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A Test of Major Assumptions About Behavior Change: A Comprehensive Look at the Effects of Passive and Active HIV-Prevention Interventions Since the Beginning of the Epidemic

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Abstract

This meta-analysis tested the major theoretical assumptions about behavior change by examining the outcomes and mediating mechanisms of different preventive strategies in a sample of 354 HIV-prevention interventions and 99 control groups, spanning the past 17 years. There were 2 main conclusions from this extensive review. First, the most effective interventions were those that contained attitudinal arguments, educational information, behavioral skills arguments, and behavioral skills training, whereas the least effective ones were those that attempted to induce fear of HIV. Second, the impact of the interventions and the different strategies behind them was contingent on the gender, age, ethnicity, risk group, and past condom use of the target audience in ways that illuminate the direction of future preventive efforts.

Keywords

behavior change; active intervention; HIV; health; communication

The development of effective health behavior interventions and adequate understanding of the processes that underlie change to risky behavior continues to top the agenda for reducing disease and death among at-risk populations. For example, infection with HIV has been diagnosed in almost 1 million people in the United States (Centers for Disease Control [CDC], 2003) as well as an estimated 40 million worldwide (UNAIDS/WHO Working Group, 2002). In some countries, the epidemic continues to escalate, and even in nations that have successfully

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curbed the spread of the disease, certain groups still show increases in infection rates (see, e.g., CDC, 2003). Given these distressing figures, it is no surprise that research on HIV prevention has become increasingly important and progressively more sophisticated. Indeed, HIV prevention presently constitutes one of the most significant paradigms for the discovery of health behavior change techniques and for the understanding of the theoretical processes that underlie such change.

In fact, the HIV epidemic of the 1980s stimulated the uniting of funds and expertise from various disciplines in the development of a shared behavior-change paradigm. As a key example, in 1992, a group of behavioral researchers joined forces—upon request from the National Institutes of Health—to develop a paradigm for behavior change that would guide research and practice in the prevention of HIV (see Fishbein et al., 1992). Various models were examined, and the key assumptions were condensed into a limited number of premises that illuminated preventive efforts.

Although the various models had independently received broad support, this support was derived almost entirely from behavior prediction studies. However, the formulation of these general assumptions contributed to the creation of a large intervention literature. As a whole, this literature offers the perfect laboratory for a more rigorous examination of the various models applied to behavior change, rather than prediction. This article presents the results of a thorough meta-analysis of HIV interventions conducted from 1985 to 2003. Our intention was to test general health-prevention premises, identify the mediators of effective interventions, and consider the applicability of interventions to populations that vary in demographic and behavioral variables that correlate with marginalization and risk for HIV.

Of course, our article complements a large quantity of prior research on the generalizability of HIV-prevention attempts. With nearly two decades of behavioral research, considerable understanding of the effects of HIV-prevention efforts comes from multisite studies and meta-analyses. For instance, at least 12 multisite trials have demonstrated significant effects of HIV-prevention programs (see CDC AIDS Community Demonstration Projects Research Group, 1999; Cottler, Leukefeld, et al., 1998; Fogarty et al., 2001; Kegeles, Hays, & Coates, 1996; Kelly et al., 1991, 1992; Kelly, Murphy, et al., 1997; Lauby, Smith, Stark, Person, & Adams, 2000; MacLachlan, Chimombo, & Mpeba, 1997; McCusker, Stoddard, Hindin, Garfield, & Frost, 1996; National Institute of Mental Health [NIMH] Multisite HIV Prevention Trial Group, 1998; O'Leary et al., 1998; Rotheram-Borus et al., 2001). Moreover, there are now several meta-analyses of the psychological outcomes of HIV prevention that illuminate the overall effects of certain types of interventions across populations. For example, intervention studies using videos for HIV education (Healton & Messeri, 1993) and interventions using techniques to strengthen behavioral skills relevant to condom use (Kalichman, Carey, & Johnson, 1996) have proven effective. In contrast, interventions that contain HIV counseling and testing (Weinhart, Carey, Johnson, & Bickham, 1999) appear to produce no overall positive increase in condom use. Likewise, communications that involve neither counseling nor behavioral training generally have no effect (Albarracín et al., 2003).[1]

Some prior meta-analyses have investigated the effects of interventions targeted to particular groups. These syntheses suggest that preventive interventions are generally effective for women (Logan, Cole, & Leukefeld, 2002; Mize, Robinson, Bockting, & Scheltema, 2002), heterosexual adults (Neumann et al., 2002), drug users (Prendergast, Urada, & Podus, 2001; Semaan et al., 2002), adolescents (B. T. Johnson, Carey, Marsh, Levin, & Scott-Sheldon, 2003; Kim, Stanton, Li, Dickersin, & Galbraith, 1997; Mullen, Ramirez, Strouse, Hedges, &

[1]Weinhart et al. (1999) as well as Albarracín et al. (2003) showed effects under some conditions. The overall effect, however, was disappointing.

Sogolow, 2002; Robin et al., 2004), and gay men (W. D. Johnson et al., 2002). To this extent, many HIV-prevention interventions have demonstrated effectiveness when analyzed across and within populations.

Despite the availability of prior meta-analyses examining the effectiveness of interventions to promote condom use, this literature suffers from three limitations. The first limitation concerns the lack of a thorough analysis comparing the effectiveness of the various intervention strategies. This deficiency is especially important when one considers that understanding the effects of the different strategies to increase condom use is critical to the development of behavior change theory and a set of rational implementation guidelines for practitioners. The aforementioned meta-analyses each concentrated on a single type of intervention and therefore do not adequately distinguish between strategic intervention approaches based on particular theoretical assumptions. Further, the only available metaanalysis to have estimated the differential effects of several types of HIV-prevention interventions (Albarracín et al., 2003) considered only communications presented to relatively passive audiences, excluding more active approaches such as clientcentered counseling, practical exercises, HIV testing, and role-playing. This is an important restriction, because the more active strategies are likely to produce the greatest increases in condom use (see J. D. Fisher & Fisher, 2000; B. T. Johnson et al., 2003; Kalichman et al., 1996; Kelly, 1995).

A second limitation of the prior meta-analytic work has been its inability to examine whether available intervention strategies, designed to affect different psychological variables such as threat or attitudes, actually influence these variables, and whether the intervention's influence or lack of influence on these mediators is responsible for the success or failure of the program to change behavior. The lack of a process analysis of the overall effects of HIV-prevention interventions is unfortunate because, as J. D. Fisher and Fisher (1992; see also Cook & Campbell, 1979) pointed out, treatments often work for reasons that the researchers do not anticipate and fail because they are unfit instantiations for the type of strategy they are supposed to model. Consequently, the present meta-analysis is the first to validate models of intervention effectiveness by looking at the sequence of psychological change that different interventions produce (e.g., attitudinal arguments should promote behavior change by first inducing procondom use attitudes, normative arguments should promote behavior change by first inducing procondom use norms, and behavioral skills training should promote behavior change by first increasing behavioral skills that promote condom use).

A third limitation concerns the generalization of specific intervention strategies to different populations. Although certain types of strategies may be differentially effective across particular audiences, current knowledge about this hypothesis is limited. For example, W. D. Johnson et al. (2002) meta-analyzed the effects of nine controlled intervention trials on the likelihood of unprotected sex for men who have sex with men, reporting that interventions promoting interpersonal skills were most effective. This work, however, could not examine whether interventions promoting behavioral skills are more, equally, or less beneficial to men who have sex with men relative to other groups, whether different genders benefit from the same or different strategies, or whether teens or adults should be approached in the same or different ways. Given this state of affairs, one objective of our meta-analysis was to investigate the generalizability of different intervention strategies to different populations, which is essential to direct future research and prevention.

To summarize, the objective of the present meta-analysis was to synthesize research on the effects of a large number of interventions conducted since the beginning of the HIV epidemic among a variety of populations, and to compare the reality of intervention effectiveness with theoretical proposals about the nature of effective interventions. To accomplish this objective, we reviewed the outcomes reported in 194 research reports spanning the years 1985 to 2003.

This collection is the most comprehensive to date, surveying 20 times as many reports as W. D. Johnson et al.'s (2002) and almost 5 times as many reports as B. T. Johnson et al.'s (2003) and Albarracín et al.'s (2003). Because of this extensive breadth, the analyses we have performed provide the most generalizable estimates of intervention outcomes available in the domain of interventions to promote condom use. Moreover, our work is both the first to examine the mediating mechanisms by which interventions have an impact and the first to estimate the generalizability of the effectiveness of certain intervention strategies across populations and settings.

Theoretical Assumptions, Intervention Strategies, and Mediating Processes

Several theoretical models that specify the motivational and cognitive antecedents of health behaviors have been advocated in the area of HIV prevention. For example, the theory of reasoned action (Fishbein & Ajzen, 1975) and the theory of planned behavior (Ajzen & Madden, 1986; for a meta-analysis, see Albarracín, Johnson, Fishbein & Muellerleile, 2001) state that protection behaviors are contingent on (a) the perceived desirability of the behavior (i.e., positive attitudes and expectancies about the behavior) and (b) the normative pressure to engage in the behavior (i.e., social norms). The theory of planned behavior also considers (c) perceptions that the behavior is easy and up to the individual (i.e., perceived behavioral control). Social–cognitive theory (Bandura, 1986, 1989, 1994) assumes that people will engage in protective behaviors when they perceive that they are capable of doing so, because self-efficacy is central to implementing behavior. Furthermore, social–cognitive theory (Bandura, 1989) and the information–motivation–behavioral skills model (J. D. Fisher & Fisher, 1992) both assume that people are more likely to perform a behavior once they acquire relevant (d) knowledge and (e) behavioral skills.

Other models have concentrated on the role of the perceived threat posed by a health problem and advanced conflicting predictions. On the one hand, the health belief model (Janz & Becker, 1984; Rosenstock, 1974; Rosenstock, Strecher, & Becker, 1994) and the protection motivation theory (Floyd, Prentice-Dunn, & Rogers, 2000; Rogers, 1975) hypothesize that people are motivated to initiate healthy behaviors when they (f) fear the severity of the disease and (g) believe that they are personally susceptible to it (but see Gerrard, Gibbons, & Bushman's [1996] null metaanalytic findings). On the other hand, Rothman and Salovey (1997) have proposed and demonstrated that threatening (*loss-framed*) persuasive messages are effective only when the target behavior consists of avoiding a risk factor (e.g., avoiding sun exposure). The same messages, however, are presumably detrimental when one wishes to promote a proactive measure (e.g., using sunscreen).

As Fishbein and his colleagues (Fishbein et al., 1992, 1993, 1995; see also Albarracín, Fishbein, & Middlestadt, 1998) observed, all of these theories suggest a number of different intervention strategies that can be expected to change behavior. Each strategy dictates the particular types of content of an intervention and the ways in which the intervention affects behavior. Interventions that attempt to modify attitudes and norms usually consist of assertions that the behavior being advocated has personally or socially beneficial consequences (see Ajzen & Fishbein, 1980). For example, large-scale projects launched by the CDC during the 1990s were designed to induce recipients' belief in the favorable outcomes of using condoms, including health promotion and increased psychological satisfaction (CDC, 1997; Kamb et al., 1998). Other interventions consist of normative appeals for college students (Reeder, Pryor, & Harsh, 1997) or men who have sex with men (Kelly, McAuliffe, et al., 1997; Kelly, Murphy, et al., 1997; Kelly et al., 1991), as well as interventions to convince a variety of higher risk populations that their social network supports condom use (see CDC, 1997; Kamb et al., 1998).

The information–motivation–behavioral skills model posits that information, motivation, and behavioral skills predict actual behaviors. Thus, one can take the model as suggesting three types of interventions to induce condom use, each of which targets information, motivation, or behavioral skills and can be used in combination with the other two (see J. D. Fisher & Fisher, 2000). An informational communication typically conveys structured data on the nature of HIV, modes of transmission, mechanisms of the disease, and methods of prevention (e.g., Borgia et al., 1997; Gerrard & Reis, 1989; Gillmore et al., 1997; Huszti, Clopton, & Mason, 1989; J. A. Johnson et al., 1988; Kelly, McAuliffe, et al., 1997; Kelly, Murphy, et al., 1997; O'Leary, Jemmott, Goodhart, & Gebelt, 1996; Sherr, 1987; Solomon & DeJong, 1989). Motivational interventions attempt to induce favorable attitudes as well as social norms in support of the behavior and perceived vulnerability to HIV, typically combining the strategies we discussed in the context of the theories of reasoned action and planned behavior (e.g., W. A. Fisher, Williams, Fisher, & Malloy, 1999).

According to the information–motivation–behavioral skills model, however, HIV-prevention programs are generally not successful unless they manage to increase behavioral skills as well. Thus, interventions based on this model often contain behavioral scripts about strategies that yield successful performance of the behavior. For example, a persuasive message may not only recommend condom use and mention its advantages but also describe how success in condom use depends on preparatory actions, such as carrying condoms around all the time or discussing condom use with potential partners. As another example, a widely accepted strategy is to have individuals role-play condom application or negotiation, with the idea that the behavioral practice and the instructional feedback will facilitate the acquisition of behavioral skills. In addition to teaching behavioral skills, interventions of this type presumably increase perceptions of control (i.e., perceived behavioral control and self-efficacy), which are a critical element in the theory of planned behavior and social–cognitive theory.

The health belief model and the protection motivation theory both suggest that inducing perceptions of threat concerning HIV should increase condom use, particularly when interventions also increase response efficacy (Rogers, 1975). Communications designed on this basis typically use highly emotional scare tactics in the hope that negative affect will stimulate condom use. For example, a campaign evaluated by Rigby, Brown, Anagnostou, Ross, and Rosser (1989) presented an image of the Grim Reaper as the source of an HIV-prevention message. Other, less extreme communications based on the same assumptions may describe the consequences of the disease (Goertzel & Bluebond-Langner, 1991), provide data on infection rates (Ruder, Flam, Flatto, & Curran, 1990), or conduct a detailed interview about HIV risk behaviors to sensitize participants to risk (Weinhardt, Carey, & Carey, 2000). As noted, however, these strategies may be counterproductive for proactive target behaviors like condom use.

Estimating the Impact of Different Theory-Based Strategies

As all the past theorizing on health behavior change would suggest, understanding the impact of HIV-prevention interventions requires a lot more than estimating the average impact of all available strategies on actual behavior. Instead, an adequate conceptualization must start by establishing the effectiveness of different intervention components. In this article, we synthesized research on the impact of interventions to increase condom use on (a) attitudes, (b) norms, (c) control perceptions, (d) intentions, (e) HIV knowledge, (f) behavioral skills, (g) perceived severity of HIV, (h) perceived susceptibility to HIV, and ultimately (i) condom use. In addition to summarizing the overall effects of the interventions, we obtained separate estimates of the effects of passive and active interventions. Passive interventions are characterized by the presentation of material to an audience that has minimal participation; they comprise (a) messages to induce procondom attitudes, (b) messages to induce procondom

norms, (c) messages to increase relevant knowledge, (d) messages to verbally model skills that promote condom use, and (e) messages to increase perceived threat. Active interventions generally include passive strategies as well, but their main distinguishing feature is the inclusion of client-tailored counseling, HIV testing, and/or activities to increase behavioral skills, such as role-playing of solutions for prototypical conflicts surrounding condom use. Perhaps more important, in addition to comparing the effects of passive and active approaches (with their corresponding control groups, when available), we estimated the differential effectiveness of the strategies that we previously classified as passive or active.

These analyses are essential for theory testing purposes. For example, if protection motivation theory is plausible, arguments that HIV is a threat should increase condom use if they manage to successfully sensitize the audience to the HIV threat. Similarly, if social–cognitive theory is reasonable, interventions to increase behavioral skills should be more effective when they manage to successfully increase behavioral skills. In these analyses, we also considered potential differences between designs with and without control groups, and factors related to sampling (e.g., participants of a given age, gender, or ethnicity and higher behavioral risk groups), setup of the intervention (e.g., presentation in schools and use of videotaped materials), and other features of the research design and implementation (e.g., performing formative research to adapt the intervention to the population, measuring change on the same sample instead of using between-subjects procedures). By analyzing the associations of these moderators with behavior change, we were able to estimate not only their potential impact but also the extent to which these decisions could bias the apparent effects of the different intervention strategies we summarized.

Change-Mediating Processes

The second requisite for testing theories relevant to HIV prevention is to establish whether the supposed mediating effects are present whenever an effect on behavior is present. Without this evidence, claims that certain types of interventions are effective in virtue of a set of presumed underlying psychological mechanisms are unsubstantiated. Therefore, we conducted mediation analyses (Baron & Kenny, 1986; Judd & Kenny, 1981) to determine whether the pattern of change in behavior in response to different passive and active strategies was itself predicted by changes in theoretically associated variables (e.g., attitudes, knowledge, and behavioral skills).

Generalizability of Intervention Strategies to Different Populations

Our meta-analysis also had the objective of determining the generalizability of the impact of different types of interventions to various populations. The main reason behind this objective is practicality. For example, assume that behavioral skills interventions are the most effective, regardless of the number of women, teens, heterosexuals, or drug users in the audience. Such population-independent effects would call for allocation of public health resources to refine effective techniques instead of customize interventions for specific groups. Alternatively, interpersonal skills may be effective only for women who experience greater difficulty in controlling an activity that is generally in the hands of men. For the same reason, condom use skills may be effective only for men who are generally in charge of applying and monitoring condoms. When such specificity is the case, HIV-prevention efforts should increase attention to the needs of specific groups, developing new interventions that are of use for these groups.

The second reason for investigating the generalizability of different types of strategies is of a theoretical nature. As one example, the finding that women's condom use is more influenced by perceptions of behavioral control than men's has led to speculation about the kinds of social factors that are likely to make behavioral skills interventions effective. To this extent, empirical confirmation of differences would further support that hypothesis, whereas disconfirmation

would make it more tentative. As another example, because teenagers pay greater attention to their peers' opinions than do adults (Kerr, Stattin, Bisecker, & Ferrer-Wreder, 2002), normative interventions emphasizing the use of condoms by similar others may be more effective for teens than for adults. As a result, establishing greater effectiveness of normative interventions for teens would further validate that proposition.

Yet another reason for analyzing the impact of HIV-prevention strategies across different populations is that the need for population-specific interventions has been advocated by almost every model of behavior change (see, e.g., Ajzen & Fishbein, 1980). For instance, the transtheoretical model (Prochaska, Di-Clemente, & Norcross, 1992) and the AIDS risk reduction model (Catania, Coates, & Kegeles, 1994; Catania, Kegeles, & Coates, 1990) have described a sequence of stages that go from behavior initiation to adoption to maintenance. Because interventions should match the behavioral stage of the audience, people who are not yet using condoms may become motivated if they are presented with an attitudinal or informational appeal. Later on, however, a focus on behavioral skills should facilitate movement toward the actual implementation of the recommended behavior (see Bandura, 1994, 1997; Schwarzer, 1992).

Method

Review and Inclusion Criteria

We conducted a review of reports that were available by September of 2003. First, we conducted a computerized search of MEDLINE, Psyc-INFO, ERIC, Social Science Citation Index, and Dissertation Abstracts International using a number of keywords, including *HIV (AIDS) messages, HIV (AIDS) communications, HIV (AIDS) interventions, HIV (AIDS) prevention, and health education and HIV (AIDS)*. Second, we manually searched all available issues, appearing during or after 1985, of the journals *AIDS, AIDS Education and Prevention, AIDS Research, American Behavioral Scientist, American Journal of Community Psychology, American Journal of Nursing, American Journal of Public Health, Basic and Applied Social Psychology, Communication Research, Communications, Health Communication, Health Education Quarterly, Health Education Research, Health Psychology, Journal of the American Medical Association, Journal of Applied Communication Research, Journal of Applied Social Psychology, Journal of Consulting and Clinical Psychology, Journal of Personality and Social Psychology, Journal of Sex Research, Medical Anthropology, Morbidity and Mortality Weekly Report, Qualitative Health Research,* and *Social Science and Medicine*. We also checked cross-references in the obtained reports, sent requests for information to researchers funded by the National Institutes of Health (NIH), and contacted selected experts and agencies who could provide relevant materials.

We used several eligibility criteria to gather an optimal, relatively homogeneous sample of studies that could serve our objectives well, as explained below.

1. Studies were included if they described the outcomes of an intervention to promote the use of condoms. We excluded interventions to promote safer intravenous-drug-related behaviors or abstinence from sex, except when they also included a condom use component.
2. The studies we included concerned outcomes of different types of interventions. Therefore, we included simple communications as well as interventions in which recipients engaged in behaviors as part of the intervention (i.e., role-playing, practicing condom-use-related skills, and HIV counseling and testing).
3. We included only studies that provided information to calculate the effect of interventions over time and excluded reports without a pretest. Most of the reports

obtained pre- and posttest measures on the same sample, but others used independent samples at each time (for an explanation of the advantages of the use of independent samples for longitudinal studies, see Cook & Campbell, 1979).[2]

Coding of Study Characteristics

Two independent raters coded characteristics relevant to the report and the methods used in the studies. Intercoder agreement for all categories included in the coding sheet was 85%, and intercoder reliability coefficients (kappas for categorical variables and simple correlations for continuous variables) are summarized in Table 1. Disagreements were resolved by discussion and further examination of the studies.

We coded studies for *characteristics of the report*, including the (a) publication year, (b) first author's affiliation to behavioral (e.g., psychology or social work) or medical sciences (e.g., epidemiology, community health, or medicine), (c) country of intervention, (d) state of intervention, and (e) language of intervention.

We recorded the *type of intervention and strategy* used in each case. Passive strategies included (a) attitudinal arguments, such as discussions of the positive implications of using condoms for the health of the partners and for the romantic relationship; (b) normative arguments about support of condom use provided by friends, family members, or partners; (c) factual information (i.e., mechanisms of HIV, HIV transmission, and HIV prevention); (d) arguments designed to model behavioral skills (what to do when partners do not want to use a condom, when recipients or their partners are sexually excited, and when alcohol or drugs are involved); and (e) threat-inducing arguments, such as discussions about the recipients' personal risk of contracting HIV or other sexually transmitted infections (STIs). We also recorded the use of active interventions, namely behavioral strategies to train audiences in condom-use-promoting skills and the administration of HIV counseling and testing. Strategies to induce behavioral skills comprised (f) condom use skills (e.g., practice with unwrapping and applying condoms), (g) interpersonal skills (e.g., role playing of interpersonal conflict over condom use and initiation of discussions about protection), and (h) self-management skills (e.g., practice in decision making while intoxicated, avoidance of risky situations),[3] whereas (i) HIV counseling and testing involved the administration of a seropositivity test as well as the type of counseling in place. When the counseling was described as involving specific arguments or training aspects, we coded for those in addition to noting the presence of counseling and testing. Finally, we kept a record of whether, prior to the posttest, the researchers provided research participants with condoms. On the basis of these codings, control groups were those to whom no passive or active intervention was applied, although some control participants received condoms as part of the study. These codings allowed us to establish the likely effects of each type of strategy and of mere condom provision.

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[2]A file containing 574 reports that we excluded following an examination of the actual report appears at i. http://www.psych.ufl.edu/~albarrac/ meta.htm. Of the 574 excluded papers, 18.8% were theoretical or review papers, 16.8% were surveys, 8.7% were qualitative, 15.7% reported interventions that did not target condom use, 12.5% had data on condom use interventions without a pretest, 11.9% reported otherwise usable interventions with statistics that could not be used to derive the effect sizes we needed, 12.0% reported no standardized intervention, 1.4% were not HIV related at all, and 2.1% had no outcome variable that we were interested in synthesizing.

[3]We also coded for more specific arguments within each category (e.g., normative arguments about the partner, friends, or family) as well as more specific behavioral techniques (e.g., how to initiate a dialogue with one's partner, how to resist coercion, and how to reward the partner as part of training in specific interpersonal skills) within each training strategy. These codes allowed us to construct ratings for the intensity of each strategy, and analyses were conducted with these ratings as well. The results with the dichotomous and polychotomous indexes were almost identical, suggesting that the coding of general categories, such as self-management skills, were highly compatible with the more specific categories detailing what participants were asked to do. From this perspective, we believe that our reference to different intervention strategies reflects components that were operationalized appropriately.

We also recorded *characteristics of the participants*, including demographics of the target group as well as specific characteristics and behaviors of the target group that are associated with HIV-infection risk. To describe the target population, we retrieved the (a) sample size; (b) percentage in each group that was male; (c) mean or median age; (d) percentage of participants of European, African, Latin, Asian, and AmericanIndian descents as measures of ethnic diversity;[4] (e) percentage of participants who completed at least high school; and (f) population of the city or village at the time the intervention was conducted.

To further describe the sampling of participants in relation to characteristics or behaviors associated with HIV-infection risk, we registered the (a) inclusion of behaviorally at-risk groups in each sample (i.e., men who have sex with men, intravenous drug users, partners of intravenous drug users, commercial sex workers, multiple-partner heterosexuals, participants with a history of STIs, participants with severe mental illness, drug users, college students, middle-school or high school students, and teachers). We also recorded the (b) baseline level of condom use for each sample, which we classified as low (i.e., mean of *never* or *almost never* when a subjective frequency scale was used to measure condom use, as well as 40% or less of the time when the mean percentage of condom use over intercourse occasions was reported), moderate (i.e., *sometimes* as well as 40% to 80% of the time), and high (i.e., *always* or *almost always*, as well as 80% or more of the time); (c) percentage of condom use over intercourse occasions at pretest, and (d) rate of HIV at pretest.

We coded for methodological characteristics that related to *intervention setup*. Thus, we classified each intervention group according to (a) the setting of the intervention (i.e., whether the intervention was delivered via mass media, clinics, community settings, or schools). We also recorded (b) the media selected to deliver the intervention, including face-to-face interactions and video- or audiotaped materials, (c) whether exposure to the communication was individual or in groups, (d) whether the researchers made efforts to produce a culturally appropriate intervention, and (e) the duration of the communication in hours.

Finally, we coded issues related to *research design and implementation*, including (a) whether the design was within subject or whether different samples were used at pre- and posttests; (b) whether participants were randomly assigned to conditions; (c) the amount of money (in U.S. dollars) received in exchange for participation (0 when none was mentioned); (d) the mean and median number of days between the intervention and the posttest; (e) whether the researchers acknowledged formal theory as a basis for the intervention and, if not, whether theory-relevant literature was at least cited; (f) whether there was formative research to adapt the intervention to the target population and media; and (g) whether the intervention was targeted to a specific group or attempted to reach general population recipients. When there was a specific target sample, we further recorded whether the target was a specific (h) ethnic or (i) gender group. We also coded groups that partook in the study voluntarily as (j) self-selected, relative to captive groups that had less flexibility in refusing to participate (i.e., volunteers vs. participants in classroom, inpatient units, or prison settings). Finally, we calculated (k) the percentage of attrition for each group included in the meta-analysis when sample sizes for the pre- and posttests were exactly reported.

Retrieval of Effect Sizes

Two raters calculated effect sizes independently. Disagreements were checked with a third researcher and resolved by discussion. Raters were instructed to calculate effect sizes

[4]The ethnicity data were retrieved regardless of country, except for the case of Native Americans, which were available only for North American countries. When these data were not reported and countries were highly ethnically homogeneous (e.g., certain African countries, the Netherlands, Italy), we obtained the information from population reports from those countries. The imputation of these data did not alter the findings but allowed a few additional effects to be included in those analyses.

representing change from the pretest to the most immediate posttest. Efforts were made to calculate effect sizes for all measures of the constructs of interest that each study measured. When there was more than one measure of a construct in one particular study, we first calculated effect sizes for each one and then obtained the average, which was used as the effect size for that particular variable.

To represent change from pretest to posttest measures, we used B. J. Becker's (1988) *g*, which is calculated by subtracting the mean at the posttest from the mean at the pretest and dividing the difference by the standard deviation of the pretest measure. This measure controls for the inflation in the standard deviation following treatment (for an excellent analysis of the problem, see Carlson & Schmidt, 1999). Effect sizes were also derived from exact reports of *t* tests, *F* ratios, proportions, *p* values, and confidence intervals. To derive effect sizes for within-subject studies, one needs the correlation between posttest and pretest measures. Because some reports did not offer this information, we adopted procedures recommended by B. J. Becker (1988) as well as by Dunlap, Cortina, Vaslow, and Burke (1996). We explain these procedures when they become relevant.

We also estimated effect sizes when a report contained inexactly described *p* values—such as when the authors indicated that a given finding was not significant at .05—using the appropriate within- or between-subjects procedures. Thus, a reported nonsignificant finding was estimated to have a probability of .99, whereas a significant finding was estimated to have a probability at the level of the cutoff value used in the study (e.g., .05 or .01). However, because the use of such reports may lead to incorrect estimations, we conducted separate analyses on the set of exactly reported effect sizes and all the effect sizes (including the ones estimated on the basis of inexactly reported *p* values). Because these sets of analyses yielded similar results, we report only the results that included all effect sizes.

We calculated effect sizes representing change in attitudes, norms, control perceptions, intentions, behavioral skills, knowledge, perceived severity, perceived susceptibility, and condom use behavior. We describe typical measures of each variable below.

Attitudes—Attitudes toward the behavior were typically measured with semantic differential types of scales (e.g., "Do you think using a condom every time you have vaginal sex with your main partner would be pleasant or unpleasant? And would you say it would be *extremely*, *quite*, or *slightly* (*pleasant*/*unpleasant*)?"; CDC, 1993, p. 12). Researchers sometimes obtained expectancy–value estimates of attitude by subjectively weighting the belief that a behavioral outcome will occur by the evaluative implications of that outcome (e.g., "showing that you care" or "making you worry less"; CDC, 1993, p. 3 and p. 5, respectively). Behavioral or outcome beliefs were typically measured with bipolar probability statements linking the behavior to a set of outcomes (e.g., "using a condom would take all the fun out of sex for me"; O'Leary et al., 1996), whereas outcome evaluations were measured by means of bipolar evaluative items (e.g., "becoming pregnant now would be *good* or *bad*"; CDC, 1993, p.5).[5] Change in overall and outcome-specific measures was combined into a global index of change in attitudes.

Norms—According to Fishbein and Ajzen (1975), subjective norms are influenced by a set of salient beliefs about the normative prescriptions of specific (salient) referents, weighted by the motivation to comply with each of those referents. For example, a man may perceive social pressure to use condoms if he believes that his partner thinks he should use condoms and he

[5]Outcome beliefs and evaluations may comprise expectancies in social– cognitive theory, as well as response efficacy and cost and barriers in the health belief model. However, there were very few studies that measured beliefs to allow us to attempt to separate these constructs. We therefore calculated a global change score including measures of attitudes and expectancies.

is motivated to comply with the partner. In this meta-analysis, we combined both overall and belief-based measures of norms to assess the normative influence of the communications. Subjective norms were typically measured with probability scales in response to statements such as "Would you say that most of the people who are important to you think that you should or should not use a condom for vaginal sex with your main partner?" (CDC, 1993, p. 12). Normative beliefs were generally assessed with bipolar probability statements about the opinion of a specific referent (e.g., "Do you feel that your main partner thinks you should or should not use a condom every time you have vaginal sex with her?"; CDC, 1993, p. 6), whereas motivations to comply were typically measured with unipolar scales in response to items such as "When it comes to protecting yourself from AIDS, do you want to do what your main partner thinks you should do?" (CDC, 1993, p. 6).

Control perceptions—Control perceptions refer to self-efficacy as well as expectations of personal control over condom use. Measures of self-efficacy comprised items that relate control to specific events. For example, the Community Demonstration Projects Research Group (CDC, 1993) included items such as "How sure are you that you can use condoms every time for vaginal sex with your main partner when your partner does not feel like using them?" or "When there aren't any condoms around, how sure are you that you can wait until you get one every time before having vaginal sex with your main partner?" (p. 7). Similarly, O'Leary and her colleagues (1996) asked participants to report whether "it would be easy or hard to refuse to have sex with a person if s/he will not use a condom" (p. 520). Measures of control perceptions included items like "Now it is just a 'what if' question, but if you wanted to use a condom every time you have anal sex with your main partner, how sure are you that you could?" (CDC, 1993, p. 17). Other researchers asked participants to rate statements such as "I can use a condom without fumbling around" (Kelly, McAuliffe, et al., 1997, p. 1285).

Intentions—Measures of intentions assessed the intent or willingness to use condoms in the future. Typical items were "In the future, do you plan to use condoms?" (Eldridge et al., 1997, p. 67) and "In the next six months, how likely do you think it is that you will start using a condom every time you have vaginal sex with your main partner?" (CDC, 1993, p. 11).

Knowledge—A large number of studies assessed the participant's knowledge about HIV or AIDS, typically through a series of statements that the participant evaluated as true or false (e.g., "The AIDS virus can be caught through ordinary close social contact, such as sitting next to an infected person"; Rigby et al., 1989, p. 149). Knowledge scores in most cases were calculated by computing the percentage of questions a participant answered correctly. When researchers reported statistics for individual items, we calculated effect sizes for each question and then averaged those effects into a global measure of change in knowledge.

Behavioral skills—Typically, measures of behavioral skills assessed the participant's ability to use (acquire and apply) condoms and to negotiate condom use (i.e., communication about sex or sexual assertiveness skills). In one study, researchers measured negotiation skills by presenting participants with coercive sexual situations leading to unsafe sex and asking them to respond as they would in that situation (Eldridge et al., 1997). Independent raters then evaluated participants' negotiation skills on a scale from 1 (*unlikely to prevent risk behavior*) to 10 (*likely to prevent risk behavior*).

Perceived severity and susceptibility (perceived threat)—Studies often assessed *perceived HIV/AIDS severity* by having participants rate their agreement with statements such as "Fear of infection with HIV and AIDS affects my life" (Hämäläinen & Keinähen-Kiukaanniemi, 1992, p. 138). *Perceived susceptibility* was typically measured with

participants' assessments of the likelihood that they could become infected with HIV in the future (e.g., "There is practically no chance I could get AIDS"; O'Leary et al., 1996, p. 520).

Stages of change—According to Prochaska, Redding, Harlow, Rossi, and Velicer (1994), during the precontemplation stage, individuals may be aware that their behavior is problematic but not intend to change it. During the contemplation stage, people consider performing the behavior at some point in their lives but have no actual plans to change their routine behavior (Prochaska et al., 1994). A person in the preparation stage is committed to changing his or her behavior within the next month and may engage in the behavior occasionally. People who engage in a behavior on a regular basis for less and more than 6 months are considered to be in the action and maintenance stages, respectively. Only nine studies reported usable statistics for stages of change (e.g., 1 [*precontemplation*] to 5 [*maintenance*]).

Condom use—Condom use measures included assessments on subjective frequency scales, as well as reports of the percentage and number of times participants use condoms over a period of time. For example, the Community Demonstration Projects Research Group (CDC, 1993) asked participants, "When you have vaginal sex with your main partner, how often do you use a condom?" (p. 11), and participants provided their response on a scale from 1 (*every time*) to 5 (*never*). To obtain a more precise report of condom use, Ploem and Byers (1997) asked participants to report the frequency of sexual intercourse over the previous 4 weeks, as well as the number of occasions of sexual intercourse for which condoms were used. The researchers then derived the percentage of condom use for each participant. Similarly, Belcher et al. (1998) asked participants to list the first name of all of their sex partners in the previous 90 days. For each name listed, participants were asked to identify the partner's gender, the partner type (regular, casual, or new), the total frequency of vaginal sex, the frequency of condom-protected vaginal sex, the total frequency of anal sex, and the frequency of condom-protected anal sex. Percentages were again derived on the basis of relative frequencies.

Effect Size Calculation and Analytic Strategy

We calculated weighted mean effect sizes to examine change over time in intervention and control groups and performed corrections for samplesize bias to estimate *d*. We used Hedges and Olkin's (1985) procedures to correct the effects for sample-size bias;[6] calculate weighted mean effect sizes, *d*.; confidence intervals; and homogeneity statistics, *Q*, which test the hypothesis that the observed variance in effect sizes is no greater than that expected by sampling error alone. Calculations of the between-subjects variance followed procedures developed by Hedges and Olkin (1985). For within-subject designs, we calculated the variance of effect sizes using Morris's (2000) procedures. Specifically, we performed calculations for the variance of within-subject effect sizes using three alternate correlations between pre- and posttest measures (see also Albarracín et al., 2003). Thus, we assumed $r = .00$ and $r = .99$ as the most extreme values and also imputed correlations from Project RESPECT (see Kamb et al., 1998), which provided moderate values of this association. Because results were similar regardless of the correlation we used, we present only the ones with the imputed correlations (see also Albarracín et al., 2003).

Computations of effect sizes were performed using fixed- and random-effects procedures. In the first case, one assumes a fixed population effect and estimates its sampling variance, which is an inverse function of the sample size of each group. The inverse of the effect size's variance is used to weigh effect sizes prior to obtaining average values. Thus, effect sizes from studies with larger sample sizes are considered more precise and carry more weight than effect sizes obtained from studies with smaller sample sizes. These procedures are powerful and produce

[6]When the *N* at the pretest differed from the *N* at the posttest, the smaller *N* was used.

narrow confidence intervals (Rosenthal, 1995; Wang & Bushman, 1999). In contrast, random-effects procedures are based on the assumption that the effect sizes are sampled from a population of effect sizes. Thus, the effect size from a given study results from sampling an effect size at random but also contains measurement error, which is again an inverse function of the sample size in that particular study. Because random-effects procedures use the variance of a sample of effect sizes as well as the variance in each study to estimate the variance in the population of effect sizes, the error term is larger and the procedure may overestimate Type I error (Hedges & Olkin, 1985; Hedges & Vevea, 1998; but see Hunter & Schmidt, 2000). Presumably, fixed-effects models are reasonable when one assumes that effect sizes vary as a result of a few, identifiable study characteristics, whereas random-effects models are appropriate when variation derives from multiple, unidentifiable sources (Raudenbush, 1994).

Results

Sample of Interventions and Controls

We included 194 reports, which provided 354 independent intervention groups and 99 independent control groups. Of the 194 reports, 44 provided a single data set, 91 provided two data sets, 28 provided three data sets, 21 provided four data sets, 3 provided five data sets, 6 provided six data sets, and 1 provided eight data sets. Table 1 summarizes information about the included reports, as well as their types of interventions, participants, and methods, with separate columns for intervention and control groups. As can be seen from the table, most studies were published around 1996 and the median sample sizes of participant groups was around 100. Most reports were affiliated with the medical sciences, with psychology as the second most frequent affiliation. Although most studies were conducted in the United States, 33 countries were represented. Of the U.S. studies, 33 states were represented, with California providing more groups than any other state.

With respect to intervention strategies, 48% of the interventions contained arguments designed to induce a positive attitude about condom use outcomes, 15% contained normative arguments in support of condom use, 94% contained HIV-relevant information, 20% included arguments designed to verbally promote recipients' behavioral skills, 47% included persuasive arguments designed to increase perceptions of threat among recipients, an average of 22% trained participants in some type of behavioral skill, and 18% administered an HIV test. Given the different combination of strategies, 51% of groups were exposed to interventions that simply presented arguments (passive interventions), whereas the remaining 49% engaged in activities to promote condom use (active interventions, i.e., HIV counseling and testing or behavioral skills training). Researchers distributed condoms to 22% of the intervention groups and to 7% of the controls.

There was great methodological variability in the studies we examined, in terms of the participants, intervention setup, and research design and implementation. Samples comprised both female and males, and participants were relatively young in age. On average, only 36% of participants were of European descent and only 35% of participants had completed high school. The samples included men who have sex with men, intravenous drug users, partners of intravenous drug users, commercial sex workers, multiple-partner heterosexuals, participants with a history of STIs, and patients with severe mental illness. Some samples included drug rehabilitation patients and general drug users; many included college, middle-school, or high school students; and a small percentage sampled teachers. Most participants for whom a measure of condom use was obtained had low condom use, and only a small percentage of participants were using condoms consistently. The average rate of infection with HIV was 20%, although most studies had no information on this issue.

More communications were presented in school and clinical settings than in any other place, although many of the messages were delivered in community settings, and some through mass-communication media. The communications were generally presented face-to-face, and video- and audiotaped materials were included in many cases. The intervention was applied exclusively to individuals (as opposed to group) in only 20% of the cases and lasted an average of 7.94 hr.

Finally, there was considerable variability in research design and implementation across the studies. For example, although all studies included pre- and posttest measures, some used different samples, whereas the majority were done within subject. The allocation of participants to study groups was done at random in 46% of the cases, and intervention participants were compensated an average of U.S. $18.31. The mean length of time between the intervention and the posttest was slightly over 3 months, although the median was about 1 month. Half of the intervention groups in our sample were explicitly based on theory, and 33% were designed from formative research with the target population. Most of the studies targeted a specific population. Quite frequently, samples were self-selected; attrition was around 12% across intervention and control groups.

Effectiveness Data

Overall effects across interventions and control groups—The weighted mean effect sizes for intervention and control groups appear in Table 2, along with confidence intervals and homogeneity indexes. The last two columns of Table 2 present *QB* statistics, which in this case are analogous to *F* ratios comparing change across intervention and control groups. The fixed-effects procedures followed Hedges and Olkin's (1985) recommendations and fit weighted factorial models to compare *d* across intervention and control groups. The weights for fixed effects followed Hedges and Olkin's computational formulas, whereas the weights for random-effects models followed Lipsey and Wilson's (2001) approach. The first *QB* in the table compared all interventions with all controls, whereas the second excluded interventions that lacked a control. As these statistics suggest, the interventions were associated with increases in recipients' knowledge about HIV, procondom use attitudes, control perceptions, norms, intentions, behavioral skills, and actual condom use. In addition, the analyses that included all intervention groups revealed an effect on perceived severity, but this effect did not emerge when we considered only interventions coupled with controls.

Furthermore, we compared the characteristics of intervention and control groups summarized in Table 1 to detect systematic biases that may confound the reported differences in effect sizes across intervention and control groups. For that purpose, we used independent-sample *t* and chi-square tests (Albarracín et al., 2003). Although intervention and control samples were highly comparable across most dimensions, there were five significant differences across these groups. First, condoms had been distributed more often to intervention than to control groups, $\chi^2(1) = 13.76$, $p < .001$. Second, the intervention groups were more likely to include drug rehabilitation patients and general drug users than the controls, $\chi^2(1) = 4.39$, $p < .03$. Third, compared with interventions, control groups were more often from the United States, $\chi^2(1) = 3.83$, $p < .05$; had less self-selection, $\chi^2(1) = 3.88$, $p < .05$; and came from studies based on past research with the target group, $\chi^2(1) = 10.48$, $p < .001$. Yet when these variables were added as covariates in the mean comparisons in Table 2, the differences between intervention and control groups remained statistically significant.

Even when the covariance analyses were reassuring, comparing all interventions with all control groups is insufficient to rule out two important rival hypotheses. First, considering interventions without controls allows for the possibility that spontaneous maturation might be responsible for the observed increases in condom use (see Cook & Campbell, 1979). Second, comparing interventions and controls that did not use random assignment cannot control for

selection biases. This difficulty leaves open the possibility that the group assigned to the intervention was simply easier to change than the group assigned to the control. In light of these alternative hypotheses, an additional analysis was conducted in which we calculated scores representing controlled change. For this purpose, we selected only studies that used random assignment as well as a control group and subtracted the *d* representing change in the control group from the *d* representing change in the treatment group. The variance of the resulting delta (B. J. Becker, 1988) equals the inverse of the sum of the variances of the *ds* that entered the calculation of delta, and was used to derive a confidence interval for the overall effectiveness of HIV prevention intervention when one selects only controlled randomized trials ($k = 33$). The result from the fixed-effects analysis was an average controlled change of 0.06 (95% CI = 0.003–0.123, $Q_{32} = 167.28$, $p < .001$), which was small but significantly different from zero. Although the convergence of this analysis and those in Table 2 is not surprising given that delta correlated .82 with the *d* representing change in the treatment group for those studies that provided both statistics, it provides further support for the use of *d* in our subsequent analyses.

Effects of passive and active interventions—More important than estimating the overall effects of HIV-prevention interventions is to determine what interventions are most effective. For instance, interventions differ in their inclusion of active strategies in which participants role-play problem situations, practice applying condoms to a model, or take an HIV test, which invariably involves some form of counseling (see Table 1). Therefore, we first attempted to determine whether the inclusion of such activities led to greater impact than the use of merely passive strategies in which participants just receive a communication. The data in Figure 1 show the weighted average effects of interventions that we classified as passive and active on behavioral change, in addition to change in control groups. As can be seen, active interventions were associated with stronger improvements in condom use than passive approaches to prevention and control groups: fixed-effects $QB_1 = 484.25$, $p < .001$, and random-effects $QB_1 = 24.71$, $p < .001$, $k = 258$. Passive interventions did not differ significantly from control groups in a consistent way: fixed-effects $QB_1 = 4.18$, $p < .05$, and random-effects $QB_1 = 1.40$, *ns*, $k = 90$.

Effects of different passive strategies in passive and active interventions—It was also important to determine whether different types of arguments that are common to passive and active strategies were more or less successful at increasing condom use. We thus analyzed *d* for condom use in all intervention groups as a function of whether interventions attempted to verbally enhance (a) positive attitudes toward condom use, (b) supporting norms concerning condom use, (c) behavioral skills, (d) knowledge, and (e) perceived threat. Whether the intervention was active or passive was also included, as was the provision of condoms as an additional factor.

The fixed-effects mean analyses conducted to describe the effects of different passive strategies are summarized in Table 3. (Random-effects analyses from here on are not reported for the sake of brevity, as the patterns were the same but the number of significant effects decreased.) Following the means, we present *QB*s for each type of argument alone and in interaction with the passive or active nature of the intervention. These analyses show that whereas attitudinal arguments, behavioral skills arguments, and condom provision were associated with significant increases in condom use, threat and normative arguments were associated with decreases in condom use. In addition, most of these patterns were stronger when the intervention was active rather than passive, as judged by the significant interactions that appear in the last column of the table. The only exception was that the provision of condoms was significant only when interventions were passive.

Influence of the various strategies used in active interventions—The fixed-effects estimates of the impact of different strategies when the interventions included an active component (either skills training or an HIV test) appear in Table 4. These analyses imply that allowing participants to gain practice with self-management strategies and undergo HIV counseling and testing coincided with greater increases in condom use, whereas practice with interpersonal skills coincided with unexpected decreases in condom use and practice with condom use skills had no association with change in condom use.[7]

Effects of Intervention Strategies Across Participant Populations and Intervention Setups

Given the need to assess intervention outcomes across different populations and intervention setups, we entered dummy-coded variables describing the nature of the groups under study in an analysis of the effectiveness of the different types of strategies. These analyses appear in Table 5–Table 7 and were conducted on passive and active interventions considered simultaneously.

To analyze the generalizability of different interventions across *populations*, we performed analyses with gender, age, and ethnicity; the inclusion of men who have sex with men, intravenous drug users, partners of intravenous drug users, and multiple-partner heterosexuals; and past condom use. (Other groups in Table 1 were not sufficiently represented to perform these analyses.) The analyses with gender, age, and ethnicity were replicated using continuous variables in addition to the breakdowns presented here: gender = predominantly male when more than 50% of the sample was male; ethnicity = predominantly European background when more than 50% of the sample had that background; age = under 21 years when the mean or median age was under 21. The analyses using dichotomous and continuous predictors were very similar, which led to presenting the ones with dichotomous predictors for interpretational purposes. The analyses with past condom use required collapsing moderate and high condom use owing to the low number of conditions with high condom use (see Table 1).

To estimate the effects of the *setup of the intervention*, we first considered whether the intervention was presented in a school, a clinic, or a community setting. Most of the interventions in our meta-analysis were delivered face-to-face (see Table 1), which made it impossible to analyze interactions between face-to-face presentation and type of strategy. However, we considered the inclusion of video- or audiotapes, which may increase the impact of certain strategies but can also detract from the interaction with real-life facilitators, as well as the use of group or individual formats for the intervention sessions.

Table 5 presents the *QB* statistics for the main effects of the population and intervention factors. It also includes the control means for different populations to permit comparison with the mean change in different intervention groups when applied to the same population. Table 6 and Table 7 present the *QB*s for the interaction between a given population or setting variable and a specific argument or behavioral strategy, as well as the *QB* for the simple effects of a strategy in a particular group. In the following sections, we summarize the significant interactions and highlight simple effects only when the statistical interaction was significant. When the interaction was not significant, one should rely on the main effects reported in Table 3 and Table 4 to reach conclusions.

[7]Because of the null and reversed results for threat-inducing arguments, we considered the possibility that the presentation of threat-inducing arguments could interact with the presentation of control arguments, condom provision, or any of the behavioral skills training strategies (see, e.g., Rogers, 1975). However, we found no statistical support for this possibility when we analyzed behavior change as a function of threat-inducing argument, control, condom provision, and skills training, and the interaction between threat-inducing arguments and any of the three variables associated with facilitating condom use. Nor were threat-inducing arguments associated with positive effects on condom use in any level of the factors representing attitudinal arguments, information, normative arguments, or HIV counseling and testing.

Independent influence of population participant characteristics and intervention setup—Not surprisingly, population and intervention factors influenced the amount of behavior change in the studies we summarized. Male, older, and minority recipients showed greater increases in condom use than female, younger, and majority recipients. Whereas groups including men who have sex with men changed more than groups not including them, the inclusion of partners of intravenous drug users and multiple-partner heterosexuals was associated with less behavior change. The inclusion of intravenous drug users and initial condom use had no significant main effects on the amount of behavior change observed.

It is important to note that even when different groups had different rates of behavior change overall, as shown in the first two sections of Table 5, the means for interventions were greater than control means in most cases. The only exception was the mean change for intervention recipients under 21, which did not differ significantly from the change in control condition. (As shall be seen from further analyses reported below, however, our meta-analysis later identified effective interventions for people under 21.)

With respect to the intervention setup, we examined the effects of presenting the intervention in a school, a clinic, or the community, as well as playing video- or audiotaped materials and performing group sessions. Of all these, only playing video- or audiotaped materials had a significant main effect on behavior change. Specifically, the use of these materials was associated with decreased behavior change.

Analysis of interactions between intervention strategies and characteristics of the populations—As suggested by the statistics in Table 6, there were manysignificant interactions. For example, an examination of the first panel, which is relevant to gender effects, reveals that the negative effect of presenting threat-inducing arguments and interpersonal skills training was stronger for predominantly male groups, whereas the negative effect of presenting normative arguments was stronger for predominantly female groups. In addition, the presentation of behavioral skills arguments as well as condom use skills training had positive effects among males but null or negative effects among females, whereas attitudinal arguments, information, self-management skills training, and HIV counseling and testing exerted more positive impact among females than among males. Actually, attitudinal arguments and information had nonsignificant effects among males.

Age also moderated which strategies were successful, with greater age generally amplifying effects that were observed across the board. Groups over 21 years of age responded more negatively to normative appeals and threat-inducing arguments than did groups under 21, which were positively affected by normative arguments and unaffected by threat-inducing arguments. At the same time, groups over 21 showed significant positive effects of behavioral skills arguments, self-management skills training, and HIV counseling and testing, whereas groups under 21 showed a nonsignificant effect of behavioral skills arguments, a positive but weaker effect of self-management skills training, and a significant negative effect of HIV counseling and testing. In addition, the provision of condoms had a positive effect for audiences under 21 but a negative effect for audiences over 21.

The ethnicity findings also suggested various ways in which the background of the sample moderated the effectiveness of the different intervention strategies. Samples of predominantly European backgrounds were less negatively affected by normative and threat-inducing arguments than those with a predominantly African background. In addition, as shown by the simple effects in Table 6, whereas condom provision benefited only samples with predominantly European backgrounds, behavioral skills arguments and HIV counseling and testing benefited only samples with predominantly African backgrounds. Finally, interpersonal skills training had stronger negative effects when the predominant background was European,

and self-management skills training had stronger positive effects when the predominant background was African.

The middle set of panels of Table 6 summarizes the outcomes of different strategies for different HIV risk groups, including men who have sex with men, intravenous drug users, partners of intravenous drug users, and multiple-partner heterosexuals. One notable finding that appears to characterize all these groups is that compared with lower risk populations, most strategies had weaker effects for these high-risk populations. For instance, groups explicitly including men who have sex with men, intravenous drug users, partners of intravenous drug users, and multiple-partner heterosexuals generally showed weaker negative effects of normative arguments (three out of four interactions were statistically significant), threat-inducing arguments (three out of four interactions were statistically significant), and interpersonal skills training (two out of three available interactions were statistically significant). Actually, interpersonal skills training had a significant positive effect when the condition included partners of intravenous drug users. The positive effects of attitudinal arguments, self-management skills training, and HIV counseling and testing were also weaker in these high-risk groups, with the exception of men who have sex with men. Further, attitudinal arguments were less effective when the samples included men who have sex with men but more effective when the samples included partners of intravenous drug users, and information was more effective when intravenous drug users were excluded rather than included. Of importance, the only strategy consistently associated with more positive effects when conditions included high-risk participants was the provision of condoms as part of the intervention.

The last section of Table 6 presents the effects of each strategy on change in condom use as a function of the level of past condom use. As suggested by most of the analyses of risk factors, low condom use as a risk factor moderated the impact of some of the strategies (see Table 5). Although consistent with Prochaska et al.'s (1992) predictions, the beneficial effects of self-management skills training were smaller among higher condom users than among low users; contrary to their predictions, the influence of attitudinal arguments and information did not vary significantly as a function of condom use. In addition, there were significant negative effects of interpersonal skills and condom provision when condom use was either moderate or high.

Analysis of interactions between intervention strategies and intervention setups—We were also interested in evaluating potential interactions between the strategies used in an intervention and characteristics of the intervention setup. The relevant fixed-effects analyses are summarized in Table 7, organized by (a) setting (clinical, school, or community), (b) use of audiovisual media, and (c) presentation to groups (vs. individuals). Again, apparent differences in simple effects were interpreted only when accompanied by a significant interaction.

As can be seen from the first three panels, all intervention strategies but condom use skills training had stronger effects in clinical than other settings. The stronger effects included lesser change in response to normative arguments, threat-inducing arguments, and interpersonal skills training, as well as greater change in response to information, behavioral skills arguments, condom provision, self-management strategies, and HIV counseling and testing. In addition, attitudinal arguments, which had favorable effects in nonclinical settings, had a reverse effect in clinical contexts.

We next compared intervention strategies for school and nonschool settings. As judged by the significant interactions in the last column of Table 7, behavioral skills arguments and threat-inducing arguments both had less impact in schools than in other places. Notably, however, normative arguments and condom use skills training had significant positive effects only in

schools. When the setting was not a school, normative arguments continued to have the previously reported reverse effect and condom use skills training had a nonsignificant effect.

With respect to community settings, the effects of information, behavioral skills arguments, threat-inducing arguments, interpersonal skills training, and self-management skills training, which were significant in noncommunity settings, were nonsignificant when the intervention was conducted in the community. Normative arguments had a significant negative effect in community settings, although the effect was weaker than the one in noncommunity settings. HIV counseling and testing continued to have a positive effect in community settings, although it was smaller in size relative to the one in noncommunity settings.

The second to last panel in Table 7 presents the effects of playing a video- or audiotape. As can be seen, playing a tape was associated with an increased positive impact of attitudinal and behavioral skills arguments and HIV counseling and testing, as well as with increased negative effects of normative arguments and interpersonal skills training. In contrast, the favorable effects of self-management skills training were stronger when the intervention did not include a tape, and the provision of condoms had a positive effect when no video was used but a negative effect when a video was used.

Finally, we analyzed whether the use of group sessions as part of the intervention coincided with increases or decreases in the effects of different intervention strategies. As seen from the last panel of Table 7, attitudinal arguments, information, self-management skills training, and HIV counseling and testing were more effective when the intervention included group sessions, whereas behavioral skills arguments and condom use skills training were more effective when the intervention did not include group sessions. Finally, normative arguments had stronger negative effects during group than individual sessions.

Supplementary analyses—We also examined the possibility that other participant and intervention factors could moderate behavior change and also be responsible for the outcomes. First, we regressed *d*. for behavior on the participant and intervention variables in Table 1 that we had not previously analyzed. As could be observed from the fixed-effects simple regressions, change in condom use was positively associated with percentage of high school graduates ($\beta = .13$, $p < .001$, $k = 83$); city population ($\beta = .37$, $p < .001$, $k = 180$); rate of HIV infection at pretest (β .42, $p < .001$, $k = 50$); and face-to-face presentation of the intervention ($\beta = .12$, $p < .001$, $k = 200$). Also, change in condom use correlated negatively with inclusion of participants with a history of STIs ($\beta = -.16$, $p < .001$, $k = 200$); inclusion of college students ($\beta = -.12$, $p < .001$, $k = 200$); and inclusion of middle and high school students ($\beta = -.33$ and $-.12$, respectively,$p < .001$ and $k = 200$ in both cases).

We also analyzed other associations with methodological features of the studies. These analyses revealed significant positive associations of behavior change with (a) the use of within-subject designs ($\beta = .18$, $p < .001$, $k = 200$); (b) random assignment of participants to conditions ($\beta = .29$, $p < .001$, $k = 200$); (c) amount of payment ($\beta = .05$, $p < .05$, $k = 200$); (d) number of days between the intervention and the posttest ($\beta = .09$, $p < .001$, $k = 191$); (e) the use of a theory-based intervention ($\beta = .10$, $p < .001$, $k = 200$); (f) targeting interventions to specific genders ($\beta = .11$, $p < .001$, $k = 200$); and (g) self-selection bias ($\beta = .13$, $p < .001$, $k = 200$). Moreover, change in condom use correlated negatively with (h) the use of formative research ($\beta = -.12$, $p < .001$, $k = 200$) and (i) attrition ($\beta = -.07$, $p < .001$, $k = 111$, $k = 200$). However, the negative effect of using formative research became nonsignificant ($\beta = -.12$, *ns*) when we reran that predictor in a multiple regression including all the methodological and population predictors entered simultaneously.

Because these supplementary analyses identified a number of factors that influence behavior change, we reran the analyses in Table 5–Table 7 to ensure that the described effects were not due to the association of the population and intervention characteristics we analyzed with other methodological features of this study. Education, pretest HIV infection rates, and attrition could not be introduced owing to low report of these factors. However, introducing the other methodological variables in Table 1 did not alter the patterns of findings we discussed.

Mediating Processes

The analyses in Table 3 suggest that arguments designed to improve attitudes and behavioral skills in favor of condom use increase condom use across passive and active interventions. However, these analyses cannot confirm that these strategies have an impact because they affect the mediator they are supposed to affect. For example, it is unclear thus far whether the interventions designed to improve attitudes and behavioral skills actually managed to do so. In addition, attitudinal arguments convey not only that "using condoms is good" but also that "*the communicator* thinks that using condoms is good." Consequently, the impact of attitudinal arguments on condom use could be mediated by changes in norms instead of changes in attitudes. Similarly, hearing a message about protection from a disease could spontaneously arouse anxiety, in which case perceived threat could be the mediator as well.

Two caveats are necessary when considering the use of path analyses in meta-analysis. There is pressure both to maximize the inclusion of effect sizes and to maintain the included effect sizes across analyses (avoiding pairwise deletion procedures). For example, because we concluded that attitudinal arguments were effective on the basis of an analysis of 200 conditions, the mediational analyses should include those 200 effects. This strategy, however, is complicated by the fact that not all studies measured the same variables, and data on potential mediators are much less frequent than data on condom use itself (see Table 2). Therefore, to maintain the original 200 units while including the available data on a particular mediator, one must resort to pairwise deletion procedures, which often produce nonpositive definite matrices (Shadish, 1996).

In light of the complications involved with the study of mediation in meta-analysis, several approaches were explored. First, we attempted to fit models to a matrix that included, in addition to condom use, the indicators for all the intervention strategies in Table 3 and Table 4 and all psychological variables in Table 2. These models yielded impossible solutions and were therefore discarded. Next, we proceeded to fit models to smaller matrices. Of the various possibilities, we chose to report models that would parallel the analyses in Table 3 and Table 4. These models included the indicator variable for the strategy being considered, the likely mediator for that strategy, and change in condom use, plus the indicators for all other strategies in Table 3 and Table 4. However, the matrices involving normative arguments and change in norms as well as threat-inducing arguments and either perceived risk or threat were non-positive definite, which led us to analyze the mediation of only the strategies that had favorable effects on condom use. The analyses we report were estimated using maximum likelihood methods and the lowest *N* in pairwise deletion matrix. Sobel (1982) tests were calculated and are presented along with the path diagrams in Figure 2–Figure 4. For the sake of simplicity, these path diagrams show only the paths relevant to the strategy that is the focus of each panel, even when all the models included the predictors in Table 3 and Table 4, depending on whether passive or active strategies were analyzed.

Figure 2 summarizes the findings from the path analysis for the effects of attitudinal and behavioral skills arguments, which had significant, positive main effects across passive and active interventions. As shown in Panel A, the positive effects of attitudinal arguments on behavior change were mediated by changes in attitudes. The influence of attitudinal arguments, however, was also mediated by norms and perceived threat, which suggests various ways in

which this type of strategy has an influence. In addition, the analyses in Panel B indicate that the possible influence of behavioral skills arguments on condom use change was mediated by control perceptions. However, as can be seen, the direct effect of behavioral skills arguments on behavior became nonsignificant only once we introduced changes in behavioral skills, and the mediation test suggested that behavioral skills was in fact a plausible mediator.

Figure 3 summarizes the effects of information, which was significant only in the context of active interventions (see Table 3). As can be seen, the favorable effects of information on condom use were in fact mediated by increases in knowledge about HIV. The path model shows that the positive direct effect of information on behavior change became slightly negative once changes in knowledge were included.

Figure 4 presents the effects of self-management skills training and HIV counseling and testing, which had significant effects in the sample of active interventions (see also Table 4). As one might expect, the effects of self-management behavior skills training strategies were mediated by changes in both control perceptions and behavioral skills. The effects of HIV counseling and testing were less clear, which led us to conduct analyses with various potential mediators. These analyses (see Figure 4, Panel B) indicated that HIV counseling and testing contributed to changes in skills. Changes in skills, in turn, correlated with changes in condom use, and their inclusion reduced the size of the direct effect from HIV counseling and testing to condom use.[8]

Assessment of Publication and Eligibility Biases

Of course, publication practices and eligibility criteria shape the sample of reports that are included in a meta-analysis. For instance, 12 of the examined reports contained insufficient statistics to derive the necessary effect sizes (see footnote 1). In addition, although we closely examined 15 unpublished reports, only one was ultimately included. To estimate potential biases in the report of findings and study inclusion, we examined the funnel plot of behavior change effect sizes (see Figure 5) and the normality of the distribution under examination (see Figure 6). If no bias is present, the plot takes the form of a funnel centered on the mean effect size, with smaller variability as the sample size increases. In the presence of publication bias, there is a distortion in the shape of the funnel. If the true effect size is zero and there is bias, the plot has a hollow in the middle. If the true effect size is not zero, the plot tends to be asymmetrical, having a large and empty section where the estimates from studies with small sample sizes and small effect sizes would otherwise be located. Following these guidelines, a subjective examination of the plot in Figure 5 thus suggests no publication or selection bias in our meta-analysis.

In addition to examining the funnel plot, we used the normal quantile plot method to uncover evidence of bias (Wang & Bushman, 1999). In a normal quantile plot, the observed values of a variable are plotted against the expected values given normality. If the sample of effect sizes is from a normal distribution, data points cluster around the diagonal; if the sample of effect sizes is biased by publication practices or eligibility criteria, data points deviate from the diagonal (Wang & Bushman, 1999). As can be seen from Figure 6, the standardized behavior effect sizes followed a straight line and generally fell within the 95% confidence intervals of the normality line. This conclusion was supported by the fact that our findings remained unaltered after excluding the most extreme outliers from the sample of conditions (see the seven extreme observations in Figure 6). In sum, there was convincing evidence that even if one determined that a large number of studies have been kept in researchers' file cabinets,

[8]Unfortunately, we could not explore other potential mediating effects for HIV counseling and testing owing to nonpositive definite matrices.

inclusion of these studies would be unlikely to alter our conclusions about the effectiveness of HIV-prevention interventions.

Discussion

The theoretical assumptions that we examined in this article constitute a general paradigm for health intervention, which has been used and advocated for a number of health problems, including smoking, unsafe dietetic practices, disease screening, and drug abuse. By testing these assumptions with the intervention literature from HIV prevention, our work provides the first and most comprehensive examination of models that are influential in many areas of health behavior change, as well as behavior change in general. In the following sections, we summarize our present empirical and theoretical contributions in light of relevant conceptualizations and prevention objectives.

Intervention Efficacy and Mediating Processes: Status of Theoretical Assumptions in Health- and HIV-Related Behavior

We conducted this meta-analysis with the idea of testing assumptions shaped by various models of behavior change. In the following sections, we comment on our findings' support for each of the models' premises, which are summarized in Table 8. For the first six models in the table, we verified whether (a) strategies targeting the theoretical causal variable effectively change behavior, (b) strategies targeting the theoretical causal variable influence changes in measures of it, (c) changes in measures of the theoretical variable influence behavior change, and (d) changes in measures of the theoretical variable mediate the effects of the strategy that targets it on behavior. (For the framing and stage models, however, only the first assumption applied, as the models make no specific claims about mediators.) When a majority of the applicable criteria (more than 50%) were met, we characterized support for the assumption as "good"; when only half of the applicable criteria were met, we characterized support for the assumption as "fair"; when less than half of the applicable criteria were met, we characterized support for the assumption as "poor."

Theory of reasoned action—Fishbein and Ajzen's (1975; Ajzen & Fishbein, 1980) theory of reasoned action assumes that people's actions are a function of their intention, which is in turn influenced by the attitude toward performing the behavior (i.e., the degree to which one has a positive vs. a negative evaluation of the behavior) and the subjective norm (i.e., the expectation that important others think that one should or should not perform the behavior). Consistent with the successful behavioral prediction achieved by this theory across studies and samples (see Albarracín et al., 2001), the present meta-analysis suggests that arguments that tout condom use (attitudinal arguments) effectively increase behavior change across many populations and across passive and active interventions. This behavioral impact is mediated by changes in attitudes and also by changes in social norms (see Figure 2, Panel A), implying that the attitudes of others (in this case, intervention facilitators) can simply exert desirable normative influences on the recipients. Such a mediation may be moderated by characteristics of the population, but we lacked the number of studies with attitude measures that would allow us to perform that test in this review.

Further, our meta-analysis also hints that the success of straight normative arguments describing social consensus for a behavior is contingent on the population one is targeting. Such attempts appear to instill reactance in most cases but are effective when the audience is under 21. However, this result does not imply that younger individuals are normatively driven whereas older ones are not. Instead, it appears to suggest that younger individuals do not perceive that making decisions based on social consensus is undesirable, whereas adults are

more prone to try to act independently even when they cannot escape being influenced by norms—even if the influence ends up being a reaction against the norms.

Theory of planned behavior—According to Ajzen's (1985) *theory of planned behavior*, considering perceived behavioral control can improve the prediction of intentions and behavior. One important conclusion from the present meta-analysis is that even when measures of perceived control generally exert small direct effects on behavior (Albarracín et al., 2001), arguments and training designed to teach behavioral skills are successful at changing behavior for most people using either passive or active interventions. Of course, one might argue that these strategies are not truly influencing control perceptions (see Figure 2) and that the key mediator is instead changes in actual behavioral skills. However, as shown in Figure 4, the effects of self-management skills training were mediated by control perceptions in addition to actual skills.

Self-efficacy—Bandura's (1989, 1992, 1994, 1997) social–cognitive theory is a general theory of self-regulatory agency, which proposes that perceived self-efficacy lies at the center of human behavior. According to this model, effective self-regulation of behavior and personal change requires that people believe in their efficacy to control their motivation, thoughts, affective states, and behaviors. In other words, people are unlikely to change unless they want to, believe they can, feel they will, and have the behavioral skills to actually change.

Because motivation, beliefs, perceptions of control, and actual skills are all implicated in Bandura's model, support for the theories of reasoned action and planned behavior also constitutes support for social–cognitive theory. In addition, the effect of behavioral skills training—which was developed by psychologists in the domain of HIV prevention (Kelly, St. Lawrence, Betts, Brasfield, & Hood, 1990; Kelly, St. Lawrence, Hood, & Brasfield, 1989)—on changes in condom use permits an assessment of the viability of this model for HIV prevention and for behavioral change in general. In this regard, our meta-analysis suggests that self-management skills are essential to regulate condom use, whereas condom use skills are important for males and interpersonal skills are important for females who are strongly motivated to avoid unsafe sex with their intravenous drug use partners. Future research may develop training in additional skills and increase understanding of what makes certain skills useful for some people but not for others.

Information–motivation–behavioral skills model—Just like support for the theory of planned behavior renders support for Bandura's (1989) social–cognitive theory, our meta-analysis' support for the theory of reasoned action, the theory of planned behavior, and Bandura's model also renders support for J. D. Fisher and Fisher's (1992, 2000; J. D. Fisher, Fisher, Misovich, Kimble, & Malloy, 1996; J. D. Fisher, Fisher, Williams, & Malloy, 1994; W. A. Fisher et al., 1999) assumption that information, motivation, and behavioral skills underlie behavioral change. The information–motivation–behavioral skills model, however, presents the additional assumption that the three components exert potentiating effects on each other. To this extent, the finding that information has positive influences on behavior *only* when accompanied with active, behavioral strategies can be taken as evidence that the confluence of strategies is as important as the selection of each individual approach.

Protection motivation theory—Protection motivation theory emphasizes the cognitive processes that mediate health behavior change. Although Rogers (1975) initially developed protection motivation theory to clarify the influence of fear appeals (Rogers, 1975), the theory has been applied to health prevention more generally (Prentice-Dunn & Rogers, 1986; Rogers, 1983). Rogers (1975) argued that people who confront external information about a disease (e.g., verbal persuasion, observational learning, and experience with a disease) engage in threat and coping appraisal (see also Prentice-Dunn & Rogers, 1986). In the case of condom use,

threat appraisal involves an evaluation of the factors that influence the probability of not using a condom (perceived barriers, such as decreases in physical pleasure) as well as the threat associated with not using a condom (perceptions of severity and vulnerability). Coping appraisal comprises judgments of the efficacy of a preventive response, as well as the assessment of one's ability to successfully accomplish the adaptive response (i.e., self-efficacy). Threat appraisal and coping appraisal combine to form protection motivation, or the intention to perform the behavior, which then yields a behavioral response (Prentice-Dunn & Rogers, 1986).

To the extent that this model advocates the use of fear appeals to induce threat appraisal, we can conclude that the results from our meta-analysis disconfirm it. In fact, no tested interactions between threat-inducing arguments and strategies that can increase threat coping (i.e., behavioral skills arguments, condom use skills training, interpersonal skills training, self-management skills training, and condom provision) yielded the predicted positive effect of threat appraisal plus coping (footnote 3), nor were threat-inducing arguments effective for a single population or intervention context.

Framing models—Rothman and Salovey (1997) have conceptualized the need for certain types of message frames for specific types of health behavior. When one is trying to get people to avoid a risk factor, a "loss," fear-inducing frame appears effective. However, when one is trying to instill a proactive behavior, a "gain," positive frame is more appropriate. To this extent, the model qualifies the protection motivation theory by specifying the conditions under which threat appeals will be influential.

In many ways, our finding that threat-inducing arguments have no positive influence whatsoever under any of the conditions that we examined is consistent with Rothman and Salovey's (1997) model. Conceivably, people who are trying to implement a behavior such as condom use may need "gain" frames of the type that attitudinal messages normally present. Correspondingly, the use of fear may be more appropriate in the context of abstinence from a behavior (e.g., sexual abstinence) or detection of a risk (e.g., getting an HIV test), because such behaviors are similar to the ones Rothman and Salovey describe as benefiting from "loss" frames.

Another direction for future research concerns understanding the mechanisms that make certain frames more effective for certain behaviors. Recent research appears to suggest that mere fit between the chronic motivation of a recipient and the motivation a given message induces increases persuasion because of the intrinsic value of "fit" (Higgins, 2000). Even when our results for the effects of threat are suggestive of such a direct mechanism, future experimental work may be able to identify the affective mediation of value for fit.

Health belief model—The health belief model is an expectancy–value model developed during the 1950s by a group of social psychologists in the United States Public Health Service in an effort to understand the failure of people to participate in healthscreening and disease-prevention programs (Rosenstock, 1960, 1966, 1974). The model has since been adapted to explore a number of health domains and to include all types of preventive actions (M. H. Becker, 1974). In the domain of HIV prevention, the health belief model predicts that people will use condoms when (a) they believe HIV poses a threat (perceived threat = perceptions of susceptibility, which are judgments of risk of contracting HIV, and perceptions of severity, which involve assessments that contracting HIV would be serious); (b) they expect considerable benefits from the behavior and do not foresee barriers to it; and (c) they feel capable of succeeding and actually performing the behavior (Janz & Becker, 1984; Rosenstock et al., 1994).[9]

Like the theory of reasoned action, the theory of planned behavior, social–cognitive theory, and the information–motivation–behavioral skills model, the health belief model incorporates various psychological variables that our meta-analysis shows are influential. After all, the relevance of attitudes, control perceptions, information, and behavioral skills is clear from the findings. However, even when increases in perceived threat were positively associated with behavior change (see Figure 2), no threat-inducing argument had any positive behavioral effect whatsoever. As a result, the most distinctive prediction of the health belief model and protection motivation theory was disconfirmed.

Stage models of change—Several models assume that behavioral change is a multiple-stage process that starts at the point of not performing the behavior at all and ends with the incorporation of the new actions into routines. The transtheoretical model (Prochaska et al., 1992) and the AIDS risk reduction model (Catania et al., 1990), as well as Bandura (1997), all attempt to define a sequence of stages that go from behavior initiation to adoption to maintenance. Successful interventions should be the ones that focus on the particular stage of change the individual is experiencing and facilitate forward progression (Prochaska et al., 1994).

Some stage-of-change conceptualizations have made more specific predictions about the types of interventions that are likely to be more effective depending on the stage of change of recipients (Prochaska et al., 1992). Presumably, knowledge of HIV/AIDS or more general risk perceptions may serve to prompt change when people are not yet performing the behavior, but may not elicit movement beyond the initial stage. Similarly, inducing favorable attitudes may be important at the very initial stages but not when people are already performing the behavior and are aware of its outcomes. People who have already adopted the idea of change and begun to perform the behavior may need new skills to foster complete success (see Bandura, 1994, 1997; Schwarzer, 1992).

The analysis of the behavioral effects resulting from the various intervention strategies we synthesized (see Table 5 and Table 8) as a function of level of initial condom use has important implications for Prochaska and colleagues' (1992) predictions. On the one hand, consistent with their framework, our findings suggest that behavioral skills arguments and self-management skills training are more important later than earlier in the change process, which supports their contentions. On the other hand, contrary to Prochaska et al.'s expectations, attitudinal and informational arguments were equally important for both inconsistent and more consistent condom users. From this point of view, our data suggest that *everything* might be more effective when people have previously engaged in condom use, rather than supporting the specific predictions made by Prochaska and his colleagues.

Decision tree for selection based on the array of available preventive interventions—By identifying strategies that change HIV risk behavior, this meta-analysis can help guide the design of effective HIV-prevention interventions. However, for the findings to have an impact, such guidance should be communicated to practitioners in a clear way. With simplicity in mind, we summarized the study's findings that are most relevant from an epidemiological perspective in a series of decision trees.

The first decision tree (see Figure 7) presents courses of action when one needs to decide whether to deliver an intervention at all. Because control groups had little effect on condom

[9]In addition, the health belief model assumes that condom use is contingent on (d) sociodemographic factors (e.g., educational attainment) and (e) external events that motivate people to think about the behavior and take action (cues to action, such as a movie or exposure to a persuasive message). These factors, however, are less specified and more rarely investigated in the context of this model (see J. D. Fisher & Fisher, 2000).

use (*d*. = 0.08; see Table 2), not implementing interventions seems justified only when one is satisfied with the current level of condom use of a target audience. In contrast, because the use of any intervention strategy appears to increase condom use in at least one population, interventions must be implemented when one intends to increase condom use. Of the available strategies, however, whenever possible, practitioners should first consider approaches that involve clients behaviorally, rather than merely presenting passive audiences with persuasive arguments.

Readers may wonder how much of a difference interventions might make if applied to a given audience. Considering the findings in Figure 1, the *d*. obtained for active interventions represents a 1.98 to 1 likelihood (1.10 to 1 for passive interventions) that participants will have increased their condom use 3 months after the intervention. Moreover, given an average condom use of 32.20% over total intercourse occasions (*SD* = 20.56; see Table 1), a *d*. of .38 for the active intervention implies a mean increase of 7.8% of the time over total condom use occasions. Also, given an initial group in which 36% of people are using condoms at least sometimes (see Table 1), a *d*. of .38 implies that an additional 17% will use condoms at least sometimes following the intervention. Correspondingly, such an increase as a result of active interventions when the average HIV seroprevalence is 16.48 (*SD* = 27.15) is suggestive of great public health gains as well as the prevention of significant social and financial losses for the affected nations (for similar conclusions, see Kahn, Kegeles, Hays, & Beltzer, 2001;Pinkerton et al., 2000;Sweet, O'Donnell, & O'Donnell, 2001).

This meta-analysis also has implications for the way in which intervention content is selected and interventions are framed. To begin with, our results suggest that HIV practitioners aiming to motivate audiences to increase condom use are more likely to succeed if they avoid aversion- or fear-inducing approaches. Presumably, these strategies induce avoidance processing and are mainly effective when people must simply abstain from a behavior to protect their health (Rothman & Salovey, 1997). Further, our findings permit conclusions about what interventionists should do. Because active interventions are generally more effective, they should be preferred to passive ones. If one can implement only a passive intervention, it makes sense to select attitudinal and behavioral skills arguments and also to distribute condoms to the audience. If, however, one is in a position to deliver an active intervention, the presentation of information and behavioral skills arguments in combination with self-management training or HIV counseling and testing seems advisable.

A comment on the effects of condom provision—The provision of condoms to communities also appears to be an effective way of intervening to curb HIV infection. There are at least two likely reasons for the effects of condom provision we uncovered in this meta-analysis. First, the availability of resources required for a behavior ought to enable the performance of that behavior. Thus, people who have a condom handy at a particular instance are more likely to use that condom when the opportunity of sexual intercourse arises. In addition, the availability of condoms can produce more permanent psychological changes under certain conditions. In particular, social psychologists have demonstrated that behavioral practices can alter people's attitudes and subsequent behaviors. People who are asked about their attitudes, for example, are likely to reflect on whether they recently performed a behavior that suggests a particular attitude (Bem, 1965; see also Albarracín & Wyer, 2000). In the domain of condom use, individuals who wonder about their attitudes about condom use may try to recall whether they recently used condoms. To the extent that they infer a favorable attitude about condom use from their recall of recent condom use, the availability of condoms may well foster a behavior that later induces important inferential changes capable of eliciting consistent practices (e.g., self-initiated acquisition of condoms).

Effects of Types of Strategies Across Different Populations

Another contribution of this meta-analysis to understanding HIV preventions for specific populations concerned clarifying interactions between the various intervention strategies and characteristics of the recipients. These interactions were fairly complex and are summarized in Table 9, with particular attention to strategies that were equally effective for two groups, effective for two groups but more effective for one of the two, or effective for a single group. The first panel of the table summarizes the effects of specific strategies across demographic groups, and the second, as a function of inclusion of various behavioral risk groups.

Effectiveness of intervention strategies across genders—With the exception of condom provision, which was effective for both males and females, all strategies had different impact for males than for females (see Table 9). For example, even when self-management skills training and HIV counseling and testing were effective across genders, these effects were all stronger for females than for males. Further, whereas attitudinal arguments and information were linked to increased condom use among females alone, behavioral skills arguments and training in condom use skills were linked to increased condom use among males alone. Thus, although these findings point to numerous strategies that can be effective for women (e.g., self-management skills training), they suggest that men are the ones who most benefit from condom use skills training approaches. As Logan et al. (2002) concluded, investments in interventions that are effective for women are still imperative.

Effectiveness of intervention strategies across ages—Just as gender moderated the impact of different intervention strategies, so did age (see Table 9). Behavioral skills arguments and HIV counseling and testing were associated with increased condom use only among populations with an average age over 21 years. Further, even when self-management skills training was effective regardless of age, the effect was stronger when the audience averaged over 21 years. However, people under 21 were positively influenced by normative arguments that others support condom use. This finding is not surprising given the developmental literature on the influence of peers for adolescents (e.g., Atwater, 1988;Dusek, 1996;Sprinthall & Collins, 1995) but is nevertheless the only instance in which we found a favorable effect of the use of this type of argument. In the future, researchers should investigate other ways in which persuasive communications create norms (for a recent review on normative influences, see Prislin & Wood, 2005), such as analyzing the effects of different communicators and intervention facilitators.

Effectiveness of intervention strategies across ethnic groups—During the last decade, concerns that ethnic minorities and disadvantaged populations are at increased risk for HIV infection have increased. Even when this concern has motivated the testing of interventions with minority groups (e.g., Raj et al., 2001; Sterk, Theall, & Elifson, 2003; St. Lawrence, Wilson, Eldridge, Brasfield, & O'Bannon, 2001; Toro-Alfonso, Varas-Díaz, & Andújar-Bello, 2002) and even when ethnicity has been examined as a moderator of intervention effectiveness (see Albarracín et al., 2003; B. T. Johnson et al., 2003), to our knowledge, there has been no research comparing the effects of the various strategies available for program implementation as applied with participants with European and African backgrounds.

Our meta-analysis was intended to reduce past limitations of the prior knowledge about the generalizability of intervention strategy effectiveness across minority and majority populations. Its findings suggest that samples with a greater number of people with African backgrounds show more behavior change in general and that this change is attributable to behavioral skills arguments, self-management strategies, and HIV counseling and testing. However, condom provision appears more effective for populations from European

backgrounds (see Table 9). These findings are intriguing and suggest that extensive empirical and theoretical work on intervention effectiveness across ethnic groups is warranted.

Effectiveness of condom provision for high-risk groups—A quick examination of Table 9 highlights the finding that distributing condoms was more effective when the sample included groups possessing a variety of behavioral risk factors. Providing condoms to participants was effective only when samples included men who have sex with men, intravenous drug users, partners of intravenous drug users, and multiple-partner heterosexuals.

Effectiveness of intervention strategies when men who have sex with men are included—Leaving condom provision aside, samples including men who have sex with men changed more in response to interventions than other samples (see Table 5). However, this group was generally insensitive to the type of intervention strategy that was used, with the exception of greater behavior change in response to condom provision and lesser change in response to attitudinal arguments (see Table 9). Future research might concentrate on improving the efficacy of other techniques that are efficacious for other at-risk populations.

Effectiveness of intervention strategies when intravenous drug users are included—Intravenous drug use continues to pose substantial HIV risks, and it is no surprise that researchers and practitioners need preventive tools for this group. In this regard, our findings (Table 6 and Table 8) indicate that attitudinal and behavioral skills arguments work as well when the groups contains intravenous drug users as when they do not, and that condom use skills training, in addition to condom provision, should be strategies of choice for this population. Although our conclusions are similar to Prendergast et al.'s (2001) conclusion that more focused interventions are better, they provide more information concerning the necessary focus in the area of condom use.

Effectiveness of intervention strategies when partners of intravenous drug users are included—Perhaps our most striking finding concerning behavioral intervention strategies is that interpersonal skills training was associated with successful increases in condom use only when the sample included partners of intravenous drug users. Because of the predominantly female composition of this sample, this result may not be surprising. After all, interpersonal skills training has been advocated for situations in which using a condom depends on obtaining the agreement of the sexual partner (e.g., Amaro, 1995; el-Bassel & Schilling, 1992; St. Lawrence et al., 2001). In this regard, female partners of intravenous drug users probably constitute the single population in which sexual assertiveness is essential to avoid HIV.

In addition to the benefits of interpersonal skills training among partners of intravenous drug users, this group also presented increases in condom use when attitudinal arguments were presented. This finding is consistent with the present similar effect of attitudinal arguments among females in general and with earlier reports that women's intentions to use condoms are more influenced by attitudes than are men's (Albarracín, Kumkale, & Johnson, 2004). Instead, behavioral skills arguments had similar effects when conditions included this group and when they did not.

Effectiveness of intervention strategies when multiple-partner heterosexuals are included—The practices of multiple-partner heterosexuals represent a major health problem, particularly because increasing HIV rates among women are attributable to sexual infection (CDC, 2003). In addition to increasing condom use with condom availability, this group manifested behavior change when attitudinal arguments and condom use skills training were provided. Future research might explore the reasons that favor these strategies among

multiple-partner heterosexuals and perhaps identify ways to make other strategies more effective for this group as well.

Effectiveness of intervention strategies when initial condom use is low—Of course, regardless of the specific risk behavior of a sample, the key objective of condom-use-promoting interventions is to increase condom use among individuals who presently fail to use condoms. As presented in detail in Table 5 and summarized in Table 9, behavioral skills arguments and self-management skills training were associated with most beneficial effects among higher condom users, even when these effects were also present among low condom users. In addition, our analyses indicated that information, attitudinal arguments, and HIV counseling and testing were associated with favorable effects across the board. Thus, continued efforts to increase testing appear justified, not only for HIV treatment purposes but also for its influence on behavior change.

Decision trees for the design of interventions for specific populations—The second and first decision trees we constructed represent the differences in the implementation of passive and active interventions for different groups of participants (Figure 8 and Figure 9). For example, as shown in Figure 8, this synthesis supports peer-oriented approaches for adolescents and children but discourages the application of normative arguments for all other groups. As another example, practitioners may strive to make condoms available to groups that reap high benefits from the mere provision of condoms. Thus, funding for HIV prevention among men who have sex with men, intravenous drug users, female partners of intravenous drug users, and multiple-partner heterosexuals must go beyond dispersing two or three condoms at a time to ensuring a continued supply of condoms when individuals leave the intervention setting.

Similarly, the selection of active strategies should be contingent on the characteristics of the target audience (see Figure 9). Possibly because most men are still in charge of buying, keeping, and applying condoms, men tend to benefit from the condom use skills training to a greater extent than women. Given this fact, practitioners may wish to implement strategies to increase women's responsibility over condom use (e.g., popularization of the female condom) before expanding programs to teach condom use skills to women. Further, although men and women both benefit from receiving condoms, not all age and ethnic groups do. Specifically, condom provision is influential only for recipients under 21 and for people from European backgrounds. Thus, even when research has yet to uncover the mediating mechanisms driving these differences, this meta-analysis supports consistent decisions whenever possible.

We expect that the decision aids in Figure 7 and Figure 9 will be updated as the HIV intervention literature grows in size and allows researchers to understand higher order interactions among different demographic and behavioral risk variables. However, the present results may increase the flexibility of practitioners who want to effectively target specific populations and previously had only general recommendations about how to structure a preventive program.

Effects of Types of Strategies Across Intervention Setups

Perhaps the most important contribution with respect to methods is the finding that the intervention setup moderates the effectiveness of particular intervention strategies. Some of these effects must be understood as being derived from a rather exploratory strategy, but nevertheless they provide key information for the design of future campaigns. First, when interventions are delivered in clinical settings, information, behavioral skills arguments, condom provision, self-management strategies, and HIV counseling and testing seem optimal. Second, when interventions are introduced in schools (see also findings for recipients under 21), normative arguments and condom use skills training work particularly well, whereas

behavioral skills arguments are substandard relative to nonschool settings. Third, the only effective community interventions in our meta-analysis were the ones implementing HIV counseling and testing, even when this strategy was still less effective in community than in noncommunity settings.

With respect to the use of audiovisual media and group sessions, using media was linked to an increased impact of attitudinal and behavioral skills arguments but to decreased effects of information and self-management skills training, which seem more effective when more time is spent in a personal interaction with the intervention facilitator. Moreover, even though behavioral skills arguments and condom use skills training were more effective when the intervention entailed individual sessions with the recipients, the inclusion of group sessions improved effectiveness when interventions included attitudinal arguments, information, self-management skills training, and HIV counseling and testing.

Finally, the impact of intervention setup, media, and session format brings attention to the processes of reception and attention in HIV prevention. Without a doubt, the effectiveness of any program is contingent on exposure to and understanding of that program (McGuire, 1968). However, because research on these aspects has been practically nonexistent in the domain of HIV prevention, efforts should be allocated to understanding the mechanisms that make certain setups or media more or less effective as a function of the intervention content. Our meta-analysis is only a first step in such an endeavor.

Limitations of the Present Meta-Analysis

There are several limitations of this study. These limitations concern the correlational nature of the results, the validity of condom use reports, the impossibility of analyzing more complex interactions, the selection of behavioral measures, and the generalizability of the current conclusions to the sample of studies and to the population of potential studies on the topic.

Correlational nature of many of the results—An obvious limitation of our work is the correlational nature of the analyses. Although the assignment to interventions and control groups was often conducted at random, the specific selection of intervention strategies is contingent on the preferences of particular researchers, which can covary with other characteristics of the studies, the populations, or the methods used. Fortunately, however, this limitation is mitigated by the use of mediation analysis and the various controls implemented to rule out spurious findings.

Factors related to measures of condom use—The current results assume that self-reported behaviors are accurate reflections of individuals' actual behaviors. Although the reliability of self-reports of sexual behavior has been established by the use of interpartner reports (Coates et al., 1986; Jaccard & Wan-Choi, 1995; McLaws, Oldenburg, Ross, & Cooper, 1990) and infection rates (CDC, 1997; Winkelstein et al., 1987), the accuracy of self-reports varies largely with the population and the behavior. For example, if groups have particularly high alcohol or drug consumption rates, reports by their members could be less reliable than reports by other persons. Similarly, self-reports could have different reliability for frequent or infrequent behaviors, depending on the standards people use to assess sexual events or on temporal factors, such as primacy or recency (for a review of such phenomena, see Wyer & Srull, 1989). In view of these possibilities, the extent and nature of self-report biases under different circumstances should be determined more precisely in the future.

Impossibility of analyzing more complex interactions—One important objective of this article was to analyze the extent to which intervention strategies impact different populations. Despite the contribution of these findings, the reality of intervention effectiveness

may be even more complex. To that extent, as new findings accumulate in the literature, researchers could consider higher order interactions that our meta-analysis was not well suited to study.

Limited data about HIV-positive individuals—The same problem that prevented us from examining higher order interactions restricted consideration of intervention effectiveness among HIV-positive individuals, those capable of transmitting HIV. We reported specifically the association between HIV-infection rates at the point of the pretest and behavior change ($\beta = .42$, $p < .001$, $k = 50$) based on the joint consideration of experimental and control groups. This finding is important because it suggests that HIV-positive people generally increase their condom use. However, seroprevalence data for intervention groups were available only in 22 cases, which severely limited the possibility of analyzing the effectiveness of different intervention components as a function of this factor. In fact, a previously unreported analysis of behavior change as a function of seroprevalence and intervention type could be conducted only for attitudinal arguments, fear-inducing arguments, and condom use provision. Of these three intervention components, only attitudinal arguments had a significant interaction with seroprevalence ($Q_1 = 15.84$,$p < .001$). This interaction reflected a favorable association between behavior change and seroprevalence when attitudinal arguments were absent ($\beta = .71$, $p < .001$), accompanied by a negative association between these two variables when attitudinal arguments were present ($\beta = -.37$,$p < .001$). Unfortunately, an understanding of this interaction may become possible only when more reports are available for a future meta-analysis of the influence of seroprevalence on intervention effectiveness.

Selection of behavioral measures—As described earlier, a commonly used measure of condom use was to obtain a percentage of condom use occasions over number of intercourses. Because the epidemiological impact of change depends not only on the amount of change but also on the baseline level of condom use (see Fishbein & Pequegnat, 2000; J. B. Jemmott & Jemmott, 2000; Pinkerton & Abrahamson, 1993, 1994; Schroeder, Carey, & Vanable, 2003), our meta-analysis incorporated a measure of initial levels of condom use that we introduced in some analyses. Even this treatment, however, should be complemented with a variety of behavioral and biological outcome measures that are likely to become common practice in the years to come.

Further mediation analyses—Another limitation of our metaanalysis is that despite the use of mediation analyses, the number of effect sizes available for the mediators did not allow for separate consideration of some potentially distinct constructs. For example, to increase the power of some analyses, change in attitudes was combined with change in intentions, as were change in perceived behavioral control and change in self-efficacy. Clearly, attitudes and intentions reflect different levels of behavioral commitment, and perceived behavioral control has been suggested to be different from self-efficacy (Armitage & Conner, 1999; Armitage, Conner, & Loach, 1999; Povey, Conner, & Sparks, 2000; but see Ajzen, 2002). In light of these subtleties, future reviews as well as primary research should examine other mediational models.

Generalizability to the sample of studies and to the population of all possible studies—The current findings from the present meta-analysis are probably the most generalizable to date. In particular, the results from the random-effects mean comparisons suggest that HIV-prevention interventions are effective no matter what sample of the potential universe of studies one might consider. The described analyses of the effects of specific intervention strategies, however, were obtained with fixed-effects models. Thus, even when the patterns did replicate when we reran the findings in Table 3–Table 7 using random-effects, the number of significant results dropped considerably. We hope that future research will

provide a sufficiently large number of effect sizes to estimate the population variance more precisely and thus reconcile the discrepancies between the fixed- and random-effects findings.

Closing Note

Efforts to prevent the spread of HIV have united scholars in psychology, sociology, education, anthropology, public policy, law, epidemiology, and medicine. A clear example of this joint expertise was the NIH (1997) consensus development conference, which recommended the dissemination of behavioral interventions to reduce HIV/AIDS, lifting legislative restrictions on needle-exchange programs and effective prevention programs for youth, and halting the erosion of funding for drug abuse treatment programs. In addition, the panel recommended the development of new research on at-risk groups, such as young people, gay individuals, ethnic minorities, and women, in the hope of reducing one of the most pressing public health problems in the world. We hope that the results from this meta-analysis will contribute to precise knowledge about intervention effectiveness and make preventive programs more effective for the people who need them the most.

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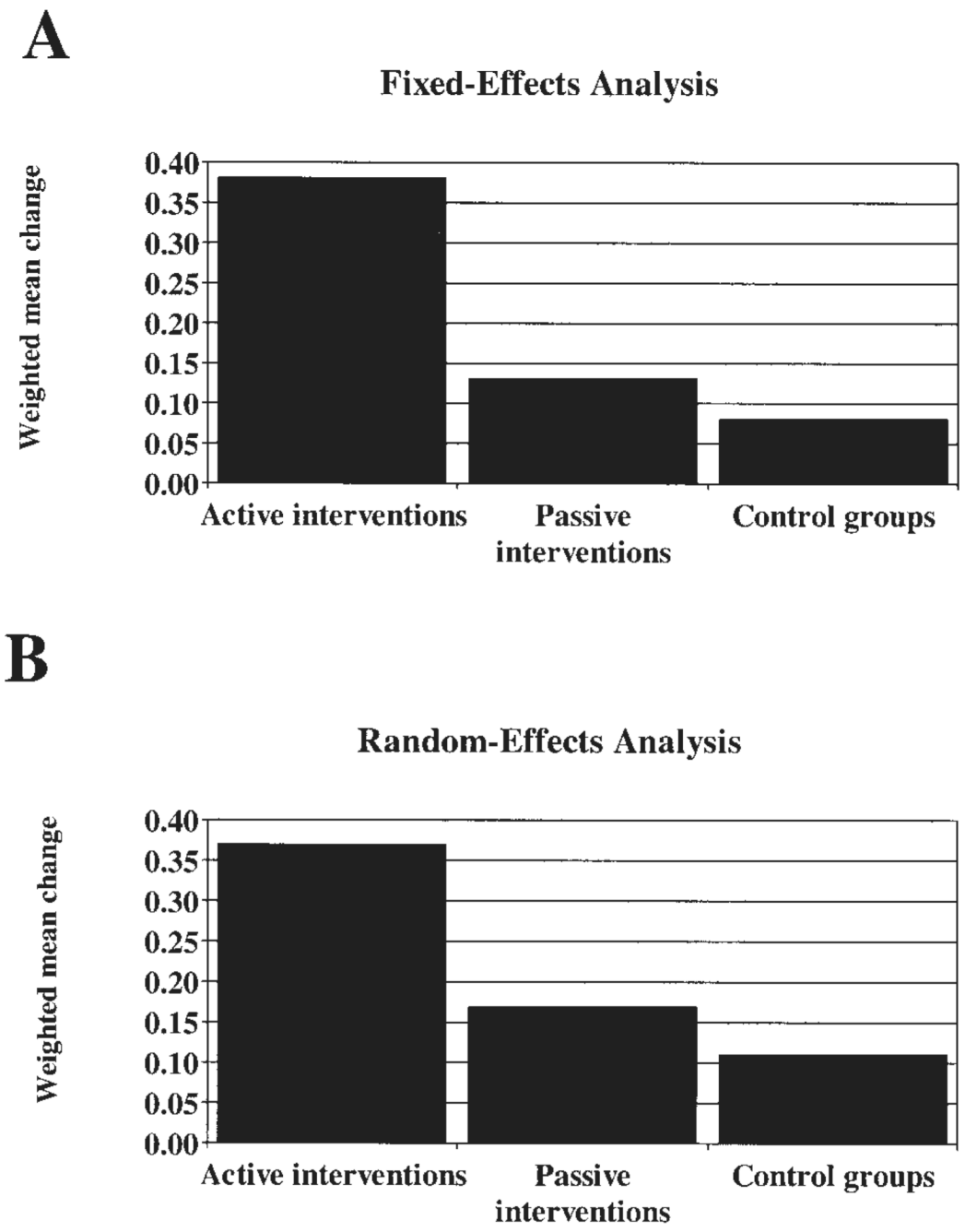

Figure 1.
Behavior change for active interventions, passive interventions, and control groups. Weighted mean change as a function of condition (passive intervention, active intervention, or control group). A: Fixed-effects models. B: Random-effects models.

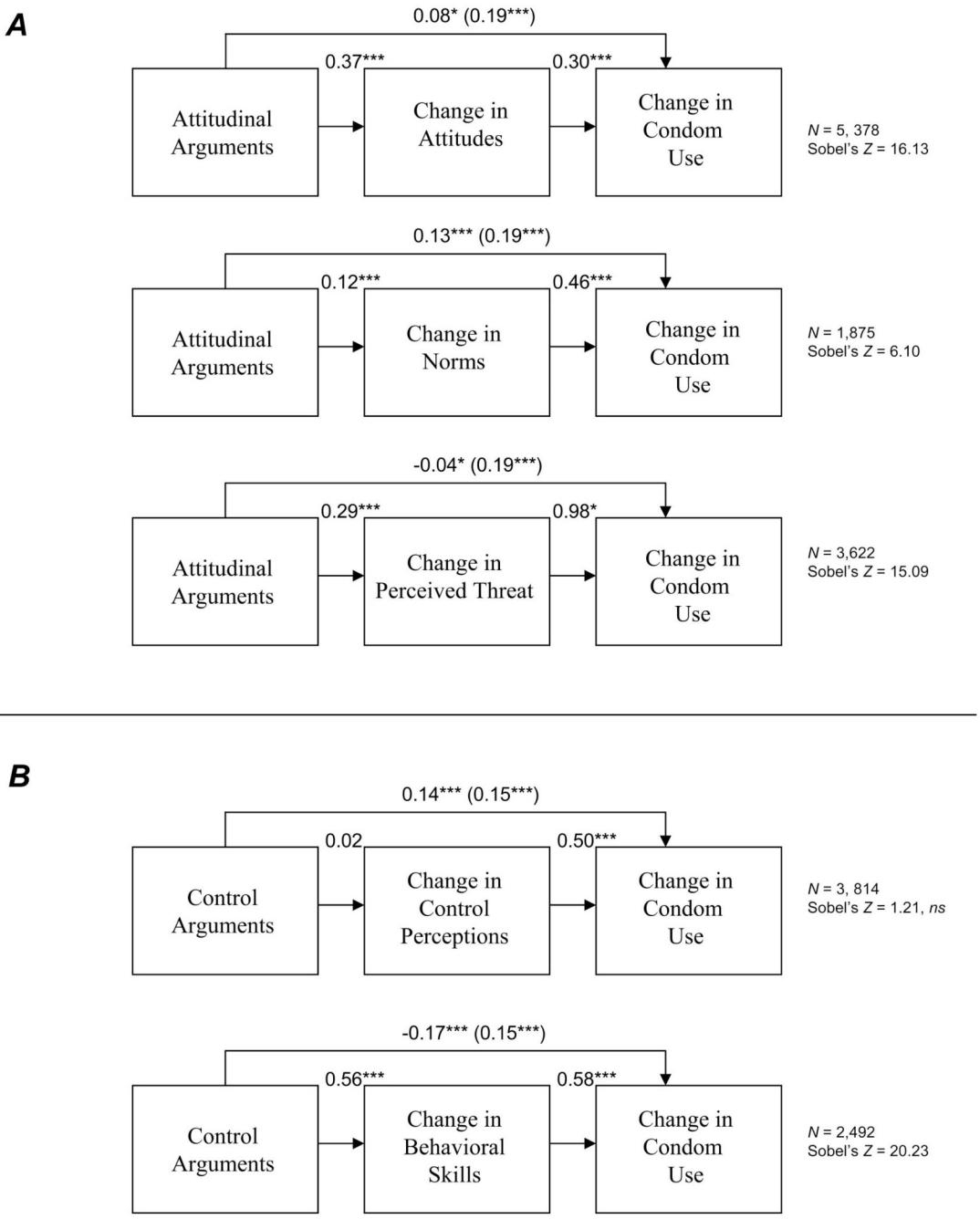

Figure 2.

Path analyses to determine the mediating effects of change in specific psychological variables on changes in condom use among passive interventions. A: Effects of attitudinal arguments. B: Effects of behavioral skills arguments. Both models also included all the strategies used in passive interventions (see Table 3). However, for simplicity, the other paths are not presented. Path coefficients are standardized. The direct path when the mediator was not included appears in parentheses. Sobel tests were significant unless indicated as *ns*. *$p < .05$. ***$p < .001$.

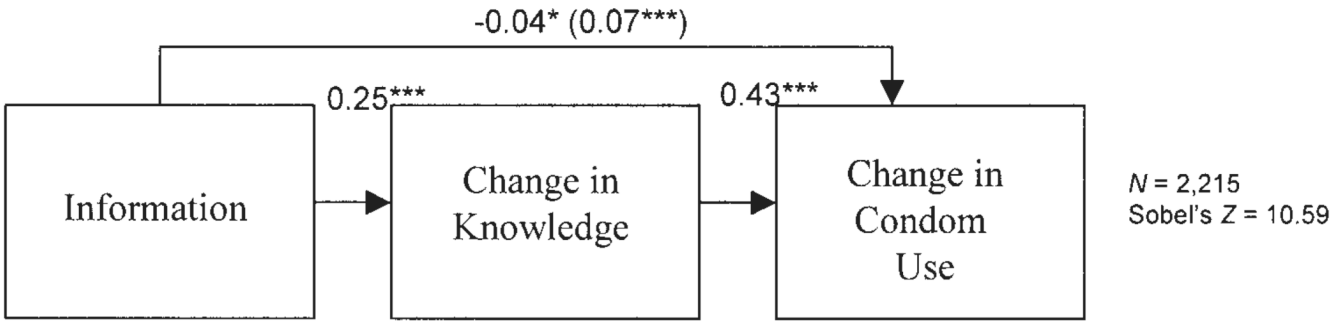

Figure 3.

Path analyses to determine the mediating effects of change in specific psychological variables on changes in condom use as a function of information among active interventions. This model also included all the strategies used in active interventions (see Table 4). However, for simplicity, the other paths are not presented. Path coefficients are standardized. The direct path when the mediator was not included appears in parentheses. The Sobel test was significant. *$p < .05$. ***$p < .001$.

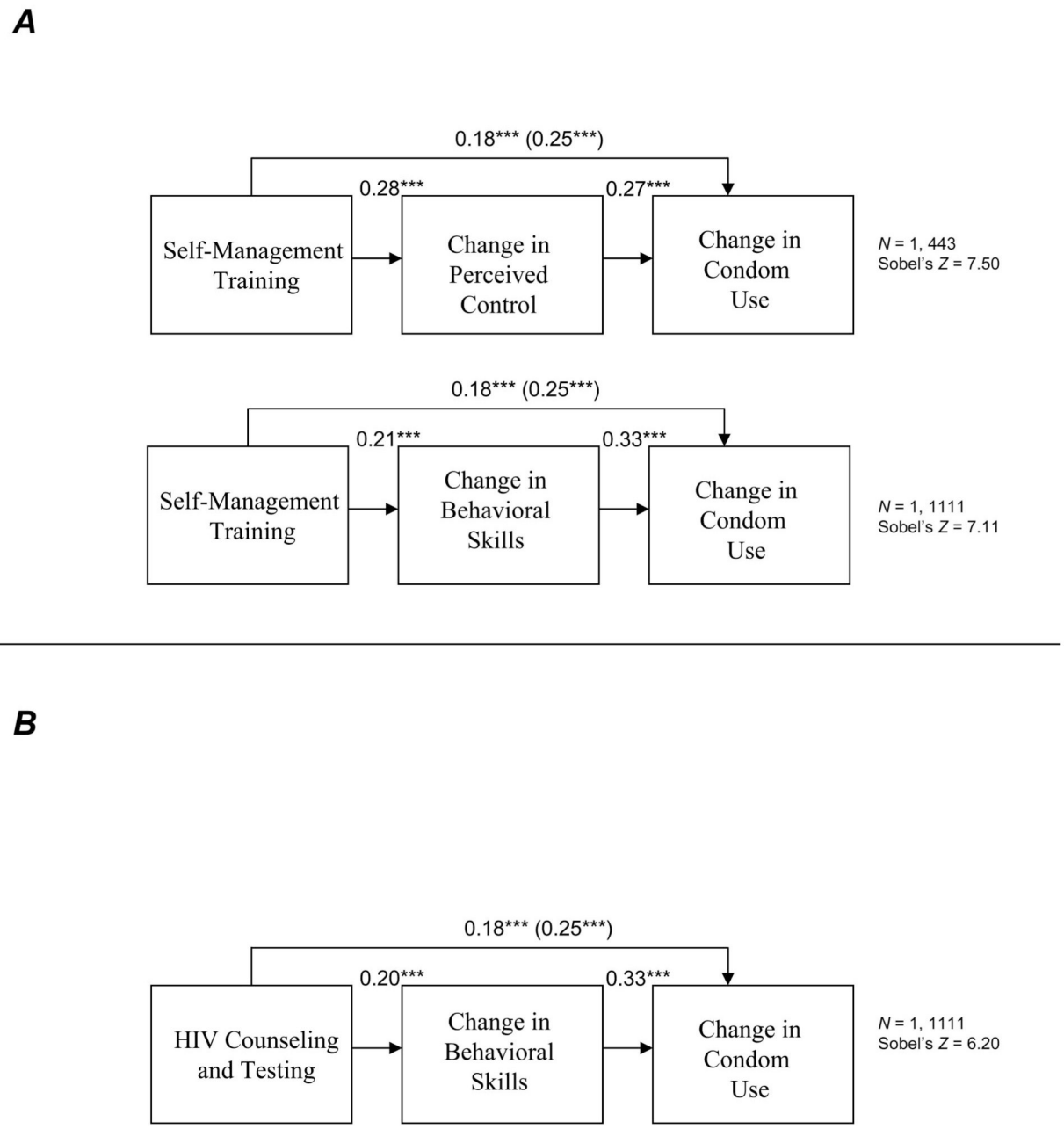

Figure 4.

Path analyses to determine the mediating effects of change in specific psychological variables on changes in condom use as a function of active strategies among active interventions. A: Effects of self-management behavioral skills training. B: Effects of HIV counseling and testing. All models also included all the strategies used in active interventions (see Table 4). However, for simplicity, the other paths are not presented. Path coefficients are standardized. The direct path when the mediator was not included appears in parentheses. Sobel tests were significant. ***$p < .001$.

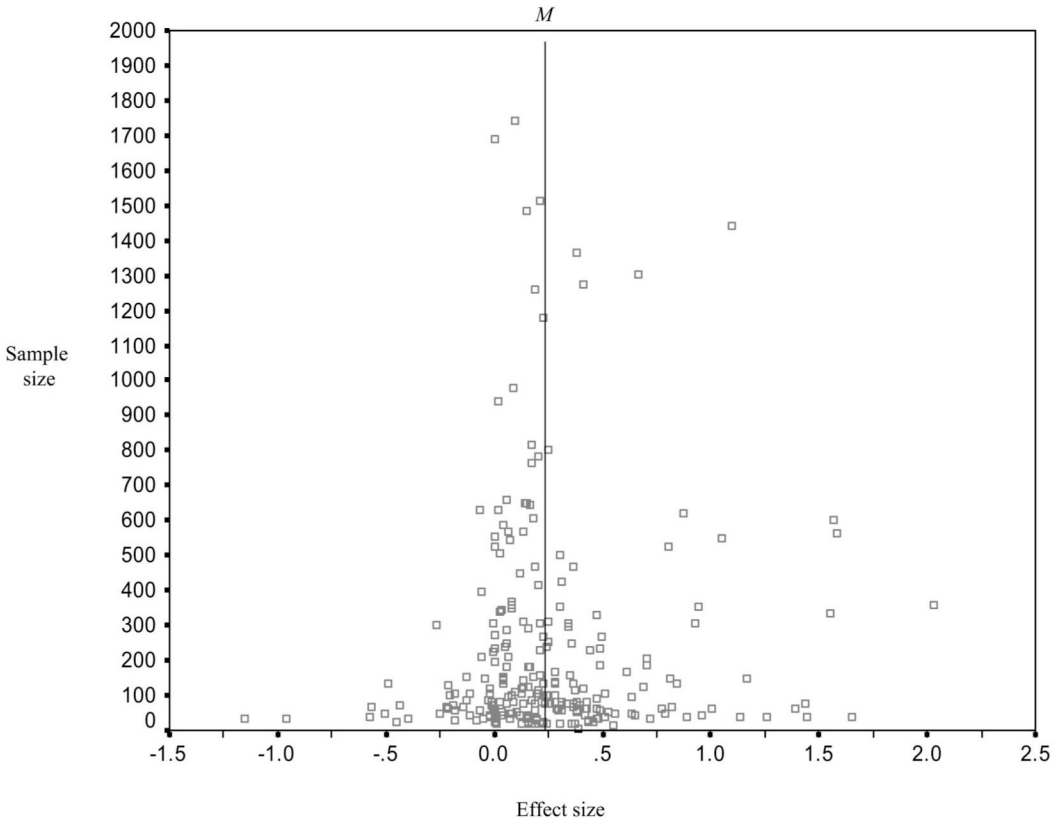

Figure 5.
Funnel plot. Two effects with extremely large sample sizes were excluded to make the shape of the plot more apparent. These large sample groups had average effect sizes.

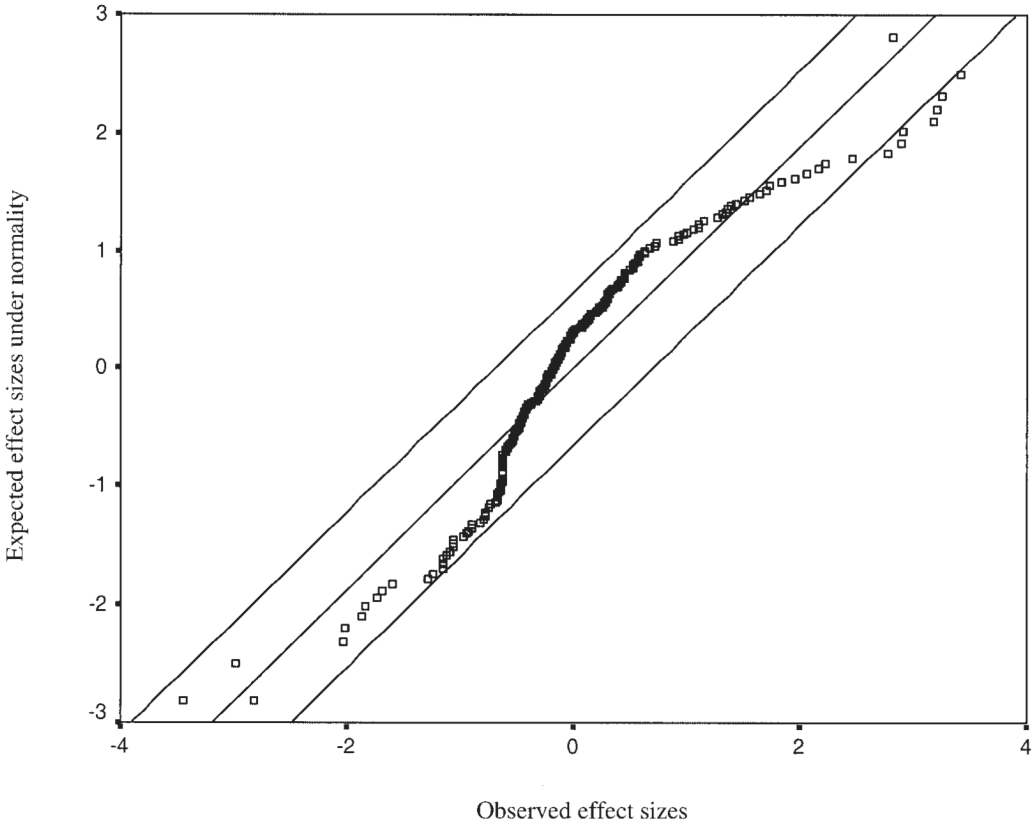

Figure 6.
Normal quantile plot. The line on the diagonal indicates normality; the lines around the diagonal represent the 95% confidence interval around the normality line.

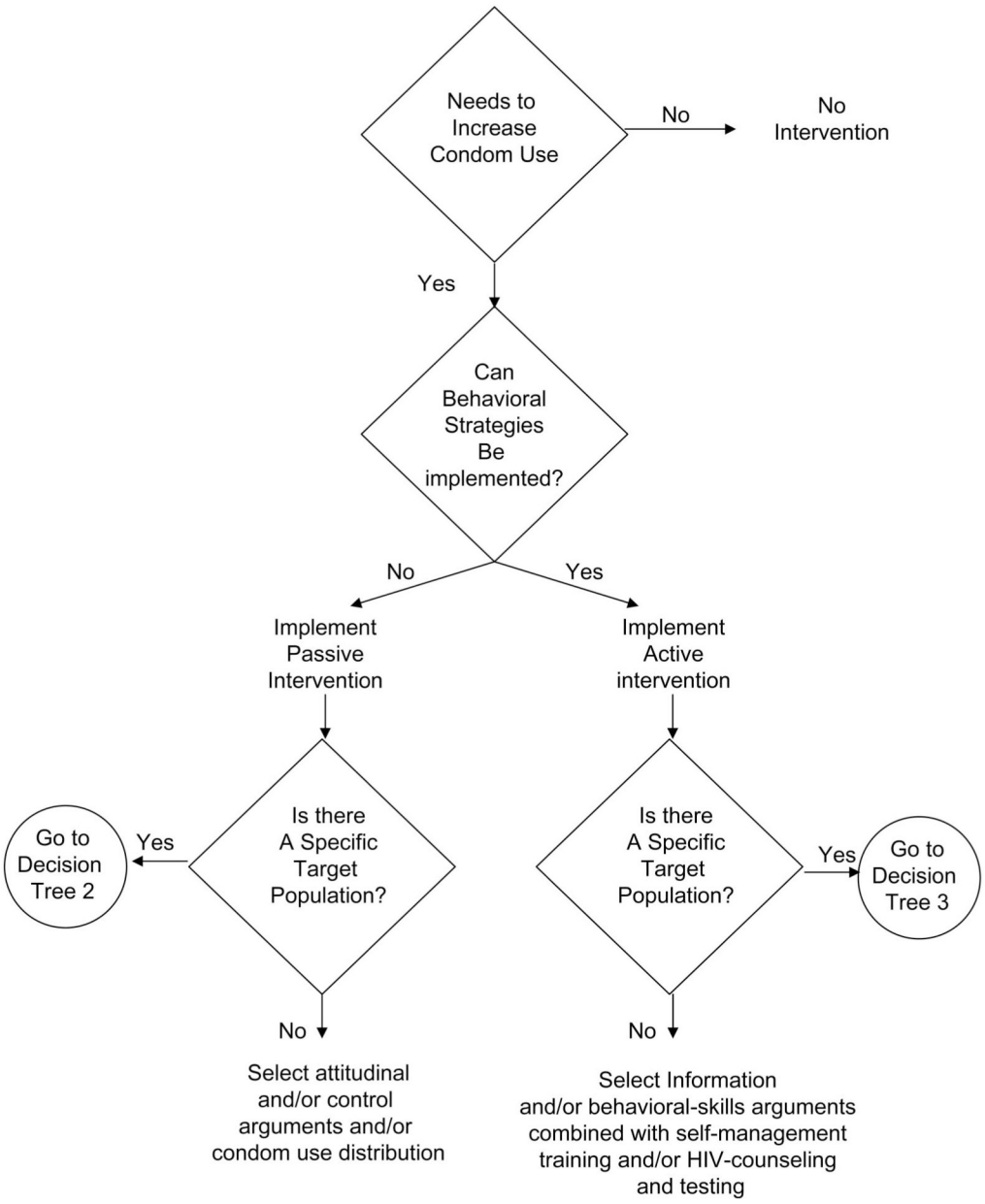

Figure 7.
Decision tree 1 (initial decisions).

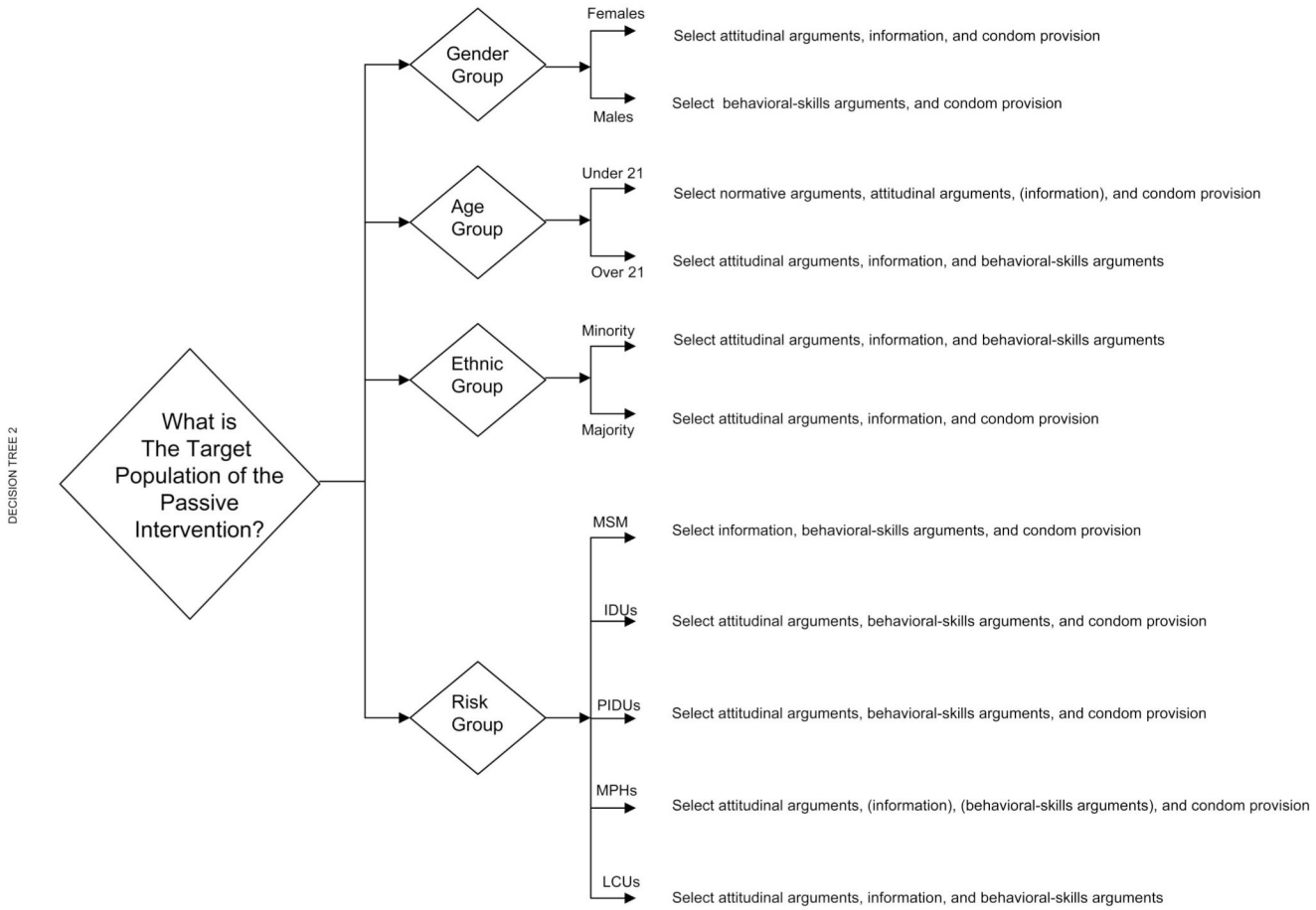

Figure 8.

Decision tree 2 (passive interventions). MSM = men who have sex with men; IDUs = intravenous drug users; PIDUs = partners of intravenous drug users; MPHs = multiple-partner heterosexuals; LCUs = low condom users.

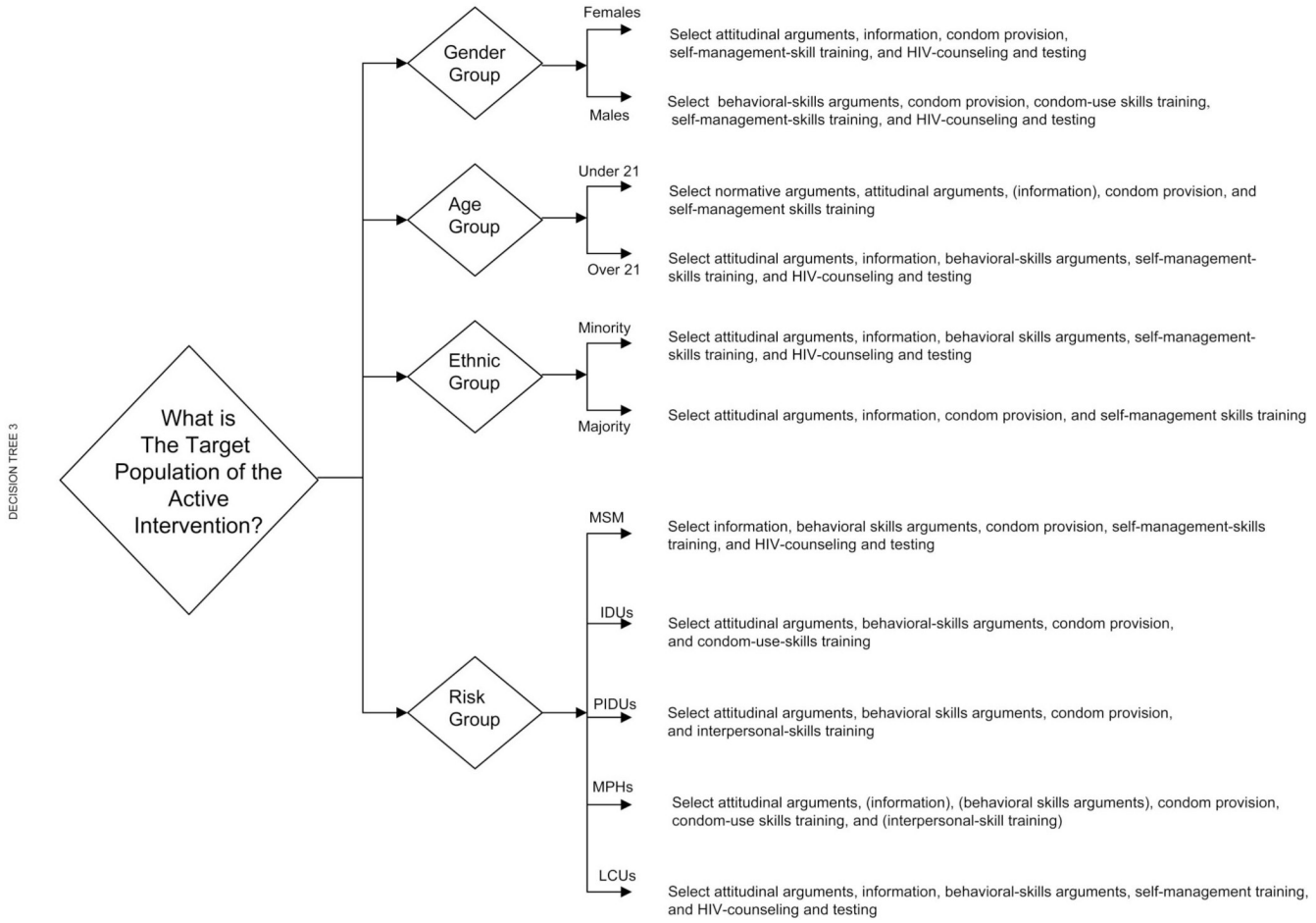

Figure 9.

Decision tree 3 (active interventions). MSM = men who have sex with men; IDUs = intravenous drug users; PIDUs = partners of intravenous drug users; MPHs = multiple-partner heterosexuals; LCUs = low condom users.

Table 1

Descriptive Statistics

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
General characteristics of the reports		
Publication year (*r* = 1)		
M	1995.96	1996.04
Mdn	1996	1997
SD	4.20	3.71
k	348	97
Academic affiliation (κ = .93)		
Medical school	32.5 (115)	33.3 (33)
Psychology	17.5 (62)	18.2 (18)
Community health	16.4 (58)	13.1 (13)
Other	19.2 (87)	25.1 (25)
Not identified	9.0 (32)	10.1 (10)
Country (κ = 1)		
United States	76.0 (269)	67.7 (67)
Other	24.0 (85)	32.3 (32)
State (U.S. only; κ = 1)		
California	21.3 (57)	16.2 (18)
New York	7.9 (41)	9.1 (11)
Other	70.8 (190)	74.7 (83)
Language (U.S. only; κ = 1)		
English	91.2 (258)	91.2 (64)
Spanish	3.1 (9)	3.1 (2)
Other	3.4 (10)	3.4 (2)
Multiple	2.3 (6)	2.3 (2)
Types of intervention strategy		
Passive strategies		
Attitudinal arguments (κ = 1)		
Yes	48.0 (170)	0
No	52.0 (184)	100 (99)
Normative arguments (κ = 1)		
Yes	15.3 (54)	0
No	84.7 (300)	100 (99)
Factorial information (κ = .83)		
Yes	93.8 (332)	0
No	6.2 (22)	100 (99)
Behavioral-skills arguments (κ 1)		
Yes	19.8 (70)	0
No	80.2 (284)	100 (99)
Threat-inducing arguments (κ = .92)		
Yes	46.6 (165)	0

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
No	53.4 (189)	100 (99)
Active strategies		
Condom use skills training (κ = 1)		
Yes	23.2 (82)	0
No	76.8 (272)	100 (99)
Interpersonal skills training (κ = 1)		
Yes	28.0 (99)	0
No	72.0 (255)	100 (99)
Self-management skills training (κ = 1)		
Yes	13.3 (47)	0
No	86.7 (307)	100 (99)
HIV counseling and testing (κ = 1)		
Yes	18.4 (65)	0
No	81.6 (289)	100 (99)
Condom provision (κ = .90)[a]		
Yes	22.0 (78)	7.1 (7)
No	78.0 (276)	92.9 (92)
Participant characteristics		
Sample size (*N*)(*r* = .997)		
Sum total	104,054	34,751
M	293.94	351.02
Mdn	107.50	97.00
SD	924.41	1,454.21
k	354	99
% men (*r* = 1)		
M	42.33	41.51
Mdn	44.40	43.00
SD	37.11	37.04
k	337	92
% recipients whose sex not identified (*r* = 1)		
M	6.83	7.07
Mdn	0	0
SD	25	26
k	354	99
Age in years (*r* = 1)		
M	26.09	24.53
Mdn	27.10	24.27
SD	8.91	8.77
k	237	66
Ethnic decent		
% European (*r* = .89)		

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
M	34.14	37.95
Mdn	19.15	24.35
SD	35.90	37.65
k	290	82
% African (*r* = .77)		
M	47.10	41.40
Mdn	41.40	33.50
SD	38.72	38.78
k	301	76
% Latin American (*r* = 1)		
M	13.28	14.87
Mdn	1.60	2.80
SD	25.44	27.76
k	275	71
% Asian (*r* = .68)		
M	6.27	8.41
Mdn	0	0
SD	20.57	23.39
k	250	63
% North American Indian (*r* = .76)		
M	0.36	0.45
Mdn	0	0
SD	1.36	1.21
k	251	61
% high school graduates (*r* = 1)		
M	33.30	37.06
Mdn	9.20	0
SD	37.24	43.75
k	150	59
Community population[b]		
M	1,432,594	1,369,890
Mdn	572,059	580,600
SD	2,241,959	2,130,756
k	329	96
Sexual behavior		
% straight participants (*r* = .91)		
M	60.17	48.70
Mdn	93.00	42.00
SD	46.00	47.46
k	83	21
% gay/lesbian participants (*r* = .90)		
M	44.00	50.64

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
Mdn	7.00	58.00
SD	46.47	47.28
k	81	21
% monogamous participants (*r* = 1)		
M	35.61	50.03
Mdn	38.50	56.00
SD	30.70	35.35
k	76	19
% multiple-partner participants (*r* = 1)		
M	55.34	47.56
Mdn	46.50	37.00
SD	34.37	36.15
k	76	19
% non-sexually-active participants (*r* = 1)		
M	8.03	12.53
Mdn	0	16.30
SD	19.23	25.00
k	354	99
Inclusion of specific groups (κ = .80)[C]		
Men who have sex with men		
Yes	11.3 (40)	13.1 (13)
No	88.7 (314)	86.9 (86)
Intravenous drug users		
Yes	15.5 (55)	12.1 (12)
No	84.5 (299)	87.9 (87)
Partners of intravenous drug users		
Yes	10.5 (37)	7.1 (7)
No	89.5 (317)	92.9 (92)
Sex workers		
Yes	8.5 (30)	5.1 (5)
No	91.5 (324)	94.9 (94)
Multiple-partner heterosexuals		
Yes	16.7 (59)	9.1 (9)
No	83.3 (295)	90.9 (90)
Participants with a history of STIs		
Yes	6.8 (24)	6.1 (6)
No	93.2 (330)	93.9 (93)
Participants with severe mental illness		
Yes	2.3 (8)	4.0 (4)
No	97.7 (346)	96.0 (95)
Drug users		
Yes	13.8 (49)	6.1 (6)

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
No	86.2 (346)	93.9 (93)
College students		
Yes	10.2 (36)	17.2 (17)
No	89.8 (318)	82.8 (82)
Middle and high school students		
Yes	33.3 (118)	38.4 (38)
No	66.7 (236)	61.6 (61)
Teachers		
Yes	1.1 (4)	1.0 (1)
No	98.9 (350)	99.0 (98)
Level of baseline condom use (κ = 1)		
Low (never/almost never and < 40%)	63.6 (112)	63.0 (29)
Moderate (sometimes and 40–80%)	34.1 (60)	34.8 (16)
High (always/almost always and 80%+)	2.3 (4)	2.2 (1)
% of condom use at pretest (*r* = .91)		
M	32.20	31.01
Mdn	29.50	27.00
SD	20.56	21.36
k	1,151	42
% HIV+ participants at pretest (*r* = 1)		
M	16.48	23.49
Mdn	4.00	14.50
SD	27.15	33.16
k	59	13
Interventions setup		
Setting of exposure (κ = 1)[c]		
School		
Yes	31.4 (111)	
No	68.6 (243)	
Clinic		
Yes	30.5 (108)	
No	69.5 (246)	
Community (street, community center, gay bar)		
Yes	20.6 (73)	
No	79.4 (281)	
Mass communication		
Yes	2.8 (10)	
No	97.2 (344)	
Medium of delivery (κ = .93)[c]		
Face to face		
Yes	86.2 (305)	

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
No	13.8 (49)	
Video- or audiotape presentation		
Yes	33.9 (120)	
No	66.1 (234)	
Intervention applied to individuals or groups (κ = .92)		
Groups	68.6 (243)	
Individuals	19.8 (70)	
Both	7.6 (27)	
Is intervention culturally appropriate? (κ = .91)		
Yes	21.2 (75)	
No	78.8 (279)	
Duration of HIV prevention intervention in hours (*r* = 1)		
M	7.94	
Mdn	3.00	
SD	13.27	
k	249	
Research design and implementation		
Experimental design (κ = 1)[a]		
Within subjects	89.3 (316)	88.9 (88)
Between subjects	10.7 (38)	11.1 (11)
Random assignment of participants to conditions (κ = .72)		
Yes	47.5 (168)	44.4 (44)
No	52.5 (186)	55.6 (55)
Payment received (U.S. dollars; *r* = 1)		
M	18.31	11.63
Mdn	0	0
SD	37.00	28.29
k	354	99
Days between intervention and posttest (*r* = 1)		
M	99.66	
Mdn	42	
SD	167.41	
k	336	
Basis for intervention (κ = 1)		
Formal theory acknowledged as basis	51.4 (182)	50.5 (50)
Informal conceptualization, no theory cited	35.0 (124)	36.4 (36)
Informal conceptualization, theory cited	13.6 (48)	13.1 (13)
Formative research was conducted (κ = 1)[a]		
Yes, mentioned	32.8 (116)	50.5 (50)
No, not mentioned	67.2 (238)	49.5 (49)
Specific population targeted (κ = 1)		

Variable	Intervention groups (*k* = 354)	Control groups (*k* = 99)
Yes	92.7 (328)	
No	7.3 (26)	
Sample targeted by ethnicity (κ = 1)		
Yes	20.3 (72)	
No	79.7 (282)	
Sample targeted by gender (κ = 1)		
Yes	35.3 (125)	
No	64.7 (229)	
Self-selected samples (κ = 1)		
Yes	70.1 (248)	59.6 (59)
No	29.9 (106)	40.4 (40)
% attrition between the pretest and the immediate posttest (*r* = 1)		
M	12	11
Mdn	0	0
SD	19	23
k	202	57

Note. For categorical variables, entries are percentages followed by frequencies in parentheses. *k* = maximum number of intervention and control groups; *r* = intercoder reliability for continuous variables; κ = intercoder reliability coefficient for categorical variables; STIs = sexually transmitted infections.

[a] Intercoder reliability was initially low but was satisfactory after both discussion of the coding criteria and recalculation of the reliability on a different set of studies. We report the second of these coefficients.

[b] Information was retrieved from an independent source.

[c] Reliability was obtained for a general category, which we later broke down into the mutually exclusive categories that follow.

Table 2

General Intervention Effectiveness

	Intervention		Control		Cross-group comparisons	
	***d*. (95% CI)**	***Q***	***d*. (95% CI)**	***Q***	**QB_1 for interventions with and without a control**	**QB_1 for interventions with a control**
Attitudes toward condom use						
Fixed	0.16 (0.14, 0.17)	1,207.31***	0.02 (−0.01, 0.04)	900.90***	92.43***	159.04***
Random	0.24 (0.17, 0.31)		−0.17 (−0.30, −0.04)		27.98***	25.04***
k		76		23	99	58
N		16,352		5,569	21,921	15,898
Perceptions of control						
Fixed	0.29 (0.28, 0.31)	1,900.67***	0.01 (−0.03, 0.05)	385.04***	183.75***	300.92***
Random	0.28 (0.19, 0.38)		−0.03 (−0.22, 0.16)		8.33**	8.44**
k		65		17	82	41
N		16,215		2,862	19,077	12,836
Norms about condom use						
Fixed	0.36 (0.33, 0.39)	3,066.24***	−0.05 (−0.12, 0.02)	24.81***	101.07***	378.68***
Random	0.52 (0.19, 0.84)		−0.03 (−0.60, 0.54)		2.73	6.46*
k		28		9	37	21
N		7,510		1,257	8,767	4,679
Intentions to use condoms						
Fixed	0.25 (0.22, 0.27)	570.14***	0.06 (0.01, 0.11)	153.27***	43.19***	59.82***
Random	0.23 (0.13, 0.34)		0.03 (−0.15, 0.21)		3.58	6.34*
k		46		15	61	36
N		8,678		2,413	11,091	9,089
HIV knowledge						
Fixed	0.46 (0.44, 0.47)	5,234.35***	0.09 (0.07, 0.11)	141.71***	825.07***	1,030.16***
Random	0.55 (0.49, 0.61)		0.09 (−0.02, 0.20)		50.00***	53.91***
k		206		59	265	141
N		50,020		12,703	62,723	36,275
Behavioral skills						

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	Intervention		Control		Cross-group comparisons	
	d. (95% CI)	*Q*	*d*. (95% CI)	*Q*	QB_1 for interventions with and without a control	QB_1 for interventions with a control
Fixed	0.15 (0.13, 0.17)	839.17***	0.03 (−0.05, 0.11)	8.43**	8.82**	27.87*
Random	0.36 (0.27, 0.45)		0.03 (−0.17, 0.21)		10.06**	10.89***
k		59		14	73	30
N		11,511		1,052	12,563	2,238
Perceived severity of HIV						
Fixed	0.14 (0.12, 0.17)	821.64***	0.03 (−0.02, 0.08)	30.03**	14.57***	1.55
Random	0.10 (0, 0.21)		0.04 (−0.15, 0.23)		0.34	0.13
k		46		14	60	30
N		12,231		3,239	15,470	9,586
Perceived susceptibility to HIV						
Fixed	0.01 (−0.01, 0.04)	1,142.58***	−0.01 (−0.05, 0.04)	27.01*	0.57	0.03
Random	0.04 (−0.06, 0.15)		0.01 (−0.18, 0.21)		0.08	0.18
k		52		16	68	38
N		11,468		3,656	15,124	10,544
Condom use						
Fixed	0.26 (0.25, 0.27)	4,042.25***	0.08 (0.06, 0.10)	229.82***	237.58*	11.95***
Random	0.29 (0.24, 0.34)		0.11 (0.02, 0.20)		11.48***	3.63
k		200		58	258	127
N		63,107		25,245	88,352	57,431
Stage of change to condom use						
Fixed	0.34 (0.31, 0.36)	197.95***	—	—	—	—
Random	0.30 (0.17, 0.43)		—	—	—	—
K		9		—	—	—
N		2,128		—	—	—

Note. Weighted mean effect sizes (*d*.) include standardized mean differences calculated within and between subjects, depending on whether pre- and posttest measures were obtained for the same or different samples. Statistics *d* are Becker's *g* ($M_{posttest} - M_{pretest}/SD_{pre}$) adjusted for sample size. The fixed-effects variance of Becker's *g* was computed following Hedges and Olkin's (1985) or Morris's (2000) recommendations for within- and between-subjects analyses, respectively. In calculating the variance of Becker's *g*, the correlations *r* were obtained from the Project RESPECT data set, because this project contained all the dependent measures of interest, was longitudinal, and had a large sample size. The random-effects variance comprised the fixed-effect variance plus the random-

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variance term (V_0; see Lipsey & Wilson, 2001). CI = confidence interval. *Q* = homogeneity index, which approximates an asymptotic chi-square distribution with *k* – 1 degrees of freedom. *QB* = between-category homogeneity index with degrees of freedom equal to number of factor levels – 1. Significant *QB*s indicate significant effects of the interventions relative to control groups. The first *QB* in the table compared all interventions with all controls, whereas the second excluded interventions that lacked a control. *k* = number of conditions in the analysis. Dashes indicate insufficient effect sizes available in analysis.

* $p < .05$.

** $p < .01$.

** $p < .001$.

Table 3

Condom Use Change as a Function of Passive Strategy Across Passive and Active Interventions (k = 200)

	Passive interventions			Active interventions				
	d.			*d.*			Overall	
Strategy	**Strategy included**	**Strategy not included**	***QB*$_1$ for simple effect**	**Strategy included**	**Strategy not included**	***QB*$_1$ for simple effect**	***QB*$_1$ for main effect**	***QB*$_1$ for interaction**
Normative arguments	0.24	0.28	1.86	0.02	0.43	293.61***	173.09***	126.42***
Attitudinal arguments	0.31	0.21	17.25***	0.29	0.15	38.07***	53.74***	2.54
Any kind of information	0.23	0.29	1.02	0.31	0.14	18.16***	2.95	11.53***
Behavioral-skills arguments	0.34	0.18	11.87***	0.31	0.13	69.77***	44.49***	0.19
Threat-inducing arguments	0.25	0.27	0.49	0.02	0.42	363.89***	201.43***	174.76***
Condom provision	0.33	0.19	38.35***	0.24	0.21	2.19	33.78***	16.06***

Note. All factors were dummy coded (strategy included = 1; strategy not included = 0). *d.* = fixed-effects weighted model means adjusted for all other effects. Control groups (*d.* = 0.08, confidence interval = 0.06 to 0.10) were excluded. Following the means, we present *QB*s for each type of argument alone and in interaction with the passive or active nature of the intervention. *QB* for simple and main effect = homogeneity coefficient for the difference across levels of a factor, distributed as a chi-square with number of factor levels – 1 degrees of freedom. *QB* for interaction = homogeneity coefficient for the interaction between factors, distributed as a chi-square with (number of levels of factor *A* –1) × (number of levels of factor *B* – 1) degrees of freedom. Significant *QB*s indicate significant effects of the involved factors.

*** $p < .001$.

Table 4

Condom Use Change as a Function of Active Strategy (k = 123)

	d.		
Strategy	**Yes**	**No**	QB_1
Condom use skills training	0.31	0.30	0.71
Interpersonal skills training	0.25	0.36	10.14**
Self-management skills training	0.51	0.10	251.08***
HIV counseling and testing	0.43	0.17	125.28**

Note. All factors were dummy coded (strategy included = 1; strategy not included = 0). *d*. = fixed-effects weighted model means adjusted for all other effects. Control groups (*d*. = 0.08, confidence interval = 0.06 to 0.10) were excluded. Threat-inducing, normative, attitudinal, informational, and behavioral-skills arguments were included in the analysis as well, as was condom provision. *QB* = homogeneity coefficient for the difference across levels of a factor, distributed as a chi-square with degrees of freedom equal to the number of factor levels − 1.

** $p < .01$.

*** $p < .001$.

Table 5

Influence of Participants' Characteristics and Intervention Setup on Behavior Change

Participant group and intervention setup	*d.*		QB_1
	Participant group characteristics		
Demographics			
Gender (*k* = 197)	Predominantly male	Predominantly female	
	0.45	0.34	6.54**
	(0.09)	(0.14)	(0.78)
Age (*k* = 200)	Mean over 21	Mean under 21	
	0.42	0.16	13.58***
	(0)	(0.14)	(6.06**)
Ethnicity (*k* = 200)	Predominantly from European background	Predominantly from African background	
	0.20	0.37	17.40***
	(0.13)	(0.17)	(0.13)
Behavioral risks			
Men who have sex with men (*k* = 200)	Yes	No	
	0.52	0.35	5.73*
	(0.10)	(0.13)	(0.92)
Intravenous drug users (*k* = 200)	Yes	No	
	0.45	0.40	0.42
	(0.17)	(0.15)	(0.25)
Partners of intravenous drug users (*k* = 200)	Yes	No	
	0.21	0.40	27.51***
	(0.16)	(0.13)	(1.30)
Multiple partner heterosexuals (*k* = 200)	Yes	No	
	0.33	0.41	21.62***
	(0.08)	(0.15)	(1.50)
Past condom use (*k* = 147)	Moderate or high	Low	
	0.43	0.35	2.15
	(0.15)	(0.10)	(1.39)
	Intervention setup		
Setting of exposure			
School (*k* = 200)	Yes	No	
	0.37	0.40	0
Clinic (*k* = 200)	Yes	No	
	0.27	0.21	2.15
Community (*k* = 200)	Yes	No	
	0.29	0.33	1.00
Presentation			

Participant group and intervention setup		*d.*	QB_1
Video- or audiotaped material (k = 200)	Yes	No	
	0.39	0.64	43.50***
Intervention applied to groups (k = 200)	Yes	No	
	0.39	0.31	2.68

These analyses correspond to models that also included intervention strategies and their interaction with each characteristic of the participant or the intervention setup. For simplicity, only the main effects of characteristics of the participants or the intervention setup are presented. All factors were dummy coded (strategy included = 1; strategy not included = 0). *d.* = fixed-effects weighted model means adjusted for all other effects in Table 3 and the interactions between those factors and the participant or intervention-setup variable being analyzed. Control means for each demographic group are necessary for comparisons with the effect of intervention characteristics for the particular group, which are presented in Table 6. Therefore, we present these means parenthetically in the table. To allow for comparisons with the model means from the intervention analyses, these means correspond to the fixed-effects analyses of change in control conditions, when analyzed as a function of each demographic group, provision of condoms, and the interaction between the two. Most of those interactions—not displayed for the sake of brevity—were nonsignificant and did not compromise the interpretation of our findings about intervention effects. The control mean for groups as a function of intervention setup continues to be *d.* = 0.08, confidence interval = 0.06 to 0.10. *QB* = homogeneity coefficient for the difference across levels of a factor, distributed as a chi-square with degrees of freedom equal to the number of factor levels – 1. Significant *QB*s indicate significant main effects of the involved factors. Interactions are presented in Table 6 and Table 7. k = number of interventions in analysis.

* $p < .05$.

** $p = .01$.

*** $p = .001$.

Table 6

Change as a Function of Strategy Across Different Participants

Participant group and intervention strategy	Group 1			Group 2			
	d.			*d.*			
	Strategy included	Strategy not included	*QB*1 for simple effect	Strategy included	Strategy not included	*QB*1 for simple effect	Overall: *QB*1 for interaction
			Demographics				
Gender (k = 197)	Predominantly male (control *d.* = 0.09)			Predominantly female (control *d.* = 0.14)			
Normative arguments	0.40	0.50	6.23*	0.22	0.46	165.10***	11.36***
Attitudinal arguments	0.45	0.45	0.05	0.39	0.29	23.80***	10.26***
Any kind of information	0.47	0.43	1.18	0.50	0.18	27.62***	13.60***
Behavioral-skills arguments	0.61	0.29	64.13***	0.33	0.35	0.23	37.80***
Threat-inducing arguments	0.32	0.58	149.28***	0.26	0.42	104.42***	11.43***
Condom provision	0.44	0.46	0.36	0.35	0.33	0.49	0.81
Condom use skills training	0.54	0.36	48.17***	0.27	0.40	9.35**	38.84***
Interpersonal skills training	0.37	0.53	14.27***	0.33	0.35	0.11	5.59*
Self-management training	0.62	0.28	94.03***	0.62	0.06	196.11***	18.38***
HIV counseling and testing	0.58	0.32	127.08***	0.54	0.14	428.31***	22.57***
Age (*k* = 200)	Mean over 21 (control *d.* = 0)			Mean under 21 (control *d.* = 0.14)			
Normative arguments	0.30	0.53	229.06***	0.33	0	29.30***	81.88***
Attitudinal arguments	0.42	0.41	0.84	0.18	0.15	0.22	0.05
Any kind of information	0.49	0.34	23.94***	0.16	—	—	—
Behavioral-skills arguments	0.55	0.28	100.37***	0.09	0.24	2.51	18.10***
Threat-inducing arguments	0.30	0.53	255.33***	0.14	0.18	0.96	21.31***
Condom provision	0.39	0.44	7.66**	0.26	0.06	8.60**	11.93***
Condom use skills training	0.42	0.41	0.12	0.24	0.08	3.25	2.77
Interpersonal skills training	0.31	0.52	45.84***	0.09	0.23	3.31	0.75
Self-management training	0.66	0.17	333.13***	0.25	0.08	6.01*	18.35***
HIV counseling and testing	0.54	0.29	283.83***	0.02	0.31	5.30*	18.20***
Ethnicity (*k* = 200)	Predominantly from European background (control *d.* = 0.13)			Predominantly from African background (control *d.* = 0.17)			

Participant group and intervention strategy	Group 1 *d.* Strategy included	Group 1 *d.* Strategy not included	Group 1 *QB*1 for simple effect	Group 2 *d.* Strategy included	Group 2 *d.* Strategy not included	Group 2 *QB*1 for simple effect	Overall: *QB*1 for interaction
Normative arguments	0.21	0.19	0.60	0.24	0.49	130.45***	60.07***
Attitudinal arguments	0.24	0.16	10.62***	0.39	0.34	7.84**	0.66
Any kind of information	0.29	0.12	13.45***	0.49	0.24	29.14***	1.78
Behavioral-skills arguments	0.19	0.21	0.29	0.49	0.25	51.12***	24.75***
Threat-inducing arguments	0.11	0.29	70.94***	0.23	0.49	217.29***	4.91*
Condom use skills training	0.25	0.15	6.20*	0.37	0.36	0.24	3.36
Interpersonal skills training	0.06	0.34	37.31***	0.32	0.41	8.64**	10.85***
Self-management training	0.35	0.05	50.40***	0.58	0.16	170.12***	5.07*
HIV counseling and testing	0.21	0.19	0.50	0.57	0.17	514.81***	137.74***
			Behavioral risks				
Inclusion of men who have sex with men (*k* = 200)		Yes (control *d.* = 0.10)			No (control *d.* = 0.13)		
Normative arguments	0.51	0.50	0.04	0.28	0.43	58.60***	9.01***
Attitudinal arguments	0.43	0.59	12.73***	0.41	0.29	51.44***	33.87***
Any kind of information	0.58	0.44	6.35*	0.46	0.24	23.64***	1.05
Behavioral-skills arguments	0.58	0.44	6.61*	0.44	0.27	32.78***	0.26
Threat-inducing arguments	0.42	0.59	11.84***	0.22	0.48	362.90***	3.27
Condom provision	0.70	0.31	12.72***	0.31	0.39	28.18***	18.34***
Condom use skills training	0.50	0.52	0.06	0.34	0.37	1.95	0
Interpersonal skills training	0.49	0.53	0.30	0.29	0.41	15.85***	1.07
Self-management training	0.72	0.30	46.85***	0.56	0.15	221.15***	0
HIV counseling and testing	0.61	0.40	4.53*	0.50	0.21	364.06***	0.66
Inclusion of intravenous drug users (*k* = 200)		Yes (control *d.* = 0.17)			No (control *d.* = 0.15)		
Normative arguments	0.39	0.51	5.40*	0.32	0.47	61.63***	0.22

Participant group and intervention strategy	Group 1 *d.* Strategy included	Group 1 *d.* Strategy not included	Group 1 *QB*1 for simple effect	Group 2 *d.* Strategy included	Group 2 *d.* Strategy not included	Group 2 *QB*1 for simple effect	Overall: *QB*1 for interaction
Attitudinal arguments	0.46	0.44	0.12	0.42	0.37	10.31***	0.97
Any kind of information	0.38	0.52	1.77	0.48	0.31	24.09***	7.29**
Behavioral-skills arguments	0.69	0.21	9.76**	0.50	0.30	66.34***	3.21
Threat-inducing arguments	0.39	0.51	7.05**	0.26	0.53	354.27***	9.63*
Condom provision	0.62	0.28	66.18***	0.36	0.43	21.63***	85.91***
Condom use skills training	0.65	0.26	30.65***	0.39	0.40	0.09	28.83***
Interpersonal skills training	0.22	0.68	18.23***	0.33	0.47	29.53***	8.18*
Self-management training	0.46	0.44	0.07	0.60	0.19	254.17***	13.64***
HIV counseling and testing	0.39	0.51	4.38*	0.56	0.24	436.20***	52.42***
Inclusion of partners of intravenous drug users (*k* = 200)	Yes (control *d.* = 0.16)			No (control *d.* = 0.13)			
Normative arguments	0.05	0.37	17.30***	0.35	0.46	41.13***	6.96*
Attitudinal arguments	0.40	0.02	23.48***	0.43	0.38	8.23**	17.14***
Any kind of information	0.21	—	—	0.49	0.31	32.55***	—
Behavioral-skills arguments	0.06	0.37	1.28	0.50	0.31	70.74***	3.41
Threat-inducing arguments	0.21	0.21	0.01	0.27	0.54	383.89***	25.90***
Condom provision	0.34	0.09	19.14***	0.39	0.42	1.96	21.09***
Condom use skills training	0.26	0.16	0.94	0.40	0.41	0.16	1.07
Interpersonal skills training	0.44	−0.02	5.37*	0.33	0.48	30.69	9.01**
Self-management training	0.13	0.30	1.00	0.62	0.19	266.30***	12.35***
HIV counseling and testing	0.23	0.19	0.84	0.54	0.27	334.73***	18.89***
Inclusion of multiple-partner heterosexuals (*k* = 200)	Yes (control *d.* = 0.08)			No (control *d.* = 0.15)			
Normative arguments	0.34	0.31	0.43	0.31	0.50	134.62***	18.31***
Attitudinal arguments	0.36	0.30	1.89	0.42	0.40	1.17	0.80
Any kind of information	0.33	—	—	0.48	0.34	21.79***	—

Participant group and intervention strategy	Group 1			Group 2			
	d.			*d.*			
	Strategy included	Strategy not included	*QB*1 for simple effect	Strategy included	Strategy not included	*QB*1 for simple effect	Overall: *QB*1 for interaction
Behavioral-skills arguments	—	—	—	0.52	0.30	84.28***	—
Threat-inducing arguments	0.28	0.37	4.06*	0.30	0.52	278.41***	7.33*
Condom provision	0.39	0.27	7.35**	0.40	0.42	1.00	8.35***
Condom use skills training	0.41	0.25	17.50***	0.39	0.42	1.06	15.93***
Interpersonal skills training	—	—	—	0.35	0.47	16.29***	—
Self-management training	0.38	0.28	1.11	0.63	0.18	257.71***	12.46***
HIV counseling and testing	0.34	0.31	0.60	0.56	0.26	372.40***	35.54***
Past condom use (k = 146)	Moderate or high (control *d.* = 0.15)			Low (control *d.* = 0.10)			
Normative arguments	0.39	0.48	13.29***	0.35	0.36	0.03	2.27
Attitudinal arguments	0.46	0.40	7.93**	0.36	0.34	0.21	0.79
Any kind of information	0.57	0.29	25.32***	0.41	0.29	2.39	3.08
Behavioral-skills arguments	0.61	0.26	95.47***	0.46	0.24	15.18***	4.06*
Threat-inducing arguments	0.31	0.55	177.78***	0.23	0.47	42.07***	0.06
Condom provision	0.36	0.50	49.35***	0.32	0.38	1.87	2.97
Condom use skills training	0.45	0.42	1.93	0.30	0.40	2.04	3.24
Interpersonal skills training	0.32	0.55	39.06***	0.38	0.33	0.63	14.31***
Self-management training	0.65	0.22	177.92***	0.44	0.26	5.16*	9.37**
HIV counseling and testing	0.59	0.28	262.80***	0.51	0.19	38.07***	0.03

Note. All factors were dummy coded (strategy included = 1; strategy not included = 0). Dashes indicate that statistic was not available owing to an empty cell. *d.* = fixed-effects weighted model means adjusted for all other effects. Control means for each participant group appear parenthetically for each group (see also Table 5). *QB* for simple and main effect = homogeneity coefficient for the difference across levels of a factor, distributed as a chi-square with number of factor levels –1 degrees of freedom. *QB* for interaction = homogeneity coefficient for the interaction between factors, distributed as a chi-square with degrees of freedom equal to (number of levels of factor A – 1) × (number of levels of factor B – 1). Significant *QB*s indicate significant effects of the involved factors. k = number of conditions in analysis.

*$p < .05$.

**$p < .01$.

***$p < .001$.

Table 7

Change as a Function of Strategy Across Intervention Setups

Intervention setup and strategy	Setup 1			Setup 2			
	d.			d.			
	Strategy included	Strategy not included	QB_1 for simple effect	Strategy included	Strategy not included	QB_1 for simple effect	Overall: QB_1 for interaction
			Settings				
Clinical (k = 200)		Yes			No		
Normative arguments	−0.03	0.57	245.58***	0.19	0.23	4.07*	169.36***
Attitudinal arguments	0.21	0.33	17.35***	0.23	0.19	5.18*	22.46***
Any kind of information	0.45	0.08	62.47***	0.22	0.19	0.52	28.15***
Behavioral-skills arguments	0.61	−0.07	177.72***	0.19	0.23	1.50	148.86***
Threat-inducing arguments	0.06	0.48	244.91***	0.20	0.22	1.43	158.07***
Condom provision	0.35	0.19	44.91***	0.25	0.17	16.93***	6.90*
Condom use skills training	0.29	0.25	1.37	0.27	0.15	13.57***	3.15
Interpersonal skills training	0.06	0.47	52.88***	0.16	0.26	10.15**	22.47***
Self-management training	0.52	0.02	169.44***	0.30	0.12	25.04***	40.11***
HIV counseling and testing	0.43	0.11	180.97***	0.21	0.21	0.09	87.68***
School (k = 200)		Yes			No		
Normative arguments	0.55	0.19	25.70***	0.28	0.52	232.68***	67.74***
Attitudinal arguments	0.35	0.39	0.25	0.40	0.39	0.02	0.27
Any kind of information	0.37	—	—	0.47	0.32	23.97***	—
Behavioral-skills arguments	0.35	0.40	0.10	0.55	0.25	119.30***	4.63*
Threat-inducing arguments	0.38	0.36	0.20	0.28	0.51	293.03***	40.70***
Condom provision	0.44	0.30	0.53	0.38	0.41	4.44*	0.77
Condom use skills training	0.54	0.20	9.26**	0.40	0.39	0.19	8.42**
Interpersonal skills training	0.26	0.49	4.09*	0.28	0.51	57.52***	0.02
Self-management training	0.49	0.25	4.25*	0.62	0.17	306.02***	3.25
HIV counseling and testing	—	0.37	—	0.52	0.27	277.25***	—
Community (k= 200)		Yes			No		

Intervention setup and strategy	Setup 1 *d.* Strategy included	Setup 1 *d.* Strategy not included	Setup 1 QB_1 for simple effect	Setup 2 d. Strategy included	Setup 2 d. Strategy not included	Setup 2 QB_1 for simple effect	Overall: QB_1 for interaction
Normative arguments	0.25	0.33	7.24**	0.16	0.50	175.08***	48.40***
Attitudinal arguments	0.30	0.28	1.15	0.34	0.33	0.15	0.33
Any kind of information	0.30	0.28	0.13	0.44	0.22	28.56***	9.51**
Behavioral-skills arguments	0.33	0.25	3.22	0.45	0.22	57.43***	9.29**
Threat-inducing arguments	0.29	0.29	0.07	0.19	0.48	321.52***	107.18***
Condom provision	0.30	0.29	0.16	0.36	0.30	9.76**	1.93
Condom use skills training	0.34	0.25	3.37	0.36	0.31	3.51	0.62
Interpersonal skills training	0.31	0.27	0.51	0.27	0.40	15.56***	8.30**
Self-management training	0.30	0.28	0.14	0.57	0.09	263.59***	55.14***
HIV counseling and testing	0.34	0.24	7.41**	0.49	0.18	349.35***	36.01***
Presentation							
Used audio- or videotaped material (k= 200)	Yes			No			
Normative arguments	−0.09	0.50	157.93***	0.39	0.47	16.23***	99.47***
Attitudinal arguments	0.28	0.12	30.15***	0.42	0.43	1.18	27.96***
Any kind of information	0.27	0.14	3.38	0.51	0.34	23.91***	0.44
Behavioral-skills arguments	0.52	−0.11	96.21***	0.58	0.34	41.22***	45.42***
Threat-inducing arguments	0.10	0.32	41.27***	0.32	0.53	202.51***	0.49
Condom provision	0.12	0.29	23.39***	0.46	0.40	12.37***	34.79***
Condom use skills training	0.25	0.16	1.56	0.47	0.38	14.61***	0
Interpersonal skills training	−0.05	0.46	37.56***	0.38	0.47	9.27**	23.97***
Self-management training	0.34	0.07	16.16***	0.65	0.20	272.97***	5.64*
HIV counseling and testing	0.48	−0.07	362.98***	0.53	0.32	138.69***	104.29***
Group sessions (k= 200)	Yes			No			
Normative arguments	0.30	0.47	72.95***	0.18	0.44	67.15***	6.08*

Intervention setup and strategy	Setup 1			Setup 2			
	d.			d.			
	Strategy included	Strategy not included	QB_1 for simple effect	Strategy included	Strategy not included	QB_1 for simple effect	Overall: QB_1 for interaction
Attitudinal arguments	0.43	0.35	19.43^{***}	0.32	0.30	0.20	4.77^{*}
Any kind of information	0.48	0.29	17.80^{***}	0.34	0.28	1.50	5.03^{*}
Behavioral-skills arguments	0.45	0.33	16.41^{***}	0.43	0.19	22.58^{***}	4.36^{*}
Threat-inducing arguments	0.27	0.50	219.58^{***}	0.23	0.39	31.21^{***}	3.50
Condom provision	0.36	0.41	8.44^{**}	0.29	0.41	1.38	0.51
Condom use skills training	0.39	0.39	0	0.41	0.21	30.13^{***}	18.69^{***}
Interpersonal skills training	0.32	0.45	16.78^{***}	0.17	0.45	14.68^{***}	3.51
Self-management training	0.62	0.15	257.55^{***}	0.44	0.18	23.87^{***}	13.95^{***}
HIV counseling and testing	0.57	0.20	481.88^{***}	0.32	0.30	0.74	106.05^{***}

Note. All factors were dummy coded (strategy included = 1; strategy not included = 0). Dashes indicate that statistic was unavailable owing to an empty cell. *d.* = fixed-effects weighted model means adjusted for all other effects. Control groups (*d.* = 0.08, confidence interval = 0.06 to 0.10) were excluded. *QB* for simple and main effect = homogeneity coefficient for the difference across levels of a factor, distributed as a chi-square with degrees of freedom equal to number of factor levels −1: *QB* for interaction = homogeneity coefficient for the interaction between factors, distributed as a chi-square with degrees of freedom equal to (number of levels of factor *A* −1) × (number of levels of factor *B* −1). Significant *QB*s indicate significant effects of the involved factors. *k* = number of conditions in analysis.

$^{*}p < .05$.

$^{**}p < .01$.

$^{***}p < .001$.

Table 8

Summary of Support for Assumptions of Behavior-Change Theories

Model and assumptions	Criteria for evaluating theoretical assumptions				Support for the assumption
	A. Strategies targeting the theoretical causal variable effectively change behavior	B. Strategies targeting the theoretical causal variable influence changes in measures of it	C. Changes in measures of the theoretical causal variable influence behavior change	D. Changes in measures of the theoretical causal variable mediate the impact of strategies that target it on behavior change	
Theory of reasoned action					
Attitudes promote behavior	Verified	Verified	Verified	Verified	Good
Norms promote behavior	Verified only for adolescents	Not testable owing to nonpositive definite matrix	Verified	Not testable among adolescents owing to small *k*	Fair
Theory of planned behavior					
Attitudes promote behavior	Verified	Verified	Verified	Verified	Good
Norms promote behavior	Verified only for adolescents	Verified	Verified	Verified	Fair
Control perceptions promote behavior	Verified	Verified for self-management skills training	Verified	Verified	Good
Social–cognitive theory					
Attitudes (outcome expectancies) promote behavior	Verified	Verified	Verified	Verified	Good
Control perceptions (self-efficacy) promote behavior	Verified	Verified	Verified	Verified	Good
Behavioral skills promote behavior	Verified	Verified	Verified	Verified	Good
Information–motivation–behavioral skills model					
Motivation (e.g., attitudes, norms, or perceptions of control) promotes behavior	Verified	Verified	Verified	Verified	Good
Behavioral skills promote behavior	Verified	Verified	Verified	Verified	Good
Information promotes behavior	Verified	Verified	Verified	Verified	Good
Motivation, behavioral skills, and information jointly promote the behavior better than in isolation	Verified	Verified	Verified	Verified	Good
Protection–motivation theory					
Perceived threat promotes safe behavior	Not verified	Not testable owing to a nonpositive definite matrix	Verified	Not verified	Poor
Perceived threat promotes safe behavior when combined with coping (e.g., self-efficacy)	Not verified	Not relevant	Not relevant	Not relevant	Poor

Model and assumptions	Criteria for evaluating theoretical assumptions				Support for the assumption
	A. Strategies targeting the theoretical causal variable effectively change behavior	B. Strategies targeting the theoretical causal variable influence changes in measures of it	C. Changes in measures of the theoretical causal variable influence behavior change	D. Changes in measures of the theoretical causal variable mediate the impact of strategies that target it on behavior change	
Framing model: Threat does not influence behavior when the behavior is proactive instead of avoidant	Verified	Not relevant	Not relevant	Not relevant	Good
Health-belief model					
Perceived threat promotes safe behavior	Not verified	Not testable owing to a nonpositive definite matrix	Verified	Not verified	Poor
Attitudes (outcome expectancies) promote behavior	Verified	Verified	Verified	Verified	Good
Control perceptions (self-efficacy) promote behavior	Verified	Verified	Verified	Verified	Good
Behavioral skills promote behavior	Verified	Verified	Verified	Verified	Good
Stage models					
The influence of different strategies depends on recipients' behavior change stage	Verified	Not relevant	Not relevant	Not relevant	Good
Information influences behavior when people are not performing the behavior yet	Verified	Not relevant	Not relevant	Not relevant	Good
Attitudes influence behavior when people are not performing the behavior yet	Verified	Notrelevant	Notrelevant	Notrelevant	Good
Behavioral skills influence behavior when people are already performing the behavior	Verified	Notrelevant	Notrelevant	Notrelevant	Good
Information influences behavior more when people are not performing the behavior yet than when they are	Not verified	Notrelevant	Notrelevant	Notrelevant	Poor
Behavioral skills influence behavior more when people are performing the behavior already than when they are not	Not verified	Notrelevant	Notrelevant	Notrelevant	Poor

Table 9

Summary of Findings Concerning Intervention Strategies

	Passive strategies			
Groups	**Normative arguments**	**Attitudinal arguments**	**Information**	**Behavioral-skills arguments**
Demographics				
Gender	Neither gender	Only for females	Only for females	Only for males
Age	Only under 21	Both for under and over 21[b]	Verified for only over 21; NA under 21	Only for over 21
Ethnicity	Neither African nor European background	Both for African and European backgrounds	Both for African and European backgrounds	Only for African background
Behavior risks				
Inclusion of men who have sex with men	Neither when included nor when not included	Only when not included	Both when included and when not included	Both when included and when not included
Inclusion of intravenous drug users	Neither when included nor when not included	Both when included and when not included[d]	Only when not included	Both when included and when not included
Inclusion of partners of intravenous drug users	Neither when included nor when not included	Both, but stronger when included	Verified only when not included; NA when included	Both when included and when not included[d]
Inclusion of multiplepartner heterosexuals	Neither when included nor when not included	Both when included and when not included[b]	Verified only when not included; NA when included;	Verified only when not included; NA when included
Past condom use	Neither high nor low	Both for high and low[b]	Both for high and low[d]	Both, but stronger for high

Note. The conclusions in this table highlight simple effects only for when the statistical interaction between a strategy and a given group was significant. When the interaction was not significant, we relied on the main effects reported in Table 3 and Table 4 to reach conclusions.

[a] Based on main effect for passive interventions (see Table 3). Within passive interventions, there were no higher order interactions between condom provision and gender.

[b] Based on main effect (see Table 3). Simple effects in this particular case were nonsignificant (see Table 6).

[c] This is the only case in which a nonsignificant effect is actually significant in one group (European background) even when the interaction was nonsignificant. However, we relied on our decision rule of interpreting simple effects only in the presence of a statistically significant interaction.

[d] The interaction was not significant, even when one of the simple effects was significant but the other was not.

Passive strategies		Active strategies			
Threat-inducing arguments	**Condom provision**	**Condom use skills training**	**Interpersonal skills training**	**Self-management training**	**HI**
Neither gender	Both genders[a]	Only for males	Neither gender	Both, but stronger for females	Bo
Neither under 21 nor over 21	Only for under 21	Neither under 21 nor over 21	Neither under 21 nor over 21	Both, but stronger for over 21	On
Neither African nor European background	Only for European background	Neither African nor European background[c]	Neither African nor European background	Both, but stronger for African background	On
Neither when included nor when not included	Only when included	Neither when included nor when not included	Neither when included nor when not included	Both when included and when not included	Bo wh
Neither when included nor when not included	Only when included	Only when included	Neither when included nor when not included	Only when not included	On
Neither when included nor when not included	Only when included	Neither when included nor when not included	Only when included	Only when not included	On
Neither when included nor when not included	Only when included	Only when included	Only when not included; NA when included	Only when not included	On
Neither high nor low	Neither high nor low	Neither high nor low	Neither high nor low	Both, but stronger for high	Bo