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Sorting through chickens and eggs: A longitudinal examination of the associations between attitudes, norms, and sexual risk behavior

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Abstract

Objective—Health behavior theories posit that health-relevant attitudes, beliefs, and behavioral skills drive subsequent actions people take to protect themselves from health threats. Within the realm of HIV-related sexual risk behavior, much of the research in support of this notion is cross-sectional, rather than longitudinal, particularly in studies of gay and bisexual men. Other psychological theories (e.g., self-perception or cognitive dissonance theories) suggest that the opposite could be true – that health-relevant attitudes and beliefs might change as a function of previous risk or precautionary behavior. Appreciating the complex nature of these associations is essential for modifying theory and developing appropriate interventions.

Design—Using longitudinal data from gay and bisexual men ($n = 1465$), we used structural equation modeling to examine three possibilities – that perceived norms and attitudes about sexual risk would be (a) related to unprotected anal intercourse cross-sectionally, (b) related to unprotected anal intercourse at a subsequent time point, and/or (c) predicted from previous instances of unprotected anal intercourse.

Results—Safe-sex norms and attitudes were related to unprotected anal intercourse cross-sectionally, but did not predict unprotected sex longitudinally. Rather, perceived norms and attitudes changed as a function of previous risk behavior.

Conclusions—These results raise the possibility that modified theoretical models might be necessary to adequately describe sexual risk behavior among gay and bisexual men.

Keywords

health behavior theory; gay men; men who have sex with men (MSM); HIV; longitudinal research; attitude-behavior relationship; social norms

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¹One exception to this are tests of the association between behavioral intentions and subsequent behavior, which tend to show robust effects (D. Albarracín, Johnson, Fishbein, & Muellerleile, 2001).

Introduction

One of the foremost pursuits of health psychology is the prediction of behaviors that enhance or harm health. Toward this end, psychologists have developed and adapted multiple theories in an effort to explain health behaviors (e.g., Ajzen & Fishbein, 1980; Bandura, 1997; Becker, 1974; Catania, Kegeles, & Coates, 1990; J. D. Fisher & Fisher, 1992; Prochaska, DiClemente, Norcross, & Goldfried, 2005; Rogers, 1975). Such theories posit that various combinations of health-relevant knowledge, attitudes, beliefs, and behavioral skills work to promote behaviors that provide risk for or protection from disease. Although each theory varies in terms of which of these predictive factors it emphasizes and how those variables are configured, a basic tenet of all theories is that the relevant psychological constructs temporally precede and causally influence subsequent health behavior.

Although health behavior theories most often describe this unidirectional causal progression from affective and cognitive variables to behavior, other psychological theories that seek to explain broader human behaviors beyond the realm of health have long recognized that the reverse is often true – that is, that an individual's behavior has the capacity to initiate change in how she or he thinks and feels about the behavior. For instance, Festinger's (1957) theory of cognitive dissonance posits that when individuals behave in a manner that is inconsistent with a strongly held prior attitude, they may change their attitudes to make them more aligned with their recent behavior. Similarly, Bem's (1972) self-perception theory suggests that when we ask individuals to report their current attitudes, they may derive them by reflecting on their past behaviors, especially when these attitudes are weak or ill-defined (Chaiken & Baldwin, 1981). Beyond these two prominent theories, many studies have documented how behavior can influence attitudes and beliefs, exploring a variety of mechanisms (e.g., Aronson, Fried, & Stone, 1991; Gaes & Tedeschi, 1978; Krueger & Clement, 1994; Monin & Norton, 2003; Moreland & Zajonc, 1976; Stone, Aronson, Crain, & Winslow, 1994); for a review, see (Olson, Stone, Albarracin, Johnson, & Zanna, 2005). However, regardless of the actual mechanisms, the fundamental phenomenon is robust – behaviors can and do lead to changes in how people think and feel.

With very limited exceptions (e.g., Dolores Albarracin, Fishbein, & Middlestadt, 1998; Gerrard, Gibbons, Benthin, & Hessling, 1996; Weinstein & Nicolich, 1993), research on health behaviors has underappreciated the potential for engaging in behaviors such as smoking, exercising, dieting, or using condoms to alter people's cognitions and affect related to those behaviors. Because of limitations on resources, the modal study of health behavior is cross-sectional: investigators routinely use questionnaires to assess current attitudes and beliefs, and simultaneously gather participants' reports of their health behaviors from some specified time period in the recent past. For example, a study might assess participants' current beliefs about the benefits of exercise, and also ask them to report how often they exercised in the past two weeks. Thus, the exercise behaviors that the participant engaged in and reported actually predate the immediate beliefs that are assessed simultaneously (Albarracin, et al., 1998). And yet, reports of such studies often imply a causal association which is the reverse – that health-related attitudes and beliefs lead to subsequent behavior, in the best cases with a brief mention of the limitations of their cross-

sectional designs. Even when longitudinal data are available, investigators uniformly model the paths from previous psychosocial constructs to future health behaviors, consistent with health behavior theories, but almost never test or even consider the possibility that past behaviors might predict future beliefs, or that a combination of these effects might occur.

One notable exception to this trend in the literature has been the work of Gerrard and Gibbons (Gerrard, Gibbons, Benthin, et al., 1996; Gibbons & Gerrard, 1995). In one longitudinal study of adolescent smoking, drinking, and reckless driving, Gerrard and colleagues found support for a model in which engaging in these risk behaviors lead adolescents to change how they thought about the behaviors approximately one year later (Gerrard, Gibbons, Benthin, et al., 1996). Specifically, once adolescents had engaged in these risk behaviors, they discounted the dangers associated with them, and believed that the behaviors were normative; in turn, these cognitive shifts facilitated more subsequent risk behavior another year later. In a separate study, they found that adolescents who engaged in smoking, drinking, and reckless driving, developed more favorable prototypes of people who engaged in those behaviors (over a 6–7 month followup), and conversely, holding those favorable prototypes made them more likely to engage in the behaviors (Gibbons & Gerrard, 1995).

One domain of health behavior that might benefit especially from a more nuanced appreciation of how behavior and psychosocial variables reciprocally affect one another is the sexual behavior that puts individuals at risk for HIV. Since the discovery of HIV more than two decades ago, behavioral scientists have sought to apply health behavior theories to understanding individuals' HIV-related sexual risk behaviors (for a review, see, Fisher & Fisher, 2000). During this time abundant cross-sectional research has been conducted which shows associations between sexual risk behavior and assorted attitudes and beliefs (e.g., Ayoola, Nettleman, & Brewer, 2007; Boone & Lefkowitz, 2004; Denny-Smith, Bairan, & Page, 2006; Downing-Matibag & Geisinger, 2009; Lin, Simoni, & Zemon, 2005; Lollis, Antoni, Johnson, Chitwood, & Griffin, 1995; Pearson, 2006; Ragsdale, Anders, & Philippakos, 2007; Rhodes & Hergenrather, 2003; Robinson, Scheltema, & Cherry, 2005; Steers, Elliott, Nemiro, Ditman, & Oskamp, 1996).

Whereas cross-sectional research carries significant, well-known limitations for establishing causality or directionality of effects, longitudinal studies have greater potential to inform whether these health behavior constructs predict changes in subsequent sexual risk or precautionary behaviors. Such longitudinal studies fall into two categories: (a) nonexperimental observational studies and (b) intervention studies, in which investigators attempt to reduce risky sexual behavior by influencing theoretically informed health behavior constructs. When observational longitudinal studies are conducted, the results sometimes reveal weak or inconsistent associations between the constructs which health behavior theories highlight and subsequent sexual risk behavior measured at a future time point, particularly when they control for previous behavior (Abraham, Sheeran, Abrams, & Spears, 1996; Aspinwall, Kemeny, Taylor, Schneider, & Dudley, 1991; Montgomery, et al., 1989; Rotheram-Borus, Rosario, Reid, & Koopman, 1995).¹ Even moreso than observational studies, experimental intervention trials have great potential to demonstrate the causal predictive power of health behavior constructs, and yet that promise is rarely

realized given the analyses that are most often reported. Abundant research documents the ability for theory-driven interventions to alter sexual risk behavior (for reviews, see, Albarracin, et al., 2005; Crepaz, et al., 2009; Darbes, Crepaz, Lyles, Kennedy, & Rutherford, 2008; Noar, 2008). While those studies provide indirect support for the theories underlying the interventions, many do not actually report the effects of the interventions on psychosocial mediators of sexual risk behavior, such as condom use norms or self-efficacy (e.g., Bryan, Schmiede, & Broaddus, 2009; Jemmott, Jemmott, & O'Leary, 2007; Martin, O'Connell, Inciardi, Surratt, & Maiden, 2008; Morgenstern, et al., 2009; Tross, et al., 2008; Williams, et al., 2008). Among those interventions studies that do report changes in mediators, almost none document the analytic steps necessary to demonstrate that changes in the mediators are actually responsible for changes in risk behavior (e.g., Alemagno, Stephens, Stephens, Shaffer-King, & White, 2009; Brems, Dewane, Johnson, & Eldridge, 2009; Choi, et al., 2008; DiClemente, et al., 2009; Jemmott, Jemmott, Braverman, & Fong, 2005; Kalichman, et al., 2001; Morrison-Beedy, Carey, Seibold-Simpson, Xia, & Tu, 2009; Wingood, et al., 2006). In the small minority of studies that (a) examine intervention effects on mediators, and (b) determine whether changes in mediators are associated with changes in sexual risk, the results often do not make a clear case for the importance of the health behavior constructs. Two separate studies demonstrated that the only mediator associated with significant changes in risk behavior was self-efficacy for condom use, whereas no other theoretical mediators were significant (e.g., peer norms, attitudes, hedonistic beliefs about condoms; O'Leary, Jemmott, & Jemmott, 2008; Schmiede, Broaddus, Levin, & Bryan, 2009). Two interventions studies that drew heavily on the Theory of Reasoned Action revealed cross-sectional associations between several theoretically informed mediators and intentions to engage in future risk behavior, but tested intentions as the only predictor of sexual risk over time (rather than testing longitudinal associations between risk and any other psychosocial mediator; Koniak-Griffin & Stein, 2006; Rhodes, Stein, Fishbein, Goldstein, & Rotheram-Borus, 2007). Finally, we were able to identify one study that did document longitudinal associations between changes in several mediators and risk, providing more compelling evidence for the utility of these constructs (NIMH Team, 2001). However, even in this case, the authors pointed out that only a small portion of the intervention effect was actually attributable to the psychosocial mediators they targeted.

Thus, the body of longitudinal research yields some support for health behavior theory's assertions regarding the predictors of sexual risk behavior over time, but given mixed findings and analytic difficulties, that support is limited. Observing these inconsistent findings, some authors have suggested that perhaps sexual behavior is more complex than other health behaviors, such as exercise or seatbelt use; thus some existing health behavior theories might be of more limited utility in this domain (Montgomery, et al., 1989), especially with certain high-risk populations (Cochran & Mays, 1993; Kalichman, Picciano, & Roffman, 2008).

Indeed, many authors have discussed the complexity of sexual behavior, noting that it is driven by intense biological impulses (Bailey & Hope, 2009; Buss, Sherman, & Alcock, 2005; Mealey, 2000; Thornhill & Palmer, 2000) and deep emotional connections (Diamond, 2008; Hiller, Wood, & Bolton, 2006; Peplau, 2001), and that the ecological context in which it occurs often limits the capacity of the individual to have substantial control over his or her

own behavior (e.g., when a sexual partner is much more powerful; Amaro, 1995; Goetz & Shackelford, 2009; Hattori & DeRose, 2008). These realities, coupled with evidence discussed above that people may alter their thoughts and attitudes to make them consistent with previous behavior (Cooper, Mirabile, Scher, Brock, & Green, 2005; Festinger & Carlsmith, 1959; Stone & Fernandez, 2008), might begin to explain the disconnect between findings from cross-sectional and longitudinal research on sexual risk. For example, it is possible that individuals engage in sexual behavior for multiple reasons, some of which have little to do with their health-relevant attitudes and beliefs, but that they subsequently adjust those attitudes and beliefs accordingly so that they are consistent with their previous behavior. Such a phenomenon would yield significant cross-sectional correlations, but limited or inconsistent longitudinal effects of cognition and affect on actual sexual behavior.

In the present study we aimed to use longitudinal data to more closely examine this “chicken-egg” dilemma. In the context of understanding sexual behavior among men who have sex with men (MSM), we sought to determine which effects we would observe, those of health-relevant attitudes and beliefs on behavior, those of behavior on attitudes and beliefs, or a combination of both. To examine this, we utilized data on health-relevant psychosocial constructs and sexual risk behavior, each measured at two points in time. For the purposes of illustration, we chose the two foundational psychosocial constructs originally noted in the Theory of Reasoned Action (Fishbein & Ajzen, 1975), but which are now incorporated in many theories of health behavior and of HIV risk more specifically (e.g., Catania, et al., 1990; Fisher & Fisher, 1992). Those were (a) attitudes toward the behavior (i.e., how much an individual reports that he enjoys safe vs. unsafe sex) and (b) perceived norms regarding the behavior (i.e., what an individual thinks his peers are doing with respect to safe sex). Using a single structural equation model, we were able to simultaneously test three alternative (though not mutually exclusive) hypotheses:

1. Attitudes and perceived norms will be related to sexual risk behavior when measured at a single point in time (i.e., cross-sectionally).
2. Attitudes and perceived norms will predict changes in sexual risk behavior over time, consistent with health behavior theories.
3. Sexual risk behavior will predict changes in attitudes and perceived norms over time, consistent with self-perception and/or cognitive dissonance theories.

Methods

Recruitment

A cohort of gay and bisexual men between the ages of 18 and 27 was recruited from Phoenix, AZ, Albuquerque, NM, and Austin, TX for participation in the “Young Men’s Survey,” a longitudinal study designed to test the effectiveness of a community-based HIV-preventive intervention. Participants were recruited independently of the intervention by peers who sought out eligible men through venues, organizations, and social networks. Detailed descriptions of the sampling methods can be found elsewhere (Kegeles, Hays, & Coates, 1996; Kegeles, Hays, Pollack, & Coates, 1999). Data from the present report come from the first two waves of data collection, separated by approximately 18 months.

Measures

Sexual Risk Behavior—Participants indicated how frequently in the previous two months they had engaged in insertive and receptive anal intercourse: (1) with a condom, (2) without a condom – without ejaculating in the partner, and (3) without a condom – ejaculating in the partner. These behaviors were reported separately for non-primary partners and boyfriends/lovers. Men also self-reported whether they had been tested for HIV, and if so, the result of their most recent test. Using this information, we created a variable reflecting the frequency with which each participant had engaged in unprotected insertive or receptive anal intercourse with any non-primary partner (regardless of whether that partner's serostatus was negative, positive, or unknown) or with a boyfriend/lover who was either (a) short term (i.e., less than six months duration), (b) nonmonogamous, or (c) sero-discordant for HIV. That is, unprotected sex with a longterm, monogamous, and HIV sero-concordant partner was not counted in our sexual risk variable. Because the frequency of unprotected sex was nonnormally distributed at both time periods (maximum skewness = 9.6; maximum kurtosis = 133.8), we log transformed it, which resulted in a more satisfactory distribution for analysis (maximum skewness = 1.9; maximum kurtosis = 3.0).

Predictors of risk—Peer norms for safe sex and attitudes toward safe sex were each assessed using items derived from previous studies of HIV risk, which were then adapted to be appropriate for use with young gay men (Ekstrand & Coates, 1990; Hays, Kegeles, & Coates, 1990; Paul, Stall, Crosby, & Barrett, 1994). Six items assessed peer norms (e.g., “My friends always use condoms when having anal sex with new partners.”), and 3 items assessed attitudes toward safe sex (e.g., “Safe sex is unsatisfying”). Participants responded to all items using 6-point Likert scales, anchored at “disagree strongly” and “agree strongly.” Measures of both norms and attitudes demonstrated good internal consistency at both time points (alphas for norms = 0.74 at time 1 and 0.79 at time 2; alphas for attitudes = 0.75, and 0.83.).

Data Analysis

Given the substantial sample size and the presence of multiple observed items assessing latent safe sex norms and latent attitudes toward safe sex, we used structural equation modeling (SEM) to investigate the relationships among these variables. We first assessed components of the measurement model comprised of correlated latent factors and their observed indicators followed by a structural equation model that specified the hypothesized relationships among the latent variables and observed sexual behavior (Anderson & Gerbing, 1988). Both models were estimated using *Mplus* version 4.2 (Muthén & Muthén, 2006). All available cases were utilized to construct the measurement and structural models, regardless of whether they were present for both or just a single wave of data collection. Incomplete data were addressed via full-information maximum likelihood estimation, which makes use of all available data to maximize the information available for data analyses, yielding optimal parameter estimates and standard errors (Allison, 2003; Schafer & Graham, 2002).

To evaluate global model fit, we report the chi-square tests of model fit and several descriptive fit indices, noted below. To account for the modest skewness and kurtosis

exhibited by our transformed observed variables, we used the *Mplus* estimator MLR, which yields a chi-square test of model fit and parameter estimate standard errors that are robust to departures from normality (Yuan & Bentler, 2000). Even with corrections for non-normal data, the chi-square test of absolute model fit can be sensitive to trivial misspecifications in the model's structure (Browne & Cudek, 1993). Consequently, we report the following descriptive measures of model fit that are often used to evaluate the soundness of a model: the standardized root mean residual (SRMR; Bollen, 1989), the Comparative Fit Index (CFI; Bentler & Bonnett, 1980), and the Root Mean Square Error of Approximation (RMSEA; Browne & Cudek, 1993). Hu and Bentler (1999) provide simulation evidence and guidelines suggesting that CFI values of .95 or higher, RMSEA values of .06 or lower, and SRMR values of .08 or lower indicate good model fit when these fit statistics are considered together. For each estimated parameter, we report its unstandardized estimate (B), its standard error (SE), the estimate divided by its standard error (Z), the p -value for Z , and the standardized parameter estimate, β .

Results

Sample Characteristics

At Time 1, 1248 men were recruited into the cohort. At Time 2, 620 of those men were retained (50%) and 217 new men were recruited into the study to refresh the cohort. Table 1 displays the demographic characteristics of participants. Compared to participants who were lost to followup between Time 1 and Time 2, those who were retained were more likely to identify their ethnicity as White, to be more educated, to be more open about their sexual orientation, and to self-label their sexual orientation as "gay." Participants lost to followup did not differ from those retained with respect to their age.

Preliminary Analyses and Measurement Model

Correlations among study variables were derived using the full information maximum likelihood estimator in *Mplus*. These correlations are presented in Table 2. Generally, variables showed significant autoregressive correlations (i.e., the variable at time 1 was highly correlated with itself at time 2), as well as correlations with other variables from the same scales.

We first constructed a measurement model consisting of a single latent factor for safe sex norms and a second latent factor for attitudes toward safe sex. Time 1 and time 2 versions of these two latent factors and their observed indicators were included in the analysis, resulting in a measurement model containing four latent factors and 18 observed indicators. Residuals for each indicator were allowed to correlate across the two measurement points to capture within-subject autocorrelation of responses not otherwise explained by the latent factors (Wheaton, Muthen, Alwin, & Summers, 1977). The fit of this model to the data met the criteria for good global model fit to the data: $\chi^2(120) = 292.86, p < .0001$; CFI = .95, RMSEA = .03, SRMR = .04. Factor loadings, inter-factor correlations, and residual correlations from this model are available from the first author.

Structural Equation Model

Following satisfactory confirmation of the measurement model, we introduced frequency of unprotected sex into the analysis as an observed variable. We then specified the paths outlined in each of the three scenarios outlined in the hypotheses, essentially generating a classic crosslagged panel design (see Figure 1). Specifically, we examined the associations among all variables at time 1 (the cross sectional hypothesis). Additionally, we examined the effect of attitudes and norms at time 1 on sexual risk behavior at time 2, controlling for past sexual risk behavior (the traditional health behavior theory hypothesis). Finally, we examined the effect of sexual risk behavior at time 1 on subsequent norms and attitudes at time 2, controlling for time 1 norms and attitudes (the alternate hypothesis). To partial out the effects of the intervention, intervention group assignment was included as a dichotomous covariate (0 = did not participate in the intervention; 1 = participated in the intervention). All latent factors and frequency of unprotected sex at both time points were regressed onto this covariate. The fit of this model was very good and met the benchmark values for good global model fit: $\chi^2(164) = 386.17, p < .0001$; CFI = .95, RMSEA = .03, SRMR = .04. Factor loadings and path coefficients from this model appear in Table 3.

Norms and attitudes were both associated with unprotected anal sex when measured simultaneously (both at time 1 and at time 2). However, contrary to most theories of health behaviors, attitudes and norms at time 1 did not predict unprotected anal sex at time 2 when behavior at time one was statistically controlled. Rather, sexual risk behavior at time 1 predicted subsequent norms and attitudes at time 2 when initial norms and attitudes were statistically controlled.

Discussion

When measured at a single point in time, both perceived norms for safe sex and attitudes toward safe sex were significantly associated with unprotected anal intercourse. The observed correlations between attitudes, norms, and unprotected sex are consistent with a large body of cross-sectional research on both sexual risk (e.g., Ayoola, et al., 2007; Boone & Lefkowitz, 2004; Denny-Smith, et al., 2006; Downing-Matibag & Geisinger, 2009; Lin, et al., 2005; Lollis, et al., 1995; Pearson, 2006; Ragsdale, et al., 2007; Rhodes & Hergenrather, 2003; Robinson, et al., 2005; Steers, et al., 1996) and other health behaviors (e.g., Aiken, West, Woodward, & Reno, 1994; Kiviniemi, Voss-Humke, & Seifert, 2007; Lindley, Wortley, Winston, & Bardenheier, 2006; McClenahan, Shevlin, Adamson, Bennett, & O'Neill, 2007). However, in contrast to the causal predictions made by most theories of health behavior, attitudes and norms did not predict sexual risk behavior over time. Rather, sexual risk behavior at time 1 was associated with changes in norms and attitudes at time 2. These findings are more consistent with a small, but growing body of investigations that suggest instead that engaging in health behaviors can also influence attitudes and beliefs about those behaviors (Dolores Albarracin, et al., 1998; Gerrard, Gibbons, Benthin, et al., 1996; Gerrard, Gibbons, & Bushman, 1996; Gibbons, Eggleston, & Benthin, 1997; Gibbons & Gerrard, 1995; Weinstein & Nicolich, 1993).

Whereas some previous work has found longitudinal associations between attitudes and/or beliefs and subsequent sexual behavior (Brunswick & Banaszak-Holl, 1996; R. J.

DiClemente, et al., 1996; Zimmerman, et al., 2007), weak or nonexistent longitudinal findings are also frequently reported (Abraham, et al., 1996; Aspinwall, et al., 1991; Montgomery, et al., 1989; Rotheram-Borus, et al., 1995), and may be even more common, given the difficulty in publishing null findings. And although an abundance of research demonstrates the efficacy of theory-driven interventions to change sexual behaviors (for reviews, see, Dolores Albarracin, et al., 2005; Nicole Crepaz, et al., 2009; Darbes, Crepaz, Lyles, Kennedy, & Rutherford, 2008; J. D. Fisher & Fisher, 1992; Noar, 2008), few of these studies test the actual mechanisms driving those effects, limiting their ability to make contributions to theory.

Given the mixed results of the literature, we believe several possibilities must be explored. One possibility is simply that unreliability in measures of sexual behavior and/or health behavior constructs makes observing distal, longitudinal associations more difficult. Participants may have difficulty accurately recalling their sexual behavior over time, or may be motivated to misreport their behavior in such a way that obscures real associations. A second possibility is that most previous research on sexual risk behavior has simply failed to adequately operationalize the predictions offered by extant health behavior theory by misspecifying the relations among those constructs. For example, in our own study, we have tested direct links between sexual risk behavior and both perceived norms and attitudes. Whereas some theories of health behavior do predict the potential for direct relations (Bandura, 1997; Becker, 1974; Catania, et al., 1990; J. D. Fisher & Fisher, 1992; Rogers, 1975), others, such as the Theory of Reasoned Action (Fishbein & Ajzen, 1975), indicate that behavioral intentions will mediate those associations. Thus, if our goal in this case had been to specifically test the utility of the Theory of Reasoned Action, we would have incorrectly operationalized its predictions.

An alternate possibility that must also be considered is that extant theories regarding the root causes of health behaviors do not adequately describe sexual risk. Protective sexual behaviors may indeed be unique, relative to other health behaviors. For example, they *always* occur in a dyad (or group), and they involve relatively more intense biological and emotional drives. This is not to suggest that behaviors such as exercise, breast cancer screening, or seat-belt use are without social and physiological roots, but rather the balance of cognitive vs. noncognitive (e.g., social, contextual, or biological) causes of these activities may differ, depending on the behavior in question. Given that most health behavior theories focus largely on cognitive influences, they may fall short in describing those behaviors for which other influences are prominent. Similarly, even when a theory does an adequate job of describing a specific health behavior in one population, it might nevertheless fail to accurately characterize the underlying motivations for behavior among other groups who face greater external pressures (Amaro, 1995).

For example, Diaz's work with Latino MSM (Diaz, 1998) has shown that although men's intentions to engage in safe sex are high, their behavior is often inconsistent with their plans. Diaz suggests that social oppression of various forms leads men to have sex in situations where their likelihood of enacting safer intentions is low (e.g., in a relationship of unequal power, in an unsafe physical environment, or while they are drunk or high; Diaz, Ayala, &

Bein, 2004). In these instances, the powerful contextual influences can overwhelm health-related cognitions about the severity of HIV or perceptions of peer norms for safe sex.

Thus, when conducting research on complex health behaviors (e.g., sex) and in specific populations (e.g., socially marginalized groups), it is important to appreciate the possibility that cross-sectional correlations between health-related cognitions and actual health behaviors might be spurious. That is, some individuals may engage in unhealthy behaviors for reasons outside of their immediate physical or conscious control, and then subsequently adjust the way they think about that behavior. The resulting correlations between thoughts and behavior offer little explanation for why the individual engaged in risk. For example, in the mid-1990's, when revolutionary new treatments for HIV became available, many began speculating that optimism about these new treatments would lead individuals to take engage in more sexual risk, reasoning that HIV is less serious than it once was (Kelly, Otto-Salaj, Sikkema, Pinkerton, & Bloom, 1998; Signorile, 1997). Around the same time, epidemiologic studies began showing increases in risk behavior in some communities (Chen, et al., 2002; US Centers for Disease Control and Prevention, 1999; Van de Ven, Prestage, Crawford, Grulich, & Kippax, 2000). A flurry of cross-sectional research followed, documenting consistent correlations between "treatment optimism" and sexual risk (Crepaz, Hart, & Marks, 2004). However, as researchers began reporting findings from longitudinal studies, the results were more mixed. Whereas some found modest longitudinal associations between optimism and risk (Stolte, Dukers, Geskus, Coutinho, & de Wit, 2004; van der Snoek, de Wit, & Mulder, 2005), others found no association, or actually the reverse – that treatment optimism resulted from previous risk behavior (Huebner, Rebhook, & Kegeles, 2004; for a review, see Elford, 2006). Despite the abundance of cross-sectional research, treatment optimism could not adequately explain all the increase in risk (Elford, 2004).

Limitations

Our findings must be qualified by a number of limitations. First, although we made efforts to ensure representation from all subgroups within the young gay and bisexual community, the men in this study were not randomly sampled, and our data carry all of the limitations associated with convenience sampling (Binson, Blair, Huebner, & Woods, 2006). Notably, this sample likely does not represent men who have sex with men who do not identify as gay or bisexual. This is a limitation our study shares with much of the literature in this field. Additionally, we experienced significant attrition in our cohort, losing disproportionate numbers of men who were non-white, bisexual, and less open about their sexual orientation. Thus, care should be taken in generalizing our longitudinal findings to these populations. Finally, as we have stated, we did not set out in this study to test the veracity of any specific theory of health behavior – our study focuses exclusively on sexual risk behavior, and does not operationalize every path or construct identified by any one theory. Therefore these findings should not be interpreted as evidence for or against any particular model. Indeed, studies which completely operationalize every construct and path specified by a theory are rare. Rather, our goal was to attempt to test for evidence of a more general phenomenon – that behavior might be associated with subsequent changes in attitudes and perceived norms about that behavior. While these findings have implications for future theory-testing (e.g.,

more longitudinal research is needed), for all of these reasons, they do not imply that extant theories are entirely inaccurate. We discuss these implications in greater detail below.

Conclusions and Future Research

As longitudinal studies that fail to support extant theoretical predictions accumulate, we must be open to the possibility that novel or amended theoretical models and innovative intervention strategies might be helpful adjuvants for understanding and improving certain health behaviors in some populations. Whereas an abundance of work has focused on intra-individual predictors of health behavior, other models do exist. Ecological models (e.g., Bronfenbrenner, 1979), which describe the greater socio-environmental setting in which a behavior occurs, might provide an important alternative framework. Similarly, community-level interventions, which seek to change the larger context in which individuals live, have proven successful in changing health behaviors, including reducing high-risk sex (e.g., Kegeles, et al., 1996; Kelly, et al., 1997).

Additionally, future research on health behaviors must attend closely to the limitations of cross-sectional designs, recognizing the very real possibility that correlations can result from causal processes that are the reverse of those that are presumed (Weinstein & Nicolich, 1993). Moreover, longitudinal studies should model health behavior both as an outcome and a predictor of health-related cognitions, and should adjust for auto-regressive correlations over time, in order to more fully understand these complex and likely reciprocal relationships. Indeed, we would predict that cross-sectional correlations between health-cognition and health behavior are most likely to result from alternative causal processes (e.g., dissonance), in situations in which the behaviors are more complex (e.g., sex), and the populations in question are more vulnerable to environmental influences (e.g., marginalized groups). Future research will be required to test this hypothesis, as well as others that are raised by the “chicken-egg” dilemma. Although such research will require more expensive, more time-intensive designs (i.e., longitudinal studies), such work is essential to refining health behavior theories and developing more effective health promotion interventions.

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References

- Abraham CS, Sheeran P, Abrams D, Spears R. Health beliefs and teenage condom use: a prospective study. *Psychology and Health*. 1996; 11(5):641–655. [PubMed: 12290322]
- Aiken LS, West SG, Woodward CK, Reno RR. Health beliefs and compliance with mammography-screening recommendations in asymptomatic women. *Health Psychology*. 1994; 13(2):122–129. [PubMed: 8020455]
- Ajzen, I.; Fishbein, M. Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice Hall; 1980.
- Albarracin D, Fishbein M, Middlestadt S. Generalizing behavioral findings across times, samples, and measures: A study of condom use. *Journal of Applied Social Psychology*. 1998; 28(8):657–674.

- Albarracin D, Gillette JC, Earl AN, Glasman LR, Durantini MR, Ho M-H. 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. *Psychological Bulletin*. 2005; 131(6):856–897. [PubMed: 16351327]
- Albarracin D, Johnson BT, Fishbein M, Muellerleile PA. Theories of reasoned action and planned behavior as models of condom use: a meta-analysis. *Psychological Bulletin*. 2001; 127(1):142–161. [PubMed: 11271752]
- Alemagno SA, Stephens RC, Stephens P, Shaffer-King P, White P. Brief motivational intervention to reduce HIV risk and to increase HIV testing among offenders under community supervision. *Journal Of Correctional Health Care: The Official Journal Of The National Commission On Correctional Health Care*. 2009; 15(3):210–221.
- Allison PD. Missing Data Techniques for Structural Equation Modeling. *Journal of Abnormal Psychology*. 2003; 112(4):545–557. [PubMed: 14674868]
- Amaro H. Love, sex, and power: Considering women's realities in HIV prevention. *American Psychologist*. 1995; 50(6):437–447. [PubMed: 7598292]
- Anderson JC, Gerbing DW. Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*. 1988; 103(3):411–423.
- Aronson E, Fried C, Stone J. Overcoming denial and increasing the intention to use condoms through the induction of hypocrisy. *American Journal of Public Health*. 1991; 81(12):1636–1638. [PubMed: 1746661]
- Aspinwall LG, Kemeny ME, Taylor SE, Schneider SG, Dudley JP. Psychosocial predictors of gay men's AIDS risk-reduction behavior. *Health Psychology*. 1991; 10(6):432–444. [PubMed: 1765039]
- Ayoola AB, Nettleman M, Brewer J. Reasons for unprotected intercourse in adult women. *Journal of Women's Health*. 2007; 16(3):302–310.
- Bailey, JM.; Hope, DA. Contemporary perspectives on lesbian, gay, and bisexual identities. New York, NY US: Springer Science + Business Media; 2009. What is sexual orientation and do women have one?; p. 43-63.
- Bandura, A. Self-efficacy: The exercise of control. New York, NY US: W H Freeman/Times Books/Henry Holt & Co; 1997.
- Becker MH. The health belief model and personal health behavior. *Health Education Monographs*. 1974; 2(4):324–508.
- Bem, DJ. Self-Perception theory. In: Berkowitz, L., editor. *Advances in Experimental Social Psychology*. Vol. 6. San Diego, CA: Academic Press; 1972. p. 1-62.
- Bentler PM, Bonnett DG. Significance Tests and Goodness of Fit in the Analysis of Covariance Structures. *Psychological Bulletin*. 1980; 88:588–606.
- Binson, D.; Blair, J.; Huebner, DM.; Woods, WJ. Sampling in surveys of lesbian, gay, bisexual and transgender people. In: Meyer, IH.; Northridge, M., editors. *The Health of Sexual Minorities: Public Health Perspectives on Lesbian, Gay, Bisexual and Transgender Populations*. New York: Springer; 2006. p. 375-418.
- Bollen, KA. *Structural equations with latent variables*. New York, NY: John Wiley & Sons; 1989.
- Boone TL, Lefkowitz ES. Safer Sex and the Health Belief Model: Considering the Contributions of Peer Norms and Socialization Factors. *Journal of Psychology & Human Sexuality*. 2004; 16(1): 51–68.
- Brems C, Dewane SL, Johnson ME, Eldridge GD. Brief motivational interventions for HIV/STI risk reduction among individuals receiving alcohol detoxification. *AIDS Education And Prevention: Official Publication Of The International Society For AIDS Education*. 2009; 21(5):397–414. [PubMed: 19842825]
- Bronfenbrenner, U. *The Ecology of Human Development: Experiments by Nature and Design*. Cambridge, MA: Harvard University Press; 1979.
- Browne, MW.; Cudek, R. Alternative ways of assessing model fit. In: Bollen, KA.; Long, JS., editors. *Testing Structural Equation Models*. Newbury Park, CA: Sage Publications; 1993. p. 136-162.

- Brunswick AF, Banaszak-Holl J. HIV Risk Behavior and the Health Belief Model: An Empirical Test in an African American Community Sample. *Journal of Community Psychology*. 1996; 24(1):44–65.
- Bryan AD, Schmiede SJ, Broaddus MR. HIV risk reduction among detained adolescents: a randomized, controlled trial. *Pediatrics*. 2009; 124(6):e1180–e1188. [PubMed: 19901006]
- Buss, DM.; Sherman, PW.; Alcock, J. Exploring animal behavior: Readings from American Scientist. 4th ed.. Sunderland, MA US: Sinauer Associates; 2005. *The Strategies of Human Mating*; p. 248-259.
- Catania JA, Kegeles SM, Coates TJ. Towards an understanding of risk behavior: An AIDS risk reduction model (ARRM). *Health Education Quarterly*. 1990; 17(1):53–72. [PubMed: 2318652]
- Chaiken S, Baldwin MW. Affective-cognitive consistency and the effect of salient behavioral information on the self-perception of attitudes. *Journal of Personality and Social Psychology*. 1981; 41(1):1–12.
- Chen SY, Gibson S, Katz MH, Klausner JD, Dilley JW, Schwarcz SK, et al. Continuing increases in sexual risk behavior and sexually transmitted diseases among men who have sex with men: San Francisco, Calif, 1999–2001, USA. *Am J Public Health*. 2002; 92(9):1387–1388. [PubMed: 12197957]
- Choi K-H, Hoff C, Gregorich SE, Grinstead O, Gomez C, Hussey W. The efficacy of female condom skills training in HIV risk reduction among women: a randomized controlled trial. *American Journal Of Public Health*. 2008; 98(10):1841–1848. [PubMed: 18703460]
- Cochran SD, Mays VM. Applying social psychological models to predicting HIV-related sexual risk behaviors among African-Americans. *Journal of Black Psychology*. 1993; 19(2):142–154. [PubMed: 23529205]
- Cooper, J.; Mirabile, R.; Scher, SJ.; Brock, TC.; Green, MC. Persuasion: Psychological insights and perspectives. 2nd ed. Thousand Oaks, CA US: Sage Publications, Inc; 2005. *Actions and Attitudes: The Theory of Cognitive Dissonance*; p. 63-79.
- Crepaz N, Hart TA, Marks G. Highly active antiretroviral therapy and sexual risk behavior: A meta-analytic review. *Journal of the American Medical Association*. 2004; 292(2):224–236. [PubMed: 15249572]
- Crepaz N, Marshall KJ, Aupont LW, Jacobs ED, Mizuno Y, Kay LS, et al. The efficacy of HIV/STI behavioral interventions for African American females in the United States: A meta-analysis. *American Journal of Public Health*. 2009; 99(11):2069–2078. [PubMed: 19762676]
- Díaz RM, Ayala G, Bein E. Sexual Risk as an Outcome of Social Oppression: Data From a Probability Sample of Latino Gay Men in Three U.S. Cities. *Cultural Diversity and Ethnic Minority Psychology*. 2004; 10(3):255–267. [PubMed: 15311978]
- Darbes L, Crepaz N, Lyles C, Kennedy G, Rutherford G. The efficacy of behavioral interventions in reducing HIV risk behaviors and incident sexually transmitted diseases in heterosexual African Americans. *AIDS*. 2008; 22(10):1177–1194. [PubMed: 18525264]
- Denny-Smith T, Bairan A, Page MC. A survey of female nursing students's knowledge, health beliefs, perceptions of risk, and risk behaviors regarding human papillomavirus and cervical cancer. *Journal of the American Academy of Nurse Practitioners*. 2006; 18(2):62–69. [PubMed: 16460412]
- Diamond, LM. *Sexual Fluidity: Understanding women's love and desire*. Cambridge: Harvard University Press; 2008.
- Diaz, RM. *Latino Gay Men and HIV: Culture, Sexuality, and Risk Behavior*. New York: Taylor & Francis, Inc; 1998.
- DiClemente RJ, Lodico M, Grinstead OA, Harper G, Rickman RL, Evans PE, et al. African-American adolescents residing in high-risk urban environments do use condoms: correlates and predictors of condom use among adolescents in public housing developments. *Pediatrics*. 1996; 98(2 Pt 1):269–278. [PubMed: 8692629]
- DiClemente RJ, Wingood GM, Rose ES, Sales JM, Lang DL, Caliendo AM, et al. Efficacy of sexually transmitted disease/human immunodeficiency virus sexual risk-reduction intervention for african american adolescent females seeking sexual health services: a randomized controlled trial. *Archives Of Pediatrics & Adolescent Medicine*. 2009; 163(12):1112–1121. [PubMed: 19996048]

- Downing-Matibag TM, Geisinger B. Hooking Up and Sexual Risk Taking Among College Students: A Health Belief Model Perspective. *Qualitative Health Research*. 2009; 19(9):1196–1209. [PubMed: 19690202]
- Ekstrand ML, Coates TJ. Maintenance of safer sexual behaviors and predictors of risky sex: the San Francisco Men's Health Study. *American Journal of Public Health*. 1990; 80(8):973–977. [PubMed: 2368861]
- Elford J. HIV treatment optimism and high-risk sexual behaviour among gay men: The attributable population risk. *AIDS and Behavior*. 2004; 18(16):2216–2217.
- Elford J. Changing patterns of sexual behaviour in the era of highly active antiretroviral therapy. *Current Opinion in Infectious Diseases*. 2006; 19(1):26–32. [PubMed: 16374214]
- Festinger L, Carlsmith JM. Cognitive consequences of forced compliance. *The Journal of Abnormal and Social Psychology*. 1959; 58(2):203–210.
- Festinger, LA. A theory of cognitive dissonance. Evanston, IL: Row, Peterson; 1957.
- Fishbein, M.; Ajzen, I. Belief, attitude, intention, and behavior: An introduction to theory and research. Reading, MA: Addison-Wesley; 1975.
- Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychological Bulletin*. 1992; 111(3):455–474. [PubMed: 1594721]
- Fisher, JD.; Fisher, WA. Theoretical Approaches to Individual-Level Change in HIV Risk behavior. In: Peterson, JL.; DiClemente, RJ., editors. *Handbook of HIV Prevention*. New York: Kluwer Academic / Plenum; 2000. p. 3-55.
- Gaes GG, Tedeschi JT. An evaluation of self-esteem and impression management theories of anticipatory belief change. *Journal of Experimental Social Psychology*. 1978; 14(6):579–587.
- Gerrard M, Gibbons FX, Benthin AC, Hessling RM. A longitudinal study of the reciprocal nature of risk behaviors and cognitions in adolescents: What you do shapes what you think, and vice versa. *Health Psychology*. 1996; 15(5):344–354. [PubMed: 8891713]
- Gerrard M, Gibbons FX, Bushman BJ. Relation between perceived vulnerability to HIV and precautionary sexual behavior. *Psychological Bulletin*. 1996; 19(3):390–409. [PubMed: 8668745]
- Gibbons FX, Eggleston TJ, Benthin AC. Cognitive reactions to smoking relapse: The reciprocal relation between dissonance and self-esteem. *Journal of Personality and Social Psychology*. 1997; 72(1):184–195. [PubMed: 9008380]
- Gibbons FX, Gerrard M. Predicting young adults' health risk behavior. *Journal of Personality and Social Psychology*. 1995; 69(3):505–517. [PubMed: 7562392]
- Goetz AT, Shackelford TK. Sexual Coercion in Intimate Relationships: A Comparative Analysis of the Effects of Women's Infidelity and Men's Dominance and Control. *Archives of Sexual Behavior*. 2009; 38(2):226–234. [PubMed: 18415011]
- Hattori MK, DeRose L. Young Women's Perceived Ability to Refuse Sex in Urban Cameroon. *Studies in Family Planning*. 2008; 39(4):309–320. [PubMed: 19248717]
- Hays RB, Kegeles SM, Coates TJ. High HIV risk-taking among young gay men. *AIDS*. 1990; 4:901–907. [PubMed: 2252563]
- Hiller, J.; Wood, H.; Bolton, W. Sex, mind, and emotion: Innovation in Psychological Theory and Practice. London England: Karnac Books; 2006.
- Huebner DM, Rebchook GM, Kegeles SM. A longitudinal study of the associations between treatment optimism and sexual risk behavior among young gay and bisexual men. *Journal of Acquired Immune Deficiency Syndrome*. 2004; 37:1514–1519.
- Jemmott JB 3rd, Jemmott LS, Braverman PK, Fong GT. HIV/STD risk reduction interventions for African American and Latino adolescent girls at an adolescent medicine clinic: a randomized controlled trial. *Archives Of Pediatrics & Adolescent Medicine*. 2005; 159(5):440–449. [PubMed: 15867118]
- Jemmott LS, Jemmott JB 3rd, O'Leary A. Effects on sexual risk behavior and STD rate of brief HIV/STD prevention interventions for African American women in primary care settings. *American Journal Of Public Health*. 2007; 97(6):1034–1040. [PubMed: 17463391]
- Kalichman SC, Picciano JF, Roffman RA. Motivation to reduce HIV risk behaviors in the context of the information, motivation and behavioral skills (IMB) model of HIV prevention. *Journal of Health Psychology*. 2008; 13(5):680–689. [PubMed: 18519441]

- Kalichman SC, Rompa D, Cage M, DiFonzo K, Simpson D, Austin J, et al. Effectiveness of an intervention to reduce HIV transmission risks in HIV-positive people. *American Journal Of Preventive Medicine*. 2001; 21(2):84–92. [PubMed: 11457627]
- Kegeles SM, Hays RB, Coates TJ. The Mpowerment Project: A community-level HIV prevention intervention for young gay men. *Am J Public Health*. 1996; 86(8 Pt 1):1129–1136. [PubMed: 8712273]
- Kegeles SM, Hays RB, Pollack LM, Coates TJ. Mobilizing young gay and bisexual men for HIV prevention: A two-community study. *AIDS*. 1999; 13:1753–1762. [PubMed: 10509578]
- Kelly JA, Murphy DA, Sikkema KJ, McAulliffe TL, Roffman RA, Solomon JJ, et al. Randomised, controlled, community-level HIV prevention intervention for sexual-risk behavior among homosexual men in U.S. cities. *The Lancet*. 1997; 350(22):1500–1505.
- Kelly JA, Otto-Salaj LL, Sikkema KJ, Pinkerton SD, Bloom F. Implications of HIV treatment advances for behavioral research on AIDS: Protease inhibitors and new challenges in HIV secondary prevention. *Health Psychology*. 1998; 17:310–319. [PubMed: 9697940]
- Kiviniemi MT, Voss-Humke AM, Seifert AL. How do i feel about the behavior? The interplay of affective associations with behaviors and cognitive beliefs as influences on physical activity behavior. *Health Psychology*. 2007; 26(2):152–158. [PubMed: 17385966]
- Koniak-Griffin D, Stein JA. Predictors of sexual risk behaviors among adolescent mothers in a human immunodeficiency virus prevention program. *The Journal Of Adolescent Health: Official Publication Of The Society For Adolescent Medicine*. 2006; 38(3) 297.e291-211.
- Krueger J, Clement RW. The truly false consensus effect: An ineradicable and egocentric bias in social perception. *Journal of Personality and Social Psychology*. 1994; 67(4):596–610. [PubMed: 7965607]
- Lin P, Simoni JM, Zemon V. The health belief model, sexual behaviors, and HIV risk among Taiwanese immigrants. *AIDS Education and Prevention*. 2005; 17(5):469–483. [PubMed: 16255642]
- Lindley MC, Wortley PM, Winston CA, Bardenheier BH. The Role of Attitudes in Understanding Disparities in Adult Influenza Vaccination. *American Journal of Preventive Medicine*. 2006; 31(4):281–285. [PubMed: 16979451]
- Lollis CM, Antoni MH, Johnson EH, Chitwood DC, Griffin DK. Does the Health Belief Model Predict Risky Sexual Practices in Injection Drug Users? *Clinical Psychology & Psychotherapy*. 1995; 2(4):227–233.
- Martin SS, O'Connell DJ, Inciardi JA, Surratt HL, Maiden KM. Integrating an HIV/HCV brief intervention in prisoner reentry: results of a multisite prospective study. *Journal Of Psychoactive Drugs*. 2008; 40(4):427–436. [PubMed: 19283947]
- McClenahan C, Shevlin M, Adamson G, Bennett C, O'Neill B. Testicular self-examination: A test of the health belief model and the theory of planned behaviour. *Health Education Research*. 2007; 22(2):272–284. [PubMed: 16885203]
- Mealey, L. Sex differences: Development and evolutionary strategies. San Diego, CA US: Academic Press; 2000.
- Monin, Bt; Norton, MI. Perceptions of a fluid consensus: Uniqueness bias, false consensus, false polarization, and pluralistic ignorance in a water conservation crisis. *Personality and Social Psychology Bulletin*. 2003; 29(5):559–567. [PubMed: 15272990]
- Montgomery SB, Joseph JG, Becker MH, Ostrow DG, Kessler RC, Kirscht JP. The Health Belief Model in understanding compliance with preventive recommendations for AIDS: how useful? *AIDS Education And Prevention: Official Publication Of The International Society For AIDS Education*. 1989; 1(4):303–323. [PubMed: 2701353]
- Moreland RL, Zajonc RB. A strong test of exposure effects. *Journal of Experimental Social Psychology*. 1976; 12(2):170–179.
- Morgenstern J, Bux DA Jr, Parsons J, Hagman BT, Wainberg M, Irwin T. Randomized trial to reduce club drug use and HIV risk behaviors among men who have sex with men. *Journal Of Consulting And Clinical Psychology*. 2009; 77(4):645–656. [PubMed: 19634958]

- Morrison-Beedy D, Carey MP, Seibold-Simpson SM, Xia Y, Tu X. Preliminary efficacy of a comprehensive HIV prevention intervention for abstinent adolescent girls: pilot study findings. *Research In Nursing & Health*. 2009; 32(6):569–581. [PubMed: 19877164]
- Muthén, LK.; Muthén, B. *Mplus User's Guide*. Los Angeles, CA: Muthen and Muthen, Inc; 2006.
- NIMH Team 2001. Social-cognitive theory mediators of behavior change in the National Institute of Mental Health Multisite HIV Prevention Trial. *Health Psychology: Official Journal Of The Division Of Health Psychology, American Psychological Association*. 2001; 20(5):369–376.
- Noar SM. Behavioral interventions to reduce HIV-related sexual risk behavior: Review and synthesis of meta-analytic evidence. *AIDS and Behavior*. 2008; 12(3):335–353. [PubMed: 17896176]
- O'Leary A, Jemmott LS, Jemmott JB. Mediation analysis of an effective sexual risk-reduction intervention for women: the importance of self-efficacy. *Health Psychology: Official Journal Of The Division Of Health Psychology, American Psychological Association*. 2008; 27(2 Suppl):S180–S184.
- Olson, JM.; Stone, J.; Albarracín, D.; Johnson, BT.; Zanna, MP. *The handbook of attitudes*. Mahwah, NJ US: Lawrence Erlbaum Associates Publishers; 2005. *The Influence of Behavior on Attitudes*; p. 223-271.
- Paul JP, Stall RD, Crosby GM, Barrett DC. Correlates of sexual risk-taking among gay male substance abusers. *Addiction*. 1994; 89(8):971–983. [PubMed: 7950855]
- Pearson J. Personal Control, Self-Efficacy in Sexual Negotiation, and Contraceptive Risk among Adolescents: The Role of Gender. *Sex Roles*. 2006; 54(9/10):615–625.
- Peplau LA. Rethinking women's sexual orientation: An interdisciplinary, relationship-focused approach. *Personal Relationships*. 2001; 8(1):1–19.
- Prochaska, JO.; DiClemente, CC.; Norcross, JC.; Goldfried, MR. *Handbook of psychotherapy integration*. 2nd ed.. New York, NY US: Oxford University Press; 2005. *The Transtheoretical Approach*; p. 147-171.
- Ragsdale K, Anders JT, Philippakos E. MIGRANT LATINAS AND BROTHEL SEX WORK IN BELIZE: SEXUAL AGENCY AND SEXUAL RISK. *Journal of Cultural Diversity*. 2007; 14(1): 26–34. [PubMed: 19172970]
- Rhodes F, Stein JA, Fishbein M, Goldstein RB, Rotheram-Borus MJ. Using theory to understand how interventions work: Project RESPECT, condom use, and the Integrative Model. *AIDS And Behavior*. 2007; 11(3):393–407. [PubMed: 17323123]
- Rhodes SD, Hergenrather KC. USING AN INTEGRATED APPROACH TO UNDERSTAND VACCINATION BEHAVIOR AMONG YOUNG MEN WHO HAVE SEX WITH MEN: STAGES OF CHANGE, THE HEALTH BELIEF MODEL, AND SELF-EFFICACY. *Journal of Community Health*. 2003; 28(5):347–362. [PubMed: 14535600]
- Robinson BBE, Scheltema K, Cherry T. Risky Sexual Behavior in Low-Income African American Women: The Impact of Sexual Health Variables. *Journal of Sex Research*. 2005; 42(3):224–237. [PubMed: 19817036]
- Rogers RW. A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*. 1975; 91:93–114.
- Rotheram-Borus MJ, Rosario M, Reid H, Koopman C. Predicting patterns of sexual acts among homosexual and bisexual youths. *American Journal of Psychiatry*. 1995; 152(4):588–595. [PubMed: 7694909]
- Schafer JL, Graham JW. Missing data: Our view of the state of the art. *Psychological Methods*. 2002; 7(2):147–177. [PubMed: 12090408]
- Schmiege SJ, Broadus MR, Levin M, Bryan AD. Randomized trial of group interventions to reduce HIV/STD risk and change theoretical mediators among detained adolescents. *Journal Of Consulting And Clinical Psychology*. 2009; 77(1):38–50. [PubMed: 19170452]
- Signorile M. Bareback and restless. *Out*. Jul.1997 :36–37.
- Steers WN, Elliott E, Nemirow J, Ditman D, Oskamp S. Health Beliefs as Predictors of HIV-Preventive Behavior and Ethnic Differences in Prediction. *Journal of Social Psychology*. 1996; 136(1):99–110. [PubMed: 8851449]

- Stolte IG, Dukers NH, Geskus RB, Coutinho RA, de Wit JB. Homosexual men change to risky sex when perceiving less threat of HIV/AIDS since availability of highly active antiretroviral therapy: a longitudinal study. *AIDS*. 2004; 18:303–309. [PubMed: 15075549]
- Stone J, Aronson E, Crain AL, Winslow MP. Inducing hypocrisy as a means of encouraging young adults to use condoms. *Personality and Social Psychology Bulletin*. 1994; 20(1):116–128.
- Stone J, Fernandez NC. To practice what we preach: The use of hypocrisy and cognitive dissonance to motivate behavior change. *Social and Personality Psychology Compass*. 2008; 2(2):1024–1051.
- Thornhill, R.; Palmer, CT. A natural history of rape: Biological bases of sexual coercion. Cambridge, MA US: The MIT Press; 2000.
- Tross S, Campbell ANC, Cohen LR, Calsyn D, Pavlicova M, Miele GM, et al. Effectiveness of HIV/STD sexual risk reduction groups for women in substance abuse treatment programs: results of NIDA Clinical Trials Network Trial. *Journal Of Acquired Immune Deficiency Syndromes* (1999). 2008; 48(5):581–589. [PubMed: 18645513]
- US Centers for Disease Control and Prevention. Increases in unsafe sex and rectal gonorrhea among men who have sex with men -- San Francisco, CA, 1994–1997. *Morbidity and Mortality Weekly Report*. 1999; 48:45–58. [PubMed: 9935141]
- Van de Ven P, Prestage G, Crawford J, Grulich A, Kippax S. Sexual risk behaviour increases and is associated with HIV optimism among HIV-negative and HIV-positive gay men in Sydney over the 4 year period to February 2000. *AIDS*. 2000; 14:2951–2953. [PubMed: 11153682]
- van der Snoek EM, de Wit JB, Mulder PG. Incidence of sexually transmitted diseases and HIV infection related to perceived HIV/AIDS threat since highly active antiretroviral therapy availability in men who have sex with men. *Sexually Transmitted Diseases*. 2005; 32(3):170–175. [PubMed: 15729154]
- Weinstein ND, Nicolich M. Correct and incorrect interpretations of correlations between risk perceptions and risk behaviors. *Health Psychology*. 1993; 12(3):235–245. [PubMed: 8500454]
- Wheaton, B.; Muthen, B.; Alwin, DF.; Summers, GF. Assessing reliability and stability in panel models. In: Heise, DR., editor. *Sociological Methodology*. San Francisco: Jossey-Bass; 1977. p. 84-136.
- Williams JK, Wyatt GE, Rivkin I, Ramamurthi HC, Li X, Liu H. Risk reduction for HIV-positive African American and Latino men with histories of childhood sexual abuse. *Archives Of Sexual Behavior*. 2008; 37(5):763–772. [PubMed: 18506611]
- Wingood GM, DiClemente RJ, Harrington KF, Lang DL, Davies SL, Hook EW 3rd, et al. Efficacy of an HIV prevention program among female adolescents experiencing gender-based violence. *American Journal Of Public Health*. 2006; 96(6):1085–1090. [PubMed: 16670238]
- Yuan, K-H.; Bentler, PM. Three likelihood-based methods for mean and covariance structure analysis with nonnormal missing data. In: Sobel, ME., editor. *Sociological Methodology* 2000. Washington, DC: American Sociological Association; 2000. p. 165-200.
- Zimmerman RS, Noar SM, Feist-Price S, Dekthar O, Cupp PK, Anderman E, et al. Longitudinal test of a multiple domain model of adolescent condom use. *Journal of Sex Research*. 2007; 44(4):380–394. [PubMed: 18321017]

Figure 1.

SEM Illustrating Temporal Effects of Favorable Safe Sex Norms, Attitudes, and Unprotected Anal Intercourse

Note: Estimates illustrated are the standardized path coefficients from the SEM.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1

Demographic characteristics of sample at each wave of data collection

Variable	Recruited at Wave 1		Recruited at Wave 2	Full Sample
	Initial Sample	Retained to Wave 2		
N	1248	620	217	1465
Age (SD)	23.3 (2.7)	23.4 (2.7)	23.4 (3.1)	23.3 (2.8)
Ethnicity				
White	58.8%	65.0%	65.0%	59.7%
Latino	28.9%	24.8%	20.3%	27.6%
African American	5.1%	3.7%	7.4%	5.5%
Asian / Pacific Islander	3.0%	3.4%	4.6%	3.2%
Native American	4.1%	3.1%	2.8%	3.9%
Other	0.1%	0%	0%	0.1%
Education				
Less than high school	4.3%	3.2%	2.3%	4.0%
High school degree	69.9%	68.1%	64.5%	69.1%
College or grad degree	25.7%	28.7%	33.2%	26.8%
Outness				
Out to almost everyone	43.2%	44.8%	42.9%	43.1%
Out to most	29.1%	31.0%	29.0%	29.0%
Out to half or less	27.8%	24.2%	28.1%	27.9%
Sexual Identity				
Gay	83.1%	87.3%	87.1%	83.5%
Bisexual	16.0%	11.3%	10.1%	15.1%
Other	0.9%	1.4%	2.8%	1.4%

Table 2

Correlations among key variables (n =1465)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Norms1 T1	1.0																			
2. Norms2 T1	.41	1.0																		
3. Norms3 T1	.22	.27	1.0																	
4. Norms4 T1	-.42	-.30	-.15	1.0																
5. Norms5 T1	.43	.33	.17	-.35	1.0															
6. Norms6 T1	.43	.46	.30	-.35	.51	1.0														
7. Norms1 T2	.34	.25	.12	-.25	.24	.27	1.0													
8. Norms2 T2	.27	.31	.11	-.17	.21	.31	.47	1.0												
9. Norms3 T2	.22	.15	.31	-.06	.09	.17	.30	.30	1.0											
10. Norms4 T2	-.23	-.13	-.08	.34	-.24	-.24	-.49	-.34	-.21	1.0										
11. Norms5 T2	.31	.20	.11	-.23	.33	.24	.53	.42	.20	-.52	1.0									
12. Norms6 T2	.27	.23	.18	-.19	.22	.32	.46	.51	.37	-.41	.58	1.0								
13. Attitude1 T1	.01	-.01	.03	.08	-.07	-.03	-.09	-.02	-.03	.12	-.07	-.10	1.0							
14. Attitude2 T1	-.07	-.06	.01	.18	-.10	-.15	-.07	-.11	-.03	.15	-.13	-.10	.50	1.0						
15. Attitude3 T1	-.05	-.12	-.04	.19	-.14	-.18	-.08	-.09	-.09	.20	-.15	-.16	.47	.60	1.0					
16. Attitude1 T2	-.02	-.04	.06	.11	-.10	-.05	-.08	-.07	.05	.16	-.14	-.12	.42	.38	.33	1.0				
17. Attitude2 T2	-.07	-.06	.01	.18	-.14	-.11	-.12	-.14	-.01	.22	-.21	-.19	.35	.42	.36	.60	1.0			
18. Attitude3 T2	-.09	-.09	-.01	.18	-.16	-.15	-.17	-.17	-.05	.19	-.22	-.22	.33	.39	.36	.56	.71	1.0		
19. UAI T1	-.08	.01	-.01	.08	-.12	-.10	-.12	-.02	-.06	.10	-.13	-.17	.22	.22	.18	.19	.20	.24	1.0	
20. UAI T2	-.04	-.05	-.05	.07	-.08	-.04	-.13	.01	-.05	.17	-.19	-.18	.15	.10	.09	.21	.20	.24	.35	1.0
Mean	4.06	5.04	4.54	3.05	3.98	4.84	4.15	5.02	4.46	3.01	3.85	4.63	3.05	2.30	2.14	3.24	2.53	2.26	0.60	0.72
SD	1.50	1.28	1.73	1.53	1.45	1.23	1.43	1.16	1.65	1.47	1.38	1.25	1.77	1.53	1.43	1.69	1.58	1.38	1.10	1.13

Notes: Correlations, means, and standard deviations are estimated via full information maximum likelihood using *Mplus*. Correlations greater than 0.062 are significant at $p < .05$; correlations greater than 0.081 are significant at $p < .01$.

Table 3
SEM Illustrating Temporal Associations of Favorable Safe Sex Norms, Attitudes, and Unprotected Anal Intercourse

Variable	Estimate	SE	Z	P	β
<i>Factor Loading</i>					
Norms Time 1					
Norms Item 1	1.00	—	—	—	.65
Norms Item 2	.77	.05	15.84	<.001	.59
Norms Item 3	.62	.06	10.05	<.001	.35
Norms Item 4	-.85	.05	-17.80	<.001	-.54
Norms Item 5	.96	.05	18.09	<.001	.65
Norms Item 6	.91	.06	16.24	<.001	.73
Norms Time 2					
Norms Item 1	1.00	—	—	—	.70
Norms Item 2	.73	.05	13.67	<.001	.62
Norms Item 3	.66	.06	10.37	<.001	.40
Norms Item 4	-.93	.06	-16.75	<.001	-.63
Norms Item 5	1.05	.06	18.14	<.001	.75
Norms Item 6	.92	.07	13.63	<.001	.74
Attitudes Time 1					
Attitudes Item 1	1.00	—	—	—	.62
Attitudes Item 2	1.10	.06	18.50	<.001	.80
Attitudes Item 3	.99	.06	18.12	<.001	.75
Attitudes Time 2					
Attitudes Item 1	1.00	—	—	—	.69
Attitudes Item 2	1.18	.06	19.94	<.001	.85
Attitudes Item 3	.98	.06	17.56	<.001	.83
<i>Directional Structural Effects</i>					
Norms T1 -> Norms T2	.52	.06	8.65	<.001	.51
Attitudes T1 -> Attitudes T2	.61	.06	10.25	<.001	.58
UAI T1 -> Norms T2	-.10	.04	-2.35	.02	-.11
UAI T1 -> Attitudes T2	-.11	.05	-2.23	.03	-.11

Variable	Estimate	SE	Z	P	β
Norms T1 -> UAI T2	-.04	.06	-0.67	.50	-.03
Attitudes T1 -> UAI T2	-.05	.05	-0.93	.35	-.05
UAI T1 -> UAI T2	.34	.05	6.46	< .001	.33
<i>Latent Variable and Residual Correlations</i>					
Attitudes T1 < Norms T1	.24	.04	5.98	< .001	.22
UAI T1 < Norms T1	-.13	.04	-3.57	< .001	-.12
UAI T1 < Attitudes T1	-.34	.04	-7.55	< .001	-.28
Attitudes T2 < Norms T2	.17	.05	3.59	< .001	.14
UAI T2 < Norms T2	-.13	.04	-3.12	.002	-.12
UAI T2 < Attitudes T2	-.19	.05	-3.83	< .001	-.15
Norms Item 1 T1 < Norms Item 1 T2	.13	.07	1.79	.07	.06
Norms Item 2 T1 < Norms Item 2 T2	.17	.07	2.45	.01	.12
Norms Item 3 T1 < Norms Item 3 T2	.64	.14	4.74	< .001	.23
Norms Item 4 T1 < Norms Item 4 T2	.36	.08	4.68	< .001	.16
Norms Item 5 T1 < Norms Item 5 T2	.19	.06	3.03	.002	.09
Norms Item 6 T1 < Norms Item 6 T2	.09	.05	1.79	.07	.06
Attitudes Item 1 T1 < Attitudes Item 1 T2	.38	.10	3.96	< .001	.13
Attitudes Item 2 T1 < Attitudes Item 2 T2	.04	.06	0.71	.48	.02
Attitudes Item 3 T1 < Attitudes Item 3 T2	.01	.05	0.17	.87	.01

Notes: $N = 1465$; < > denotes covariances; < > denotes directional effects; $B =$ Unstandardized regression weight; $SE =$ standard error of B ; $Z =$ Z-test of $B = 0$; $P =$ p-value for Z-test; $\beta =$ standardized regression coefficient.