Using computer technology for HIV prevention among African-Americans: development of a tailored information program for safer sex (TIPSS)

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Abstract

New prevention options are urgently needed for African-Americans in the United States given the disproportionate impact of HIV/AIDS on this group. This combined with recent evidence supporting the efficacy of computer technology-based interventions in HIV prevention led our research group to pursue the development of a computer-delivered individually tailored intervention for heterosexually active African-Americans—the tailored information program for safer sex (TIPSS). In the current article, we discuss the development of the TIPSS program, including (i) the targeted population and behavior, (ii) theoretical basis for the intervention, (iii) design of the intervention, (iv) formative research, (v) technical development and testing and (vi) intervention delivery and ongoing randomized controlled trial. Given the many advantages of computer-based interventions, including low-cost delivery once developed, they offer much promise for the future of HIV prevention among African-Americans and other at-risk groups.

Introduction

African-Americans are dramatically disproportionately impacted by HIV/AIDS in the United States. While African-Americans make up just 13% of the US population, data continue to indicate that they make up approximately 50% of new HIV infections [1]. Heterosexual contact is the number one route of transmission among African-American women and the number three route of transmission among African-American men (after sexual contact with other men and injection drug use) [1]. Given these troubling figures, the Centers for Disease Control and Prevention (CDC) has called HIV/AIDS among African-Americans a ‘major health crisis’ and issued a ‘heightened national response’ to this crisis [2].

Given the severity of the epidemic among African-Americans, the CDC [2] and others [3] have noted that novel intervention strategies are urgently needed. While efficacious interventions to reduce sexual risk behaviors among heterosexual African-Americans exist [4], they are limited in a number of ways. For example, a recent review of existing interventions demonstrated that many were dated (63% were developed before the year 2000) and also that few were developed for one-to-one delivery (75% were developed for a group setting) [4]. Perhaps the most limiting factor, however, is the fact that all the interventions were designed to be delivered by a health educator, counselor or other human facilitator. Given that many community and clinic-based settings are resource constrained, consistent delivery of prevention interventions in settings such...
as busy sexually transmitted infection (STI) clinics has proven to be a major challenge [5, 6].

**Computer technology-based interventions**

A promising avenue for HIV behavioral intervention research is computer technology-based interventions. Computer technology-based interventions are those programs that use computer technology as the primary or sole medium to deliver an intervention [7]. Perhaps the greatest advantage of such interventions is the cost of implementing these interventions once they are developed is likely to be minimal compared with human-delivered interventions, thus potentially facilitating their dissemination. Other advantages include the following: intervention fidelity is maintained through the standardization of content; computerized interventions can ‘individually’ tailor intervention content; computer technologies include engaging user features such as interactivity and multimedia; computerized interventions are flexible in terms of dissemination channels; and, opportunities to apply new technologies to HIV prevention will only grow in the future [8–10], including among African-Americans [11].

Given the many advantages of such interventions, recent meta-analytic evidence in support of their efficacy[7, 12] and the great need for novel intervention strategies for African-Americans, our research group has recently developed a computer-delivered individually tailored intervention for heterosexually active African-Americans. The intervention is called the tailored information program for safer sex (TIPSS). In the current article, we discuss the development of the TIPSS program in detail, including (i) the targeted population and behavior, (ii) theoretical basis for the intervention, (iii) design of the intervention, (iv) formative research, (v) technical development and testing and (vi) intervention delivery and ongoing randomized controlled trial evaluating the efficacy of the intervention.

**Development of TIPSS**

**Targeted population and behavior**

Given the disproportionate impact of HIV/AIDS among African-Americans, the current intervention focuses on this group—in particular, the target population is heterosexually active African-Americans aged 18–29 years. A particularly opportune venue to access high-risk populations are STI clinics. The current study is thus situated in a large publicly funded clinic that serves a predominantly low-income African-American clientele. Data suggest that the population that frequents this clinic tend to have multiple sexual partners and to engage in sexual risk behaviors with low levels of consistent and correct condom use [13, 14]. Similar to other STI clinics, recidivism is high [15], which is notable given the connection between incident STIs and HIV infection [16]. Thus, the focus of the current intervention is to increase both consistent and correct condom use with all sexual partners. More on the theoretical basis of the intervention, including a specific focus on different partner types, is discussed next.

**Theoretical basis**

The primary theoretical basis for the current intervention is the Attitude–Social Influence–Efficacy (ASE) model [17–19]. The theory is an integration of the Theory of Reasoned Action [20], Social Cognitive Theory [21] and the Trans-theoretical Model [22]. It suggests that three sets of proximal factors—attitudes, social influences and self-efficacy—are critical determinants of health behavior change. In addition, the theory takes a broad view of these concepts. Attitudes include positive and negative aspects of a behavior and consideration of cognitive and emotional beliefs. Social influences include perceived behavior of others (descriptive norms) and direct pressure or support to perform a behavior (injunctive norms). Finally, self-efficacy includes confidence in one’s ability to perform a behavior and/or difficulty in performing the behavior. These proximal factors are thought to influence progression through the
stages of change and ultimately are theorized to impact behavior and behavioral change. The five stages of change include the following: Precontemplation, no intention to change; Contemplation, intention to change in the future; Preparation, intention to change in the near future and steps currently being taken toward that goal; Action, recently changed behavior; Maintenance, changed behavior and have been practicing the behavior for an extended time period [22].

In the safer sex area, studies have demonstrated that factors in addition to those encapsulated in the ASE model must be considered. Specifically, numerous studies have demonstrated the importance of ‘interpersonal’ factors, such as condom negotiation, to condom use behavior [23, 24]. Studies have also demonstrated that condom use behaviors (and associated beliefs) differ according to type of sexual partner in that condom use is less likely to take place with ‘known’ partners (i.e. main or steady partners) as compared with casual sexual partners [25, 26]. Our formative qualitative research has validated that these partner distinctions are meaningful in our study population [14].

As part of the formative research for the TIPSS intervention, we tested the ASE model in a sample of \(N = 293\) heterosexually active African-Americans (recruited from our research site—a publicly funded STI clinic). Study participants were male (54%), identified as African-American (95%) or multi-racial (5%), were unmarried (84%), had a high school or less education (77%) and were unemployed (54%) or employed part time (22%). Since the project was originally going to focus on the 18–44 age range (but as described below was later amended to ages 18–29 years), the 18–44 age group was the focus of this study (mean age = 26.93 years, SD = 6.90). This work revealed that the theory provided a valuable explanatory framework for condom use among this population [13]. ASE model variables exhibited meaningful relationships with stages of change in that those in early stages for consistent condom use (e.g. Precontemplation and Contemplation) exhibited low levels of condom attitudes, social influences, self-efficacy and negotiation strategies, while those in later stages exhibited higher levels on these variables. These patterns held up in both main/steady as well as casual sexual partners. Thus, this study provided evidence that the ASE model advanced an understanding of condom use in this population and provided a valuable theoretical framework for the TIPSS intervention. We also note that many of the constructs in the ASE model have provided conceptual bases for other efficacious HIV prevention interventions [27].

HIV prevention interventions tend to be more efficacious when they address skills training [28]. Thus, in addition to ASE model constructs, two sets of skills were focused upon. First, since evidence suggests that individuals make condom use errors that may put them at risk for STIs/HIV or may lead to discontinuation of condom use [29, 30], correct condom use was addressed. Second, because effective condom negotiation clearly requires a level of skill, this was also addressed.

The skills training literature suggests many theoretical principles for effective skills training [31]. First, effective skills training begins by assessing where individuals are with regard to particular skills and by providing instruction and feedback on those skills. The TIPSS program was designed to assess individuals on all ASE variables (including the skill-oriented variables condom self-efficacy and condom negotiation strategies) and to provide feedback tailored to where individuals are on these variables. Second, individuals can attain skills and build self-efficacy to use skills through vicarious learning, consistent with Social Cognitive Theory [21]. Modeling can provide important suggestions for how to carry out skills and may lead to direct rehearsal of the behavior. The TIPSS program was designed with modeling in mind and includes both correct condom use animation as well as modeling of positive negotiation statements. Third, individuals learn and perfect skills from experience with those skills. When individuals perform the behavior and feel like they have some mastery over the behavior, their self-efficacy increases. The two skill activities designed for the TIPSS program (discussed below) were designed with this principle in mind. Finally, where possible, skills training
programs use homework assignments and follow-up feedback to help individuals continue to build and master relevant skills. The TIPSS program encourages individuals (particularly those in later stages of change) to use these newly acquired negotiation skills. While the current TIPSS intervention study includes just a single session with the computer, follow-up feedback will likely be integrated in a future version of the program.

**Design of the computer-based program**

With the above conceptual basis in mind, the TIPSS program was developed. Figure 1 presents the conceptual framework for the intervention. As can be seen, modules were developed for (i) main partner and (ii) casual partners (divided into other partners, for those with main and casual sexual partners, and general partners, for those with only casual partners). The TIPSS program works as follows: individuals are asked questions about sexual partners that determine which module(s) they receive. Assessment of all ASE variables is conducted separately by partner type, allowing for partner-specific beliefs to be assessed and appropriate feedback to be provided. This aspect of the intervention has proven to be very useful, as our formative research suggested many differences on this partner dimension [14]. Different approaches to condom negotiation, for example, were integrated into both the feedback messages as well as the negotiation interactive activity.

The TIPSS program is comprised of two content mechanisms. The first is tailored feedback, which is the core mechanism in any computer-tailored intervention [32, 33]. The second are interactive

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Fig. 1. Conceptual framework for the TIPSS intervention.
exercises, which as indicated above were used for skills training purposes. These are both now discussed in detail.

**Tailored feedback messages**

In the current intervention, stage of change was used as the key organizing construct for the tailored feedback. Thus, once individuals move down a particular path (e.g., main partner), they are staged for consistent condom use with that partner and they receive feedback on their stage of change and level of condom use. Then, all the feedback that they subsequently receive (on condom attitudes, norms, self-efficacy and negotiation strategies) is sensitive to which stage of change they are in. Figure 2 depicts the way in which this operates. As can be seen, after someone is placed in a particular stage, he or she remains on that path throughout the entire module.

Once an individual completes the assessment for a particular theoretical construct, the program computes the score and compares it with the predetermined cut-point for that construct. This determines whether the individual receives ‘above cutoff’ or ‘below cutoff’ feedback on that particular construct (see Fig. 2). In all cases, except for cons (where the situation is reversed), ‘above cutoff’ indicates that individuals have scored adequately on the construct, while ‘below cutoff’ indicates that they have a deficit on that construct. ‘Above cutoff’ feedback thus provides positive evaluation and briefly reinforces aspects of the theoretical construct. Below cutoff feedback communicates that they are not where they need to be, and this feedback is more in-depth and detailed. Table 1 provides examples of both above and below cutoff feedback that is delivered to participants. An elegant feature of tailored interventions is the fact that they are sensitive to where individuals are on these theoretical constructs, and this responsiveness in feedback is thought to play to the efficacy of these interventions [34, 35].

In addition, the intervention feedback was structured in this manner because the idea is to encourage individuals to advance forward by a stage, not necessarily to move them to consistent condom use right away [22]. Thus, taking this perspective, empirical cutoffs for the feedback were generated from normative data collected from the target audience [36]. We used the data from our previous study of the target audience to generate such cut-points [13]. But how are such cut-points determined? Since the goal is to move people forward by one stage, the cut-point for someone in the Precontemplation stage is determined (approximately) by the average score of someone in the Contemplation stage. If the individual scores below this, below cutoff feedback is provided; if they score at or above this cutoff, above cutoff feedback is provided. This stage-oriented empirically based approach to tailoring was adopted here given the success of this approach as applied to a vast array of tailored interventions based upon the Transtheoretical Model of Change [32, 36–38].

In addition, unlike websites where individuals can self-direct where they want to go, the TIPSS program provides a structured experience. While the intervention is mostly directed by the computer using this ‘expert system’ paradigm [36], we sought to give individuals some control over what content they were exposed to. Thus, we developed a ‘click to learn more’ feature, typically in the below cutoff feedback, that gives the user some choice as to what feedback they receive (see Table 1). Thus, all individuals receiving below cutoff feedback first receive a message regarding where they are on a particular construct. After this message is delivered, the individual then has some control over what and how much of the more extensive feedback they receive. For example, while all individuals would receive feedback on where they are on self-efficacy, the participant is then able to click on which dimension(s) of self-efficacy they would like to receive more feedback on. Then, they can click on other dimension(s) of self-efficacy or move on to the next construct (see Table 1; Fig. 2).

**Interactive exercises**

The second content mechanism are interactive exercises that were developed around skills training, including correct condom use and negotiating
Fig. 2. Flow of assessment and feedback in the TIPSS program (Above and Below refer to the type of feedback given, and Click refers to places where participants have some options regarding which content they wish to view. See text for details).
condom use. The correct condom use activity was designed to train individuals how to correctly use a condom. Because correct condom use applies to all sexual partners, this activity was not specific to type of partner. This activity consists of numerous screens addressing 15 areas of correct condom use, and each screen includes images of both the correct and incorrect answer (see Fig. 3). The images used were a combination of photographs of condoms and lubricant, as well as original drawings of an African-American male putting on a condom. The areas covered by the activity include how to properly open and put on a condom; what types of lubricant to use; what types of condoms to use (including for those who are allergic); what to do if the condom starts to dry out during sex and how to properly remove and discard of the condom.

The objective of this activity is for the participant to identify the correct answer on each screen (see Fig. 3). If they choose the correct answer, they are positively praised, given some additional information, and the correct image is again displayed (see Fig. 4). If they choose the incorrect answer, they are told this, an explanation for the correct
answer is given, and the correct image is displayed. Once the participant clicks on the final screen of the activity, a 30-s condom animation sequence is initiated (see Fig. 5). This gives the participant an opportunity to see all the steps of condom use put into action in a single sequence.
The condom negotiation activity was designed to be specific to partner type (main or casual). We designed it this way because individuals may use very different negotiation strategies for main versus casual sexual partners. Thus, we had the opportunity to use examples that may be more relevant to main or casual partners in their respective modules. Thus, individuals with only main or only casual partners receive just one activity, while those with both types of partners receive both activities.

Both negotiation activities (main and casual) consist of three scenarios modeling three different negotiation approaches. In each, the participant is told: ‘Imagine you are in the following situation with your [main or casual] partner: You are being intimate, kissing, and getting ready to have sex. You take out a condom and tell your partner you want to use it. Your partner says …’. Then, a particular statement likely to be used by a main or casual partner is listed. Participants are asked to think about what they would say back and then to choose one of two options. In each sequence, one option models a positive communication statement while the other models a negative statement. Positive statements use ‘I’ language, respond to the partner’s concern about condoms and clearly express the participant’s feelings. Negative statements use ‘you’ language and are worded in such a way that they are much more likely to bring about partner reactance rather than partner cooperation.

The objective of this activity is for the participant to choose the correct answer on each screen. If they choose the correct answer, they are positively praised and given an explanation for why this was a good choice for a negotiation statement. If they choose the incorrect answer, they are told this, an explanation for the correct answer is given and the correct answer is reinforced as a good alternative.

Formative research

We applied a variety of types of formative research to inform the development of this tailored intervention. First, as already described, we conducted a quantitative study testing the application of the ASE model to this population [13]. We also used these data to develop cut-points for use in message tailoring. Second, we conducted a set of four focus groups (two
male and two female groups) to discuss issues surrounding sexuality, relationships and condom use [14, 39]. These focus groups allowed us to explore these topics in depth and to be sure that we were not missing any important issues that might be salient for this population. These focus groups were very useful in informing the tailored feedback, as individuals gave us information that helped us to contextualize some of our feedback messages according to partner type. Inclusion criteria for the focus groups were as follows: (i) African-American; (ii) aged 18–44 years; (iii) heterosexually active in the past 3 months and (iv) not knowingly HIV positive. To help make the groups as informal and conversational as possible, we did not assess specific demographics (e.g. using a survey) beyond these general inclusion criteria.

Third and finally, we conducted a second round of four focus groups (two males and two females, divided by age into groups of 18- to 29- and 30- to 44-year-olds) after we had developed a prototype of the TIPSS intervention. During these groups, it became clear that this computer program resonated greatly with the younger audience (ages 18–29) and much less so with the older audience (ages 30–44), especially the men. Given that STI and HIV rates tend to be significantly higher in the younger population [40, 41], as well as the fact that our own data suggested that this clinic was frequented much more by the 18–29 age group [13], we made the decision to restrict the focus of the intervention to 18- to 29-year-olds.

In these focus groups, individuals went through sections of the intervention and then had discussions about aspects of the program. Participants gave their ideas about graphic design, fonts used, feedback messages, interactive activities, narrator’s voice and other elements. This feedback helped us to choose specific images, colors and fonts for the intervention and allowed us to ‘pilot test’ particular feedback messages and activities for clarity and receptivity. Ultimately, these focus groups gave us more confidence that we were on track toward acceptability of the intervention with the target audience (see Fig. 6 for the intervention home screen chosen by the focus groups).

### Technical development and testing

Individually tailored interventions quickly become complex with regard to programming. The program must assess individuals on stage of change and other theoretical constructs, compute the staging algorithm (or scale score), compare the score with a predetermined cutoff, pull the appropriate message(s) from the message library and present it to the participant. The messages must be designed so they ‘fit together’ both in terms of the space allotted on the computer screen as well as to the extent that they form a coherent narrative. All these tasks require not only a research team to write the messages but also a technical development team. Our technical development team used FileMaker Pro Version 10 software running on Macintosh computers for this purpose. They applied this software to execute several interrelated tasks, including conducting the assessment, recording the data in a database, computing algorithms and applying decision rules and displaying the tailored feedback with the appropriate design backgrounds.

A graphic design team also developed the backgrounds, images and animation for the interactive exercises (Figs 3–6). The technical development team took the raw materials of the graphic design work and the intervention logic and messages and produced the actual computer-based product. This proved to be an iterative process where the technical group developed part of the intervention, tested it internally and then turned it over to the research team for external testing. As the research team found errors and bugs, we reported them back to the technical team for revision and further internal (followed by external) testing. This process went on for months as we developed new sections of the intervention. The intervention testing process was very intensive, and given the number of possible iterations, every possible path that a participant might take could not be tested. Rather, systematic testing was conducted to ensure (as much as is humanly possible) that algorithms and decision rules functioned as they were intended. Interactive exercises were also tested to be sure their programming logic was sound.
Intervention delivery and randomized controlled trial

The TIPSS intervention was developed as a stand-alone intervention delivered on a laptop computer. Due to concerns about access to a reliable high-speed internet connection in a publicly funded clinic atmosphere, the program was developed to run locally. Individuals sit at the computer station, put on headphones and interact with the TIPSS program. To be sensitive to those with low literacy skills, and to enhance the TIPSS experience, a narrator was used throughout the program. The narrator reads all the assessment questions and response options to the participant. All the tailored feedback and interactive exercises are also narrated. We used an African-American female as the narrator, as both men and women responded well to her voice during focus group testing.

To maximize individuals’ use of the feedback messages provided by TIPSS, we also developed stage-targeted print materials to complement the computer-based program. When a participant finishes the program, the on-site recruiter clicks a ‘secret button’ that takes her to a screen that indicates which print materials to give to the participant. The materials are one-page (printed front and back) preprinted stage-matched materials. Since they are preprinted, they cannot contain the same level of tailoring specificity as the on-screen TIPSS program does. Instead, stage of change as well as the key theoretical domains of the program (i.e. attitudes, norms, self-efficacy, negotiation, correct condom use) are addressed but in a manner that is targeted to stage only, not tailored to exactly where individuals score on these theoretical constructs. These materials are intended to be an adjunct to the main TIPSS program.

The TIPSS program is currently being tested in a randomized controlled trial at a large, publicly funded STI clinic in the southeastern United States. The design of the trial is such that we plan to enroll approximately N = 312 heterosexually active African-Americans aged 18–29 years into the trial—half randomized to receive the TIPSS program and half to receive assessment plus generic information print materials. Condoms are being provided to all participants in the trial.
In this research trial, participants are given information about the study in the waiting room and are screened for the study (in a private room) after they finish their clinic appointment. If eligible and interested, they interact with the TIPSS program (~45 min) and are followed up 3 months later for assessment (~30 min). The key outcomes to be examined include condom use during vaginal sex with main partners; condom use during vaginal sex with casual partner(s) and, if the numbers permit, condom use during anal sex with main and casual partner(s). Also, since this large publicly funded clinic is the only low-cost option in this metropolitan area and the surrounding counties, individuals tend to come back to the same clinic if they are infected/reinfected with an STI. Thus, we are also linking their self-report data with their chart at the clinic and plan to follow STI infection/reinfection in the year after they complete the TIPSS program.

Conclusion

The current article has described the development of the TIPSS program—an innovative, computer-based, individually tailored program for heterosexually active African-Americans visiting an STI clinic. The program is theory based and significant formative research was conducted to inform its development. If TIPSS and other computer-based programs are demonstrated to be efficacious, they will offer another prevention tool for HIV prevention practitioners. A key advantage of TIPSS is that unlike the vast majority of the HIV behavioral intervention research literature (e.g. refs [4, 28]), this program does not necessitate a human counselor or facilitator. Thus, the ability to sustain such an intervention over the longer term may be more feasible given its lower cost to deliver when compared with human counseling interventions [5].

In closing, we offer some lessons learned from the current project—in particular, two places where we clearly learned from listening carefully to our audience. First, in our efforts to make TIPSS as targeted and tailored to the audience as possible, we expected that all the images in the program would be of African-Americans. In contrast to this, the focus groups preferred the multicultural design (Fig. 6), as they liked the diverse images and they liked the inherent message that sexual health, and HIV/AIDS, is a concern to all people (not just African-Americans). Thus, in behavioral interventions, we must strike a careful balance between targeting on the one hand and acceptability on the other. Second, while we initially conceptualized TIPSS for the vast majority of African-Americans who come to the clinic (i.e., ages 18–44 years), the focus group reactions told us that this program resonated most with the 18–29 age group. Thus, as noted above, we amended the project to focus on the (higher risk) 18- to 29-year-old audience. The challenge of this for the HIV prevention field, however, is significant. While increasingly data suggest that the most efficacious programs are also the most targeted [28], it is likely that dissemination, a topic increasingly focused on in HIV prevention, is best served by interventions that are appropriate and effective with the broadest audiences. Thus, as a field we must struggle with the fact that one intervention will not fit all audiences and that we need to do a better job disseminating (targeted) interventions to all at-risk audiences.

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Conflict of interest statement

None declared.

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