User-centered, interaction design research approaches to inform the development of health risk behavior intervention technologies

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A B S T R A C T

Background: Computers have tremendous potential for helping people change behaviors that put their health at risk. This potential has led to the development of a variety of health behavior intervention technologies (BITs) in recent years. While many of these BITs have been informed by scientific theories on behavior change, poor design can fail to engage intended users. User-centered, interaction design (IxD) research can help BIT developers create tools that are intuitive and enjoyable and that align with intended users' goals. In this manuscript, we describe an IxD research process we used to inform the development of a tablet-optimized web application designed to help heavy drinking gay and bisexual men reduce their risk for HIV when they seek HIV testing.
Methods: We conducted focus groups with subject matter experts (SMEs, $N = 10$) and intended users ($N = 25$). In the SME group, HIV test counselors were recruited to provide an understanding of the priorities and challenges of post-test counseling. In focus groups with intended users, participants created detailed, personalized models of two "typical" users of the proposed app ("personas") that could be used to guide design decisions.
Results: SMEs emphasized the importance of putting patients at ease, and suggested that interventions should prioritize identifying personal risks and provide options for change. Personas created by intended users provided important details about users' attitudinal and emotional contexts, and their possible motivations and goals for using the app. These suggested that users might be most motivated to use the app in order to understand their personal risks, compare their behavior with others like them, help them decide whether they want to change to reduce their risk, and see all their options for doing so. Personas also provided insights about the aesthetic experience that might be most appealing to users.
Conclusions: Interaction design research can provide BIT development teams with personal models of likely users to help guide decisions about the allocation of design resources and the overall form and spirit of the software. These insights can help teams build BITs that are more engaging and interesting to intended users.

1. Introduction

Innovations in healthcare technologies like electronic health records (EHRs) and patient web portals have become routine parts of healthcare delivery in recent years (Poon et al., 2006). Concurrently, diseases primarily caused or exacerbated by lifestyle and behavioral factors have become leading causes of morbidity and mortality (Johnson et al., 2014; Uthman, 2016). Together, these trends have increased interest in technological tools that encourage patients to make healthier decisions and that can be used outside of typical healthcare interactions. These tools, called behavioral intervention technologies (BITs), use various computing technologies (e.g., web sites, smartphone applications) to help encourage healthier decisions (Mohr et al., 2014). To date, BITs

have been developed and tested for many health behaviors, including physical activity, diet, substance abuse, family planning, and others (Mohr et al., 2013; Wantland et al., 2004; Murray et al., 2005).

Existing descriptions of these BITs have primarily focused on their *clinical aims*, or content promoting behavior change [(Mohr et al., 2014); see Table 1 for definitions]. As such, there are many BITs that are based on well-supported behavioral theories and have been tested to ensure they help users enact change (Noar et al., 2007; Krebs et al., 2010). Less attention has been devoted to *usage aims* of BITs—features that increase engagement with the intervention (Mohr et al., 2014). Explicitly addressing these aims and ensuring that BITs are engaging and interesting to users is critical, since the amount of a users' exposure to its content is entirely mediated by engagement (Bennett and

Table 1
Glossary of key terms.

User-focused design	A design process that is influenced by the users of the product being designed (Abras et al., 2004).
Participatory design	A design process in which a product's users actively contribute to its design (Johnson, 1998).
Clinical aims	Intervention content that is intended to promote changes in behavior or relevant antecedents of behavior (Mohr et al., 2014).
Usage aims	Intervention features that are intended to increase engagement with the intervention (Mohr et al., 2014).
Human-computer interaction	A field that involves studying how users interact with computer systems (Card et al., 1983).
User experience	A field devoted to understanding what interacting with a product feels like to a user (Rogers et al., 2011).
Persona	Specific representations of potential users intended to personify these characteristics and provide a realistic, detailed model the design team can empathize with.
End goal	A user's specific motivations for engaging with a product (Cooper et al., 2007).
Experience goal	What a user might want to feel when using a product (Cooper et al., 2007).

Glasgow, 2009). One meta-analysis found that metrics of intervention exposure were associated with effectiveness in facilitating and maintaining behavior change (Donkin et al., 2011). The lack of attention to usage aims in BITs may also partly explain the pervasive problem with non-adherence and attrition reported in many BIT studies (Kelders et al., 2012; Eysenbach, 2005).

Interaction design (IxD) is a field that has grown out of industry's increasing demand for software tools that are intuitive, effortless, and enjoyable (Goodwin, 2011). IxD combines insights from fields like human-computer interaction and user experience design to inform decisions about software's form, behavior, and spirit. Interaction designers are often part of larger design and development teams that incorporate subject matter experts, graphic designers, and developers. To use an analogy, if the team built a home, interaction designers would be like architects, developers would be in charge of construction, and graphic designers would be interior designers. So, interaction designers plan the overall essence and structure of software products to ensure that they support and facilitate users' goals so that they find the product helpful and engaging (Cooper et al., 2007). Interaction design also overlaps with user experience and graphic design to inform the software's overall aesthetic, which is important given evidence that the aesthetic approach can also influence engagement and usability (Tractinsky et al., 2000).

User-centered design (UCD) is one approach to IxD that involves designing software from the user's perspective so that it is more likely to meet their needs and offers them a more intuitive experience (Goodwin, 2011; Cooper et al., 2007; Cooper, 2004). The first steps of UCD involve conducting research to help the team develop a more thorough understanding of users' perspectives, experiences, and goals for using the software (Goodwin, 2011) so that designers can then translate that understanding into interfaces that are attractive and practical to those users. This research also encourages empathy for the product's intended users among all members of the design team (Kouprie and Visser, 2009). Empathy is critical in IxD, since it encourages the team to think and feel like users do, ultimately helping designers generate solutions with users' perspectives in mind (Goodwin, 2011; Kouprie and Visser, 2009). This is especially important for BITs, since designers often have little experience with the specific users the software is built for (Lerouge et al., 2013).

For products that address technical areas like healthcare, an important first step often involves conducting qualitative interviews with subject matter experts (SME) and other relevant stakeholders. These interviews contribute to a better understanding of products' opportunities and challenges (Cooper et al., 2007). However, the focus of UCD research often involves conducting qualitative interviews with intended users with the goal of helping the team develop user *personas*—a set of archetypical users of a product that characterize their attitudes, aptitudes, emotions, motivations, and goals (Cooper et al., 2007; Cooper, 2004). Personas are specific representations of potential users that are intended to personify these characteristics and provide team members with a realistic, detailed model they can empathize with when making design decisions (Pruitt and Adlin, 2010; Brangier and Bornet, 2011).

As such, personas provide a model for helping designers think about how users think and feel, as well as what they hope to accomplish and why (Cooper et al., 2007). These models help guide designers in deciding what a product should do and how it should look, and enables more efficient design decisions by allowing them to refer to a concise representation of users' goals (Cooper et al., 2007; Cooper, 2004; Long, 2009). To humanize these personas, they are given names, pictures, demographics, attitudes, and emotional states that align with contexts in which intended users might use the product (Miaskiewicz and Kozar, 2011). Personas are also given specific *end goals*, or specific motivations for using the software, as well as *experience goals*, or what the persona wants to feel during product use (Cooper et al., 2007).

1.1. Study aims

In this paper, we describe initial user-centered IxD research we conducted to guide the development of a BIT: a tablet-optimized web application intended to help HIV test-seeking gay and bisexual men reduce their risk for HIV and alcohol use, a key risk factor for HIV acquisition (Koblin et al., 2006; Sander et al., 2013). This application, called Game Plan, was conceptually modeled from brief motivational interventions, which are typically 30–60 min, in-person interventions designed to enable behavior change by prompting users to reflect on their risk and their motivation to change, and then assist them in planning for that change (Bien et al., 1993; Moyer et al., 2002; Lustria et al., 2009). This manuscript describes qualitative research we conducted first with SMEs, and then with intended users, as well as the resulting personas we developed to guide interaction design for this BIT. In doing so, we hope to illustrate the utility and value of these methods for helping BIT researchers design products for their intended users.

2. Method

2.1. Subject matter experts and other stakeholders

2.1.1. Participants

Ten local HIV testing providers with (1) 1+ year of experience conducting testing and (2) experience testing gay and bisexual men were recruited from local clinics and agencies through all-staff emails at these clinics, existing contacts, and word-of-mouth. These providers were affiliated with a range of organizations, including local social service organizations, community-based organizations, and medical clinics.

2.1.2. Procedures

We conducted a semi-structured interview with these participants during a 2-hour focus group that took place at our research facility. The purpose of this interview was to understand the typical activities involved in HIV testing, as well as the motivations and emotional contexts of their patients for both testing and counseling. Interviews also inquired about the practical challenges and frustrations about offering

counseling alongside HIV testing and the topics they prioritize during counseling. The goal was to use these responses to inform the overall spirit of the app to align with what SMEs believed was needed to effectively counsel in these contexts, as well as which tasks to prioritize. Participants were compensated $50 for attending the focus group. Although many authors suggest conducting one-on-one, ethnographic interviews with all interaction design research participants in the same contexts in which they might use the prospective tool (Goodwin, 2011; Cooper et al., 2007), budget and timeline constraints prevented us from traveling to these locations for each participant and conducting individual interviews.

2.2. Intended user focus groups

2.2.1. Participants

Twenty-five participants were recruited to participate in two separate focus groups ($N = 12$, $N = 13$) from gay-oriented dating smartphone apps (e.g., Grindr, Scruff), social networking websites (e.g., Facebook, Instagram), and outreach methods (e.g., flyers). Eligible participants were (1) 18+ years old, (2) assigned male sex at birth, (3) were HIV-negative or unsure, and (4) were fluent in English. They also reported (5) having had condomless anal sex with a casual male partner within the last year, (6) were "heavy drinkers," meaning they reported having consumed either 14+ drinks per week or 5+ drinks on a single occasion at least once in the last month [NIAAA, (National Institute on Alcohol Abuse and Alcoholism, 2005)], and (7) reported having tested for HIV within the past 6 months. We recruited those with a recent testing experience because we believed these participants might be more familiar with their own cognitive and emotional states while seeking testing. Demographic characteristics for study participants are reported in Table 2.

2.2.2. Procedures

In two 90-minute focus groups that took place at our research facility, intended users were first asked to participate in a semi-structured interview before we described the general purpose of the app. Then, we asked participants to create a poster that depicted who they thought a typical user of this app might be. Participants were asked to form groups of two and were provided with poster boards, art supplies, magazines, and newspapers. They were asked to select an image that

depicted this user, provide him with a name, and describe his demographic characteristics. They were also asked to divide the poster into four quadrants and in the four resulting sections describe what their user might be thinking, feeling, saying, and doing when using the product, and then were asked to share and explain their poster's content. Other focus group members could then provide further discussion or elaborate on important concepts. We instructed participants to avoid including personally identifying information in their depictions. Participatory approaches to design research suggest that involving users directly in design tasks – like creating personas – can help produce tools that more directly meet users' needs (Danbjorg et al., 2016). Active user involvement may also be especially important for products that address sensitive topics, like sexual behavior and HIV risk, because focusing interviews on personas rather than users' actual personal experiences might encourage more disclosure and honesty (Kwon et al., 2014). Participants were paid $50 for attending the focus group.

2.2.3. Analysis

All focus groups were audio recorded and transcribed, and participants provided permission for the authors to retain and digitize the design artifacts (i.e., posters) they produced during user focus groups. However, their original picture selections have been replaced with open-source images to avoid copyright restrictions. Transcripts and design artifacts were then coded and analyzed thematically using a directed content approach (Hsieh and Shannon, 2005). For SME focus groups, the goal of this approach was to extract prominent themes shared by participants that could ultimately inform when, where, how, and by whom Game Plan might be used. For intended user focus groups, analysis focused on extracting common characteristics of the personas these participants created, synthesizing this data, and prioritizing the most relevant personas. We then characterized each persona's end and experience goals for using the product using data participants provided. Although there may be a diversity of possible users, accommodating the needs of too many individuals can produce designs that are overly complex and difficult to navigate. Therefore, the aim is to identify a persona that will serve as the primary design target. This allows designers to focus on creating one interface that suits the primary persona's needs but that does not alienate any of the other personas (Cooper et al., 2007). All procedures were reviewed and approved by the Brown University IRB.

3. Results

3.1. SME focus groups

SMEs noted that HIV testing most often involves several steps, which include orienting the patient to the test itself, taking the sample, waiting for the result, and providing post-test counseling. Participants agreed that offering counseling to patients about the ways they can reduce their risk was important but added that it should not be mandatory because it could then become a barrier to testing.

3.1.1. Theme #1: patients test out of concern for possible exposure or as a routine practice

SMEs identified two key themes that characterized the motivations and emotional contexts of users. Specifically, they noted that one subset of patients seek testing specifically because they are concerned about a possible exposure, and that these patients are often nervous and apprehensive about testing. These patients often seek testing irregularly, mostly in response to these events, and so, may be less familiar with which behaviors are risky and how to reduce risk. Another subset, they reported, test at more regular intervals, and therefore are more familiar and at ease with the process. They added that these patients may be aware of risks but more ambivalent about taking steps to reduce it.

"I would say most of the people I have tested […] either they come

Table 2
Demographic characteristics of intended user focus groups ($N = 23$).

Characteristics	Mean (*SD*) or *N* (%)
Age (range: 18–72, $M \pm SD$)	38.3 (12.7)
Race	
White	17 (73.9)
Black or African American	2 (8.7)
American Indian/Alaska Native	0 (0.0)
Asian	2 (8.7)
Pacific Islander/Native Hawaiian	0 (0.0)
Multiracial	1 (4.3)
Ethnicity (Hispanic or Latino)	3 (13.0)
Currently in Exclusive Relationship[1]	2 (13.0)
College degree	23 (100.0)
Low income[2]	6 (26.1)
Unemployed	1 (4.3)
Gay or bisexual identity	23 (100.0)
Days since last HIV test	202 (114.7)
Days since last CAS with casual partner[3]	92.5 (119.95)
Average number of drinks per week	11.3 (8.0)
Alcohol-related problem (AUDIT ≥ 8)	6 (26.1)

Note. [1]Represents participants who reported currently being in a sexually exclusive, monogamous relationship with one partner. [2]Represents those with a household annual income < $30,000/year. [3]Condomless anal sex (CAS) with a partner outside of an exclusive, monogamous relationship.

regularly every three months because they are high risk behavior and they [already] know that, […] or those who are scared because something happened."

3.1.2. Theme #2: time and reluctance to "open up" are key challenges for counseling

SMEs also identified two key challenges to conducting counseling alongside HIV testing. First, providers noted time was a major constraint for offering thorough counseling because the clinic was often busy and individual providers were required to juggle multiple patients at once.

"When you have a line out the door, that counseling session gets cut super short. So [you] try to give as much information that's going to stick with them as possible in that short amount of time."

These time constraints often prevented them from addressing factors that were clearly relevant to their patients' risk behavior, like alcohol use and other drug use. As such, they suggested that while patients' drinking was a frequent precipitating risk factor, they often lacked time to address it specifically. This highlights that an app could offer an avenue for intervention and could efficiently address important behavioral risks not addressed by counselors. However, it also emphasizes the need to keep app content brief. Second, SMEs suggested conducting counseling with testing patients was challenging because many can be hesitant to "open up" about their behavior due to nervousness about testing or shame about behavior. In this scenario, participants noted that the *timing* of counseling often encourages patients to respond more openly.

"A lot of times, once the person gets the result […] they're like alright, well, now I'll tell you what happened. And so sometimes in counseling it actually happens after the result is given."

SMEs discussed taking steps with patients to put them at ease. For example, several highlighted the importance of explicitly mentioning that providers are "not here to judge" patients and that all discussions are confidential. However, some also mentioned that another reason patients may not discuss risky behaviors is because some patients may simply be uncomfortable opening up to someone they just met. In these cases, providers noted, an app may encourage more honesty than a human counselor would.

"Once in a while, you get people that don't want to open up. They're ashamed or whatever. […] They might be more honest with a computer than they would with a human being, so I think there's potentially a level of success with this and it should be considered."

This theme suggests that the app should be delivered at an appropriate time in order to encourage honest disclosure, and that it may best be offered after HIV testing results have been delivered. It also emphasizes that the app should take specific steps to acknowledge patients' emotional states and offer re-assurance when possible. It also points to the importance of ensuring that the app itself is anonymous and avoids

judgment, and explicitly informs users of this to encourage openness. Finally, it also highlights an important opportunity that the app itself may offer for intervening with those who are hesitant about addressing HIV risk behavior with an unfamiliar person.

3.1.3. Theme #3: app content should prioritize identifying personal risks, providing options for change

Finally, providers noted prioritizing several topics during counseling interactions to make efficient use of limited time. Providing information about a patient's specific risk level was the foundation of most counseling interactions, as well as basic education about specific types of sex that confer risk. However, providers also added that many participants are aware of this information and suggested that for these patients, counseling might instead explore why they continue risk behaviors, potential precipitating factors, or small changes in behavior that reduce harm.

"Just try to remind them about the little things, the little five second behavior change that can just make you a little safer in the things that you're doing."

However, SMEs were careful to add that counseling should always avoid being overly prescriptive or telling patients what to do. Instead, it should involve helping to guide patients individually decide what is right for them.

"I don't like telling them what to do. I like them to work with me in how they can find better ways, and then I take it from there, and then give them suggestions, and I say those are only suggestions."

"I like to design questions in a way that allows somebody to come to their own conclusion, primarily like value things. So I've directed people to their own moral values and beliefs, and have strategically asked them questions so that they can form their own conclusion on whether or not their quality of life has decreased."

These perspectives highlight the importance of ensuring users' autonomy, which is consistent with the spirit of the brief motivational interventions that inspired this app. Like these interventions, the app could frame questions and content in ways that prompt reflection and provide users with options that allow them to choose what fits them best. These perspectives also highlight the need to tailor the app's design for users with varying levels of baseline knowledge about HIV and their personal risks. Although users' personal risks might serve as the foundation of content, additional modules are needed to help those who are already aware of their risks to reflect further on their behavior and consider smaller change options that be feasible. Each of these themes, and the design insights they inspired, are presented in Table 3.

3.2. Intended user focus groups

Two posters are shown in Figs. 1 and 2 that represent many of the key characteristics that participants believed would represent a "typical" user of the Game Plan app. The first (Fig. 1), depicts a user that

Table 3
Themes identified through SME focus groups and design insights they inspired.

| Theme	Design insights
1.) Patients often test out of concern for possible exposure or as a routine practice.	• App should acknowledge these scenarios, provide affirmation • Provide content tailored for each type of patient
2.) Time and patients' reluctance to "open up" are key challenges for counseling	• App content should be as brief as possible • Should be provided after HIV test results are given • Elements of the app should help put users "at ease" • Tone should emphasize lack of judgment, confidentiality
3.) App content should prioritize identifying personal risks, providing options for change	• Devote considerable resources to assessment and feedback about personal risks • Tailor to users' level of knowledge about HIV • Provide many options for reducing risk • Allow users to choose options that are right for them
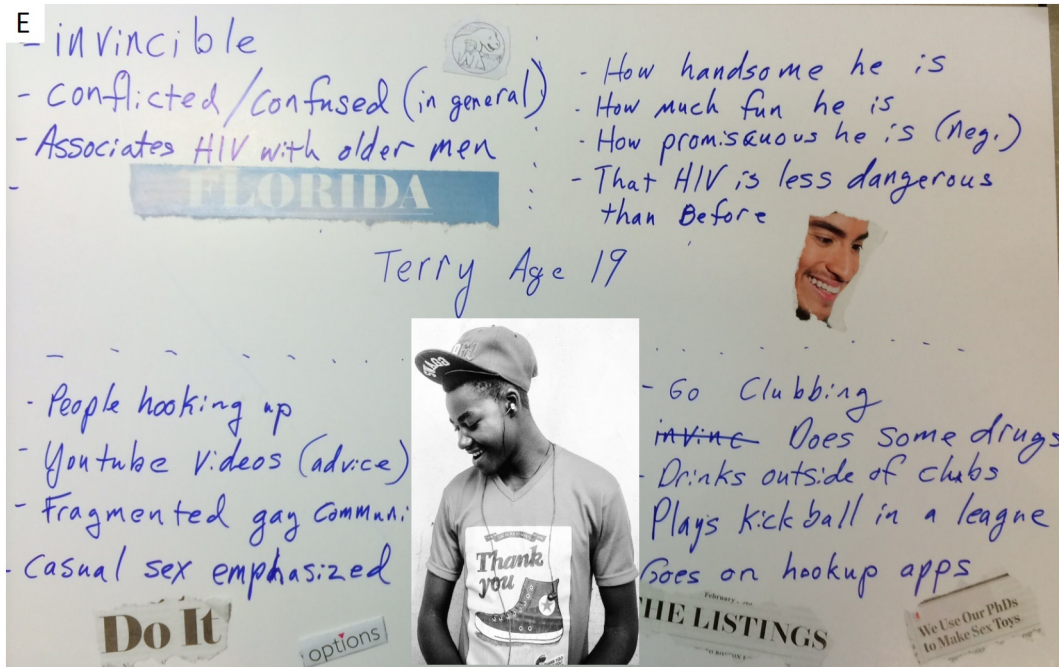
Fig. 1. Primary persona ("Terry") created by focus group participants.

participants named "Terry," a 19 year-old gay man, who is seeking HIV testing because of a possible recent exposure. Participants described Terry as generally young and healthy, and that he was enjoying the new freedoms and increased attention from other guys. As a result, they said, he may see himself as invincible. Many important things in Terry's life, participants said, glamorize casual sex, including his friends, social media, and the magazines he regularly flips through. He most often met guys using smartphone apps or when "clubbing" with friends, which often made practicing safe sex difficult. Participants mentioned that Terry may feel conflicted about his choices as he tries to understand his identity. Terry was also not particularly well-connected with the gay community where he lives, instead seeking advice and information

from popular online personalities (e.g., social media). These skew his perspective of gay relationships and idealize hookups. Through these sources, and his few young friends, Terry mostly associates HIV with older gay men, believing that HIV is less dangerous now than it was previously. Users like Terry may be less enthusiastic about making safer sexual choices because he does not believe he is at-risk, he believes his behavior aligns with what others his age do, and he values being care-free and fun.

The second (Fig. 2) depicts a user participants named "Joel," a 55 year-old single gay man who seeks testing as a part of his normal routine, regardless of risky incidents. Participants imagined that Joel is more aware of the risks posed by HIV because he is older and
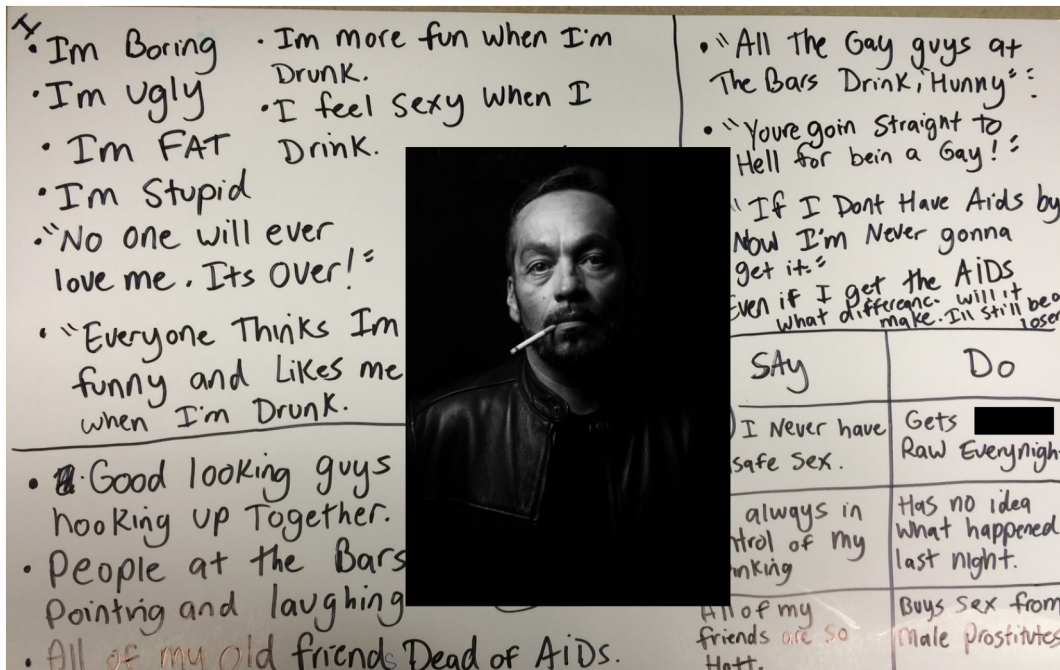

Fig. 2. Secondary persona ("Joel") created by focus group participants.

experienced the effects AIDS had on his friends first-hand. Yet, they noted that Joel may still struggle to make safe decisions because of a poor self-image that is in part due to his struggle to find love later in life, leading to negative thoughts about himself and his lack of attractiveness. Participants pictured Joel attempting to meet guys primarily in gay bars and clubs, often drinking to intoxication because he believes he is more charming (and less boring) when he has been drinking, thus encouraging him to drink more with the hope of meeting someone. They added that he often sees other attractive guys hooking up together at the bars and clubs he frequents, making him feel alone and left out. When he does meet someone, participants mentioned, Joel may make unsafe decisions because he is too intoxicated to care. However, his fatalistic beliefs about HIV may contribute to this behavior. Overall, users like Joel may be ambivalent about making safer decisions about sex because although he knows HIV poses a serious risk, he is afraid of rejection if he is assertive about his safety and believes drinking may help him find a partner.

3.2.1. Final personas

Using these depictions, we assigned end and experience goals to each persona that guided the team's branding, visual strategy, and prioritization of app tasks. These personas and goals are depicted in Fig. 3. We ultimately chose Terry as the primary persona, because in our experience, his perspective represents a common scenario for many patients who present for testing. As a result of Terry's limited knowledge about HIV, his end goals might involve learning about his personal risks for HIV based on his behavior. Since he also values what his peers do and think, comparing his behavior and risk to other gay men in his age group would likely be another important motivation for using the app. Finally, because he is ambivalent about reducing his risks, tasks that help him decide whether his personal risks outweigh the fun and excitement of meeting new partners are also priorities. An app that creates a fun and adventurous experience would likely appeal to Terry at this stage in his life. Given the value he likely places on his newfound freedoms, imparting a sense of personal control and autonomy through the app's visual elements and content would also likely be important.

Some of Joel's primary motivations for using this app overlap with Terry's, but others are unique. Given that engaging in unsafe sex may be motivated in part by the desire to find a partner and feel attractive, incorporating tasks that encourage him to reflect on whether his choices indeed help him toward these goals (or are counter-productive) would be a priority. Such a task could also help users decide whether their decisions about sex are helping them toward the lives they want, which is a motivation Terry shares. However, Joel may be interested specifically in considering ways of being safer that reduce the risk of rejection from partners. Such a task could involve presenting users with specific ideas for discussing protection with their partners or other, individually-focused ways of reducing their risk (i.e., using pre-exposure prophylaxis, a once-daily antiviral medication taken to prevent HIV, or using other harm reduction techniques, like preparing for anal sex adequately). Given that a negative self-image may also play a key role in his decisions about sex, Joel may also be motivated to use the app in order to find more intensive resources to help him address this, such as mental health counseling or alcohol/drug treatment. In terms of experience goals, Joel likely would likely value feeling validated and smart, given his self-image. An app that uses visual elements that equate safety with sexiness may also create an attractive experience for Joel.

4. Discussion

This paper describes interaction design research we conducted in order to support the planning, design, and development of a web application that is intended to help gay, bisexual, and other MSM reflect on their sexual risk behavior and alcohol use, and initiate risk-reducing changes. The goal of this research was to understand the app's intended users to assist in planning and constructing a product that helps users accomplish their goals in a desirable way. These focus groups provided valuable insights that guided our thinking about the app's overall structure and use context, as well as its aesthetic qualities. Focus group results also helped us determine which content areas demanded the bulk of design and development resources. Below, we describe how

Fig. 3. Personas of intended users and their end/experience goals.

focus group data was used to guide each of these decisions.

One of the most important benefits of conducting interaction design research is that it can provide concrete data that shapes the design team's overall vision of the product, providing global principles and constraints that the team can use to plan the software's structure, flow, and behavior. The themes that emerged from the SME focus group were particularly relevant to this goal. For example, since SMEs identified putting patients "at ease" as an important priority, we elected to design the app to be anonymous, collecting only enough information to serve appropriate information and content to users. This meant that no personal information or logins would be required, so the system was designed for single sessions. Time constraints also emphasized the need for brief content. Data entry forms, interfaces, and visual content were all designed to minimize time-intensiveness and tediousness.

Another key benefit of IxD research is that it helps the design team think deeply about the product's aesthetic qualities, so that its branding and visual elements assist in creating an engaging and effective experience for users. This aesthetic approach should align with the app's purpose and the experience goals of personas, and ultimately guide the overall brand identity and visual elements. Our personas' experience goals emphasized a desire to feel adventurous, fun, and sexy when using an app that addresses sexual decisions while also feeling validated and in control. Given this, it was important to create a fun, exciting, and sex-positive experience that helps convey a sense of autonomy and non-judgment. These qualities are consistent with personas' desire to feel reassured, "in control" and "validated," since it communicates that it is up to the user to decide what is best for their lives. They also affirm that the app is intended to help users make *safer* choices about sex, not necessarily less sex. Personas' experience goals and SMEs stressed the importance of a relaxed experience that helps put users at ease, since this could alleviate testing anxiety and assist users in reflecting on their lives and how their recent sexual decisions fit in. Given this, we designed a light-hearted and animated aesthetic. At the same time, we avoided overly racy or vivid sexual imagery, since this could distract from the product's purpose of preparing users for safer sexual decisions. Our branding strategy is reflected in Fig. 4. As shown, our approach blended hand-drawn iconography reflecting a light, relaxed, and sex-positive tone with font and color scheme that is emblematic of class and refinement. Together, these elements create an experience that is exciting and provocative, yet can also impart a sense of composure and elegance.

Our research also suggested that several tasks should be prioritized. The end goals of our primary persona (Terry) suggest that the app should provide personal information about the user's HIV risk level given their recent behavior, and allow comparisons to an important peer group (in our case, other gay and bisexual men in the user's age group). This is consistent with many similar BITs, which provide feedback about users' behavior and compare it with a valued social group (Lustria et al., 2009; Miller et al., 2013; Walters and Neighbors, 2005). Although these existing BITs provide an appropriate model for many behaviors (including alcohol use), extending these tasks to HIV risk behavior is challenging given research suggesting that personal feedback about users' HIV risk should avoid provoking excessive fear (Earl and Albarracín, 2007). As such, determining how to present this information efficiently and persuasively was important.

Intended users imagined that both personas would have some ambivalence about changing, so the end goals of both reflected a desire to use the app to help decide whether recent sexual choices are consistent with broader life goals. Many face-to-face health behavior interventions incorporate similar tasks (Bien et al., 1993), most of which were inspired by early writings on motivational interviewing (Miller and Rollnick, 1991). For example, these tasks involve helping participants resolve ambivalence by encouraging reflections about values or life goals and asking whether current behavior is consistent with them. This can encourage introspection about recent behavior, helping participants decide whether or not changing is important (Miller et al., 2001;

Miller and Rollnick, 2012). While some BITs have adopted at least one of these tasks [i.e., a "decisional balance" or "pros and cons" exercise; 28, 33], few other examples exist. As such, the importance of this end goal to both of our personas stressed the importance of developing similar activities that help users resolve ambivalence.

The end goals of our secondary persona (Joel) emphasized the need to consider specific, achievable ways of changing to reduce risk and minimize the risk of rejection. This highlighted the need for a change planning section that presented users with many options, including harm reduction options. Providing several possible change options is consistent with "best practices" identified in past research on HIV prevention interventions (Coates et al., 2008). It is also consistent with both personas' experience goals, as providing several risk reduction options is consistent with goals of feeling "in control" and "validated." Given broader app goals, designing this task necessitated careful consideration of how to present options in ways that encouraged users to first consider those that reduce risk the most (i.e., condom use with all partners, taking pre-exposure prophylaxis), before progressing to options that may only reduce risk slightly (e.g., only "topping" with partners unprotected, instead of "bottoming"). Since most existing BITs have not incorporated substantive change planning components (Lustria et al., 2009; Miller et al., 2013), considerable effort was needed to arrive at a balance of these needs.

Finally, SME interviews also provided insights into the psychological and emotional context of intended users, which informed design priorities. Specifically, they noted that many users may be generally apprehensive about disclosing their behavior for fear of being judged, told what to do, or that their discussions may not be confidential. Given this, we prioritized designing an "onboarding" (introductory sequence) that explicitly informs users that the app is neither intended to judge nor tell users what to do, while also highlighting that no identifiable information is collected. SMEs also noted that many patients may feel nervous after testing, because like Terry, they may be motivated to seek testing because of possible exposure to HIV. SMEs added that this emotional context could prevent some patients from either fully disclosing behavior or being able to reflect on it meaningfully. However, like Joel, not all patients experience nervousness when testing because doing so may be routine, regardless of potential exposure. Given these considerations, we designed an initial task intended to assess thoughts and feelings about having tested and provide a tailored message that either provides re-assurance or reinforcement. For those who report feeling nervous, a tailored response might acknowledge these feelings and note that the app could help them identify ways to avoid similar feelings in the future. In this way, the task could help recognize the context of testing, use this to transition users to reflecting on their HIV risk behavior, and relieve some nervousness.

4.1. Limitations

While we illustrate how methods commonly used in industry can help academic research teams plan and build more attractive software for users, several limitations are important to note. First, the methods we describe are unique to UCD approaches to interaction design. Many alternative approaches to IxD have been described, including self-design, genius design, and activity-focused design (Kaptelinin et al., 1995). Although reviewing these approaches is beyond the scope of this manuscript, what distinguishes each of these approaches from UCD is that each relies on the designers' intuitions, logic, and experience as opposed to understanding users' perspectives, meaning that they rarely involve conducting user research. Given this, the main advantage of these alternatives is that they often take less time than UCD, but they also could risk making design decisions that are unsuitable for users. Second, UCD research methods are themselves flexible, and our approach differed in some ways from those suggested by key leaders in the area. Namely, many argue that IxD researchers should adopt an ethnographic approach to interviews, meeting with current or intended

Fig. 4. Branding strategy for Game Plan.

users in environments in which they might use the product (Goodwin, 2011; Cooper et al., 2007) to gain more insights from their environments. They also suggest conducting one-on-one interviews with users, since important individual perspectives can be lost in group interviews. Although we agree these steps might be valuable, budget and time constraints prevented our team from conducting all interviews one-on-one in settings where HIV testing is conducted. Finally, since this research was intended to support a specific product that focused on specific behaviors (i.e., HIV risk, alcohol use) in a specific population (i.e., MSM), findings about our users' perspectives are likely not generalizable to other products that address different behaviors and populations. Our goal was to describe these methods to serve as one model that other researchers might use to help understand their unique users.

4.2. Conclusions

This project demonstrates how researchers can use interaction design methods to help center the process of planning and building a BIT around its intended users by providing a rich, personal model of their motivations, goals, and contexts that help guide design decisions. Using these personas, designers can consider ways of addressing the key usage aims of BITs and ultimately build a product that engages users and keeps their interest.

Declarations

Ethics approval and consent to participate

All procedures were reviewed and approved by the Brown University IRB. All participants provided informed consent prior to participating.

Consent for publication

Not applicable.

Availability of data and materials

Transcripts analyzed for the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Alcoholism (NIAAA). However, NIAAA played no role in the design of the study, or the collection, analysis, or interpretation of the data.

Authors' contributions

TW conceptualized this study, and led data collection, analysis, interpretation, and preparation of the manuscript. CK and DO assisted in study conceptualization, data collection, analysis, and interpretation, and assisted in manuscript preparation and revision. ES assisted in data collection, analysis, and interpretation.

CRediT authorship contribution statement

Tyler B. Wray: Conceptualization, Data curation, Formal analysis, Project administration, Writing - original draft. **Christopher W. Kahler:** Conceptualization, Data curation, Formal analysis, Writing - review & editing. **Erik M. Simpanen:** Data curation, Formal analysis, Project administration. **Don Operario:** Conceptualization, Data curation, Formal analysis, Writing - review & editing.

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Authors' information

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