Mobile Health Intervention Development Principles: Lessons from an Adolescent Cyberbullying Intervention

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Abstract

Mobile health interventions are becoming increasingly popular, yet challenges in developing effective, user-friendly, evidence-based technology-augmented interventions persist. In this paper, we describe the process of developing an acceptable, evidence-based text messaging program for adolescents experiencing cyberbullying in hopes of addressing some of the challenges encountered by many researchers and developers in this area of intervention development. Participants were 23 adolescents with past-year histories of cyber-victimization and online conflict who enrolled in an hour long qualitative interview. Participants were asked to draw from personal experience to provide feedback on intervention content and design. Results focus on the main principles of intervention development for adolescents involved in cyberbullying: listening for the why in interviews, storyboarding to model abstract concepts, and strategies to develop acceptable theory and tone. Design process and final product design are described. The paper closes with final thoughts on the design process of mobile intervention development.

1. Introduction

Healthcare-focused mobile and social media interventions have been promising. [1] The delivery of interventions directly to personal mobile devices, occurring at the place and time which they may be most effective, has appeal to patients and healthcare practitioners alike. Applying design principles to develop these interventions in practice, however, is difficult and rarely completed effectively [2]. This difficulty is due to the need for expertise in not only healthcare-specific topics, intervention development theory, and population-specific characteristics, but also design and development of technology for effective intervention delivery. In this paper, we describe the process of using best practices for development of a novel, two-part, mobile health intervention for adolescents who are victims of cyberbullying. In the process, we elucidate three common principles for the early stages of mobile health intervention development.

1.1. Related work: principles of mobile health intervention design

Ideally, design of a mobile health intervention combines expert opinion, behavioral theory, and iterative qualitative refinement of intervention structure and content [3]. Merging traditional intervention design principles (e.g., use of a theoretical model) with human computer interaction analysis (e.g. real-time observation of end-users) can, however, be challenging. Additionally, some mobile interventions – such as those delivered through text-messaging - require sensitivity to the constraints of that platform. These challenges stretch the skillset and typical design strategies of both interventionists and computer scientists.

For instance, technology-based behavioral interventions require attention to specific algorithms and workflow at an earlier phase than is typical for many behavioral interventionists. During the pilot phase, developers must pay attention not just to the intervention content, but also to the format and algorithms that govern intervention delivery. Answering the question of "how" to deliver a technology-based intervention, at this early stage, is critical for maintaining forward momentum and

minimizing costs [4]. Yet, interventionists often find it challenging to articulate the "right" structure for an intervention before fully articulating their content.

Similarly, both technologists and interventionists can be challenged by the need to evaluate not just participants' interpretation and comprehension of intervention content [5], but also participants' ability to interact with and comprehend this content in the medium in which it is being delivered [6]. Ideally, the design of a technology-based intervention uses a "person-based approach," in which *"intervention designers…build a deep understanding of the psychosocial context of users and their view of the behavioral elements of the intervention."* [7] Identifying what is "liked" in the moment, versus what they *think* they would like (design features), versus what would *actually* induce change and/or adhere to theory, however, is difficult in practice [8, 9].

Most existing mobile and social media health interventions focus on changing so-called behavioral risk factors, such as smoking, drinking, obesity, and medication adherence [10]. Many of these interventions rely on theoretical underpinnings such as the Transtheoretical Model of Behavior Change [11], in which the goal is to move a patient to the ability to take action, and then maintain their self-efficacy. An extensive literature supports the positive impact of interventions based upon theoretical models [2, 10, 12]. Increasingly, though, researchers and healthcare practitioners are exploring the use of mobile and social media technologies to change health risks such as mental illness and violence victimization [13-19]. The application of theoretical bases for changing these types of risks (such as Social Cognitive Learning Theory) are less well-described.

Finally, the process of true iterative design – also known as "agile" design methods – is often uncomfortable and unfamiliar to researchers [20-22] [CITES]. We and others have previously written about the importance of including the patient in digital health design [23], and about the findings from such complex, iterative design work [10, 24-26]. The literature lacks, however, a discussion of how to apply these concepts in practice.

1.2. The use case: a cyberbullying text message intervention

Cyberbullying victimization is estimated to affect 20%-70% of adolescents, with recent studies reporting higher rates of victimization [27-35]. Cyberbullying is associated with multiple negative outcomes, ranging from depression to suicidal ideation to substance use [36-43]. A few universal, school-based preventive interventions, that focus on cyberbullying as part of a larger violence prevention aim, have shown a signal of efficacy [44]. These modules are, however, expensive to roll out; compete with multiple other school-based initiatives; and may not help those who have already been victimized. Automated, text message-based psychosocial preventive interventions are effective in reducing violence and bullying in general [13, 24, 25, 45]. In the larger project which serves as the use case for this manuscript, our aims were to iteratively develop and then pilot an automated technology-augmented preventive intervention for adolescents reporting prior cyberbullying victimization.

1.3. Underlying theory

The underlying theory for this intervention is Social Cognitive Learning Theory (SCLT) [46, 47], which posits that behavior is determined by interactions between individual factors (e.g. core beliefs, pre-existing coping skills, personal aggressiveness) and environmental factors (e.g., prior cyberbullying exposure, peer normative behavior). This theory also serves as the basis for Cognitive Behavioral therapy, in which changing one's maladaptive behaviors and thoughts can impact one's feelings. By encouraging teens to engage in and model adaptive cognitive re-evaluation, emotional regulation skills, and pro-social behavior patterns (including healthy online habits), teens can shift their experience of their environment.
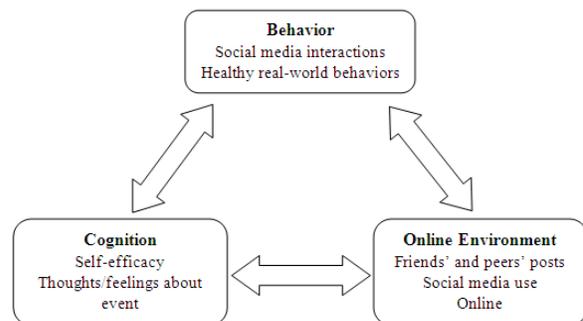

Figure 1: SCLT concept of how adolescents' behavior, online environment and cognition interact

As described above, the goal was to adapt this theory into an enjoyable and effective text-message intervention created with teens for teens. In this manuscript, we describe how we utilized adolescents' feedback to enhance this theory-based technology intervention to help them with their problems.

2. Methods

2.1. Recruitment

We recruited participants from the pediatric clinic of an urban teaching hospital in New England. Inclusion criteria included: being between the ages of 13-17, English speaking, and with a parent who could consent based upon one's medical record; additionally, participants had to self-report cyberbullying victimization on an electronically-administered, previously validated Cyberbullying Scale [48]. Youth verbal assent and caregiver written consent were obtained for eligible youth. Participants were compensated with a $25 gift card after completing the interview.

2.2. Interviews

Prior to initiating the study, the research assistant (RA) responsible for data collection completed a multi-day training in qualitative interviewing techniques, including cognitive interviewing, and completed multiple mock interviews with study co-investigators (all of whom have extensive prior experience in both digital health intervention design and preventive interventions). Ongoing reviews of qualitative interviewing skills were conducted throughout the six-month interview period.

The interviews were conducted at a private location of the participant's choice. To elucidate both the applications of theory and the ideal structure for their intervention, throughout the interview process, participants were asked open ended questions about their cell phone and social media use broadly, their experience with online "drama" and cyberbullying, and their usual strategies for coping with cyberbullying and online drama (or their peers' strategies). Participants were also presented with mockups of intervention content, including story boards of the in-clinic intervention, a sample of representative text messages, and preference testing in an A vs. B format. All interviews were audio-recorded, transcribed verbatim and checked for accuracy prior to coding. A written debrief of each interview was also completed by the RA and reviewed by the team members.

2.3. Analysis

Our analysis used both thematic (deductive) and data driven (inductive) codes. Deductive codes were drawn from the topics in questions used to facilitate the interviews; inductive codes captured additional concepts that emerged from the participants. Early interviews were coded by three team members, until stability of the coding structure was reached. All interviews thereafter were independently coded by two research team members using the coding scheme, then compared in person to ensure agreement. Agreed upon codes were entered into NVivo [49]. Throughout the process, a framework matrix was created. This data reduction tool, a matrix of cases and themes based on interview debriefs and individual interview codes, was used to track emergent ideas and concepts that would affect intervention design and future interviews [50-52]. After every few interviews, research team members would examine our framework matrix, identify reoccurring major themes voiced by participants, make changes to intervention content as appropriate, then test the edits in subsequent interviews. This method allowed for quick, iterative turnaround of participant feedback to intervention edits, and nearly-real-time modifications of interview questions.

When all interviews were completed and the team determined that thematic saturation was reached, members of the research team wrote summaries of the data in each topic code. The project team discussed these summaries to develop the themes presented in this manuscript.

3. Results

Of 142 adolescents who were screened, 48 (33.8%) were eligible for the interview, 36 assented, and 23 completed interviews. (NB: This rate of completion is similar to that of other qualitative studies conducted with adolescents.) Participant mean age was 14.8 years (SD = 1.03), with 65.2% female, 47.8% Hispanic, 73.9% low SES, and 35% Black or African American. The average cyberbullying score[48] was 7.36 (SD = 5.51; range: 2-20). See Table 1 for a complete profile of participant demographics.

Table 1. Participant Characteristics

Participant	Gender	Age	Cyberbullying score[48]
1	Male	16	2
2	Female	15	12
3	Female	14	1
4	Female	15	11
5	Female	15	2
6	Female	16	2
7	Male	15	3
8	Male	14	4
9	Female	16	11
10	Female	15	14
11	Female	16	4
12	Male	14	11

13	Female	16	13
14	Male	14	2
15	Male	13	20
16	Female	13	5
17	Female	15	5
18	Female	13	10
19	Female	15	3
20	Male	14	17
21	Female	16	10
22	Female	15	2
23	Male	16	12

3.1. Design process

Our first intervention prototype was developed based on expert consultation, review of prior text-message interventions for physical violence and bullying, and existing bullying and cyberbullying prevention resources [53-55]. Based on this review, we included 1) an in-person training session, which introduced basic concept of cognitive and behavioral regulation as well as basic bullying-prevention skills; 2) a daily text-message assessment of teens' social media experiences; 3) a daily, fully automated text-message curriculum communicating both cognitive behavioral skills for coping with bullying victimization as well as tactics to reduce the likelihood of violence victimization in the future.
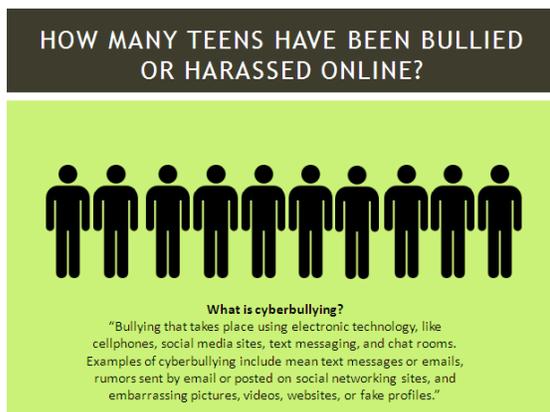
Figure 2: An example of the early version of the in-clinic session.
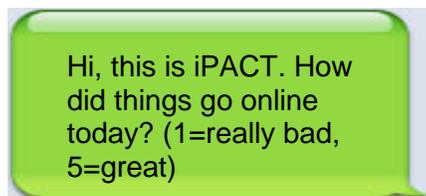

Figure 3: An example of the early text messages.

To refine this initial model, early interviews (n~10) used classic semi-structured interview techniques. They focused on describing cyberbullying experiences, elucidating adolescent-centric prevention and coping techniques, and exploring the applicability of violence and bullying prevention theories to cyberbullying. They primarily focused on the "big picture": how adolescents conceived of, and responded to, cyberbullying victimization. As such, these interviews mostly relied on open ended questions/prompts (e.g. "tell me about a time…" "how did that make you feel?"…. "what would you tell a friend"….), rather than on obtaining user feedback on specific layouts and content.

During these interviews, we continuously updated our framework matrix, as described in methods above, identifying initial themes regarding content and structure of the intervention. We iteratively refined the intervention algorithm and example content; changed the design of both the in-person on-boarding and the daily assessments; and compiled new intervention material to reflect identified themes.

Figure 4: Example of early framework analysis

Once we reached saturation regarding cyberbullying experiences and coping strategies, later interviews (n~13 utilized fewer open-ended questions. We instead spent more interview time using cognitive interviewing strategies [56], in which we asked

participants to think aloud with the RA about their reactions to intervention materials. These interviews focused on the "why/how" of potential intervention components – how adolescents interpreted, understood, and would use the proposed content. As such, these interviews focused more on direct interview questions and prompts (e.g. "do you like the way this is worded? Why or why not? In your own words, tell us what this text means.").

After 23 interviews, the research team concluded that we had reached saturation regarding both content and structure. We formally analyzed data at this point, identifying specific language and tone for the interviews, further tweaking the structure, and further refining specific content.

3.2. Principles regarding development of a technology-based cyberbullying intervention

During the process of interviewing and intervention refinement, we identified several principles related to the process of iterative development of technology-based interventions. While these principles were developed during a specific intervention development effort, the co-investigators (who have completed over a dozen digital health intervention development studies), believe that these principles can be applied to other topics, populations, and technology formats.

3.2.1. Principle 1: Listen for the "why": handling negative and contradictory views about intervention format. A common refrain in manuscripts describing development of mobile health interventions is that participants "don't agree" on what they want or need [8, 24]. We observed a similar issue in our interviews. Participants expressed varied, and often contradictory, views on a variety of issues, ranging from the structural (e.g., how often and when to text; which media would be most appropriate) to the content (e.g., which words to use to refer to cyberbullying, whether to use emojis and abbreviations).

In many cases, apparent contradictions were resolved by identifying the "least common denominator" – the outlier, the lowest reading level participant, or the one who was likely to take offence with a specific phrase. The classical qualitative research teaching of paying attention to – and seeking out - the outlier becomes more complicated, however, in mobile health development. For instance, one teen told us that although he personally liked shorthand in text messages, "*sometimes, like, you might get that one teenager who doesn't understand the lingo, like online lingo*" (ID 12); another teen said, "*I think it should be,*

like, formal but not too, like—not too informal but kind of informal but still formal" (ID 22). In this case, we wanted to alienate neither teens who *wanted* "online lingo," nor those who did not understand it. We therefore probed further with other teens, and confirmed that many found certain terms "confusing" or "outdated" or "trying too hard". The initial contradictory statements therefore led us to an important principle of avoiding slang and abbreviations, preferring simple and commonly-used words. We had similar findings on other key structural questions.

In other cases, use of cognitive interview-style probes could resolve a contradiction during a single interview. We found this technique to be particularly useful when a participant's suggestion contradicted majority opinion, their own prior statements, or existing literature. For instance, one participant told us: "*I think you should have 'choose' and 'handle' in all caps*" (ID 22). The interviewer astutely recognized that this statement contradicted most of the prior interviews, in which participants told us that using CAPITAL LETTERS in texts felt like the intervention was "yelling" at them. The interviewer probed for reasoning, and the participant explained: "'*Cause it would—it would be, like, that's basically the main key of the—the text message.*" Based on this feedback, we put the "key point" at the beginning of a text message; and judiciously used capitalization when emphasizing a main point or introducing a concept for the first time. These changes were, on iterative interviewing, acceptable and comprehensible to participants.

Some contradictions could only be resolved based on reverting to external evidence. For instance, teens disagreed about *how* they would want to receive supplemental information: some said they would read a written story sent to them, while others said they would prefer stories in the form of a video. Some participants said they might not click on links unless they were really engaging. To improve "click-throughs," we borrowed basic concepts from the advertising industry concept of "clickbait" (e.g., "5 amazing things!" "Click here for more!"). Interviewees articulated that it would encourage them to use the supplementary information.

Finally, seeming contradictions sometimes could be resolved through tailoring. For instance, in our study as in others' [20, 24, 25], there was no consensus about the best time of day or number of messages to send. We resolved this conflict by letting participants choose their optimal time of day, and by giving teens the option to request additional content as-needed. Similarly, participants highlighted that some content would only be useful to them on a day when they had experienced online conflict. We therefore refined our

daily text-message assessments to ask about both daily mood and daily experiences with cyberbullying.

3.2.2. Principle 2: Storyboarding makes abstract concepts approachable.
Many participants had difficulty articulating not only their reasoning, but also whether or why they even liked an intervention element. This challenge was commonly encountered when discussing abstract or unusual intervention elements. Although this challenge is not unique to mobile health interventions, the impossibility of presenting a "finished product" during mobile health intervention development makes the challenge more acute.

To solve this problem, we "storyboarded" as much of the intervention as possible, presenting teens with a mock-up of content that they could touch, write on, and change. This practice is very common in the technology-development world.

We also found that there was a "sweet spot" in presenting the storyboard to participants. If we presented the storyboard too early, it stymied participants' imagination and willingness to share experiences and ideas; it thereby limited our ability to innovate in intervention content and structure. If we presented the storyboard too late in the interview, the participants stopped talking and began to "check out" of the interview. When presented at the right time – when participants' ideas had slowed down, but not stopped – the storyboard could spur a new round of ideas and conversation. For instance, one participant had been extremely loquacious, and then became stuck after being asked about what links they would find interesting in the texting program *"I never really thought about this, so hmm…. 'Cause like, I don't know. I'm really bad at comin' up with ideas"* (ID 13). The interviewer appropriately identified this as the right moment to show the participant the mock intervention: *"RA: No, that's okay. You had some great ideas so far. I'll just give you some that we thought of and get your feedback on them."* The participant then talked for another 4 minutes about her opinions of links we could send, and longer about other aspects of the intervention (e.g. possibilities of a weekly check-in).

For some teens, even the storyboard was limiting. For instance, one participant kept repeating *"Oh, well, probably to like, um—to, uh—I don't know. [Laughter] I'm bad with this"* (ID 2). Neither participant age nor prior tech experience correlated with this lack of confidence. In these cases, asking participants' thoughts about how their friends would react often induced more clarity. Having a few example messages as well as text preference options, with only one element of the message different between two messages (e.g., "showing alternative designs" [57]), also helped with more concrete participants. We would ask them to compare option A and option B, and tell us which they liked or didn't like about each option; this strategy would often lead to more discussion.

Participants' ambivalence about certain intervention elements, and inability to tell us what a message meant was – in itself – often illuminating. For example, we initially incorporated quantitative information in the intervention; for instance, we included messages saying that ~30% of adolescents in our state have experienced cyberbullying. We quickly found that teens either didn't understand or didn't believe these statistics; consequently, we removed or rephrased them.

Participants' written comments on the storyboard, notes taken during the interview by the RA, and written debriefs completed immediately after interview completion were critically important for analyzing the storyboarded portions of the interviews. Transcribed interview content alone would miss much of the content, as in this participant comment on a portion of the onboarding: [talking about a slide on the PowerPoint] *"Then here if you're gonna do it in words, at least show an example with it"* (ID 6) Only by referring to the interview debrief and written storyboard notes could we understand that the participant was talking about showing an example of cyberbullying on the PowerPoint slide.

3.2.3. Principle 3: "We wanna stay the way we are" – getting the tone and theory right.
Unlike traditional digital marketing, the goal of a technology-augmented behavioral intervention is to induce healthy behaviors. As with all marketing endeavors, however, the tone is critical. The mere mention of healthy behaviors can be interpreted as preachy, or a reason to tune out the intervention [26]. This conundrum was particularly pertinent for our intervention, in which we were trying to encourage healthy social media habits and use patterns. Teens repeatedly told us that hearing about healthy social media strategies would make people not listen: *"We think that adults are just gonna change our decisions— and we're really scared of that 'cause we wanna stay the way we are"* (ID 8). On the other hand, when we tried to communicate facts instead of recommendations, we were told that *"you guys sound like teachers"* (ID 5).

To develop a more appropriate tone, returning to the theoretical basis of the intervention can be helpful. In our case, SCLT posits that environment and norms greatly influence behavior. Early in the interviews, a teen commented *"Like Facebook is just like monkey see, monkey do. Once one person does something, like the whole Facebook does it"* (ID 13). Based on theory

and these comments, we started presenting content using adaptations of teens' own words. As interviews progressed, we also used new stories and new terms in our exemplar content. For example, one teen suggested that instead of saying "Selfie smart: be careful about selfies," we should tell teens that *"you're on social media to show yourself to other people, but…. Be careful what you put out there"* (ID 11). This new language ("Be careful what you put out there") proved more acceptable to other teens. Similarly, adolescents wanted messages to make them feel like they were part of a group: "*[Sighs]. I wouldn't say how it would make YOU feel. I would say how it would make the other person feel. [*underlines "you" and writes "others" underneath it].*"

Even when we didn't use teens' exact language, we explicitly portrayed messages as coming *from* teens. For example, we incorporated paraphrased peer stories, and added links to webpages with "suggestions from other teens." This subtle change in presentation proved more acceptable to later interview participants, and reduced teens' perception of the intervention as sounding like a parent or teacher. Similarly, including inspirational quotes from other teens was widely viewed as increasing acceptability and normative relevance.

Teens were, by and large, very supportive of using technology to teach strategies and coping skills: "*so like you guys are like doin' your research, but as you guys are researching, you're helping the other person like express theirself [sic] kinda' sorta' at the same time"* (ID 9). Consistent with prior work [24], they also felt that the anonymity of texting would permit them to accept advice that they wouldn't welcome in "real" life. Consistent with SCLT theory, however, they also worried about whether they'd be able to adequately "relate" to the "computer" that was sending the texts: "*"If it's something like these three things happened, you know, then you would want something to feel empathy, but how will you make a machine feel empathy, right?"* (ID 2). They felt that the need for human support would be particularly acute in certain situations: Whereas in most situations "*you would feel more attached to it if it's a video, like—like more than a text cuz it's—it's actually them saying it to you, not just text"* (ID 12), in some situations, "*if I'm angry, I'm not gonna want to watch a video. I'm gonna want to talk to somebody"* (ID 11).

3.3. Final Product
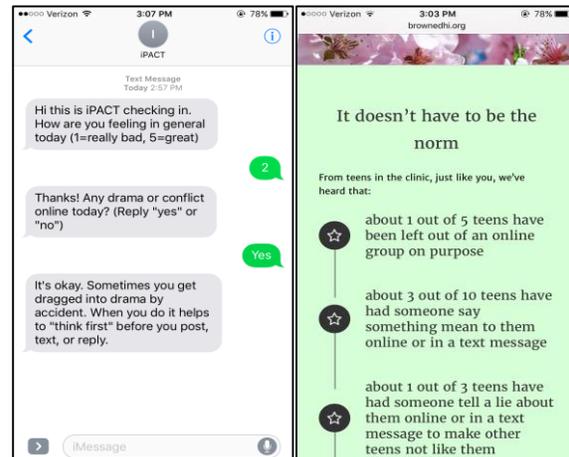
Figure 5: Examples of the final product from this stage of development.

By applying these three major principles, by the close of this project, we developed a technology-based cyberbullying victimization intervention that uses behavioral theory in a presentation and context acceptable to adolescents. It consisted of a brief in-person intervention focusing on self-efficacy; two daily assessment questions; daily tailored text-messages to reset norms, change actions, and improve self-efficacy and coping skills; and additional on-demand content, including web pages and videos. Our next step is to pilot the program in a series of non-controlled trials, and then to test the program in a randomized control trial (RCT) against enhanced usual care (EUC).

4. Discussion

In this first development phase for an interactive, two-part, automated cyberbullying victimization intervention, we used an iterative development design process that solicited constant feedback from youth. In so doing, three key principles emerged: These principles highlight the importance of relying not just on theoretical "personas", but also real-life interviews of potential participants.

First, it is critically important – and entirely feasible – to handle the contradictory and negative views articulated during intervention development [8]. We found that participants *do* know what they want, but their contradictory opinions need to be contextualized through thoughtful interviewing, attention to outliers, use of theory, and appropriate tailoring. These opinions would not have been identified – nor would solutions have been found – without rigorous, iterative interviews.

Second, even the most concrete or non-talkative interviewee can provide valuable information for study development [58]. Sometimes, the difficulty can be due

to problems with comprehension, highlighting parts of the intervention which need to be refined. Other times, thoughtful storyboarding and judicious A/B testing can get a recalcitrant participant to offer useful information.

Third, it is critically important to consider not just theory, but also the participants' voices, in as many ways as possible. We also need to be explicit about our use of "their" words, so that it doesn't sound like interventionists are trying to appropriate participants' experience. This can also include presenting content in a variety of formats: the power of technology is that different people, who access content differently, can each have a home in an intervention. When all else fails, an underlying theoretical basis can inform these crucial design and content decisions. In multiple situations during our interviews, we returned to theory to enhance our understanding of participants' statements. We urge other designers to do the same.

Finally, although not a specific principle for design, we highlight the value of interviews for improving tailoring of mobile health interventions. In-person interventions are inherently tailored; indeed, learning skills such as therapeutic alliance and mirroring are essential parts of psychiatric training. Technology developers, however, are more challenged when developing tailoring mechanisms: they often lack ongoing data about a participant, lack ability (or funds, or time) to create adequately complex tailoring algorithms, and lack a library of appropriate content for various types of individuals. Other literature has highlighted that key design features include social context and support, regular contact with the intervention, tailoring, and enhancement of self-management skills [59]. As illustrated by our data, qualitative development work can enhance efforts to create such trustworthy and usable tailoring assessments. As computer scientists and behavioral interventionists collaborate, we must both accept the uncertainty inherent to the design process, and communicate explicitly about the trajectory of iterative development.

4.1. Limitations

This study is subject to a few limitations. First, the participants were largely low socioeconomic status and minority; the study was also conducted at a single site. The specific results may, therefore, not be generalizable. Additionally, the usability and acceptability of the intervention content should be quantitatively as well as qualitatively tested.

5. Conclusion

In this paper, we have demonstrated the application of best principles of mobile and social media health intervention development to a sensitive topic – cyberbullying prevention. We iterate on the experimental design through a participatory piloting process with 23 participants of the target population of adolescents. With this method, we learned how to deal with contradictory participant opinions in the experimental design, eliciting information from participants in situations where they had difficulty articulating the points, and using empathetic language to convey the same message in a more compelling way. By listening to our participants, we developed an intervention that is engaging, feels relevant, and allows us to introduce new concepts and ideas without alienating the participant. The lessons we learned could be relevant to researchers developing intervention-based studies about sensitive topics, especially for challenging populations like adolescents. Finally, we believe our approach of involving participants in the iterative experimental design process serves as a successful example model for designing mobile intervention studies.

6. References

[1] Klasnja, P. and W. Pratt, *Healthcare in the pocket: mapping the space of mobile-phone health interventions.* J Biomed Inform, 2012. **45**(1): p. 184-98.

[2] Schueller, S.M., R.F. Muñoz, and D.C. Mohr, *Realizing the Potential of Behavioral Intervention Technologies.* Current Directions in Psychological Science, 2013. **22**(6): p. 478-483.

[3] Bock, B.C., et al., *Translating Behavioral Interventions Onto mHealth Platforms: Developing Text Message Interventions for Smoking and Alcohol.* JMIR Mhealth Uhealth, 2015. **3**(1): p. e22.

[4] Mohr, D.C., et al., *The behavioral intervention technology model: an integrated conceptual and technological framework for eHealth and mHealth interventions.* J Med Internet Res, 2014. **16**(6): p. e146.

[5] Broderick, J., et al., *Designing Health Literate Apps.* 2014, Institute of Medicine.

[6] Jones, D.J., *Future directions in the design, development, and investigation of technology as a service delivery vehicle.* J Clin Child Adolesc Psychol, 2014. **43**(1): p. 128-42.

[7] Yardley, L., et al., *The person-based approach to intervention development: application to digital health-related behavior change interventions.* J Med Internet Res, 2015. **17**(1): p. e30.

[8] Waterlander, W., et al., *Development of an Evidence-Based mHealth Weight Management Program Using a Formative Research Process.* JMIR Mhealth Uhealth, 2014. **2**(3): p. e18.

[9] Whittaker, R., et al., *A multimedia mobile phone-based youth smoking cessation intervention: Findings from content development and piloting studies.* J Med Internet Res, 2008. **10**(5): p. e49.

[10] Armanasco, A.A., et al., *Preventive Health Behavior Change Text Message Interventions: A Meta-analysis.* Am J Prev Med, 2017.

[11] Prochaska, J.O. and C.C. DiClemente, *The transtheoretical approach*, in *Handbook of psychotherapy integration*, J.C. Norcross and M.R. Goldfried, Editors. 2005, Oxford University Press: New York. p. 147–171.

[12] Head, K.J., et al., *Efficacy of text messaging-based interventions for health promotion: A meta-analysis.* Social Science & Medicine, 2013. **97**(0): p. 41-48.

[13] Ranney, M.L., et al., *A Depression Prevention Intervention for Adolescents in the Emergency Department.* J Adolesc Health, 2016. **59**(4).

[14] Thorsen, M.M., et al., *Using High-Risk Adolescents' Voices to Develop a Comprehensible Cognitive Behavioral Therapy-Based Text-Message Program.* Behav Med, 2016: p. 1-11.

[15] Rizvi, S.L., et al., *A pilot study of the DBT coach: an interactive mobile phone application for individuals with borderline personality disorder and substance use disorder.* Behav Ther, 2011. **42**(4): p. 589-600.

[16] Van Voorhees, B.W., et al., *Randomized clinical trial of an Internet-based depression prevention program for adolescents (Project CATCH-IT) in primary care: 12-week outcomes.* J Dev Behav Pediatr, 2009. **30**(1): p. 23-37.

[17] Kauer, S.D., et al., *Self-monitoring using mobile phones in the early stages of adolescent depression: randomized controlled trial.* J Med Internet Res, 2012. **14**(3): p. e67.

[18] Joyce, D. and S. Weibelzahl. *Text messaging as a means of lowering barriers to help-seeking in students with depression.* in *Proceedings of IADIS International Conference e-Society*. 2006. Dublin, Ireland: IADIS.

[19] Clarke, J., et al., *Therapeutic Alliance With a Fully Automated Mobile Phone and Web-Based Intervention: Secondary Analysis of a Randomized Controlled Trial.* JMIR Ment Health, 2016. **3**(1): p. e10.

[20] Rosen, R.K., M. Ranney, and E.W. Boyer, *Formative research for mhealth HIV adherence: the iHAART app*, in *Proceedings of the 48th Annual Hawaii International Conference on System Sciences*. 2015, IEEE & Computer Society Press. p. 2779-2785.

[21] Hekler, E.B., et al., *Agile science: creating useful products for behavior change in the real world.* Transl Behav Med, 2016. **6**(2): p. 317-28.

[22] Patrick, K., et al., *The Pace of Technologic Change: Implications for Digital Health Behavior Intervention Research.* Am J Prev Med, 2016. **51**(5): p. 816-824.

[23] Birnbaum, F., et al., *Patient engagement and the design of digital health.* Acad Emerg Med, 2015. **22**(6): p. 754-6.

[24] Ranney, M.L., et al., *'You need to get them where they feel it': Conflicting Perspectives on How to Maximize the Structure of Text-Message Psychological Interventions for Adolescents.*, in *Proceedings of the 48th Annual Hawaii International Conference on System Sciences*. 2015, IEEE & Computer Society Press. p. 3247-3255.

[25] Ranney, M.L., et al., *Acceptability, language, and structure of text message-based behavioral interventions for high-risk adolescent females: a qualitative study.* J Adolesc Health, 2014. **55**(1): p. 33-40.

[26] Muench, F., et al., *Understanding messaging preferences to inform development of mobile goal-directed behavioral interventions.* J Med Internet Res, 2014. **16**(2): p. e14.

[27] Aboujaoude, E., et al., *Cyberbullying: Review of an Old Problem Gone Viral.* Journal of Adolescent Health 2015. **57**(1): p. 10-8.

[28] Ybarra, M.L. and K.J. Mitchell, *Online aggressor/targets, aggressors, and targets: A comparison of associated youth characteristics.* J Child Psychol Psychiatry, 2004. **45**(7): p. 1308-1316.

[29] Ybarra, M.L., et al., *Examining characteristics and associated distress related to internet harassment: Findings from the second Youth Internet Safety Survey.* Pediatrics, 2006. **118**(4): p. e1169-1177.

[30] Mishna, F., et al., *Cyber bullying behaviors among middle and high school students.* Am J Orthopsychiatry, 2010. **80**(3): p. 362-74.

[31] Juvonen, J. and E.F. Gross, *Extending the school grounds?—Bullying experiences in cyberspace.* J Sch Health, 2008. **78**(9): p. 496-505.

[32] Elgar, F.J., et al., *Cyberbullying victimization and mental health in adolescents and the moderating role of family dinners.* JAMA Pediatr, 2014. **168**(11): p. 1015-22.

[33] Selkie, E.M., J.L. Fales, and M.A. Moreno, *Cyberbullying Prevalence Among US Middle and High*

School-Aged Adolescents: A Systematic Review and Quality Assessment. J Adolesc Health, 2016. **58**(2): p. 125-33.

[34] Peskin, M.F., et al., *Prevalence and Correlates of the Perpetration of Cyber Dating Abuse among Early Adolescents.* J Youth Adolesc, 2016. **IN PRESS**.

[35] Mitchell, K.J., et al., *The role of technology in peer harassment: Does it amplify harm for youth?* Psychology of Violence, 2016. **6**(2): p. 193-204.

[36] Bottino, S.M., et al., *Cyberbullying and adolescent mental health: systematic review.* Cad Saude Publica, 2015. **31**(3): p. 463-75.

[37] Messias, E., K. Kindrick, and J. Castro, *School bullying, cyberbullying, or both: correlates of teen suicidality in the 2011 CDC Youth Risk Behavior Survey.* Comprehensive Psychiatry, 2014. **55**(5): p. 1063-8.

[38] Hinduja, S. and J.W. Patchin, *Bullying, cyberbullying, and suicide.* Archives of Suicide Research, 2010. **14**(3): p. 206-21.

[39] Kowalski, R.M., et al., *Bullying in the digital age: a critical review and meta-analysis of cyberbullying research among youth.* Psychol Bull, 2014. **140**(4): p. 1073-137.

[40] Remond, J.J., L. Kern, and L. Romo, *[A cyberbullying study: Analysis of cyberbullying, comorbidities and coping mechanisms.].* Encephale, 2014. **41**(4).

[41] Smokowski, P.R., C.B. Evans, and K.L. Cotter, *The differential impacts of episodic, chronic, and cumulative physical bullying and cyberbullying: the effects of victimization on the school experiences, social support, and mental health of rural adolescents.* Violence Vict, 2014. **29**(6): p. 1029-46.

[42] Schneider, S.K., et al., *Cyberbullying, school bullying, and psychological distress: a regional census of high school students.* American Journal of Public Health, 2012. **102**(1): p. 171-7.

[43] Sinclair, K.O., et al., *Cyber and bias-based harassment: associations with academic, substance use, and mental health problems.* J Adolesc Health, 2012. **50**(5): p. 521-3.

[44] Cantone, E., et al., *Interventions on bullying and cyberbullying in schools: a systematic review.* Clin Pract Epidemiol Ment Health, 2015. **11**(Suppl 1 M4): p. 58-76.

[45] Ybarra, M.L., T.L. Prescott, and D.L. Espelage, *Stepwise Development a Text Messaging-Based Bullying Prevention Program for Middle School Students (BullyDown).* JMIR Mhealth Uhealth, 2016. **4**(2): p. e60.

[46] Bandura, A., *Social cognitive theory: an agentic perspective.* Annu Rev Psychol, 2001. **52**: p. 1-26.

[47] Bandura, A., *Growing Primacy of Human Agency in Adaptation and Change in the Electronic Era.* European Psychologist, 2002. **7**(1): p. 2-16.

[48] Stewart, R.W., et al., *The Development and Psychometric Investigation of the Cyberbullying Scale.* J Interpers Violence, 2014. **29**(12): p. 2218-2238.

[49] QSR International, *NVivo Qualitative Data Analysis Program (Version 10). [Computer software].* 2012, Melbourne, Australia.

[50] Ritchie, J., et al., *Qualitative research practice: A guide for social science students and researchers.* 2013: Sage.

[51] Gale, N.K., et al., *Using the framework method for the analysis of qualitative data in multi-disciplinary health research.* BMC Med Res Methodol, 2013. **13**: p. 117.

[52] Smith, J. and J. Firth, *Qualitative data analysis: the framework approach.* Nurse Res, 2011. **18**(2): p. 52-62.

[53] *Preventing Cyberbullying.* stopbullying.gov [cited 2017; Available from: https://www.stopbullying.gov/cyberbullying/prevention/index.html.

[54] Center, C.R. *Teens.* [cited 2017; Available from: http://cyberbullying.org/resources/teens.

[55] Safely, C. *Tips to Help Stop Cyberbullying.* 2013 [cited 2017; Available from: https://www.connectsafely.org/tips-to-help-stop-cyberbullying/.

[56] Willis, G.B., *Cognitive interviewing: A tool for improving questionnaire design.* 2004: Sage Publications.

[57] Tohidi, M., et al., *Getting the right design and the design right*, in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* 2006, ACM: Montréal, Québec, Canada. p. 1243-1252.

[58] Maar, M.A., et al., *Unpacking the Black Box: A Formative Research Approach to the Development of Theory-Driven, Evidence-Based, and Culturally Safe Text Messages in Mobile Health Interventions.* JMIR Mhealth Uhealth, 2016. **4**(1): p. e10.

[59] Morrison, L.G., et al., *What design features are used in effective e-health interventions? A review using techniques from Critical Interpretive Synthesis.* Telemed J E Health, 2012. **18**(2): p. 137-44.