, Peer Plus. As previously described, the program is based on six personal recovery modules that each contain a series of lived experience videos. Peer Plus is a four-session program designed to be used on an iPad by a PSW and young person in a face-to-face session to access the lived experience videos. Participants are introduced to the six



Connections

This topic looks at relationships and connections with family, friends and people in our community and on social media.

Connections
Relationships

Connections - Relationships

Connections
Family

Connections - Family

Connections
Social media

Connections - Social media

FIGURE 3 | Example of the connections module in Peer Plus.

Connections - Social media

Discussion prompts:
- What are your experiences with social media (positive or negative)?
- How has social media impacted on your mental health? If negative experience, how have you managed this?
- What have you found helpful (or unhelpful) in using social media?
- Could you relate to any of the social media views expressed by the peer speakers?

FIGURE 4 | Example of the discussion prompts for the connections module in Peer Plus.

personal recovery themes and decide what themes they would like to explore in each of the sessions. The lived experience videos are intended to help facilitate recovery-oriented conversations and promote a sense of hope and validation. The next phase of this project involves a pilot trial of Peer Plus across the Alfred hYEPP sites in Victoria, Australia. The feasibility, acceptability and preliminary outcomes of Peer Plus in young people aged 16–25 years old is currently being investigated. Formal pilot trial data will be provided in detail in future reports and publications.

DISCUSSION

In this paper, we illustrated how a novel digital video-based peer support resource could be developed through a participatory process. These early research processes are more commonly being documented given the benefits in disseminating knowledge and experience in developing new methods (65).

The detailed descriptions of the personal recovery themes and lived experience video development showcases the ways in which differing expertise can be involved in the creation of new tools (65). The process of transforming consumer material from the content development workshops into a series of digital videos was an innovative approach to creating peer resources that were grounded in lived experience. Illustrating this approach helps create dialogue on how digital technology could be integrated into the peer support work context and used to establish meaningful resources (29). Ultimately, by valuing and incorporating consumers, mental health service, and PSWs perspectives throughout the study, we were able to develop personal recovery based lived experience videos as part of a broader digitally assisted peer support program. This participatory process may assist in breaking down some of the barriers commonly associated with translating research into practice and provide a program that may be utilized by the peer workforce (58, 66).

The development process described here substantially refines the video production process developed in the SMART research program (31) by generating the initial content framework *via* a participatory process, and embedding user participation at all steps of development. In this way content was developed *via* a relatively pure "bottom-up" process of synthesising lived experience content from an initial consumer-based framework, rather than a "top-down" process in which content is based on a framework developed by researchers or developers. This bottom-up approach had particular application within the explicit lived experience-based domains of personal recovery and peer work, and was especially suitable given the lack of existing models of personal recovery for young people experiencing psychosis at the time of development. More top-down aspects may nonetheless be valuable in other applications where there is an existing therapeutic model to translate. For example, developing video material for a self-guided program for bipolar disorder (67, 68) has involved developing an initial framework based on empirically-supported treatment models, and using lived experience input to inform how to communicate these concepts. Understanding how personal recovery could be conceptualized in young people experiencing psychosis was important in learning about the specific personal recovery priorities relevant to this population to create the digital peer videos. Existing research on the theoretical framework of personal recovery in mental health [i.e., CHIME; (11)] have predominantly been conducted in adult mental health populations, with the exception of a couple of studies exploring personal recovery in young people with a range of mental health experiences (17, 69). The specific personal recovery areas for young people with psychosis, however needs to be explored further, as personal recovery is a dynamic process (59).

The six recovery themes that arose from the development process drew similarities with previous research [i.e., (11, 16, 17, 70)]. There was substantial overlap with the CHIME framework, but a number of new areas arose, and common areas were reframed to align more closely with young people. For example, the connections and my identity themes appeared to be consistent with the connectedness and identity process in CHIME (11). The mental health theme involved conversations about young people's experiences and challenges with mental health services, and how such challenges were navigated, which drew parallels with empowerment in CHIME (11), as well as Bird et al. (12) issues around misdiagnosis and medications. Similarly, life appeared to share similar underlying themes with the meaning in life and empowerment processes of CHIME, as well as Bird et al. (12) practical support theme. The CHIME process of hope and optimism for the future appeared to align with my journey but also presented as being important across all themes. The young people sharing their own experiences and navigation of difficulties in the videos aimed to create a sense of hope and belief in the possibility of personal recovery.

A new area that arose within the realm of connections was participants preference to hear lived experience perspectives on the impact of social media. Research has shown young people with psychosis are increasingly using digital technology (28), in which this may be a topic relevant to a youth population in connecting with others. Additional differences arose in the various life challenges associated with the age and development of young people (e.g., getting a driving license while on certain medication). This highlights the necessity of integrating lived experience accounts into research to prioritize relevant recovery factors (59, 69). However, it is important to note the purpose of the current study and development of the recovery-oriented themes was to inform the creation of the digital tool. These themes arose from a small sample size, which limits the generalizability of these findings. Research is required to more thoroughly investigate the personal recovery themes specific to young people experiencing psychosis.

Although successfully creating a digital resource, challenges occurred throughout the development process. There was difficulty experienced in identifying young people who were willing to share their lived experiences on film. The video development phase was extended six months in an attempt to capture additional content and diversity in the people filmed, however a decision was made to include additional interview material from another resource [i.e., (31)]. This allowed for 10 lived experience speakers to be in the videos, which provided diversity in age, gender, sexuality, and ethnicity. An adequate amount of detail was obtained to broadly cover each of the personal recovery themes, however not all of the areas had sufficient content to generate viable interview material for the videos, in which these areas were revised based on the content obtained.

Additional time and practical constraints associated with mental health service staff turnover lengthened the development stage and led to difficulty in maintaining lived experience involvement in the entire development process. For instance, there was a total of two team leaders, three service professionals, and nine PSWs involved at differing time-points throughout the study, which led to time being spent developing new relationships with the employees, orientating them to the project and discussing potential changes to tailor the program to the new PSWs preferences and model of working with young people to improve implementation. These changes, alongside the extensive and time-consuming nature of the video development process also meant it was not feasible to have lived experience input in all phases of the video development, in which the researchers own biases may have influenced the final video clips included in the videos. Lastly, while the videos were designed to contrast a variety of experiences related to mental illness and personal recovery, it is important to note that the researchers endeavoured to create an overall positive feel to the videos, which could have minimized some of the difficulties experienced with mental illness (71).

The model described has potential to develop analogous tools and models of working for other populations. A similar digital tool has been developed for adults with severe and enduring mental health problems (31), but this has yet to be trialled as a peer work tool. There may be additional applications to other settings in which PSWs are employed such as peer group programs. It is notable that the use of this tool requires interest from both consumers and PSWs, which may limit uptake. Non-peer workers have expressed some support for digital interventions in mental health services, but identified key barriers related to their use and implementation [e.g., accessibility and usefulness to service delivery; (33, 72)]. Further research is needed to understand the views of PSWs who were not involved in the development process on the use of digital tools in peer work.

In conclusion, the study findings highlight a new avenue for the development of digital tools in peer support work and beyond. The contributions made by consumers, mental health service, and PSWs were instrumental in being able to create digital resources that may be more likely to be tailored to young people experiencing psychosis and utilized by the peer workforce (66, 73). Such understanding would not have been achieved without their involvement. The use of personal recovery based lived experience videos as a tool for change by facilitating conversations about a young person's own mental health experiences and promoting a sense of hope within peer support work is an area to be investigated.

DATA AVAILABILITY STATEMENT

Within the bounds of participant consent, the datasets generated for this study are available on reasonable request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Swinburne University of Technology and The Alfred Human Research Ethics Committee. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

All authors were involved in conceptualizing, planning, and developing the peer support intervention model and digital tool. All authors contributed to the article and approved the final version.

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