Published in final edited form as:

AIDS Behav. 2012 August ; 16(6): 1501–1510. doi:10.1007/s10461-012-0187-0.

Using Growth Mixture Modeling to Identify Heterosexual Men who Reduce Their Frequency of Unprotected Sex Following a Behavioral Intervention

Jennifer L. Walsh¹, Theresa E. Senn², Lori A. J. Scott-Sheldon¹, Peter A. Venable², and Michael P. Carey¹

¹Centers for Behavioral and Preventive Medicine, Warren Alpert Medical School of Brown University and the Miriam Hospital, Providence, RI

²Center for Health and Behavior, Syracuse University, Syracuse, NY

Abstract

Using growth mixture modeling, two 12-month trajectories of unprotected sex were identified in 210 heterosexual men (76% African American, $M_{age} = 33.2$ years) attending a sexual risk reduction intervention. Risk Reducers (46%) reported fewer acts of unprotected sex following intervention, whereas Risk Maintainers (54%) reported continuously high levels of unprotected sex. These groups did not differ with respect to demographic characteristics or intervention type. However, Risk Maintainers were more likely than Risk Reducers to report lifetime sex work, forced sex in the past year, and alcohol use before sex at baseline. They had higher levels of peak alcohol use, poorer condom skills, and scored lower on stage of change for condom use at baseline. Risk Maintainers were also more likely to have steady partners at baseline and less likely to change partner status following intervention. Understanding factors distinguishing these groups can contribute to the development of targeted risk reduction interventions.

Keywords

sexual risk reduction; HIV prevention; sexually transmitted disease; unsafe sex; longitudinal studies

INTRODUCTION

More than one million people in the United States live with HIV (1), with 56,000 new infections annually (2). Additionally, an estimated 19 million new sexually transmitted infections (STIs) occur each year (3); rates of some STIs, such as Chlamydia, are increasing more rapidly among men than among women (4). Interventions targeting sexual risk behavior are effective in increasing condom use and reducing unprotected sex, important steps toward reducing the number of new HIV and other STI infections (5, 6).

To improve sexual risk reduction interventions, it is necessary to know who does and who does not reduce sexual risk behavior following intervention. Meta-analyses have investigated moderators of sexual risk reduction intervention effects (5, 6); these studies have found intervention effectiveness to differ based on *demographic characteristics* such as age (6, 7) and ethnicity (6, 8, 9). In addition to demographic variables, *sexual history* often

relates to changes in risk behavior following intervention. Previous research suggests that pre-intervention levels of sexual behavior may be associated with intervention success; indeed, past behavior is often the best predictor of future sexual behavior (10–13). In studies of patients at STI clinics, greater success has been found for interventions including more individuals diagnosed with STIs (6). Additionally, a meta-analysis found interventions that included more participants who engaged in sex trading were more successful in reducing the number of sexual partners (14).

Research also shows that *substance use* may interfere with intervention effectiveness. Experiments have shown that alcohol use interferes with safe sex negotiation skills and decreases safe sex intentions (15), and both alcohol and drug use are related to increased levels of sexual risk behavior (16). Additionally, *psychological antecedents* such as knowledge, attitudes, intentions, behavioral skills, and stage of change (17), which are suggested by health behavior models (18, 19), often predict sexual risk behavior (10, 19) and may be associated with intervention success. Finally, given the dyadic nature of sexual behavior (20–22), *partner characteristics* may also influence who responds to an intervention (10). For example, studies have found that individuals are less likely to use condoms with steady than casual partners (23, 24).

Despite the importance of identifying intervention responders and non-responders, only one study has documented sexual risk trajectories following a risk reduction intervention. Beadnell et al. (25) determined risk trajectories for women participating in an HIV preventive intervention, identifying a Risk Eliminator group (14% of women), a Risk Reducer group (53%), and a High Risk group (33%). These groups were differentiated by sexual history, substance use, and partner characteristics. No study has identified risk-taking trajectories among heterosexual men. Therefore, the purposes of this study were to identify trajectories of unprotected sex for heterosexual men who attended an STI/HIV prevention intervention and to examine characteristics associated with decreases in risk behavior following intervention. This research included a high-risk population of men recruited from a publicly-funded STI clinic. A wide variety of predictors suggested by previous research were examined, including demographics, sexual history, substance use, psychological antecedents (such as attitudes and behavioral skills), and partner characteristics.

METHODS

Participants and Procedures

Participants were 210 heterosexual men (76% African American; $M_{\text{age}} = 33.2$ years) receiving care at a publicly-funded STI clinic who attended an intensive sexual risk reduction intervention as part of a larger study (26, 27). To be eligible to participate, these men reported: (a) that they were age 18 or older; (b) that they engaged in sexual risk behavior (e.g., had more than one sexual partner, had a partner with risk characteristics, or used condoms inconsistently) in the past 3 months; and (c) that they were willing to be tested for HIV. Patients were excluded if they were: (a) infected with HIV; (b) impaired (e.g., due to substance use); (c) receiving inpatient substance abuse treatment; or (d) planning to move out of the area within the next year.

Eligible patients who provided written consent were asked to complete an audio-computer assisted self-interview (ACASI) on a laptop computer. Men in the current study then received STI testing and treatment; a brief, clinic-based sexual risk reduction intervention; and, within two weeks, an intensive intervention. All participants were reimbursed \$60 for their time. At 3, 6, and 12 months post-intervention, participants completed an ACASI and were reimbursed \$30. The protocol was approved by Institutional Review Boards of the participating institutions and, to protect participant privacy, a Federal Certificate of

Confidentiality was obtained. Extensive details regarding the intervention are available elsewhere (26, 27).

In addition to attending the intensive intervention, men included in the current analyses completed at least one follow-up assessment and self-identified as heterosexual. Of the 5,613 patients initially screened at the clinic, 2,683 (48%) were eligible to participate and 1483 (55% of those eligible) agreed to participate. Of those who agreed to participate, 987 (67%) were assigned to an intensive intervention, and 551 (56%) of these individuals attended their assigned intervention. Of those attending interventions, 210 (38%) were heterosexual men who participated in at least one wave of follow-up; these men constitute the current sample.

The intensive interventions required 4 hours and were conducted at the STI clinic. Workshops were led by male and female co-facilitators (at least one of whom was African-American and one of whom was a professional), who received training and ongoing supervision. Both interventions followed a detailed manual (available from the authors). One intervention was information-focused (e.g., information about HIV/STI transmission, prevention, testing, and treatment) whereas the other intervention involved information, motivational, and skills components, guided by the information-motivation-behavioral skills (IMB) model (28, 29), and adapted from empirically-validated interventions (30–34). Participants in these interventions reported fewer sexual partners, fewer episodes of unprotected sex, and a lower percentage of unprotected sexual events at 3, 6, and 12 month follow-ups than they did at baseline (26). Previous analyses showed no differences between the two intervention conditions, and thus we combined participants in both conditions for the current analyses. Further information on these interventions is provided elsewhere (26, 27).

Measures: Outcome

Unprotected sex (past 3 months) was assessed by asking participants how many times they had engaged in vaginal or anal sex without a condom, separately for steady and non-steady partners. Responses were summed to create a count of unprotected sexual events in the past 3 months.

Measures: Predictors

Demographic and background variables—At study enrollment, patients reported their age and indicated the racial or ethnic group with which they most closely identified. They also indicated their level of education, annual income, and whether they were currently employed using categorical response options.

Intervention condition—Participants attended either an information-only intervention or an IMB intervention; a dummy variable indicated whether they had attended the information intervention.

Sexual history—Participants reported their age when they first had vaginal sex and the number of partners with whom they had sex in their lifetime. At study enrollment, patients were tested for STIs (including Chlamydia, gonorrhea, and trichomoniasis); a dummy variable indicated whether they tested positive. Participants reported the number of times in their lifetime they had engaged in sex in order to get money, drugs, food, or a place to stay and the number of times in their lifetime they had given someone else money, drugs, food, or a place to stay in exchange for sex; these variables were recoded to indicate whether each participant had ever engaged in sex for money or exchanged money for sex. Participants reported whether they had been forced to engage in sexual behavior during the past year.

Childhood sexual abuse was coded based on a series of questions about childhood experiences; participants who reported oral, vaginal, or anal sex before age 13 with someone 5 or more years older, between ages 13 and 16 with someone 10 or more years older, or before age 17 involving force were considered to have experienced childhood sexual abuse.

Substance use—Participants reported the largest number of alcoholic beverages they had consumed on any single day during the past 3 months. They also reported whether they had used eight illegal drugs in the past 3 months, and a variable was created indicating whether they had used drugs. Finally, participants reported the frequency with which they used alcohol and drugs prior to sex during the past 3 months with steady partners and other partners on a scale from “never” to “almost always”; dummy variables indicated whether they ever did so.

Stage of change—To assess individual readiness to change their condom use (35), participants indicated how they felt about using condoms every time with every partner on a scale from 1 (“I see no need to use condoms every time with every partner”) to 6 (“I have been using condoms every time with every partner for more than 6 months”).

Knowledge—HIV knowledge was assessed using the Brief HIV Knowledge Questionnaire (HIVKQ-18) (36). Items assess knowledge about HIV transmission, condom use, and signs and symptoms of HIV (e.g., ‘Can a woman get HIV if she has anal sex with a man?’). Participants responded by choosing “yes,” “no,” or “I don’t know.” Correct responses were coded as 1 and incorrect or uncertain responses were coded as 0. Higher scores indicated greater knowledge ($\alpha = .79$).

Condom attitudes—Condom attitudes were assessed using five items (e.g., ‘Sex with a condom can still be pleasurable’) adapted from published scales (37, 38). Response options ranged from “strongly disagree” to “strongly agree.” Items were averaged, with higher scores indicating more positive attitudes ($\alpha = .69$).

Condom use intentions—Intentions were assessed using one item in response to a scenario: “I would refuse to have sex if we didn’t use a condom.” Participants rated their intentions using a four-point scale ranging from “definitely no” to “definitely yes.”

Behavioral skills—Behavioral skills were measured using seven items (e.g., ‘I refused to have sex with my partner unless a condom was used’) from the Condom Influence Strategy Questionnaire (CISQ) (21). Response choices were on a five-point scale ranging from “never” to “almost always.” Items were averaged, with higher scores indicating the use of more skills ($\alpha = .89$).

Partner characteristics—Participants reported whether they had a steady partner in the past 3 months. If they did have a steady partner, they reported whether they thought their partner had other partners, with response options of “yes,” “no,” and “I don’t know.” This variable was recoded to indicate if the steady partner may have other partners (0 = no, 1 = yes or don’t know). A variable was created indicating whether there was a change in partner status between baseline and follow-up points; participants were coded as having experienced a change in partner status if they reported a steady partner at baseline but not at some later point or no steady partner at baseline but a steady partner at some later point. Finally, participants reported whether they had been physically abused (hit, kicked, punched, or otherwise hurt) or threatened by a partner in the past year.

Data Management and Analysis

All variables were examined for univariate and multivariate outliers by inspecting box plots and examining the Mahalanobis distance statistic (δ^2). Univariate outliers (i.e., those more than three times the interquartile range from the 75th percentile) were truncated to three times the interquartile range from the 75th percentile plus one (39). Two multivariate outliers were identified and removed from the sample. Data that were non-normally distributed (i.e., unprotected sex, age, number of lifetime partners, peak alcohol consumption) were transformed using a natural log transformation. We made use of a full-information maximum-likelihood (FIML) estimator in MPlus (the ML estimator) (40). The FIML approach provides reasonable estimates of standard errors with missing data (41) and allows for the use of all available data.

Growth mixture modeling (GMM) (42) in MPlus was used to identify trajectories of change over time. The outcome examined was the number of episodes of unprotected sex. GMM is a method for identifying unobserved groups using longitudinal data and provides an empirical basis for determining the number of classes that best fit the data. This method can divide a heterogeneous population into more homogeneous subpopulations (43). Piecewise trajectories with separate slopes representing change from baseline to 3 months and from 3 to 12 months were utilized, because previous work had shown change to be greatest immediately following the intervention (26). Model solutions were evaluated primarily on the basis of the Bayesian information criterion (BIC) (44, 45), which performs better than other information criteria in identifying the appropriate number of latent classes (45). Better fitting models are indicated by lower BIC values. A secondary indicator considered was the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (LMRT) (46), which is used to compare a solution with more classes to one with fewer. A significant LMRT indicates that the target solution fits the data better than the solution with one fewer class. Following class assignment, *t*-tests and chi-square tests examined differences between classes.

RESULTS

Sample Characteristics

Descriptive statistics (Table 1) showed high levels of risk behavior, with participants reporting nearly 40 past sexual partners on average and many participants reporting use of illegal drugs (68%), use of alcohol or other drugs prior to sex (64% and 47% respectively), steady partners who have other sexual partners (56% of those with steady partners), a history of childhood sexual abuse (52%), and paying for sex (40%). Additionally, 23% of the sample tested positive for an STI at baseline. Overall, men reported an average of 17.97 acts of unprotected sex in the past 3 months at baseline ($SD = 21.32$, range = 0–84), 12.05 at the 3 month follow-up ($SD = 16.62$, range = 0–58), 12.33 at the 6 month follow-up ($SD = 17.48$, range = 0–62), and 14.35 at the 12 month follow-up ($SD = 19.02$, range = 0–70).

Missing Data

All men included in the current analyses completed a baseline assessment along with at least one wave of follow-up. None of the men were missing baseline reports of unprotected sex. Nineteen (9%) were missing 3 month reports, 21 (10%) were missing 6 month reports, and 43 (21%) were missing 12 month reports. There were no differences in number of unprotected sex acts at baseline between those who provided data at all four time points ($N = 149$) and those who provided data at two or three time points ($N = 61$), $t(208) = -1.13$, $p = .26$. Men with some missing data were slightly younger than those without missing data, $t(208) = -3.37$, $p = .001$, and were less likely to be unemployed, $\chi^2(1) = 4.57$, $p < .05$. They were also more likely to identify as Latino, $\chi^2(1) = 5.30$, $p < .05$, or “Other” ethnicities, $\chi^2(1) = 17.81$, $p < .001$, and less likely to identify as Black, $\chi^2(1) = 4.30$, $p < .05$. Use of the

FIML estimator allowed for use of all available data from men completing at least two assessments.

Risk Trajectories

GMM was used to examine the log transformed number of unprotected sex acts (past 3 months) measured at baseline (pre-intervention), 3, 6, and 12 months. The two-class solution had a lower BIC (2422.93) than did the one-class solution (2446.95); including a third class did not improve the BIC (2420.99; guidelines suggest a drop of at least 5 is necessary for the more complex model to be favored) (47). Similarly, the LMRT indicated that the two-class solution improved fit over the one-class solution, $LMRT = 43.41$, $p < .001$, and that a three-class solution did not improve on the two-class solution, $LMRT = 22.31$, $p = .20$. With both indicators in agreement, the two-class solution (Figure 1) was selected as the best fitting model.

Class 1 (“Risk Reducers,” 46% of the sample, $n = 97$) showed decreases in unprotected sex following the intervention, whereas Class 2 (“Risk Maintainers,” 54% of the sample, $n = 113$) maintained high levels of unprotected sex throughout the study. For Risk Reducers, repeated measures ANOVAs (Table 2) showed a significant decrease in unprotected sex acts between baseline and 3 months, followed by a significant increase between 3 months and 6 months. This group reported approximately 10 unprotected sex acts over the past 3 months at baseline and 1 unprotected sex act following intervention (at 3 months); they had returned to 4 unprotected sex acts by 12 months. For Risk Maintainers, there was no significant change in number of unprotected sex acts over time (Table 2); they reported between 21 and 26 unprotected sex acts on average in the past 3 months throughout the study. There were significant differences in the number of unprotected sex acts between Risk Reducers and Risk Maintainers at all time points, including baseline (all $ps < .001$).

Predictors of Risk Trajectories

Group comparisons are detailed in Table 3.

Demographic characteristics—No differences were observed between trajectory groups on age, race, education, income, or unemployment.

Intervention condition—No differences were observed between trajectory groups in terms of intervention condition, with 63% of Risk Reducers and 53% of Risk Maintainers attending the information intervention.

Sexual history—Risk Maintainers were more likely than Risk Reducers (27% vs. 10%) to have exchanged sex for money or drugs. They were also more likely to report forced sex during the past year (14% vs. 3%). There were no differences between groups in age at first sex, number of lifetime sexual partners, history of exchanging money for sex, or childhood sexual abuse.

Substance use—Risk Maintainers reported higher peak alcohol use during the past 3 months than did Risk Reducers (a mean of 5.02 vs. 4.13 alcoholic beverages in a single day). They were also more likely to report alcohol use prior to sex during the past 3 months (67% vs. 41%). There were no significant differences in illegal drug use or the use of drugs prior to sex.

Psychological characteristics—Risk Reducers scored higher than did Risk Maintainers in stage of change for consistent condom use and they reported higher levels of condom

skills at baseline. The two groups did not differ in terms of condom attitudes, condom use intentions, or HIV knowledge (Table 2).

Partner characteristics—Risk Maintainers were more likely to report having a steady partner at baseline than were Risk Reducers (83% vs. 62%). In contrast, Risk Reducers were more likely to report (a) that their steady partners may have other partners than Risk Maintainers (68% vs. 49%) and (b) a change in partner status (i.e., a new steady partner or the loss of a steady partner) following the intervention than Risk Maintainers (67% vs. 41%). There were no differences in terms of partner abuse or threat in the past year.

DISCUSSION

Using data collected from a high-risk sample of men attending intensive sexual risk reduction interventions, we identified two risk trajectory groups for heterosexual men. One group (Risk Reducers, 46% of the sample) changed behavior following the intervention, reporting lower levels of unprotected sex at 3, 6, and 12 months than at baseline. The other group (Risk Maintainers, 54% of the sample) reported high levels of unprotected sex both before and after intervention, with no significant changes in unprotected sex throughout the study. There were no demographic differences between men in these two groups, and no differences based on the particular intervention they received. However, the groups differed in terms of sexual history, alcohol use, psychological characteristics, and partner characteristics.

Men in the Risk Maintainers group were more likely to report having engaged in sex work and forced sex in the past year than men in the Risk Reducers group. This finding is consistent with studies identifying sex work (48–50) and rape (51, 52) as predictors of risky sexual behavior, although most studies of these factors have focused on heterosexual women or gay men. Additionally, a study examining risk trajectories for women found that those with consistently high risk were more likely to have recent paying partners and to have been raped as adults (25). Our results suggest that sex work and rape are also risk factors for heterosexual men, and that the presence of these factors might indicate the need for more intensive or tailored risk reduction interventions to address these participant characteristics and life experiences.

Men in the Risk Maintainers group also reported higher levels of alcohol use and a greater co-occurrence of alcohol use and sex than men in the Risk Reducers group. Substance use has frequently been identified as an important factor in HIV risk behavior (15, 16, 53). Beadnell et al. (25) found that high risk women also reported higher levels of alcohol use than did women responding to a risk reduction intervention; our results suggest that the same pattern is evident for men. Alcohol use may interfere with implementation of skills learned in interventions—for example, alcohol myopia theory suggests that intoxication will make individuals more likely to practice unsafe sex when impelling cues (e.g., attractive partners) are present (54). In the context of an intervention, alcohol use may also adversely affect motivation to change behavior or information processing.

In terms of psychological characteristics, men in the Risk Reducers group were more ready to use condoms consistently and reported higher levels of behavioral skills at baseline. Stronger readiness to change (55) and better behavioral skills (19) often positively correlate with condom use. Additionally, behavioral skills are frequently targeted by interventions (5, 19). Our results suggest that baseline readiness to change and behavioral skills may differentiate those who show changes in risk behavior following an intervention and those who do not. Unfortunately, those who are less ready to change and possess fewer skills—

presumably those most in need of intervention—may need more than a traditional sexual risk reduction intervention.

Finally, men in the two trajectory groups reported different partner characteristics. Risk Reducers were less likely to report steady partners at baseline, more likely to report that their steady partners may have other partners, and more likely to change their partner status over the course of the study than Risk Maintainers. This pattern suggests that partner characteristics influence men's sexual risk behavior following a risk reduction intervention. Studies have found that individuals are less likely to use condoms with steady than casual partners (23, 24). Men with steady partners may not believe they are at risk for HIV or STIs (56); such men may be less likely to change their behavior following an intervention. Men who have steady partners might also have a harder time implementing what they learn in interventions because they may have established patterns of behavior with their partners and introducing condom use may undermine trust. Ending an existing relationship or beginning a new relationship may provide a “fresh start,” allowing men to begin using condoms more consistently (57). These results also suggest that men who recognize their vulnerability (e.g., men who know their steady partners have other partners) might protect themselves more consistently and be more likely to reduce the amount of unprotected sex in which they engage following an intensive intervention. Although STI testing and mutual monogamy may serve as an alternative method of risk-reduction, very few men in our sample ($N = 11$, 5%) reported a single partner who did not have other partners and who they believed to be HIV negative. Therefore, increasing condom use among men with steady partners should remain a goal.

These findings have important implications for intervention development. Nearly half of men showed reduced levels of unprotected sex following an intensive intervention. However, the other half of our sample showed no reduction in sexual risk behavior over time. These men were also those higher in risk initially, and they were differentiated by a number of risk factors, including a history of sex work and forced sex and substance use. Men with these risk factors may need specially targeted (and/or more intensive) interventions. For example, it may be helpful to add a substance use component to sexual risk reduction interventions—some research has found that a substance use intervention alone may reduce sexual risk behavior (31, 58, 59), while other studies have found success for combined interventions targeting both sexual and alcohol-related risk-taking (60).

Risk Maintainers were also differentiated from Risk Reducers by a variety of partner characteristics. That Risk Maintainers were more likely to report steady partners and less likely to change partner status during the study suggests that interventions may need to provide additional guidance for increasing safer sex behavior with established partners or include partners in intervention activities, moving beyond purely individual-level theories and interventions (61). Further research is needed to determine the types of interventions that would benefit men who do not change behavior following typical sexual risk reduction interventions.

This study had several limitations. First, the current analyses included only heterosexual men from a high-risk sample recruited at a community STI clinic. This population is important to focus on, given that many previous studies have focused on women (25) or gay men (62). However, results from this sample cannot be generalized to all men. Second, risk trajectories were based only on number of unprotected sexual acts. Unprotected sexual acts are believed to be a valid measure of risk (63), but there are alternative measures of sexual risk (e.g., number of partners) that future studies might consider. Third, the changes in sexual risk behavior observed among the “Risk Reducers” cannot definitively be attributed to their participation in the intervention; any one of a number of factors, such as the time and

attention they received from participating in a study, receipt of sexual health services at the clinic, or the fact that they were less risky at baseline and were perhaps already in the process of reducing their risk at enrollment, could have led to the reduction in sexual risk behaviors we observed in that group.

In conclusion, this study uses GMM to identify risk trajectories for heterosexual men following attendance at an intensive risk reduction intervention, building on previous studies that have identified risk trajectories for women (25). Results suggest that some men show reduced risk behavior following intervention, while others maintained high levels of risk behavior over time. Consideration of baseline characteristics differentiating those who change behavior and those who do not may help in designing more effective interventions for men.

Acknowledgments

Funding: This study was supported by grant R01-MH068171 from the Center for Mental Health Research on AIDS, National Institute of Mental Health to Michael P. Carey.

References

1. CDC. HIV prevalence estimates--United States, 2006. *MMWR*. 2009; 57(39):1073–1076.
2. Hall HL, Song R, Rhodes P, Prejean J, An Q, Lee LM, et al. Estimation of HIV incidence in the United States. *JAMA*. 2008; 300(5):520. [PubMed: 18677024]
3. Weinstock H, Berman S, Cates W. Sexually transmitted diseases among American youth: Incidence and prevalence estimates, 2000. *Perspect Sex Reprod Health*. 2004 Jan-Feb;36(1):6–10. [PubMed: 14982671]
4. CDC. Atlanta: National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention; 2009. 2007 disease profile.
5. Noar SM. Behavioral interventions to reduce HIV-related sexual risk behavior: Review and synthesis of meta-analytic evidence. *AIDS Behav*. 2008; 12(3):335–353. [PubMed: 17896176]
6. Scott-Sheldon LAJ, Fielder RL, Carey MP. Sexual risk reduction interventions for patients attending sexually transmitted disease clinics in the United States: A meta-analytic review, 1986 to early 2009. *Ann Behav Med*. 2010; 40(2):191–204. [PubMed: 20652778]
7. Johnson BT, Carey MP, Chaudoir SR, Reid AE. Sexual risk reduction for persons living with HIV: Research synthesis of randomized controlled trials, 1993–2004. *J Acquir Immune Defic Syndr*. 2006; 41(5):642–650. [PubMed: 16652039]
8. Albarracin J, Albarracin D, Durantini M. Effects of HIV-prevention interventions for samples with higher and lower percents of Latinos and Latin Americans: A meta-analysis of change in condom use and knowledge. *AIDS Behav*. 2008; 12(4):521–543. [PubMed: 17265011]
9. Prendergast ML, Urada D, Podus D. Meta-analysis of HIV risk-reduction interventions within drug abuse treatment programs. *J Consult Clin Psychol*. 2001; 69(3):389–405. [PubMed: 11495169]
10. Sheeran P, Abraham C, Orbell S. Psychosocial correlates of heterosexual condom use: A meta-analysis. *Psychol Bull*. 1999 Jan; 125(1):90–132. [PubMed: 9990846]
11. Bagozzi RP, Kimmel SK. A comparison of leading theories for the prediction of goal-directed behaviours. *Br J Soc Psychol*. 1995 Dec;34:437–461.
12. Conner M, Armitage CJ. Extending the theory of planned behavior: A review and avenues for further research. *J Appl Soc Psychol*. 1998 Aug 15; 28(15):1429–1464.
13. Yzer MC, Siero FW, Buunk BP. Bringing up condom use and using condoms with new sexual partners: Intentional or habitual? *Psychology & Health*. 2001; 16(4):409–421.
14. Smoak ND, Scott-Sheldon LAJ, Johnson BT, Carey MP, Team SR. Sexua risk reduction interventions do not inadvertently increase the overall frequency of sexual behavior: A meta-analysis of 174 studies with 116,735 participants. *J Acquir Immune Defic Syndr*. 2006 Mar; 41(3): 374–384. [PubMed: 16540941]

15. Maisto SA, Carey MP, Carey KB, Gordon CM, Schum JL, Lynch KG. The relationship between alcohol and individual differences variables on attitudes and behavioral skills relevant to sexual health among heterosexual young adult men. *Arch Sex Behav.* 2004; 33(6):571–584. [PubMed: 15483371]
16. Weinhardt LS, Carey MP, Carey KB, Maisto SA, Gordon CM. The relation of alcohol use to HIV-risk sexual behavior among adults with a severe and persistent mental illness. *J Consult Clin Psychol.* 2001 Feb; 69(1):77–84. [PubMed: 11302280]
17. Prochaska JO. Decision making in the transtheoretical model of behavior change. *Med Decis Making.* 2008 Nov; 28(6):845–849. [PubMed: 19015286]
18. Ajzen I. The Theory of Planned Behavior. *Organ Behav Hum Decis Process.* 1991 Dec; 50(2): 179–211.
19. Fisher, JD.; Fisher, WA.; Shuper, PA. The Information–Motivation–Behavioral Skills model of HIV preventive behavior. In: DiClemente, RJ.; Crosby, RA.; Kegler, MC., editors. *Emerging theories in health promotion practice and research.* San Francisco: Jossey-Bass; 2009. p. 21-63.
20. Amaro H. Love, sex, and power: Considering women's realities in HIV prevention. *Am Psychol.* 1995 Jun; 50(6):437–447. [PubMed: 7598292]
21. Noar SM, Morokoff PJ, Harlow LL. Condom negotiation in heterosexually active men and women: Development and validation of a condom influence strategy questionnaire. *Psychology & Health.* 2002; 17(6):711–735.
22. Noar SM, Morokoff PJ, Harlow LL. Condom influence strategies in a community sample of ethnically diverse men and women. *J Appl Soc Psychol.* 2004; 34(8):1730–1751.
23. Macaluso M, Demand MJ, Artz LM, Hook EW III. Partner type and condom use. *AIDS.* 2000; 14(5):537–546. [PubMed: 10780716]
24. Cooper ML, Orcutt HK. Alcohol use, condom use and partner type among heterosexual adolescents and young adults. *J Stud Alcohol Drugs.* 2000; 61(3):413.
25. Beadnell B, Baker SA, Morrison DM, Huang B, Stielstra S, Stoner S. Change trajectories in women's STD/HIV risk behaviors following intervention. *Prev Sci.* 2006 Sep; 7(3):321–331. [PubMed: 16802194]
26. Carey MP, Senn TE, Venable PA, Coury-Doniger P, Urban MA. Brief and intensive behavioral interventions to promote sexual risk reduction among STD clinic patients: Results from a randomized controlled trial. *AIDS Behav.* 2010; 14(3):504–517. [PubMed: 19590947]
27. Carey MP, Venable PA, Senn TE, Coury-Doniger P, Urban MA. Evaluating a two-step approach to sexual risk reduction in a publicly-funded STI clinic: Rationale, design, and baseline data from the Health Improvement Project-Rochester (HIP-R). *Contemp Clin Trials.* 2008 Jul; 29(4):569–586. [PubMed: 18325853]
28. Fisher, JD.; Fisher, WA. Theoretical approaches to individual-level change in HIV risk behavior. In: Peterson, JL.; DiClemente, RJ., editors. *Handbook of HIV prevention.* New York: Kluwer Academic/Plenum; 2000. p. 3-55.
29. Fisher JD, Fisher WA. Changing AIDS risk behavior. *Psychol Bull.* 1992 May; 111(3):455–474. [PubMed: 1594721]
30. Carey MP, Braaten LS, Maisto SA, Gleason JR, Forsyth AD, Durant LE, et al. Using information, motivational enhancement, and skills training to reduce the risk of HIV infection for low-income urban women: A second randomized clinical trial. *Health Psychol.* 2000 Jan; 19(1):3–11. [PubMed: 10711582]
31. Carey MP, Carey KB, Maisto SA, Gordon CM, Schroder KEE, Venable PA. Reducing HIV-risk behavior among adults receiving outpatient psychiatric treatment: Results from a randomized controlled trial. *J Consult Clin Psychol.* 2004 Apr; 72(2):252–268. [PubMed: 15065959]
32. Carey MP, Maisto SA, Kalichman SC, Forsyth AD, Wright EM, Johnson BT. Enhancing motivation to reduce the risk of HIV infection for economically disadvantaged urban women. *J Consult Clin Psychol.* 1997 Aug; 65(4):531–541. [PubMed: 9256553]
33. Celentano DD, Dilorio C, Hartwell T, Kelly J, Magana R, Maibach E, et al. The NIMH multisite HIV prevention trial: Reducing HIV sexual risk behavior. *Science.* 1998 Jun 19; 280(5371):1889–1894. [PubMed: 9632382]

34. Center for AIDS Intervention Research. Partners in prevention (intervention manual). 2007
Available from: <http://www.mcw.edu/display/docid6269/PartnersinPrevention.htm>.
35. Prochaska JO, Redding CA, Harlow LL, Rossi JS, Velicer WF. The Transtheoretical Model of Change and HIV prevention: A review. *Health Educ Q*. 1994 Win;21(4):471–486. [PubMed: 7843978]
36. Carey MP, Schroder KEE. Development and psychometric evaluation of the brief HIV knowledge questionnaire. *AIDS Educ Prev*. 2002 Apr; 14(2):172–182. [PubMed: 12000234]
37. Brown IS. Development of a Scale to Measure Attitude toward the Condom as a Method of Birth-Control. *J Sex Res*. 1984; 20(3):255–263.
38. Sacco W, Levine B, Reed D, Thompson K. Attitudes about condom use as an AIDS-relevant behavior: Their factor structure and relation to condom use. *Psychol Assess*. 1991; 3(2):265–272.
39. Tabachnick, BG.; Fidell, LS. Using multivariate statistics. 5th ed.. Boston: Pearson/Allyn & Bacon; 2007.
40. Muthén BO. Multilevel covariance structure analysis. *Sociological Methods & Research*. 1994; 22(3):376–398.
41. Duncan, TE.; Duncan, SC.; Strycker, LA. An introduction to latent variable growth curve modeling: Concepts, issues, and applications. 2nd ed.. Mahwah, N.J: Lawrence Erlbaum Associates; 2006.
42. Ram N, Grimm KJ. Growth mixture modeling: A method for identifying differences in longitudinal change among unobserved groups. *International Journal of Behavioral Development*. 2009 Nov; 33(6):565–576.
43. Jung T, Wickrama KAS. An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass*. 2008; 2(1):302–317.
44. Muthén B. Statistical and substantive checking in growth mixture modeling: Comment on Bauer and Curran 2003. *Psychol Methods*. 2003 Sep; 8(3):369–377. [PubMed: 14596497]
45. Nylund KL, Asparoutiov T, Muthen BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Struct Equ Modeling*. 2007; 14(4):535–569.
46. Lo Y, Mendell NR, Rubin DB. Testing the number of components in a normal mixture. *Biometrika*. 2001; 88:767–778.
47. Jones BL, Nagin DS, Roeder K. A SAS procedure based on mixture models for estimating developmental trajectories. *Sociological Methods & Research*. 2001 Feb 1; 29(3):374–393. 2001.
48. Crofts N, Marcus L, Meade J, Sattler G. Determinants of HIV risk among men who have homosexual sex and inject drugs. *AIDS Care*. 1995; 7(5):647–655. [PubMed: 8652699]
49. Baseman J, Ross M, Williams M. Sale of sex for drugs and drugs for sex: an economic context of sexual risk behavior for STDs. *Sex Transm Dis*. 1999; 26(8):444. [PubMed: 10494935]
50. Burt RD, Thiede H, Barash ET, Sabin K. Recent condom use by arrested injection drug users in King County, Washington, USA. *International Journal of Drug Policy*. 2006; 17(3):222–229.
51. Wingood GM, DiClemente RJ. Rape among African American women: Sexual, psychological, and social correlates predisposing survivors to risk of STD/HIV. *J Womens Health*. 1998; 7(1):77–84. [PubMed: 9511135]
52. Nilsson U, Hellberg D, Shoubnikova M, Nilsson S, Mardh P-A. Sexual behavior risk factors associated with bacterial vaginosis and chlamydia trachomatis infection. *Sex Transm Dis*. 1997; 24(5):241–246. [PubMed: 9153730]
53. Purcell DW, Parsons JT, Halkitis PN, Mizuno Y, Woods WJ. Substance use and sexual transmission risk behavior of HIV-positive men who have sex with men. *J Subst Abuse*. 2001; 13(1–2):185–200. [PubMed: 11547619]
54. MacDonald TK, Fong GT, Zanna MP, Martineau AM. Alcohol myopia and condom use: Can alcohol intoxication be associated with more prudent behavior? *J Pers*. 2000; 78(4):605–619.
55. Noar SM, Morokoff PJ, Redding CA. An examination of transtheoretical predictors of condom use in late-adolescent heterosexual men. *Journal of Applied Biobehavioral Research*. 2001; 6(1):1–26.
56. Pilkington CJ, Kern W, Indest D. Is safer sex necessary with a "safe" partner? Condom use and romantic feelings. *J Sex Res*. 1994; 31(3):203–210.

57. Ku L, Sonenstein FL, Pleck JH. The dynamics of young men's condom use during and across relationships. *Fam Plann Perspect.* 1994; 26(6):246–251. [PubMed: 7867771]
58. Avins AL, Lindan CP, Woods WJ, Hudes ES, Boscarino JA, Kay J, et al. Changes in HIV-related behaviors among heterosexual alcoholics following addiction treatment. *Drug Alcohol Depend.* 1997; 44(1):47–55. [PubMed: 9031820]
59. Eldridge GD, St Lawrence JS, Little CE, Shelby MC, Brasfield T. Evaluation of an HIV risk reduction intervention for women entering inpatient substance abuse treatment. *AIDS Educ Prev.* 1997; 9(1):62–76. [PubMed: 9083599]
60. Schmiege SJ, Broaddus MR, Levin M, Bryan AD. Randomized trial of group interventions to reduce HIV/STD risk and change theoretical mediators among detained adolescents. *J Consult Clin Psychol.* 2009 Feb; 77(1):38–50. [PubMed: 19170452]
61. Johnson BT, Redding C, DiClemente R, Mustanski B, Dodge B, Sheeran P, et al. A network-individual-resource model for HIV prevention. *AIDS Behav.* 2010; 14 S:204–21.
62. Roffman RA, Downey L, Beadnell B, Gordon JR, Craver JN, Stephens RS. Cognitive-behavioral group counseling to prevent HIV transmission in gay and bisexual men: Factors contributing to successful risk reduction. *Research on Social Work Practice.* 1997; 7(2):165–186.
63. Fishbein M, Pequegnat W. Evaluating AIDS prevention interventions using behavioral and biological outcome measures. *Sex Transm Dis.* 2000 Feb; 27(2):101–110. [PubMed: 10676977]

Figure 1.
Trajectories of unprotected sex for men participating in a sexual risk reduction intervention.

Table 1

Descriptive Statistics for Predictor Variables

	M (SD) / %	Range (Observed)
Demographics		
Age	33.2 (11.1)	18–62
Latino	6%	
Black	77%	
Other Ethnicity	9%	
Education: High School or Less	62%	
Income: \$15,000 or Less	55%	
Unemployed	56%	
Intervention Condition		
Attended Info Intervention	58%	
Sexual History (Baseline)		
Age of First Sex	14.57 (3.24)	4–26
Number of Life Partners	39.28 (36.56)	1–139
Tested Positive for STI	23%	
Ever Engaged in Sex Work	20%	
Ever Paid for Sex	40%	
Sex by Force in Past Year	9%	
Childhood Sexual Abuse	52%	
Substance Use (Baseline)		
Peak Alcohol Use	4.61 (4.99)	0–24
Use of Illegal Drugs	68%	
Co-Occurrence of Alcohol and Sex	64%	
Co-Occurrence of Drugs and Sex	47%	
Psychological Antecedents (Baseline)		
Stage of Change (1–6)	2.56 (1.11)	1–6
Condom Attitudes (1–6)	4.21 (1.00)	1.58–6
Condom Use Intentions (1–4)	3.08 (.99)	1–4
Behavioral Skills (1–5)	2.33 (1.13)	1–5
Knowledge (0–18)	13.50 (3.78)	2–18
Partner Characteristics		
Steady Partner (Baseline)	73%	
Steady Partner Has Other Partners (Baseline) ^f	56%	
Change in Partner Status After Intervention	54%	
Partner Abuse or Threat in Past Year (Baseline)	12%	

Notes:

¹Percentage of those reporting a steady partner at baseline.

Table 2
Number of Unprotected Sexual Acts Over Time for Risk Reducers and Risk Maintainers

	Baseline	3 month	6 month	12 month	F
Risk Reducers (N=97)	10.29 (1.76) ^a	.80 (.15) ^b	2.87 (.71) ^c	4.33 (.95) ^c	29.52***
Risk Maintainers (N=113)	25.59 (2.56)	21.21 (2.00)	22.43 (2.29)	23.55 (2.46)	.96

Tests were performed on log-transformed values, but untransformed values are reported for interpretability. Repeated-measures ANOVA tests change over time within each group. Different subscripts indicate significant differences between means according to Scheffé post-hoc tests.

 $p < .001$

Table 3
T-tests and Chi-Square Tests Comparing Risk Reducer and Risk Maintainer Trajectory Groups

	Risk Reducers	Risk Maintainers	t	χ^2	df
Demographics					
Age (Log)	3.46 (.34)	3.44 (.32)	.63		208
Latino	5%	6%		.11	1
Black	77%	76%		.04	1
Other Ethnicity	8%	9%		.02	1
Education: High School or Less	63%	62%		.02	1
Income: \$15,000 or Less	56%	55%		.01	1
Unemployed	56%	56%		.00	1
Intervention Condition					
Attended Info Intervention	63%	53%		2.05	1
Sexual History (Baseline)					
Age of First Sex	14.53 (2.94)	14.60 (3.48)	-.15		204
Number of Life Partners (Log)	1.42 (.43)	1.43 (.39)	-.21		208
Tested Positive for STI	26%	20%		.87	1
Ever Engaged in Sex Work	10%	27%		9.74**	1
Ever Paid for Sex	34%	45%		2.62	1
Sex by Force in Past Year	3%	14%		7.77**	1
Childhood Sexual Abuse	54%	51%		.12	1
Substance Use (Baseline)					
Peak Alcohol Use (Log)	1.18 (1.00)	1.44 (.92)	-1.98*		197.36
Use of Illegal Drugs	65%	70%		.59	1
Co-Occurrence of Alcohol and Sex	55%	72%		6.57**	1
Co-Occurrence of Drugs and Sex	42%	50%		1.40	1

	Risk Reducers	Risk Maintainers	t	χ^2	df
Psychological Variables (Baseline)					
Stage of Change	2.79 (1.18)	2.36 (1.01)	2.85**		208
Condom Attitudes	4.30 (1.06)	4.14 (.95)	1.13		208
Condom Use Intentions	3.11 (.95)	3.05 (1.03)	.44		208
Behavioral Skills	2.65 (1.17)	2.07 (1.02)	3.84***		208
HIV Knowledge	13.58 (3.61)	13.42 (3.93)	.29		206
Partner Characteristics					
Steady Partner (Baseline)	62%	83%		12.14***	1
Steady Partner Has Other Partners (BL) [/]	68%	49%		5.61*	1
Change in Partner Status After Intervention	47%	26%		10.76***	1
Partner Abuse/Threat in Past Year (BL)	11%	12%		.06	1

 $p < .001$

**
 $p < .01$

*
 $p < .05$

Notes:

[/] Percentage of those reporting a steady partner at baseline.