

Development and Feasibility Testing of a Videogame Intervention to Reduce High-Risk Sexual Behavior in Black and Hispanic Adolescents

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Abstract

Objective: Develop and test feasibility of a mobile videogame intervention to decrease high-risk sexual behavior in black and Hispanic adolescents.

Materials and Methods: Iterative design to develop intervention in partnership with target audience. Feasibility and preliminary impact data collected at baseline, following 2–3 hours of gameplay and at 8-week follow-up.

Results: Twenty-six 15–17-year-olds completed pilot testing: 16 (62%) were male, 20 (77%) black or Hispanic. Pilot testing demonstrated feasibility, including producing a usable videogame prototype, incorporating videogame testing within a high school, and participants' acceptability of the videogame. Participants' gameplay experience reflected that most would play the videogame again (77%), stated that they felt responsible for the choices they made in the videogame (73%), and would tell their friends to play the videogame (58%). Most suggested adding more videogame content to further engage participants. From baseline to follow-up, participants demonstrated improvements in condom and contraception self-efficacy ($P=0.003$), risk perceptions ($P=0.009$), and high-risk sexual behavior knowledge ($P<0.0001$). Among black or Hispanic adolescents, we found improvements in summary measures of intentions ($P=0.04$), self-efficacy ($P=0.003$), risk perceptions ($P=0.002$), and sexual knowledge ($P=0.0002$). Adolescents with previous sexual experience showed similar improvements.

Conclusion: Pilot testing of an innovative videogame, developed in partnership with the target audience, demonstrated feasibility and preliminary impact with this cohort of black or Hispanic adolescents. We developed a usable videogame prototype and gained important data about how to enhance the next videogame iteration. Future plans include targeting an older age group to maximize our ability to measure potential impact among sexually experienced adolescents.

Keywords: Adolescent, Disparity, High-risk sexual behavior, Videogame

Introduction

BLACK and Hispanic adolescents are more likely to report some measures of high-risk sexual behavior (including vaginal intercourse without condoms, multiple sequential or concurrent sexual partners, and intercourse under the influence of alcohol or drugs) compared with non-Hispanic white adolescents.^{1,2} Consequently, black and Hispanic adolescents are disproportionately affected by sequela of high-risk sexual behavior, including higher rates of unintended pregnancy, sexually transmitted infections (STIs), and human immunodeficiency virus (HIV).^{3,4}

Some evidence supports behavioral interventions that target knowledge, intentions, risk perception, and self-efficacy as critical antecedents to decreasing high-risk sexual behavior in adolescents.^{1,5} These targets are consistent with three theories of behavioral change that are incorporated into the videogame. The Theory of Planned Behavior holds that an individual's intention to engage in a specific behavior predicts that behavior. The Health Belief Model emphasizes the importance of individuals' self-efficacy to accomplish a given behavior, their perceptions of susceptibility to a given health problem, and their knowledge of and beliefs in the effectiveness of an intervention. The Social Cognitive

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Theory posits that observational learning, seeing the modeling of a behavior and the consequences of that behavior, may increase the likelihood of behavioral change.

Therefore, our framework (Fig. 1) for the videogame incorporates these theories as the basis for intervention targets proved to be effective at decreasing overall sexual risk-taking behavior in adolescents, such as improving intentions regarding sexual decision-making (number of partners, intercourse under the influence of alcohol or marijuana), self-efficacy regarding discussion and use of condoms, risk perception, and sexual knowledge. Addressing these targets has been shown to empower adolescents to increase condom use, increase use of contraception, decrease the number of concurrent sexual partners, and increase STI testing and treatment.⁶ However, existing evidence-based interventions predominantly rely on being integrated into overloaded school curriculums and are limited by abstinence-only education mandates,⁷ overextended educators, and nonexistent national standards. Therefore, innovative approaches to decrease high-risk behavior that have the potential to address current limitations for delivering evidence-based interventions and are tailored to address racial and ethnic disparities are needed.⁸

Videogames can be developed as interventions for improving health behaviors and are a novel and effective way to reach at-risk populations, including adolescents.^{9,10} Video-

games offer opportunities for visually modeling risk and risk prevention, including simulating consequences of high-risk sexual behavior, and practicing self-efficacy skills in a risk free, virtual world.⁹⁻¹¹ The purpose of this study was to develop and evaluate a videogame to deliver a behavioral intervention to decrease high-risk sexual behavior among black and Hispanic adolescents, especially as it relates to unintended pregnancy.

Materials and Methods

We used an iterative design methodology to develop and test a videogame intervention (Table 1) with black and Hispanic adolescents. The study consisted of two stages, intervention development and pilot testing, and was approved by the Yale University Human Research Protection Program.

Formative work: intervention development

We performed formative work in two phases. In Phase 1, we conducted four focus groups (total participants $n = 16$) to explore high-risk sexual behavior in adolescents and to understand specific risk behaviors, including contraception use/nonuse and drug use/nonuse, which could be integrated into the design and development of a tailored mobile videogame

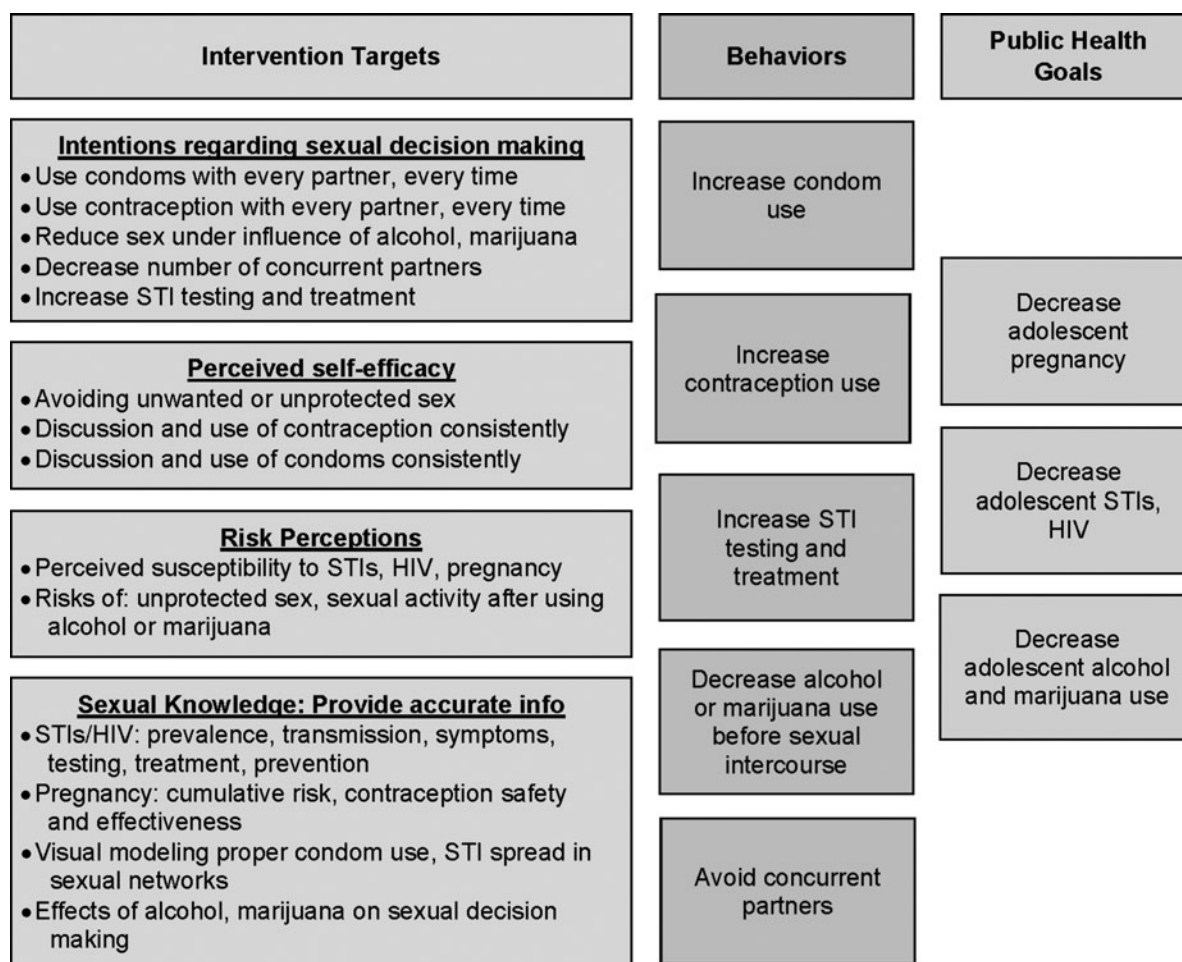


FIG. 1. Focused logic model. Modified from “Sexual Risk & Protective Factors. Factors affecting teen sexual behavior, pregnancy, childbearing, and sexually transmitted disease: Which are important? Which can you change?”¹

TABLE 1. CHARACTERISTICS OF A VIDEOGAME FOR HEALTH

Development and feasibility testing of a videogame intervention to reduce high-risk sexual behavior in black and Hispanic adolescents	
Health topic(s)	High-risk sexual behavior (e.g., vaginal intercourse without condoms, multiple sequential or concurrent sexual partners, and intercourse under the influence of alcohol or drugs)
Targeted age group(s)	15–17 years old
Other targeted group characteristics	Males and females, black and/or Hispanic
Short description of game idea	Adolescent players choose an avatar and go to a house party as that avatar. At the party they are faced with decisions regarding drinking alcohol, smoking marijuana, engaging in sexual activity, using a condom, and using other forms of contraception. After the party they are given the option of looking up information on the Internet, getting advice from a friend, or going to see a doctor. At the doctor, they can choose to get tested for pregnancy, STIs, and can discuss and choose contraception. If they had chosen to have sex, players are then led to a conversation with their sexual partner to communicate with partner about concerns, symptoms, or test results. Players are then sent back to choose a different avatar, go to a new house party, and are presented with different scenarios and choices, as above.
	Key videogame components include simulation of decision-making in real-life scenarios, and modeling short- and long-term consequences of decisions.
Target player(s)	Individual
Guiding knowledge or behavior change theory(ies), models, or conceptual framework(s)	Theory of Planned Behavior, Health Belief Model, and Social Cognitive Theory
Intended health behavior changes	Decreasing overall sexual risk-taking behavior, such as improving intentions regarding sexual decision-making (number of partners, intercourse under the influence of alcohol or marijuana), self-efficacy regarding discussion and use of condoms, risk perception, and sexual knowledge. Addressing these targets has been shown to increase condom use, increase use of contraception, decrease the number of concurrent sexual partners, and increase STI testing and treatment. Increase condom use, increase contraception use, decrease use of alcohol and marijuana, avoid concurrent partners, and increase STI testing and treatment.
Knowledge element(s) to be learned	See Figure 1, below.
Behavior change procedure(s) (taken from Michie inventory) or therapeutic procedure(s) used	From Michie's Inventory: Education, Persuasion, Incentivization within the videogame, Training, Restriction within the videogame, Modeling
Clinical or parental support needed? (please specify)	No
Data shared with parent or clinician	No
Type of game: (check all that apply)	Role-playing, simulation, educational
Story (if any)	
Synopsis (including story arc)	You arrive at a house party and have conversations with different people at the party. Conversations can turn to flirting depending on what the player chooses in the dialog tree. You have the option to drink alcohol and/or smoke marijuana. You have the option to go upstairs with the person you've been flirting with, which results in choices to exit the bedroom or have sex. Sometimes a condom is available, or the partner has other pregnancy prevention. If the player has chosen to have their avatar drink alcohol or smoke marijuana, the number of choices is decreased or eliminated. The videogame simulates risk of pregnancy and STIs (including HIV), having difficult discussions about sex with friends, a supportive doctor, and sexual partners.
How the story relates to targeted behavior change	Story simulates decision-making in real-life scenarios, and modeling short- and long-term consequences of decisions related to condom use, contraception use, use of alcohol and marijuana, concurrent partners, and STI testing and treatment.
Game components	
Player's game goal/objective(s)	Become a sex expert, unlock information in the videogame to gain points and gain more dialog options. Unlock "Achievements" in certain categories (see Fig. 1, Intervention Targets).

(continued)

TABLE 1. (CONTINUED)

Rules	May lose options to refuse sex, use a condom and/or other form of contraception if avatar drinks alcohol or smokes marijuana.
Game mechanic(s)	If chose to have sex, videogame simulates risk of pregnancy, STI based on risk of transmission, whether condom used, whether other contraception used, whether drugs or alcohol used.
Procedures to generalize or transfer what's learned in the game to outside the game	How to refuse sex, how to negotiate condom use with a partner, how alcohol and marijuana use can influence sexual risk taking, where and how to obtain pregnancy tests, STI testing and treatment, and condoms and contraception.
Virtual environment Setting (describe)	First-person point of view at a house party
Avatar Characteristics	Static, male or female avatar (three options for each). Can customize name, cannot customize avatar appearance.
Abilities	Decision-making
Game platform(s) needed to play the game	Smartphone or tablet or computer
Sensors used	Touch
Estimated play time	2–3 hours

Baranowski.¹⁵

HIV, human immunodeficiency virus; STI, sexually transmitted infection.

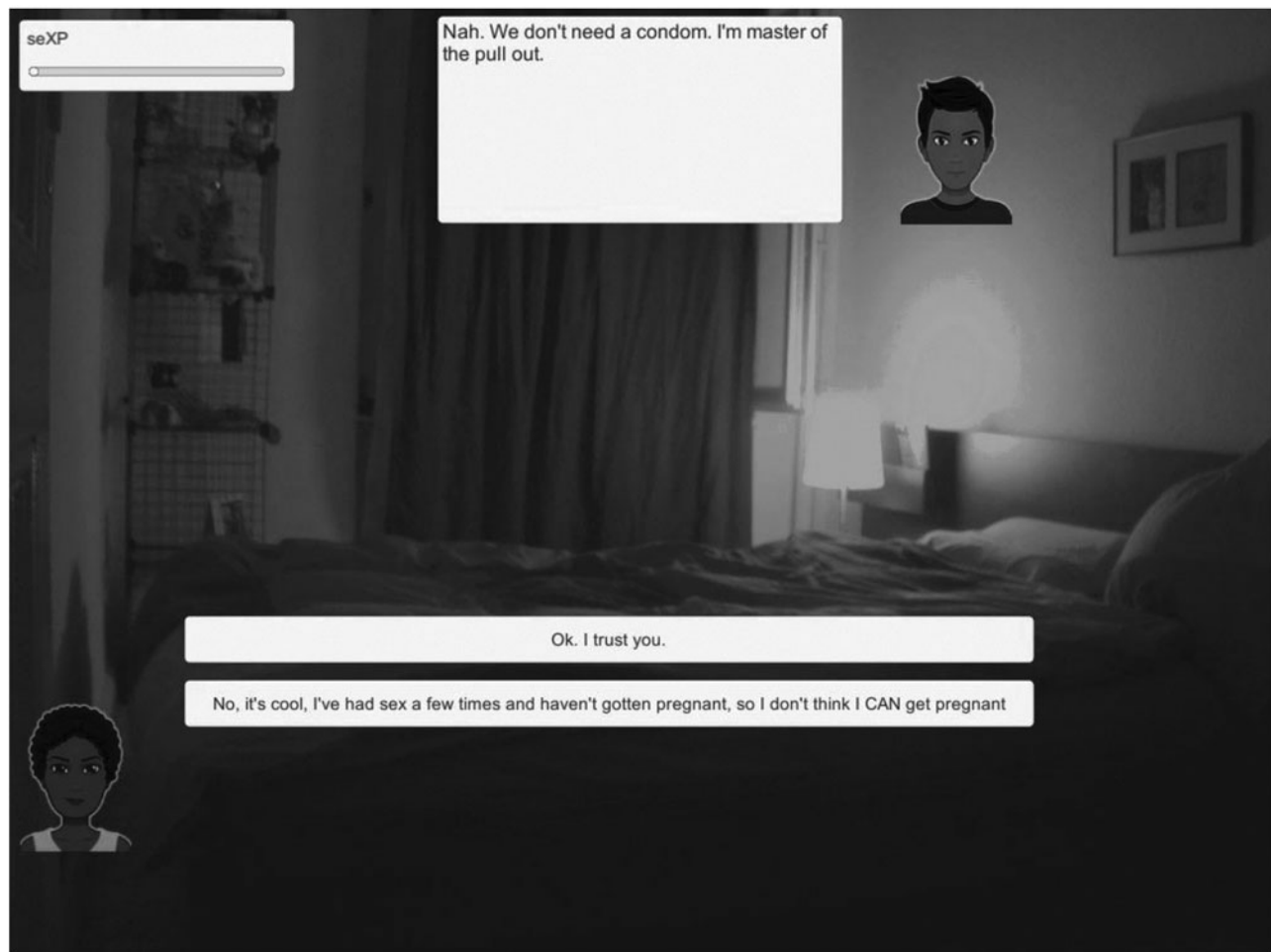


FIG. 2. Screenshot from videogame depicting bedroom scene, dialog tree, and seXP (sexpert points meter) in upper left-hand corner.

intervention. We recruited adolescents from a local high school and an afterschool program. Eligibility criteria included the following: adolescent females and males, aged 15–17 years, English-speaking, and who have their own mobile phone. There were no eligibility criteria for prior sexual experience. Parental notification and adolescent verbal assent was provided. Only nonidentifying demographic information was collected.

Focus group participants in Phase 1 had a mean age of 16 years, participants primarily identified as black (44%) and Hispanic (62%), and 63% of participants were female. Four prominent themes emerged in these focus groups: (1) videogames and social media permeate adolescents' lives, (2) alcohol and marijuana use is common among peers and escalates high-risk sexual behavior, (3) misperceptions related to sexual behavior are prevalent among peers and impact adolescents' decisions, and (4) adolescents perceive a lack of control (self-efficacy) over their sexual health.

These themes confirmed and supported our key intervention targets (Fig. 1). In general, adolescents agreed that a mobile videogame that teaches and demonstrates the consequences of sexual risk taking could be useful and made detailed and creative suggestions for how to improve the videogame. For example, participants suggested specific dialog to be used when avatars in the videogame were discussing sexual decision-making. They recommended using avatars with diverse skin tones, blurring any background images in the videogame to represent the effect that choosing to use alcohol or drugs in the videogame had on the player, and endorsed a house party as the basic foundation for the videogame.

Information from the focus groups in Phase 1 was used to create an initial prototype of the videogame, which was then play tested on individual iPads by three focus groups (total participants $n=10$). We recruited adolescents from a local high school and two afterschool programs in New Haven County. Eligibility criteria for Phase 2 were the same as for Phase 1. In addition, adolescents could not have previously participated in the study. Parental notification and participant verbal assent were provided.

Focus group participants in Phase 2 had a mean age of 16 years, and primarily identified as black (70%) and Hispanic (10%), and 70% were female. Ideas and feedback from one focus group discussion were incorporated into the next videogame prototype and focus group until thematic saturation was reached and a final prototype was produced.^{9–11} Participants spent 20–30 minutes playing the initial prototype of the videogame and then participated in focus group discussions to provide feedback and suggestions for improving the videogame. For example, participants recommended awarding points for unlocking information in the videogame and recommended that avatars be prevented from exiting sexual encounters if they had chosen to use alcohol or drugs in the videogame, to simulate the flawed decision-making that accompanies alcohol or drug use.

Pilot testing

We pilot tested the videogame prototype (Fig. 2) with adolescents to determine feasibility and preliminary impact. Eligibility criteria included the following: ages 15–17 years, English-speaking, who had not participated in the study previously. To protect participants' privacy (from parents,

other participants), there were no eligibility criteria for previous sexual experience. For pilot testing, written parental consent and written adolescent assent were provided. We assessed gameplay experience, including acceptability, engagement, game completion, and satisfaction using Likert-type scales. We conducted focus groups at 8-weeks follow-up, directly after participants completed quantitative surveys.

We collected demographic data, including sexual behavior at baseline via self-administered paper survey, after 2–3 hours of gameplay, and 8-weeks after completion. We measured intentions regarding sexual decision-making (number of partners, intercourse under the influence of drugs, condom use), risk perceptions, self-efficacy, and sexual knowledge using validated instruments and questions.^{1,12–14}

For all focus groups, we used a standard interview guide and asked open-ended questions to gain insights into overall sexual risk-taking behavior in adolescents,^{1,5} and videogame content, mechanics, and storylines. Focus groups were audio recorded, transcribed, and analyzed using framework analysis to identify key concepts. Salient concepts and suggestions were then incorporated into iterative videogame refinement. Baseline participant demographics and quantitative survey items were analyzed using descriptive statistics. We used paired signed-rank tests to compare data at baseline and follow-up and Pearson's correlations to describe associations between feasibility and outcome measures.

Results

Twenty-six adolescents (aged 15–17) participated in videogame pilot testing (Table 2): mean age of 16 years, 16 (62%) were male, 20 (77%) self-identified as black or

TABLE 2. PARTICIPANT CHARACTERISTICS

<i>Characteristic</i>	<i>N (%)</i>
Age	
15	7 (26.9)
16	13 (50)
17	6 (23.1)
Sex/gender	
Female	9 (34.6)
Male	16 (61.5)
Transgender	1 (3.8)
Race and ethnicity	
Black or African American, non-Hispanic	6 (23.1)
Black or African American, Hispanic	0 (0)
White, non-Hispanic	2 (7.7)
White, Hispanic	2 (7.7)
Other, non-Hispanic	1 (3.8)
Other, Hispanic	7 (26.9)
White and Other, non-Hispanic	0 (0)
White and Other, Hispanic	3 (11.5)
No race chosen, non-Hispanic	0 (0)
No race chosen, Hispanic	2 (7.7)
Asian, non-Hispanic	3 (11.5)
Asian, Hispanic	0 (0)
Language	
Only English	11 (42.3)
English and Spanish	10 (38.5)
English and Patois, Chinese, Filipino, or Thai	5 (19.2)

Hispanic. At baseline, 12 (46%) of participants had ever been sexually active with mean age of sexual debut of 14 years old, 50% of sexually experienced participants reported two or more lifetime sexual partners and two or more sexual partners in the last 3 months. Participants played the videogame for 2–3 hours on average.

Pilot testing demonstrated feasibility, including producing a usable videogame prototype, incorporating videogame testing within a high school, and participants' acceptability of the videogame. Participants' gameplay experience reflected that most would play the videogame again (77%), stated that they felt responsible for the choices they made in the videogame (73%), and would tell their friends to play the videogame (58%). Some (39%) stated that they would make decisions in life as they made in the videogame, which likely reflects the discrepancy between the videogame's focus on sexual encounters compared with the proportion (46%) of our participants who were not sexually experienced.

Stronger agreement with making decisions in life, as they made in the videogame, was associated with greater improvements in summary self-efficacy ($r=0.41$, $P=0.04$) and summary risk perception scores ($r=0.52$, $P=0.008$) from baseline to immediate postgameplay testing. Adolescents reporting that they would play the videogame again had

greater improvements in summary risk perception scores from baseline to 8-week follow-up testing ($r=0.40$, $P=0.045$). Adolescents reporting that they enjoyed playing the game had greater improvements in summary risk perception scores from baseline to 8-week follow-up testing ($r=0.51$, $P=0.009$), and from postgameplay to 8-week follow-up ($r=0.42$, $P=0.04$). Comparing baseline to 8-week follow-up testing for adolescents who said that they were frustrated with this game, there was a moderate inverse correlation ($r=-0.41$, $P=0.04$) with summary risk perception scores.

There were no significant correlations between gameplay variables and summary intention scores or summary knowledge percent scores. During focus group discussion, most adolescents suggested adding more videogame content to further engage participants, including more characters, adding levels of difficulty, extending the story to simulate conversations with parents and partners about an unintended pregnancy.

Pilot testing demonstrated improvements in summary scores (Cronbach's α 0.74–0.88) for self-efficacy regarding condom and contraception negotiation ($P=0.003$), risk perceptions ($P=0.009$), and sexual knowledge ($P<0.0001$) from baseline to 8-week follow-up (Table 3). Although there

TABLE 3. PARTICIPANT DATA BEFORE AND AFTER VIDEOGAME INTERVENTION

	Baseline, n=26, n (%)	After Gameplay, n=26, n (%)	P-value ^a , baseline to after Gameplay	8-Week follow-up, n=25, n (%)	P-value ^a , baseline to follow-up
Self-reported behaviors ^b					
Ever had sexual intercourse					
Yes	12 (46.2)	13 (50)	0.32	14 (56)	0.16
If history of sexual intercourse					
Mean age of first intercourse (SD)	14.7 (1.5)	14.6 (1.19)		15.0 (1.45)	NA
≥2 Lifetime sexual partners	6 (50)	6 (50)	1.0	6 (42.9)	1.0
≥2 Sexual partners in last 3 months	0 (0)	0 (0)	1.0	2 (13.3)	0.16
Contraception used at last sex			0.99		0.99
Only condoms	7 (58.3)	6 (46.2)		5 (35.7)	
Condom + withdrawal	1 (3.8)	0		0	
Condom + oral contracept. pills	0	0		1 (7.1)	
Withdrawal	0	1 (7.7)		4 (28.6)	
No method	3 (25)	5 (38.5)		3 (21.4)	
Unsure	1 (3.8)	1 (7.7)		1 (7.1)	
Shot, patch, ring, IUD, implant	0	0		0	
Use of alcohol or drugs at last sex	3 (25.0)	1 (7.7)	0.16	1 (7.1)	0.16
History of prior STI	0 (0)	1 (3.9)	0.32	0 (0)	1.0
Summary scores ^c (SD)					
Mean Summary Intention Score (0–20) [5 questions, Cronbach's $\alpha=0.80$]	14.3 (4.2)	15.4 (4.0)	0.05	15.6 (3.7)	0.11
Mean Summary Efficacy Score (0–48) [12 questions, Cronbach's $\alpha=0.74$]	34.2 (6.3)	37.5 (7.6)	0.004	38.0 (8.0)	0.003
Mean Summary Risk Perception Score (0–44) [11 questions, Cronbach's $\alpha=0.86$]	32.0 (8.1)	33.65 (7.4)	0.23	35.4 (6.0)	0.009
Summary Knowledge Score (0–100%) (Percent correct) [35 questions, Cronbach's $\alpha=0.88$]	38% (16.3%)	55% (20.5%)	0.0001	59% (21%)	<0.0001

Bolded text indicates statistically significant result.

^aP values evaluated by Signed rank.

^bTotal scores and percentages may change due to missing observations.

^cHigher scores indicate improved intentions, self-efficacy, and risk perceptions as measured by five-point Likert scales where 0=I strongly disagree, 1=I disagree, 2=not sure, 3=I agree, 4=I strongly agree. The statements are worded in the affirmative. For example, "If I have sex without contraception (something to prevent pregnancy), I would probably get pregnant (or get someone pregnant)."

SD, standard deviation.

was no measurable impact on overall summary intention scores, one individual question assessing intention to use effective contraception during future sexual encounters showed improvement ($P=0.035$). No significant changes were seen in self-reported sexual behavior (Table 3).

When stratified by previous sexual experience, adolescents who reported having at least one prior experience of sexual intercourse demonstrated statistically significant improvements in summary measurements of intentions ($P=0.04$) from immediate postgameplay to 8-week follow-up, and significant improvements in self-efficacy ($P=0.046$), risk perceptions ($P=0.02$), and knowledge ($P=0.001$) from baseline to 8-week follow-up.

When stratified by race and ethnicity, black or Hispanic adolescents demonstrated statistically significant improvements in summary measurements of intentions ($P=0.04$), self-efficacy ($P=0.003$), risk perceptions ($P=0.02$), and knowledge ($P=0.0002$) from baseline to 8-week follow-up. We found no statistically significant differences in summary measurements of intentions, self-efficacy, risk perceptions, or knowledge from baseline to after gameplay, from baseline to 8-week follow-up, or from after gameplay to 8-week follow-up among three groups of participants: black non-Hispanic ($n=6$), nonblack Hispanic ($n=14$), and nonblack, non-Hispanic adolescents ($n=6$).

Discussion

Pilot testing of an innovative videogame, developed in partnership with the target audience, demonstrated feasibility and impact with this cohort of black or Hispanic adolescents. We developed a usable videogame prototype that most participants would play again and we gained important data about how to enhance the next videogame iteration: adding more videogame content to further engage participants and targeting an older age group to maximize our ability to measure potential impact among sexually experienced adolescents.

Overall, significant improvements were noted in summary scores for self-efficacy, risk perceptions, and sexual knowledge. One individual question assessing intention to use effective contraception during future sexual encounters showed improvement. Perhaps more importantly given our target audience of black or Hispanic adolescents, we found improvements in summary measures of intentions, self-efficacy, risk perceptions, and sexual knowledge among sexually experienced adolescents, and among black or Hispanic adolescents. Our findings add to growing evidence supporting the potential for videogame interventions to deliver behavioral change.⁹

Our study is limited by its small sample size, lack of control group, and short follow-up time that precluded our ability to test for changes in sexual behavior. Recruitment bias may have occurred if adolescents chose not to participate to avoid disclosing their sexual experience. However, this did not seem to be a hindrance as 56% of participants reported sexual intercourse.

Further rigorous testing of this innovative videogame to decrease high-risk sexual behavior will include a control group and target an older age group to maximize our ability to measure potential impact among sexually experienced adolescents. If successful, a videogame for adolescents that decreases high-risk sexual behavior has the potential to de-

crease unintended pregnancy and STIs/HIV in this vulnerable and difficult to reach population.^{1,4}

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Author Disclosure Statement

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