Theory of Planned Behavior Interventions for Reducing Heterosexual Risk Behaviors: A

Meta-Analysis

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Abstract

Objective: The meta-analysis reported here examined interventions informed by the theory of planned behavior (TPB) or theory of reasoned action (TRA) aimed at reducing heterosexual risk behaviors (prevention of STDs and unwanted pregnancy).

Methods: Studies were eligible for inclusion if they were either randomized control trials or quasi-experimental studies which compared the TPB-based intervention against a control group. Search strategy consisted of papers identified in previous reviews, keyword search through search engines, examination of key journals, and contacting key experts.

Results: Forty-seven intervention studies were included in the meta-analysis. Random effects models revealed that pooled effect sizes for TPB-based interventions had small but significant effects on behavior and other secondary outcomes (i.e., knowledge, attitudes, normative beliefs, perceived behavioral control, and intentions). Significant heterogeneity found between effect sizes was explored using meta-regression. Larger effects were found for interventions that provided opportunities for social comparison.

Conclusions: The TPB provides a valuable framework for designing interventions to change heterosexual risk behaviors. However, effect sizes varied quite substantially between studies and further research is needed to explore the reasons why.

Key words: Intervention, meta-analysis, theory of planned behavior, theory of reasoned action, sexual risk behavior

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Centers for Disease Control and Prevention (CDC) have prioritized reducing teen

pregnancy as part of President Obama's Teen pregnancy Prevention Initiative (CDC, 2012).

While unwanted pregnancy continues to be a health concern, sexually transmitted diseases

(STDs) also continue to persist globally (World Health Organization [WHO], 2007). In the

US, sexually active younger people (aged 15-24) are at a higher risk of acquiring STDs,

compared to older adults. Around half of all newly diagnosed STDs are in this younger age

group, despite only accounting for 25% of the sexually active population (CDC, 2011). This

continued prevalence of STDs has resulted in a number of international authorities issuing

policy and guidance (WHO, 2007; CDC, 2010; National Institute for Health and Clinical

Excellence [NICE], 2007). Importantly, this guidance has emphasized the need for sexual

behavior interventions which are grounded in *theory*.

For many years, theories of health behavior such as the health belief model (HBM:

Becker, 1974), social cognitive theory (SCT: Bandura, 1986) and the theory of planned

behavior (TPB: Ajzen, 1991), with its predecessor the theory of reasoned action (TRA:

Ajzen, 1985; Ajzen & Fishbein, 1980), have been at the forefront of research into predicting

and explaining health behaviors. Each of these theories provide the foundation for potentially

successful interventions by proposing sets of potential modifiable constructs that might

influence people's intentions and behavior (Rutter & Quine, 2002). However, choosing

between the theories is not straightforward, not least because they share similar, but

differently named, constructs. For example, they all highlight the role of the perceived

outcomes of the behavior - perceived benefits and barriers (HBM), outcome expectancies

(SCT), and attitudes (TRA, TPB). They also emphasize the role of control beliefs through

self-efficacy beliefs (HBM, SCT) or perceptions of behavioral control (TPB). Somewhat

different types of social influence are however proposed – whilst the HBM lacks a social element, the other models include vicarious experience (SCT) and subjective norms (TRA, TPB) amongst their constructs.

In this paper the focus is on the TPB and its predecessor the TRA. It is a very popular model that has been researched extensively, with clearly defined constructs which have been established as reliable predictors of a range of health behaviors (Armitage & Conner, 2001; Godin & Kok, 1996; McEachan, Conner, Taylor, & Lawton, 2011) and sexual risk behaviors specifically. Systematic reviews and meta-analyses have demonstrated its value as an explanatory model for sexual risk behavior (Abraham & Sheeran, 1994; Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Albarracín, Kumkale, & Johnson, 2004; Buhi & Goodson, 2007).

The TPB and TRA have also been used as frameworks for designing interventions, with studies evaluating its efficacy at reducing sexual risk behaviors published since the early 1990s (e.g., Armitage & Talibudeen, 2010; Bellingham & Gillies, 1993; Jemmott, Jemmott, & Fong, 1998; Koniak-Griffin et al., 2003). The existing systematic reviews of this literature are however limited in their scope or are in need of updating. Although a systematic review has been published recently of TPB-based interventions (Lopez, Tolley, Grimes, & Chen-Mok, 2011), this was specifically focused on contraceptive use and identified only one intervention study (Coyle et al., 2006). Prior to this, Hardeman et al. (2002) systematically reviewed the literature on the application of the TPB to the development of interventions across a range of different types of health behaviors. However, only two studies were identified that focused on sexual risk behaviors, with a positive effect reported in one study (Jemmott et al., 1998) and effect sizes not calculated in the other (Sanderson & Jemmott, 1996). The existing systematic reviews of the literature therefore provide limited insights into the efficacy of TPB-based interventions on changing sexual risk behaviors.

That being said, more up-to-date systematic reviews and meta-analyses of the literature are available that have pooled together the findings from numerous HIV prevention interventions (Albarracín, Albarracín, & Durantini, 2008; Albarracín et al., 2005; Durantini, Albarracín, Mitchell, Earl, & Gillette, 2006; Henny et al., 2012; Earl & Albarracín, 2007; Noar, 2008; Noar, Carlyle, & Cole, 2006; Tolou-Shams, Stewart, Fasciano, & Brown, 2010; van Empelen et al., 2003) and the transmission of STDs (Shepherd, Hampton, & Harris, 2011). Although these reviews have not specifically analyzed the efficacy of TPB-based interventions, some of these findings can provide valuable insights.

For example, Albarracín et al. (2005) carried out a meta-analysis of HIV prevention interventions, focusing on studies which promoted the use of condoms. The difference between pre-test and post-test condom use was larger in intervention than control groups. They also linked their findings to specific components of the TPB. Interventions that included strategies addressing either attitudinal or behavioral skills arguments increased behavior change across many populations. Although the findings of this review do not provide direct evidence of the efficacy of using the TPB as a framework for intervention design, it has highlighted the benefits of targeting specific constructs.

The systematic review and meta-analysis reported in this paper aims to build upon this work. It includes studies reporting evaluations of interventions that have been explicitly informed in their design by the TPB or its predecessor the TRA (both referred to hereafter as TPB-based interventions). Its focus is also somewhat broader than some of the existing reviews. It does not restrict itself to a particular population group or demographic and includes studies concerned with the prevention of all types of STDs contracted through heterosexual contact and the prevention of unwanted pregnancy. Relevant randomized trials and quasi-experimental studies were retrieved using systematic reviewing methods to ensure

that this meta-analysis provided a robust evaluation of the TPB's value as a framework for intervention design.

By concentrating specifically on TPB-based interventions, this review allowed an in-depth analysis of the theory's efficacy in changing people's sexual risk behaviors. The effects on secondary outcomes including the TPB constructs (i.e., attitudes, normative beliefs, perceived behavioral control, and intentions) and knowledge were also examined. By pooling together the research conducted to-date, the aim was to provide insights not only into the overall value of using the TPB as a framework for intervention design but also to examine whether its efficacy is moderated by characteristics of the samples tested (e.g., their age or gender), or specific features of the intervention and control conditions (e.g., delivery method; behavior change techniques). The quality of the evidence was also evaluated by scoring the methodological quality of the studies using the Cochrane Risk of Bias Tool (Higgins & Green, 2011). This analysis not only provided specific insights into the robustness of the conclusions that can be drawn from this meta-analysis but also highlights areas of concern about methodology that should be addressed in future evaluation studies.

Method

Inclusion and Exclusion Criteria

Participants. All ages, levels of sexual experience, gender, socio-economic status, ethnicities, and recognized high risk groups (e.g., commercial sex workers and sexual partners thereof) were included. However, studies targeting only men who have sex with men (MSM) were excluded. This was because we were interested in evaluating the efficacy of TPB-based interventions at reducing risk behaviors linked to unwanted pregnancy and STDs contracted through heterosexual contact. Interventions conducted on bisexuals were therefore included so long as the intervention addressed heterosexual practices. Studies which focused on individuals living with HIV were also excluded, based on the finding that sexual behavior

decision making in HIV positive persons is predominantly motivated by a sense of responsibility to avoid onward transmission to sexual partners (Wolitski, Bailey, O'Leary, Gómez, & Parsons, 2003).

Experimental intervention method. Studies were required to explicitly use the TRA or TPB to design an intervention aimed at changing sexual behavior. If other theories (e.g., social cognitive theory: Bandura, 1986) were also utilized in the intervention design, this information was noted. All modes of delivery were included (e.g., one-to-one; group work; role play; videos; leaflets), as were all intervention delivery frequencies (i.e., one session or multiple sessions), and whether studies used professionally qualified or unqualified facilitators. Behavior change techniques were coded according to Abraham and Michie's (2008) taxonomy.

Study design & control intervention. Study designs were either randomized controlled trials (RCTs) or quasi-experimental studies which compared the TPB-based intervention against a control group. Control groups consisted of either (1) no intervention; (2) alternative sexual health interventions designed without using the TRA or TPB – which in some cases was treatment as usual; or (3) interventions targeting non-sexual behaviors.

Outcome measures & follow-up intervals. The primary outcome of interest was behavior (e.g., condom use/ safer sex). However, studies were still included if they did not measure behavior but measured one or more of the following secondary outcomes: knowledge, attitudes, normative beliefs, perceived behavioral control, or intentions. The timing of the follow-up intervals were recorded.

Search Strategy

Three independent reviewers (JC & MT/ JC & HR) identified potential studies using the search strategy shown in Figure 1. Two keyword searches of Web of Knowledge, Web of Science with Conference Proceedings and Medline, Pubmed, Embase, and CINAHL were

conducted of papers catalogued up until March 21 2013. The first keyword search

[Topic=(meta-analysis OR meta-analytic or meta analysis OR meta analytic OR systematic

review) AND Topic=(theory of planned behavior OR theory of planned behaviour OR theory

of reasoned action)] was used to identify EITHER existing reviews of the TPB or TRA

literature in contexts which might include sexual risk behaviors OR existing meta-

analyses/systematic reviews of interventions to change sexual risk behaviors. Interventions

which met the inclusion criteria were identified from the reference lists of these systematic

reviews/ meta-analyses and from a second keyword search [Topic=(planned behavior or

planned behaviour or ajzen or fishbein or reasoned action) AND Topic=(intervention or trial)

AND Topic=(condom* or sex* or contraceptive* or STD or HIV or AIDS or pregnancy or

partner*)]. A hand search was also conducted of articles published since January 2006 in key

journals (e.g., Health Psychology, Psychology and Health, Journal of Adolescent Research,

AIDS and Behavior) and key experts and authors in the field were contacted. Papers in all

languages were considered.

Data Extraction

  Retrieval of effect sizes. Lipsey and Wilson's (2001) online effect size calculator

(http://www.campbellcollaboration.org/escalc/html/EffectSizeCalculator-Home.php) was

used to compute standardized mean difference effect sizes (d) and variances ($v(d)$) from post-

test measures of reported outcomes (e.g., post-test Ms and SDs, t-tests, ANOVAs, or

frequency data). Authors were contacted if reported data was insufficient to compute effect

sizes, and studies (or elements thereof) were excluded if authors did not respond. A positive d

indicated a positive effect (e.g., post-test attitudes towards condom use were more favorable

in the TRA/TPB condition than the control). It is worth noting that the use of post-test

measures of outcomes to compute the effect sizes rests on the assumption that the pre-test

scores in the intervention and control groups were equivalent (e.g., through unbiased methods

of allocating participants to conditions), or that any pre-test differences were controlled for in the analysis (e.g., using ANCOVA). The extent to which studies could be assumed to meet these assumptions was assessed by one of the risk of bias assessment criteria (baseline imbalances in participant characteristics).

Risk of Bias Scoring

The methodological quality of each study was assessed using the Cochrane Risk of Bias Tool outlined by the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011): selection bias, performance bias, detection bias, attrition bias, reporting bias, and other sources of bias (baseline imbalances in participant characteristics). Risk of bias for each criterion was scored as low risk, high risk, or unclear risk (if insufficient detail was provided to make a judgment).

Results

Thirty three articles were identified in total, published between 1981 (McCarty, 1981) and 2012 (Jemmott, 2012; Markham et al., 2012). However two papers published findings from the same intervention (Jemmott, Jemmott, O'Leary, et al., 2010; Jemmott, 2012), resulting in 32 unique publications A number of articles also reported data from more than one TPB-based intervention (Jemmott, Jemmott, Braverman, & Fong, 2005; Jemmott, Jemmott, & Fong, 1998; Jemmott, Jemmott, & Fong, 2010; Kamb et al., 1998; Krahe, Abraham, & Scheinberger-Olwig, 2005; Markham et al., 2012; Roye, Silverman, & Krauss, 2007; Schmiege, Broaddus, Levin, & Bryan, 2009; Smith & Katner, 1995; Sterk, Theall, & Elifson, 2003), or compared the same TPB-based intervention in different population groups (Bull, Pratte, Whitesell, Rietmeijer, & McFarlane, 2009; Caron, Godin, Otis & Lambert, 2004). As a consequence, this meta-analysis therefore reports the findings from a total of 47 interventions. Characteristics of each intervention are summarized in Table 1 (available online as supplementary material).

Study Characteristics

Age range. All but one paper (Jamner, Wolitski, & Corby, 1997) provided information about the ages of the participants recruited for the study. Although the Fishbein et al. (1999) study included both the youngest (11 years) and oldest (87 years) participants, this large age range was an exception. Most studies recruited teenagers or participants in their early 20s, with a mean of 18.13 years (across the 36 studies which reported mean age).

Gender. The majority of studies recruited both male and female participants (k=35). Notably, all remaining studies (k=12) recruited females only – none recruited males only.

Study setting. Most interventions were conducted in the US (k=33) with the remainder from Canada (k=5), UK (k=4), Germany (k=2), Belize (k=1), Peru (k=1), and South Africa (k=1). This places the majority (k = 44) of studies in developed, rather than developing (k = 3) countries (World Bank, 2012). There was a range of settings including schools, universities, juvenile rehabilitation centers, clinics, and community settings.

Experimental intervention. The inclusion criteria stated that all experimental interventions were informed in their design by the TPB or the TRA. For example, Armitage and Talibudeen (2010) designed a leaflet-based intervention for carrying condoms which focused on attitudes (e.g., most effective way to stop STDs), perceived behavioral control (e.g., discrete and readily available), and normative beliefs (e.g., family and potential partners would approve). However, 40 of the 47 studies noted the input of one or more additional theories in the intervention design. Social cognitive theory was the most frequent additional theory (SCT; k=37; Bandura, 1986), followed by the transtheoretical model of behavior change (TTM; k=4; Prochaska & DiClemente, 1983), health belief model (HBM; k=4; Becker, 1974), Triandis' theory of interpersonal behavior (IB; k=3; Triandis, 1980), AIDS risk reduction model (ARR; k=1; Catania, Kegeles, & Coates, 1990), information,

motivation, behavior skills model (IMB; k=1; Fisher & Fisher, 1992), and extended parallel

process model (EPPM; k=1, Witte, 1992). For example, Jemmott et al.'s (1998) condom use

intervention enhanced positive attitudes and perceived behavioral control but also utilized

SCT by incorporating group discussion, brainstorming, games, and experiential exercises,

which created opportunity for vicarious learning.

Importantly, while studies referred to the theory underpinning the interventions, there

was generally a lack of explicit detail about how these theories were utilized in the design and

delivery of the interventions. However, studies were also coded according to the taxonomy of

26 specific behavior change techniques outlined by Abraham and Michie (2008) shown in

Table 2. Three of these techniques were identified by Abraham and Michie (2008) as

mapping onto the TRA or TPB – but they were not described as being used in all the studies.

T02 (PROVIDE INFORMATION ON CONSEQUENCES) was described as being used in

44 out of the 47 studies, T03 (PROVIDE INFORMATION ABOUT OTHERS'

APPROVAL) in 21 out of 47, and T04 (PROMPT INTENTION FORMATION) in 13 out of

47. The most frequently used techniques were: T02 (PROVIDE INFORMATION ON

CONSEQUENCES, k=44), T05 (PROMPT BARRIER IDENTIFICATION, k=31), T01

(PROVIDE INFORMATION ON BEHAVIOR-HEALTH, k=23), T03 (PROVIDE

INFORMATION ABOUT OTHERS' APPROVAL, k=21), T17 (PROMPT PRACTICE,

k=21), T08 (PROVIDE INSTRUCTION, k=20), T19 (PROVIDE OPPORTUNITIES FOR

SOCIAL COMPARISON, k=13), and T04 (PROMPT INTENTION FORMATION, k=13).

The experimental interventions consisted of a range of delivery methods including

handouts/leaflets, one-to-one counseling, and group sessions or lessons delivered over a

number of weeks or years. The majority of interventions were delivered face to face (k=38)

rather than the receipt of information using leaflets or computers (k=9). All but one

intervention focused on STD prevention (k=46) but only a minority focused on pregnancy prevention instead of or as well as STD prevention (k=17).

Control intervention. The experimental intervention was compared with no intervention (k=10), sexual risk behavior interventions (k=19; e.g., standard sex education program or leaflet on history of condom), or interventions unrelated to sexual health (k=18; e.g., general health promotion). The control conditions were also coded according to Abraham and Michie's (2008) taxonomy, however the only technique used in the control conditions was T01 (PROVIDE INFORMATION ON BEHAVIOR-HEALTH, k=10).

Outcome measures. A range of different outcomes were measured across studies (see Table 3 available as an online supplement). The primary outcome of interest was behavior and the large majority of studies measured either condom use/ protected sexual intercourse (k=40), or carrying/ purchasing condoms (k=3). The secondary outcomes were measured less frequently: knowledge (of either HIV/ AIDS/ STDS or pregnancy contraception - k=22), attitudes (towards condom use/ contraception or carrying condoms – k=29), normative beliefs (subjective norms, descriptive norms, or personal norms - k=23), perceived control (self-efficacy towards condom use or carrying/ obtaining condoms or delaying/ refusing sex – k=30), intentions (to use or carry condoms, take protective actions against HIV/AIDS/STDs and unwanted pregnancy, or refuse sex – k=27). Where more than one outcome measure for the same type of secondary outcome were reported, a single effect size and variance was obtained for the meta-analysis based on the mean of the effect sizes and variances of all the specific outcome measures.

Follow-up intervals. The majority of studies collected outcome data at more than one time point (k=33). Time intervals ranged from immediate post-intervention to 24 months with the longest follow-ups ranging from an average of 4.05 months (for knowledge) to 8.18 months (for condom use/ protected sex). In studies which reported outcome data at more than

one follow-up three different effect sizes and variances were obtained for the meta-analysis – the effect size and variance from the shortest follow-up, the effect size and variance from the longest follow-up, and the mean of the effect sizes and variances obtained across all follow-ups. Table 4 shows the effect sizes and variances obtained across all follow-ups for each study included in the meta-analysis.

Study Design and Risk of Bias Scores

For studies with randomized controlled trials (k=23), individual participants were randomly assigned to the experimental or control conditions. The remaining quasi-experimental studies (k=24) assigned participants to conditions at a group level. For example, by school class (e.g., Krahe et al., 2005) or geographic living area (e.g., Jamner et al., 1997).

For most of the risk of bias criteria (with the exception of reporting bias and baseline imbalance) a relatively large number of studies were scored as unclear risk because of insufficient detail to make an informed low or high risk judgment (see Table 5 available as an online supplement). When risk of bias ratings could be confidently made studies were more likely to be assigned high risk for selection bias, performance bias, and detection bias, and assigned low risk for attrition bias, reporting bias, and baseline imbalance. This latter finding suggests that although half of the studies were quasi-experimental, many had made efforts to control for potentially biased baseline imbalances in participant characteristics which could arise through non-randomized allocation to condition.

Intervention Efficacy

Analytical strategy. To examine the overall efficacy of the interventions the effect sizes (d) were weighted by the inverse of the variances which are a function of the sample sizes (i.e., $w = 1/v(d)$). Tests of homogeneity (i.e., Q statistics) shown in Table 6 determined whether to use fixed or random effects models to compute the pooled effect sizes. If the tests were non-significant (i.e., homogeneity assumed between effect sizes) then fixed effects

models were used; if the tests were significant (i.e., heterogeneity between effect sizes that can be explained by random variation) then random effects models were used.

Pooled effect sizes. As the majority of the studies (k=33) reported post-intervention outcome data at more than one follow-up, pooled effect sizes were based on the mean of effect sizes and variances obtained at: (1) the shortest follow-up; and (2) the longest follow-up, and (3) averaged across all follow-ups. As shown in Table 6, the pooled effect sizes for the shortest follow-up were slightly larger than those for the longest follow-up. However, as these differences were not statistically significant (ts≤1.67, ps>05) all further analyses were based on the pooled effect sizes averaged across all follow-ups.

The pooled effect sizes were highly significant for all measures ($p<.001$). The largest pooled effect (d=0.522) was found for condom carrying/ purchasing although this measure was obtained in only three studies. The other measures produced smaller effects ranging from 0.127 for condom use/ protected sex to 0.333 for knowledge.

Publication bias. As studies are often only published when their results are significant, the sample of studies retrieved for review may not be representative of all conducted studies. This publication bias could lead to overestimation of the pooled effect size either because too much weight is given to small studies, which produces inflated treatment effects as they are methodologically flawed, or because large numbers of non-significant studies remain unpublished in researchers' file drawers.

Small-study effects can be identified from funnel plot asymmetry (Sterne, Becker, & Egger, 2005) which can be tested statistically using Egger's linear regression method (Sterne & Egger, 2005). Egger's regression intercept was significantly greater than zero for intentions and attitudes (see Table 6) and the funnel plots (see Figure 2 available as an online supplement) showed that the largest effect sizes tended to be produced by the smallest studies (i.e., Kinsler, Sneed, Morisky, & Ang, 2004; Ploem & Byers, 1997; Sanderson & Jemmott,

1996; Smith & Dickson, 1993). If these small studies produced larger effects because they were methodologically flawed then the pooled effects shown in Table 6 may be overestimates. However, it is notable that the risk of bias scores for these studies did not identify any particular methodological weaknesses often associated with small studies. For example, as shown in Table 5 all four studies scored low risk for baseline imbalance in participant characteristics and only one out of the four scored high risk for attrition bias.

Although obvious methodological flaws in the small studies were not apparent, pooled effect sizes were also estimated using Hedge's g which corrects for small-samples (Hedges & Olkin, 1985). Also following recommendations by Kraemer, Gardner, Brooks, and Yesavage (1998) and Coyne, Thombs, and Hagedoorn (2010) we examined the effects of removing underpowered studies from the pooled effect size calculations for all measures. Coyne et al.'s (2010) criterion was adopted for adequate power – at least a .55 probability of detecting a moderate effect size (d=0.50) which equates to a minimum of 35 participants in each condition. As shown in Table 6 neither of these methods made much difference to the overall results. The pooled effects were still highly significant and reduced by no more than 0.002 by using Hedge's g or 0.020 by excluding underpowered studies.

Table 6 also presents estimates of the number of additional non-significant results (failsafe N) that would be needed to reduce the overall tests of the pooled effects to non-significance (Rosenthal, 1979). Failsafe N for all outcomes exceed Rosenthal's (1979) 5k + 10 rule of thumb which suggests that the results of this meta-analysis can be considered robust for publication bias. It would be very unlikely to find such a large number of additional unpublished results.

Moderator analyses (meta-regression). Significant heterogeneity (Q statistics) was found between the studies for all outcomes apart from normative beliefs indicating that random variation could not fully account for variance in the effect sizes. Random effects

meta-regression models were fitted for a range of moderator variables that were coded from study descriptions. The smallest number of studies included in the fitted models was 25 which exceeds the minimum of 10 recommended by the Cochrane Handbook (Higgins & Green, 2011).

Moderators included the power of the study to produce a moderate effect size, risk of bias scores, the age and gender of the participants, whether the study was conducted in a developed or developing country, features of the control and experimental conditions, and the follow-up interval. The unstandardized regression coefficients and significance levels for each moderator tested are shown in Table 7. It should however be noted that the coefficients shown in [brackets] were based on regressions where three or fewer studies provided effect sizes for one level of the predictor. Hence, some caution is needed when considering the significance level of these predictors.

Primary behavioral outcome – condom use/ protected sex. Six predictors were significant – selection bias, age, face to face delivery, T02, T11 and T19. Effect sizes were significantly larger in studies which scored low on selection bias, recruited younger participants, were delivered face to face, and used techniques T02 (PROVIDE INFORMATION ON CONSEQUENCES) and T19 (PROVIDE OPPORTUNITIES FOR SOCIAL COMPARISON) but did not use technique T11 (PROMPT REVIEW OF BEHAVIORAL GOALS). However, some of these coefficients were based on small numbers of studies within one level of the predictor: only two did not use technique T02 (PROVIDE INFORMATION ON CONSEQUENCES), and only three studies used technique T11 (PROMPT REVIEW OF BEHAVIORAL GOALS). Also only one predictor made a unique contribution to the effect sizes: the use of technique T19 (PROVIDE OPPORTUNITIES FOR SOCIAL COMPARISON) remained significant at $p<.01$ even when the other significant predictors were entered simultaneously into the regression model. Sub-group analyses

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showed that the pooled effect size was only significant from the nine studies that provided opportunities for social comparison (d=0.301, p<.001). The pooled effect size from the 25 studies that did not use this technique was not significant (d=0.061, p=.121).

Secondary outcomes. Although T19 was found to have a significant and robust effect on the effect size for condom use/ protected sex, there was no evidence from the regression analyses on the secondary outcomes that the effect was mediated through the effects of the interventions on intentions, attitudes, perceived control, or knowledge. As shown in Table 7, a variety of other predictors significantly affected these secondary outcomes – none of which had comparable effects on condom use/ protected sex. Moreover, unique contributions were only evident for a few predictors. There was one predictor of the intentions effect size (larger in studies with low power), one predictor of the perceived control effect size (smaller in studies which used an intervention-based control condition), and three predictors of the attitude effect size (smaller in studies that had longer follow-up intervals and larger in studies with low power or conducted in developing countries). Although the country coefficient retained its significance for attitudes when other predictors were entered in the model, it should be noted that this coefficient is based upon only two studies that were conducted in developing countries; one in Peru (Caceres, Rosasco, Mandel, & Hearst, 1994) and the other in Belize (Kinsler et al., 2004).

Discussion

This meta-analysis aimed to examine the efficacy of the TPB or TRA in the design of sexual health behavior interventions. It updates previous systematic reviews and meta-analyses of sexual health interventions - the most recently published of which searched papers published up until 2008 (Henny et al., 2012), 2009 (Shepherd et al., 2011; Tolou-Shams et al., 2010), and 2010 (Lopez et al., 2011). In addition, previous meta-analyses concerned with sexual health have tended to focus on specific issues such as contraceptive

use (Lopez et al., 2011) and HIV prevention (Albarracín et al., 2005), or on specific population groups like juvenile offenders (Tolou-Shams et al., 2010) and African American men (Henny et al., 2012). The current analysis adopted a somewhat broader perspective and included any interventions concerned with the prevention of all types of STDs and unwanted pregnancy in a heterosexual context. Because of this broader perspective and the updated literature search, over a third of the papers were not included in the previous systematic reviews (12 out of 32), and six or seven at most have been included before in any single review paper (Albarracín et al., 2005; Shepherd et al., 2011).

The 32 papers included in this meta-analysis have tested the efficacy of TPB-based interventions across a range of settings (e.g., schools, universities, juvenile rehabilitation centers, STD clinics) using a variety of delivery methods (e.g., leaflets, one-to-one counseling, multiple group sessions). The methodological quality of the studies was scored using the Cochrane Risk of Bias Tool and areas of both good and problematic methodological practice in this body of research have been identified. The papers tended to score high or unclear risk for selection bias (i.e., studies did not report adequate methods of random sequence generation or prevent foreknowledge of condition allocation), performance bias (i.e., inadequate blinding of participants and personnel to condition allocation), and detection bias (i.e., inadequate blinding of outcome assessment to condition allocation). Papers were generally rated low risk for attrition bias (i.e., incomplete outcome data across conditions was generally balanced), reporting bias (i.e., most studies did not appear to be selective when reporting outcomes), and baseline imbalance (i.e., although half of the studies were quasi-experimental, many had made efforts to control for potentially biased baseline imbalances in participant characteristics which could arise through non-randomized allocation to condition). However, a lack of detail provided in many studies made the scoring difficult, resulting in many studies rated as 'unclear risk' in some areas. This highlights the importance of

researchers in providing sufficient detail for other researchers to accurately evaluate the rigor of their research.

In terms of the efficacy of the TPB-based interventions, the pooled effect size from the 34 interventions that measured condom use/ protected sex was highly significant and not unduly affected by publication bias Although the effect size was quite small (d=0.127), the TPB-based interventions performed equally well when tested against control conditions that included some sexual health content as they did against no information control conditions. The finding of no difference depending on the nature of the control group is an important one. It clearly demonstrates that TPB-based interventions can even outperform the more methodologically rigorous control conditions that have controlled for sexual health content. Although this result increases our confidence in attributing the efficacy of the TPB-based interventions to their theoretical content rather than just their more general focus on sexual health issues, it is worth noting that the coding of the interventions using Abraham and Michie's (2008) taxonomy showed that the three techniques which are supposed to map onto the TPB were not described as being used in all the TPB-based interventions (i.e., T02 - PROVIDE INFORMATION ON CONSEQUENCES; T03 - PROVIDE INFORMATION ABOUT OTHERS' APPROVAL, and T04 - PROMPT INTENTION FORMATION). Also, although the meta-regressions showed that the studies which described using T02 produced significantly larger effect sizes for condom use/ protected sex, there was no increase in the effect sizes in studies which described using either T03 or T04.

Also a more compelling argument for basing interventions specifically on the TPB might be provided by comparing the efficacy of interventions designed using different theoretical models – i.e., TPB or TRA vs. SCT, HBM or TTM. That being said the TPB was rarely used in isolation as the only theoretical framework underpinning intervention design. In most studies included in this meta-analysis, the intervention design was also informed by

other theories like SCT, HBM and TTM. Separating out the specific influence of any one theory is therefore an almost impossible endeavor. The alternative approach used in this paper was to code interventions according to Abraham and Michie's (2008) taxonomy of 26 specific behavior change techniques. This approach has already been used successfully by Michie, Abraham, Whittington, McAteer, and Gupta (2009) to evaluate effective techniques for encouraging healthy eating.

In addition to the behavior change techniques and other features of the control and experimental conditions, a range of moderators were tested in the meta-regressions, including the risk of bias criteria and participant characteristics. Both simple meta-regressions (in which single predictors were entered) and multiple meta-regressions (in which two or more predictors were entered) were conducted – the latter of which controlled for the effects of other predictors and identified the strongest independent predictors of intervention efficacy.

Although the simple meta-regressions identified a number of significant predictors of intervention efficacy, caution needs to be taken in reading too much into their influence. Some significant predictors were found to be non-significant when other predictors were included in the model (e.g., age, selection bias). A little less caution is arguably needed regarding the influence of one specific behavior change technique not mapped by Abraham and Michie (2008) onto the TPB – T19 (PROVIDE OPPORTUNITIES FOR SOCIAL COMPARISON). The effect sizes on behavioral outcomes were significantly larger in studies which facilitated observation of nonexpert others' performance – for example, in a group class or using video or case study.

The effects of this specific technique need further testing and exploration using experimental techniques that control for the influence of other potential sources of variance in effect sizes. Although the multiple meta-regressions demonstrated that the predictive ability of this technique was largely unaffected by the inclusion of other moderators in the model,

we cannot rule out the possibility that the effect is attributable to another unmeasured source of variance. A randomized controlled study is therefore needed to provide a more robust and direct test of its potential influence and mediators.

In conclusion, this meta-analysis has established that the TPB provides a valuable framework for designing interventions to change sexual risk behaviors. It provides a number of significant advances over previous systematic reviews and meta-analyses of sexual health interventions. Its reach has been somewhat broader, encompassing interventions that are concerned with both STD prevention and pregnancy prevention in heterosexual contexts. It has also provided a focused analysis of interventions that have been informed specifically by the TPB or TRA and, although we cannot guarantee that every relevant study has been included in this review, it provides an up-to-date, comprehensive, and in-depth analysis of the existing literature.

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Table 1
Study characteristics

[ID] Study	Age[a] (gender)	Setting	Control Condition		Experimental Condition				Follow ups
			Description	Sexual health content	Description[b]	Focus of intervention	Face to face	Behavior change techniques[c]	
[1] Abraham 2004	14.17 (mixed)	School (UK)	Standard sex education program	Yes	20 x sex education lessons informed by TPB and SCT	STDs + pregnancy	Yes	01[d], 02, 03, 04, 05, 19	6mths
[2] Armitage 2010	16.79 (mixed)	College (UK)	Handout on history of condom	Yes	Handout with messages targeting TPB components	STDs only	No	01, 02, 05	Immediate
[3] Bellingham 1993	17.50[a] (mixed)	Youth training centre (UK)	No intervention	No	Streetwise UK comic with discussion/ role play based on TPB and SCT	STDs only	Yes	01, 02, 08	2wks
[4] Bull 2009 (internet)	21.75 (mixed)	Internet (US)	Internet-based interactive risk assessment and generic HIV prevention information	Yes	Internet-based interactive risk assessment with role model stories addressing constructs from TPB and SCT	STDs only	No	02, 03, 05	2mths
[5] Bull 2009 (clinic)	21.35 (mixed)	STD clinic (US)	Clinic-based computerized risk assessment and generic HIV prevention information	Yes	Clinic-based computerized risk assessment with role model stories addressing constructs from TPB and SCT	STDs only	No	02, 03, 05	3mths
[6] Caceres 1994	15.50 (mixed)	School (Peru)	No intervention	No	7 x 2hr weekly sessions informed by TRA and SLT	STDs + pregnancy	Yes	01, 02, 08, 09, 17	1-3mths
[7] Caron 2004 (senior high)	16.00 (mixed)	Senior high school (Canada)	Standard sex education program	Yes	One 2-3 hour group presentation informed by TPB, SCT and IB	STDs + pregnancy	Yes	02, 05	9mths
[8] Caron 2004 (junior high)	14.20 (mixed)	Junior high school (Canada)	Standard sex education program	Yes	One 2-3 hour group presentation informed by TPB, SCT and IB	STDs + pregnancy	Yes	02, 05	9mths
[9] Coyle 2006	16.00 (mixed)	Community school (US)	Standard sex education program	Yes	14 sessions (total 26hrs) of classroom activities and visits to volunteer sites – informed by TRA/TPB and SCT	STDs + pregnancy	Yes	01, 02, 03, 08, 09, 12, 17	6-18mths

[10] Dancy 2009	12.50 (mixed)	Community school (US)	Nutrition and exercise program	No	HIV risk reduction interventions delivered by mothers or health experts informed by TRA/TPB and SCT	STDs only	Yes	01, 02, 03, 04, 05, 09, 13, 16, 17	0-6mths
[11] Fishbein 1999	34.50[a] (mixed)	Community (US)	No intervention	No	Community members mobilized to distribute leaflets/ reinforce prevention messages – informed by TPB and TTM	STDs only	Yes	01, 02, 03, 05, 08, 19	3mths
[12] Godin 2003	15.10 (mixed)	Juvenile rehab (Canada)	No intervention	No	10 x 75-90min weekly sessions informed by TPB, SCT and IB	STDs only	Yes	01, 02, 05, 08, 09	10 days
[13] Hill 2008	17.00 (mixed)	School (UK)	No intervention	No	Leaflet promoting condom use targeting TPB components	STDs + pregnancy	No	02, 03, 04, 05, 08, 14,	4wks
[14] Jamner 1997	n/a (mixed)	Community (US)	No intervention	No	Community members mobilized to distribute leaflets/ reinforce prevention messages – informed by TPB and TTM	STDs + pregnancy	Yes	01, 02, 03, 05, 19	3mths
[15] Jemmott 2005 (information)	15.50 (mixed)	Adolescent medical clinic (US)	General health promotion intervention	No	Information-based group sessions (250 mins) informed by TRA/TPB and SCT	STDs only	Yes	01, 02, 08, 09	Immediate-12mths
[16] Jemmott 2005 (skills)	15.50 (mixed)	Adolescent medical clinic (US)	General health promotion intervention	No	Skills-based group sessions (250 mins) informed by TRA/TPB and SCT	STDs only	Yes	01, 02, 05, 08, 09, 17	Immediate-12mths
[17] Jemmott 1998 (abstinence)	11.80 (mixed)	School (US)	General health promotion intervention	No	8 x 1-hour sessions over two weeks promoting sexual abstinence - informed by TRA/TPB and SCT	STDs + pregnancy	Yes	01, 02, 05, 08	Immediate-3mths
[18] Jemmott 1998 (safer sex)	11.80 (mixed)	School (US)	General health promotion intervention	No	8 x 1-hour sessions over two weeks focused on HIV prevention/ safe sex- informed by TRA/TPB and SCT	STDs + pregnancy	Yes	01, 02, 05, 08	Immediate-12mths
[19] Jemmott 2010 (abstinence)	12.20 (mixed)	Middle school (US)	General health promotion intervention	No	5hr abstinence intervention informed by TRA/TPB and SCT	STDs + pregnancy	Yes	01, 02, 05, 17, 18	3-24mths
[20] Jemmott	12.20	Middle school	General health	No	5hr safer sex intervention	STDs +	Yes	01, 02, 05, 17,	3-24mths

2010 (safer sex)	(mixed)	(US)	promotion intervention		informed by TRA/TPB and SCT	pregnancy		18	
[21] Jemmott 2010 (both 8hr)	12.20 (mixed)	Middle school (US)	General health promotion intervention	No	8hr safer sex + abstinence intervention informed by TRA/TPB and SCT	STDs + pregnancy	Yes	01, 02. 05, 17, 18	3-24mths
[22] Jemmott 2010 (both 12hr)	12.20 (mixed)	Middle school (US)	General health promotion intervention	No	12hr safer sex + abstinence intervention informed by TRA/TPB and SCT	STDs + pregnancy	Yes	01, 02, 05, 17, 18	3-24mths
[23] Jemmott 1999	13.20 (mixed)	School (US)	General health promotion intervention	No	5-hour session on HIV prevention – informed by TRA/TPB and SCT	STDs only	Yes	01, 02, 05, 08, 14, 17, 19	Immediate-6mths
[24] Jemmott 2010/12	12.40 (mixed)	School (South Africa)	General health promotion intervention	No	6 x 2hr sessions on sexual risk behaviors based on TPB and SCT	STDs + pregnancy	Yes	01, 02, 03, 05, 17	3-12mths
[25] Kamb 1998 (enhanced)	25.00 (mixed)	STD clinic (US)	2 x 5min didactic sessions on HIV/STD prevention	Yes	1x 20min and 3 x 60min enhanced counseling sessions informed by TRA and SCT	STDs only	Yes	02, 03, 04, 05	3-6mths
[26] Kamb 1998 (brief)	25.00 (mixed)	STD clinic (US)	2 x 5min didactic sessions on HIV/STD prevention	Yes	2 x 20min brief counseling sessions informed by TRA and SCT	STDs only	Yes	02, 03, 04, 05	3-6mths
[27] Kelly 1994	29.00 (female only)	Adult education (US)	3 x 90min general health promotion sessions	No	4 x 90min weekly sessions informed by TRA/TPB and SCT	STDs only	Yes	01, 02, 03, 05	3mths
[28] Kinsler 2004	15.30 (mixed)	School (Belize)	HIV/AIDS educational handbook	Yes	7 x 2hr weekly sessions informed by TRA and SCT	STDs only	Yes	01[d], 02, 03, 04, 17, 19	1mth
[29] Koniak-Griffin 2003	16.67 (female only)	School (US)	General health promotion/ parenting sessions	No	4 x 2hr sessions informed by TRA and SCT	STDs only	Yes	01, 02, 08, 17	Immediate-12mths
[30] Krahe 2005 (L)	15.80 (mixed)	School (Germ-any)	No intervention	No	Publicly available safe sex promotion leaflet (scored highly on TRA/TPB elements)	STDs + pregnancy	No	02, 03, 08	Immediate-4wks
[31] Krahe 2005 (L+M)	15.80 (mixed)	School (Germ-any)	No intervention	No	Publicly available safe sex promotion leaflet (scored highly on TRA/TPB elements) + motivational incentive to answers questions correctly	STDs + pregnancy	No	02, 03, 08, 14	Immediate-4wks

[32] Markham 2012 (RR)	12.60 (mixed)	School (US)	Regular health education classes	No	24 x 50min sessions on benefits of abstinence until older informed by TPB and SCT	STDs only	Yes	01, 02, 03, 05, 17, 19	Immediate-10mths
[33] Markham 2012 (RA)	12.60 (mixed)	School (US)	Regular health education classes	No	24 x 50min sessions on benefits of abstinence until married informed by TPB and SCT	STDs only	Yes	01, 02, 03, 05, 17, 19	Immediate-10mths
[34] McCarty 1981	22.50[a] (mixed)	Further education (US)	Educational handout about STIs/HIV	Yes	As control plus messages informed by TRA/TPB	Pregnancy only	No	02, 03	Immediate
[35] Otto-Salaj 2001	38.40 (mixed)	Mental health clinic (US)	General health promotion sessions	Yes	7 x twice-weekly sessions with follow-up booster sessions one and two months later – informed by TRA, SCT, IMB and ARR	STDs only	Yes	01[d], 02, 04, 05, 08, 09, 11, 14, 17, 23	3-12mths
[36] Ploem 1997	18.00 (female only)	University (Canada)	Information about AIDS in pamphlet or video form	Yes	As control plus audiotaped materials/ communication skills training informed by TRA and SCT	STDs only	No	01[d], 02, 03, 05, 19	4wks
[37] Roye 2007 (counseling)	18.00 (female only)	Planned parent-hood sites (US)	Usual advice about contraception/ sexual health	No	Single counseling session informed by TRA, HBM and SCT	STDs only	Yes	04, 05, 07, 17, 19, 20	3-12mths
[38] Roye 2007 (video)	18.00 (female only)	Planned parent-hood sites (US)	Usual advice about contraception/ sexual health	No	21min video informed by TRA, HBM and SCT	STDs only	No	02, 05, 07, 17, 19, 21	3-12mths
[39] Roye 2007 (counseling + video)	18.00 (female only)	Planned parent-hood sites (US)	Usual advice about contraception/ sexual health	No	21min video followed by single counseling session - informed by SCT, HBM and EPPM	STDs only	Yes	02, 04, 05, 07, 17, 19, 20	3-12mths
[40] Sanderson 1996	19.80 (mixed)	Further education (US)	No intervention	No	2 x weekly 90min sessions – informed by TPB and SCT	STDs only	Yes	02, 08, 14, 17,	Immediate-3mths
[41] Schmeige 2009 (GPI)	15.80 (mixed)	Juvenile rehab (US)	One 2-hour session providing information about STIs/ HIV	Yes	3-hour session – informed by TPB and SCT	STDs only	Yes	01[d], 02, 03, 04, 08, 09, 19	Immediate-3mths
[42] Schmeige 2009 (GPI + MET)	15.50 (mixed)	Juvenile rehab (US)	One 2-hour session providing information about STIs/ HIV	Yes	3-4 hour session informed by TPB and SCT with personal feedback on alcohol intake as part of motivational	STDs only	Yes	01[d], 02, 03, 04, 08, 09, 19	Immediate-3mths

					enhancement therapy				
[43] Smith 1993	18.80 (female only)	University (Canada)	No intervention	No	30min condom desensitization session informed by TRA/TPB	STDs only	Yes	01, 02, 05, 08, 09, 17	Immediate-2mths
[44] Smith 1995 (Q&A)	18.50[a] (mixed)	High school (US)	50-min educational slide show followed by presentation from person with AIDS	Yes	50-min educational slide show followed by Q&A informed by TRA	STDs only	Yes	01[d], 02	Immediate-1mth
[45] Smith 1995 (role play)	18.50[a] (mixed)	High school (US)	50-min educational slide show followed by presentation from person with AIDS	Yes	50-min educational slide show followed by role playing informed by TRA and SCT	STDs only	Yes	01[d], 02, 17	Immediate-1mth
[46] Sterk 2003 (motivation)	37.20 (mixed)	Community (US)	2 x weekly sessions focusing on knowledge of HIV	Yes	4 x weekly sessions aimed at enhancing motivation informed by TRA/TPB, SCT and TTM	STDs only	Yes	01[d], 04, 11	6mths
[47] Sterk 2003 (negotiation)	37.20 (mixed)	Community (US)	2 x weekly sessions focusing on knowledge of HIV	Yes	4 x weekly sessions aimed at enhancing negotiation skills informed by TRA/TPB, SCT and TTM	STDs only	Yes	01[d], 04, 08, 11	6mths

Notes:

[a]The mean age of the participants in the study is provided where possible. In studies which not report the mean the mid-point of the age-range is provided.

[b]ARR – AIDS risk reduction model (Catania, Kegeles, & Coates, 1990); EPPM – Extended Parallel Process Model (Witte, 1992); HBM – Health Belief Model (Becker, 1974); IB – Triandis' Theory of Interpersonal Behavior (Triandis, 1980); IMB - Information, Motivation, Behavior Skills Model (Fisher & Fisher, 1992); SLT – Social Learning Theory (Bandura, 1977); SCT – Social Cognitive Theory (Bandura, 1986); TTM – Transtheoretical Model (Prochaska & DiClemente, 1983)

[c]The techniques used in the control and experimental interventions were coded by HR (checked by JC) according to the 26 techniques outlined by Abraham and Michie (2008) – see Table 2

[d]This technique was also used in the control condition

Table 2

Taxonomy of behavior change techniques (source: Abraham & Michie, 2008)

Behavior Change Technique (theoretical framework[a])	k
T1 PROVIDE INFORMATION ON BEHAVIOR-HEALTH LINK–general information about behavioral risk-e.g., susceptibility to poor health outcomes or mortality risk in relation to the behavior (IMB)	23
T2 PROVIDE INFORMATION ON CONSEQUENCES – information about the benefits and costs of inaction or action, focusing on what will happen if the person does or does not perform the behavior (TRA, TPB, SCT, IMB)	44
T3 PROVIDE INFORMATION ABOUT OTHERS' APPROVAL – information about what others think about the person's behavior and whether others will approve or disapprove of any proposed behavior change (TRA, TPB, IMB)	21
T4 PROMPT INTENTION FORMATION – encouraging the person to decide to act or set a general goal – e.g., to make a behavioral resolution such as "I will take more exercise next week" (TRA, TPB, SCT, IMB)	13
T5 PROMPT BARRIER IDENTIFICATION – identify barriers to performing the behavior and plan ways of overcoming them (SCT)	31
T6 PROVIDE GENERAL ENCOURAGEMENT – praising or rewarding the person for effort or performance without this being contingent on specific behaviors or standards of performance (SCT)	0
T7 SET GRADED TASKS – set easy tasks, and increase difficulty until target behavior is performed (SCT)	3
T8 PROVIDE INSTRUCTION – telling the person how to perform a behavior and/or preparatory behaviors (SCT)	20
T9 MODEL/ DEMONSTRATE THE BEHAVIOR– an expert shows the person how to correctly perform a behavior, e.g., in class or on video (SCT)	10
T10 PROMPT SPECIFIC GOAL SETTING – detailed planning of what the person will do, specifying frequency, intensity, or duration and specification of at least one context – that is where when how or with whom	0
T11 PROMPT REVIEW OF BEHAVIORAL GOALS – review and/ or reconsideration of previously set goals or intentions	3
T12 PROMPT SELF-MONITORING OF BEHAVIOR – the person is asked to keep a record of specified behaviors (e.g, in a diary)	1
T13 PROVIDE FEEDBACK ON PERFORMANCE – providing data about recorded behavior or evaluating performance in relation to a set standard or others' performance – i.e., the person received feedback on their behavior	1
T14 PROVIDE CONTINGENT REWARDS– praise, encouragement or material rewards that are explicitly linked to the achievement of specified behaviors	5
T15 TEACH TO USE PROMPTS/ CUES – teach the person to identify environmental cues that can be used to remind them to perform a behavior, including times of day or elements of contexts	0
T16 AGREE A BEHAVIORAL CONTRACT – agreement or signing of a contract specifying behavior to be performed so that there is a written record of the person's resolution witnessed by another	1
T17 PROMPT PRACTICE – prompt the person to rehearse and repeat the behavior or preparatory behaviors	21
T18 USE OF FOLLOW-UP PROMPTS – contacting the person again after the main part of the intervention is complete	4
T19 PROVIDE OPPORTUNITIES FOR SOCIAL COMPARISON – facilitate observation of nonexpert others' performance, e.g. in a group class or using video or case study	13
T20 PLAN SOCIAL SUPPORT/ SOCIAL CHANGE – prompting consideration of how others could change their behavior to offer the person help or instrumental social support, including buddy systems and/or providing social support	3
T21 PROMPT IDENTIFICATION AS ROLE MODEL/ POSITIVE ADVOCATE – indicating how the person may be an example to others and influence their behavior or provide an opportunity for the person to set a good example	0
T22 PROMPT SELF TALK – encourage use of self-instruction and self-encouragement (aloud or silently) to support action	0

T23 RELAPSE PREVENTION – following initial change, help identify situations likely to result in readopting risk behaviors or failure to maintain new behaviors and help the person plan to avoid or manage these situations	1
T24 STRESS MANAGEMENT – may involve a variety of specific techniques (e.g., progressive relaxation) that do not target the behavior but seek to reduce anxiety and stress	0
T25 MOTIVATIONAL INTERVIEWING – prompting the person to provide self-motivating statements and evaluations of their own behavior to minimize resistance to change	0
T26 TIME MANAGEMENT – helping the person make time for the behavior (e.g., to fit into a daily schedule)	0

[a] The theoretical frameworks that Abraham and Michie (2008) mapped onto each technique are shown in brackets: IMB - Information, Motivation, Behavior Skills Model (Fisher & Fisher, 1992); SCT – Social Cognitive Theory (Bandura, 1986); TRA – Theory of Reasoned Action (Ajzen, 1985; Ajzen & Fishbein); TPB – Theory of Planned Behavior (Ajzen, 1991)

Table 3

Specific outcome measures reported in the studies included in the meta-analysis

Outcome measure	Outcome measures reported (Study ID)[a]	Example item(s)
Knowledge	Knowledge about transmission or consequences of HIV/AIDS/STDs (1, 3, 6, 9, 10, 12, 15-18, 23, 27-33, 35, 36, 44, 45	"You can get HIV from anal sex" (3)
	Knowledge about pregnancy/ contraception (1, 6, 9)	"A girl can get pregnant the first time she has sex" (1)
Attitudes	Positive or negative attitudes to condom use/ contraception (1, 4-10, 12, 13, 15-18, 23, 29-36, 40-43)	"Condoms make sex less intimate and romantic" (30, 31)
	Attitude to carrying condoms (2)	Overall my attitude towards carrying a condom with me every time I go out for the evening in the next 2 months is (good-bad; anti-pro)" (2)
Normative beliefs	Subjective norms (1, 2, 4, 5, 7-9, 13, 15, 16, 23, 28-33, 36, 41-43)	"Most of my friends think people should always use a condom when having sex" (41, 42)
		"Generally speaking I want to do what my parents [other family members, close friends, sexual partner] think I should do" (43)
	Descriptive norms (1, 4, 5, 7-9, 13, 28, 32-34, 36, 41, 42)	Friend's perceived sexual behaviour (32, 33)
	Personal norms (12)	"It is within my principles to use a condom each time" (12)
Perceived Control	Self-efficacy towards condom use (1, 4-8, 10, 12, 13, 15-18, 23, 28, 30-33, 40-43)	"How easy or difficult would it be for you to use a condom properly?" (1)
	Self-efficacy in negotiating condom use/ refuse sex without a condom (4, 5, 7-9, 15-18, 27, 28, 32, 33, 37-39, 41-43)	"I can get my partner(s) to agree for us to use a condom without any trouble" (37-39)
	Self-efficacy in carrying/ obtaining condoms (2, 9, 32, 33)	"How confident are you that you will be able to carry a condom with you every time you go out for the evening in the next 2 months" (2)
	Self-efficacy in delaying/ refusing sex (7, 8, 10)	"If a boy insists I have sex and I have already decided to postpone intercourse I would be able to say no" (7, 8)
Intentions	Intention to use condoms (1, 3, 7-10, 12, 13, 15-18, 23, 28-35, 40, 43)	"I intend to always use a condom when I have sexual intercourse" (13)
	Intention to carry condoms (2, 13)	"How likely is it that you will carry a condom with you every time you go out for the evening in the next 2 months" (2)
	Intention to take preventive actions against HIV/AIDS, STDs and unwanted pregnancy (6)	Unspecified (6)
	Intention to refuse sex (10)	Plan to say no to sex (10)

Behavior	Condom use/ unprotected sexual intercourse (1, 3-5, 7-9, 11-13, 15-29, 32, 33, 35-47)	"In the last 4 weeks how often did you use a condom during sexual intercourse with a new [steady] partner? (13)
		"Had unprotected sexual intercourse in the past 3 mo" (19-22)
	Carry/ purchase condoms (11, 13, 14)	Participants asked whether they were carrying a condom (and show to researcher) (14)

[a]See Table 1 (available as an online supplement) or Table 4 for the ID numbers assigned to each study

Table 4
Study outcomes (all follow-ups[a])

[ID] Study	Behavioral Outcomes		Secondary Outcomes				
	Condom use/ protected sex	Condom carrying/ purchasing	Knowledge	Attitudes	Normative beliefs	Perc'd Control	Intentions
[1] Abraham 2004	nr[b]	-	ns[c]	0.046 (.001)	ns[c]	ns[c]	0.019 (.001)
[2] Armitage 2010	-	-	-	0.274* (.014)	0.285*(.014)	0.091 (.014)	0.074 (.014)
[3] Bellingham 1993	-0.289 (.033)	-	0.385**(.017)	-	-	-	-0.487* (.045)
[4] Bull 2009 (internet)	-0.083 (.004)	-	-	ns[c]	0.120† (.004)	ns[c]	-
[5] Bull 2009 (clinic)	-0.144† (.007)	-	-	ns[c]	ns[c]	-0.201* (.007)	-
[6] Caceres 1994	-	-	0.748***(.005)	0.303***(.005)	-	0.608***(.005)	0.236** (.005)
[7] Caron 2004 (senior high)	sig[d]	-	-	-0.225*(.013)	0.261* (.013)	0.352** (.013)	0.268* (.013)
[8] Caron 2004 (junior high)	ns[c]	-	-	-0.186*(.006)	0.037 (.006)	-0.183* (.006)	0.251** (.006)
[9] Coyle 2006	0.080 (0.010)	-	0.168† (.009)	0.006 (.009)	-0.017 (.009)	0.033 (.009)	-0.070 (.011)
[10] Dancy 2009	-	-	0.381***(.011)	0.317** (.011)	-	0.155 (.011)	0.298** (.011)
[11] Fishbein 1999	0.147* (.008)	0.341***(.005)	-	-	-	-	-
[12] Godin 2003	nr[b]	-	0.176*(.008)	0.325***(.008)	0.325***(.008)	0.300** (.008)	0.287** (.008)
[13] Hill 2008	-0.055 (.010)	0.543***(.010)	-	0.380***(.010)	0.190† (.010)	0.495***(.010)	0.470***(.010)
[14] Jamner 1997	-	0.798***(.029)	-	-	-	-	-
[15] Jemmott 2005 (information)	0.049 (.010)	-	0.554***(.009)	0.352***(.009)	0.161† (.009)	0.162† (.009)	0.319** (.009)

[16] Jemmott 2005 (skills)	0.082 (.010)	-	0.637***(.009)	0.305** (.008)	0.226** (.009)	0.140 (.009)	0.216* (.009)
[17] Jemmott 1998 (abstinence)	0.253* (.010)	-	-0.039 (.009)	-0.054 (.009)	-	0.046 (.009)	-0.012 (.009)
[18] Jemmott 1998 (safer sex)	0.360***(.010)	-	0.962***(.010)	0.393 (.010)	-	0.126 (.009)	0.062 (.009)
[19] Jemmott 2010 (abstinence)	0.030 (.092)	-	-	-	-	-	-
[20] Jemmott 2010 (safer sex)	-0.026 (.093)	-	-	-	-	-	-
[21] Jemmott 2010 (both 8hr)	0.030 (.092)	-	-	-	-	-	-
[22] Jemmott 2010 (both 12hr)	0.039 (.092)	-	-	-	-	-	-
[23] Jemmott 1999	0.492***(.008)	-	0.363***(.008)	0.218* (.008)	0.097 (.008)	0.191* (.008)	0.206* (.008)
[24] Jemmott 2010/12	0.410* (0.042)	-	-	-	-	-	-
[25] Kamb 1998 (enhanced)	0.172** (.003)	-	-	-	-	-	-
[26] Kamb 1998 (brief)	0.088 (.003)	-	-	-	-	-	-
[27] Kelly 1994	0.267 (.044)	-	0.282 (.044)	-	-	0.589** (.046)	-
[28] Kinsler 2004	0.563* (.080)	-	0.400* (.029)	1.38***(.033)	0.413* (.029)	0.168 (.028)	1.48***(.099)
[29] Koniak-Griffin 2003	0.021 (.009)	-	0.109 (.009)	0.229*(.009)	0.034 (.009)	0.055 (.009)	0.049 (.009)
[30] Krahe 2005 (L)	-	-	0.354*(.027)	-0.066 (.027)	-0.052 (.027)	-0.010 (.027)	0.161 (.027)
[31] Krahe 2005 (L+M)	-	-	0.435**(.028)	0.438**(.028)	0.228 (.027)	0.250 (.028)	0.379* (.028)

Study							
[32] Markham 2012 (RR)	0.255** (.006)	-	0.114 (.005)	0.080 (.005)	0.063 (.005)	0.106 (.005)	0.040 (.005)
[33] Markham 2012 (RA)	0.110 (.005)	-	0.153* (.005)	0.070 (.004)	0.147* (.004)	0.040 (.005)	0.041 (.004)
[34] McCarty 1981	-	-	-	0.842*** (.016)	0.274* (.015)	-	0.350** (.015)
[35] Otto-Salaj 2001	0.103 (.026)	-	0.186 (.026)	0.167 (.026)	-	-	0.050 (.026)
[36] Ploem 1997	1.07** (.195)	-	0.388† (.043)	0.523* (.044)	-.257 (.042)	-	-
[37] Roye 2007 (counseling)	ns	-	-	-	-	ns	-
[38] Roye 2007 (video)	ns	-	-	-	-	ns	-
[39] Roye 2007 (counseling + video)	0.333† (.041)	-	-	-	-	0.413† (.046)	-
[40] Sanderson 1996	-0.305 (.062)	-	-	0.711*** (.035)	-	0.653*** (.034)	0.406* (.033)
[41] Schmeige 2009 (GPI)	0.425*** (.019)	-	-	0.024 (.013)	0.084 (.013)	0.280* (.013)	0.120 (.013)
[42] Schmeige 2009 (GPI + MET)	0.202 (.020)	-	-	0.381** (.013)	0.168 (.013)	0.535*** (.013)	0.326** (.013)
[43] Smith 1993	0.053 (.076)	-	-	0.568* (.080)	0.144 (.077)	0.240 (.077)	0.614* (.081)
[44] Smith 1995 (Q&A)	0.000 (.012)	-	0.203* (.010)	-	-	-	-
[45] Smith 1995 (role play)	0.634*** (.019)	-	0.055 (.012)	-	-	-	-
[46] Sterk 2003 (motivation)	-0.272† (.023)	-	-	-	-	-	-
[47] Sterk 2003 (negotiation)	-0.222 (.023)	-	-	-	-	-	-

†p≤.10, *p<.05, **p<.01, ***p<.001

Notes:

[a] In studies which reported outcome data at more than one follow-up three different effect sizes and variances were obtained for the meta-analysis – the effect size and variance from the shortest follow-up, the effect size and variance from the longest follow-up, and the mean of the effect sizes and variances obtained across all follow-ups. Although the pooled effect sizes for the shortest follow-up were slightly larger than those for the longest follow-up (see Table 6), the differences were not statistically significant (ts ≤ 1.66, ps $\geq .113$). The data shown in this table are therefore based on the pooled effect sizes averaged across all follow-ups.

[b] nr - Outcome measured in the study but no data on differences between conditions reported or made available by the author to compute an effect size

[c] ns - Difference between conditions reported as not significant in the paper but no data reported or made available by the author to compute an effect size

[d] sig – Difference between conditions reported as significant in the paper (p<.01) but no data reported or made available by the author to compute an effect size

Table 5
Risk of bias scores

ID	Study	Risk of bias criteria[a]							
		1a	1b	2a	2b	3	4	5	6
1	Abraham 2004	high risk	unclear	high risk	high risk	high risk	unclear	low risk	high risk
2	Armitage 2010	low risk	low risk	unclear	low risk	unclear	unclear	low risk	low risk
3	Bellingham 1993	unclear	unclear	high risk	high risk	high risk	unclear	low risk	high risk
4	Bull 2009 (internet study)	unclear	unclear	unclear	low risk	unclear	unclear	low risk	low risk
5	Bull 2009 (clinic study)	unclear	unclear	unclear	low risk	unclear	unclear	low risk	low risk
6	Caceres 2006	unclear	low risk	unclear	unclear	unclear	low risk	low risk	low risk
7	Caron 2004 (senior high)	high risk	unclear	high risk	high risk	high risk	high risk	low risk	high risk
8	Caron 2004 (junior high)	high risk	unclear	high risk	high risk	high risk	high risk	low risk	high risk
9	Coyle 2006	unclear	low risk	unclear	unclear	unclear	low risk	low risk	low risk
10	Dancy 2009	unclear	unclear	unclear	unclear	unclear	low risk	unclear	unclear
11	Fishbein 1999	high risk	unclear	unclear	high risk	unclear	low risk	low risk	high risk
12	Godin 2003	high risk	high risk	unclear	high risk	unclear	high risk	low risk	low risk
13	Hill 2008	low risk	low risk	low risk	high risk	low risk	high risk	low risk	low risk
14	Jamner 1997	high risk	unclear	unclear	high risk	unclear	low risk	low risk	high risk

ID	Study	1a	1b	2a	2b	3	4	5	6
15	Jemmott 2005 (information)	low risk	unclear	unclear	unclear	unclear	low risk	unclear	low risk
16	Jemmott 2005 (skills)	low risk	unclear	unclear	unclear	unclear	low risk	unclear	low risk
17	Jemmott 1998 (abstinence)	low risk	low risk	unclear	unclear	unclear	low risk	low risk	low risk
18	Jemmott 1998 (safer sex)	low risk	low risk	unclear	unclear	unclear	low risk	low risk	low risk
19	Jemmott 2010 (abstinence)	low risk	unclear	unclear	low risk	unclear	low risk	unclear	unclear
20	Jemmott 2010 (safer sex)	low risk	unclear	unclear	low risk	unclear	low risk	unclear	unclear
21	Jemmott 2010 (combined-8hr)	low risk	unclear	unclear	low risk	unclear	low risk	unclear	unclear
22	Jemmott 2010 (combined-12hr)	low risk	unclear	unclear	low risk	unclear	low risk	unclear	unclear
23	Jemmott 1999	low risk	low risk	unclear	unclear	unclear	low risk	low risk	low risk
24	Jemmott 2010/12	low risk	low risk	unclear	unclear	low risk	low risk	unclear	low risk
25	Kamb 1998 (enhanced)	low risk	low risk	unclear	unclear	unclear	low risk	high risk	low risk
26	Kamb 1998 (brief)	low risk	low risk	unclear	unclear	unclear	low risk	high risk	low risk
27	Kelly 1994	unclear	low risk	unclear	unclear	unclear	low risk	low risk	low risk
28	Kinsler 2004	unclear	unclear	high risk	high risk	unclear	unclear	low risk	low risk
29	Koniak-Griffin 2003	unclear	unclear	unclear	unclear	unclear	low risk	low risk	low risk
30	Krahe 2005 (L)	unclear	low risk	low risk	low risk	unclear	high risk	low risk	low risk

ID	Study	1a	1b	2a	2b	3	4	5	6
31	Krahe 2005 (L+M)	unclear	low risk	low risk	low risk	unclear	high risk	low risk	low risk
32	Markham 2012 (RR)	unclear	unclear	unclear	high risk	unclear	low risk	low risk	low risk
33	Markham 2012 (RA)	unclear	unclear	unclear	high risk	unclear	low risk	low risk	low risk
34	McCarty 1981	unclear	low risk	low risk	low risk	low risk	low risk	low risk	unclear
35	Otto-Salaj 2001	unclear	low risk	high risk	unclear	high risk	low risk	low risk	low risk
36	Ploem 1997	unclear	low risk	low risk	low risk	unclear	low risk	unclear	low risk
37	Roye 2007 (counseling)	unclear	unclear	low risk	unclear	unclear	high risk	high risk	unclear
38	Roye 2007 (video)	unclear	unclear	low risk	unclear	unclear	high risk	high risk	unclear
39	Roye 2007 (counseling + video)	unclear	unclear	low risk	unclear	unclear	high risk	high risk	unclear
40	Sanderson 1996	unclear	low risk	high risk	unclear	high risk	unclear	low risk	low risk
41	Schmeige 2009 (GPI)	low risk	low risk	high risk	high risk	high risk	high risk	low risk	low risk
42	Schmeige 2009 (GPI + MET)	low risk	low risk	high risk	high risk	high risk	high risk	low risk	low risk
43	Smith 1993	unclear	unclear	high risk	unclear	high risk	high risk	low risk	low risk
44	Smith 1995 (Q&A)	high risk	unclear	unclear	high risk	unclear	high risk	low risk	low risk
45	Smith 1995 (role play)	high risk	unclear	unclear	high risk	unclear	high risk	low risk	low risk

ID	Study	1a	1b	2a	2b	3	4	5	6
46	Sterk 2003 (motivation)	high risk	high risk	high risk	unclear	high risk	low risk	low risk	low risk
47	Sterk 2003 (negotiation)	high risk	high risk	high risk	unclear	high risk	low risk	low risk	low risk
	Unclear risk	21	25	27	21	33	7	9	9
	Low risk	16	19	8	11	3	26	33	32
	High risk	10	3	12	15	11	14	5	6

Notes:

[a]The guidance for assessing the risk of bias in studies was based on the tool recommended by Cochrane reviews (Higgins & Green, 2011). Further details about the criteria used can be found in the sections of the online handbook (http://www.mrc-bsu.cam.ac.uk/cochrane/handbook/chapter_8/8_assessing_risk_of_bias_in_included_studies.htm).

1. Selection bias
    a. Random sequence generation (8.9)
    b. Allocation sequence concealment (8.10)
2. Performance bias
    a. Blinding of participants to condition allocation (8.11)
    b. Blinding of personnel to condition allocation (8.11)
3. Detection bias – Blinding of outcome assessment (8.12)
4. Attrition bias - Incomplete outcome data (8.13)
5. Reporting bias - Selective reporting of outcome reporting (8.14)
6. Baseline imbalance in participant characteristics (8.15.1.2)

Table 6
Pooled effect sizes

	Behavioral outcomes		Secondary outcomes				
	Condom use/ protected sex	Condom carrying/ purchasing	Knowledge	Attitudes	Normative beliefs	Perc'd Control	Intentions
Number of studies[a]	34	3	21	27	21	26	27
Shortest follow-up							
M (SD) mths	3.24 (2.16)	2.27 (1.27)	0.79 (1.53)	1.40 (2.75)	1.38 (2.87)	1.43 (2.67)	1.39 (2.75)
Q	107***	7.46*	149***	198***	26.3	138***	136***
d	0.126***	0.522***	0.341***	0.261***	0.135***	0.210***	0.191***
(95%CI)	(0.052-0.199)	(0.289-0.755)	(0.219; 0.463)	(0.159; 0.363)	(0.093; 0.177)	(0.115; 0.305)	(0.107; 0.276)
Longest follow-up							
M (SD) mths	8.18 (7.42)	2.27 (1.27)	4.05 (5.28)	3.61 (4.83)	3.22 (4.95)	3.72 (4.82)	4.04 (5.04)
Q	181***	7.46*	147***	169***	23.8	124***	88.1***
d	0.136***	0.522***	0.328***	0.248***	0.137***	0.189***	0.187***
(95%CI)	(0.040-0.231)	(0.289-0.755)	(0.204; 0.451)	(0.153; 0.344)	(0.094; 0.179)	(0.098; 0.280)	(0.117; 0.256)
All follow-ups[b]							
M (SD) mths	5.54 (3.76)	2.27 (1.27)	2.31 (3.05)	2.51 (3.43)	2.30 (3.57)	2.57 (3.38)	2.69 (3.44)
Q	107***	7.46*	139***	177***	24.7	128***	92.5***
d	0.127***	0.522***	0.333***	0.257***	0.136***	0.200***	0.186***
(95%CI)	(0.053-0.199)	(0.289-0.755)	(0.214; 0.452)	(0.160; 0.354)	(0.094; 0.179)	(0.108; 0.292)	(0.115; 0.257)
Failsafe N	286	n/a	1102	864	189	532	563
(5k + 10)	(180)		(115)	(145)	(115)	(140)	(145)
Egger's regression intercept	0.341	n/a	0.121	2.77**	0.343	1.76	2.06**
Exclusion of underpowered studies (<.55)							
Number excluded	3	0	0	1	1	1	2
d	0.115***	n/a	n/a	0.251***	0.139***	0.199***	0.166***
(95%CI)	(0.042-0.188)			(0.153; 0.349)	(0.089; 0.189)	(0.106; 0.293)	(0.100; 0.231)
Hedge's small-sample correction							
g	0.125***	0.521***	0.332***	0.256***	0.136***	0.199***	0.185***
(95% CI)	(0.053-0.198)	(0.289-0.754)	(0.213-0.451)	(0.159-0.353)	(0.094-0.178)	(0.107-0.291)	(9.115-0.256)

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

Notes:

[a] The number of studies and pooled effect sizes shown in this table do not include studies which measured some of these outcomes and either reported them as non-significant or did not report the findings (see Table 4). If the effect sizes from these studies were assumed to be zero, the pooled effect sizes were smaller but still highly significant (*All follow-ups*: Condom use/ protected sex - k=40, *d*=0.111*** (0.050: 0.171); Knowledge - k=22, d=0.315*** (0.192; 0.483); Attitudes - k=29, d=0.235 (0.144; 0.325); Normative beliefs - k=23, d=0.119*** (0.068; 0.170); Perceived control - k=30, d=0.172*** (0.092; 0.253); Intentions – no missing effect sizes).

[b] Paired t-tests showed no significant differences between the effect sizes from the shortest and longest follow-ups (ts≤1.67, ps>05). Hence, in studies which reported post-intervention outcome data at more than one follow-up the mean effect sizes and variances obtained from all follow-ups were computed.

Table 7
Meta-regression analyses (all follow-ups)

	Unstandardized regression coefficients [≤3 studies[a]]				
			Secondary outcomes		
	Condom use/ protected sex	Knowledge	Attitudes	Perc'd Control	Intentions
Number of studies	34	21	27	26	27
Power	-0.002	-0.004	-0.008†	-0.006	-0.013***
Design (1=RCT, 2=Quasi-expt)	0.011	-0.152	-0.153†	-0.018	-0.038
Selection bias[b]	-0.089$^{(*)}$	-0.134†	-0.017	-0.079	-0.009
Performance bias	[0.107]	[-0.034]	-0.116†	[-0.045]	[0.077]
Detection bias	[0.019]	n/a	[-0.375]$^{(*)}$	[-0.309]	[-0.250]†
Attrition bias	-0.059	-0.084	0.016	0.051	0.112
Reporting bias	0.036	0.205	0.121	-0.006	0.104
Baseline imbalance	-0.084	[0.056]	-0.145	-0.061	-0.038
Follow-up interval	0.0002	-0.028	-0.046***	-0.015	-0.017†
Participant characteristics					
Country (1=developed, 2=developing)	[0.355]†	[0.300]	[0.510]*	[0.263]†	[0.294]†
Average age (years)	-0.011$^{(*)}$	-0.007	0.013	0.021	0.003
Gender (1=mixed, 2=females)	-0.098	0.090	0.121	0.020	0.074
Features of control condition					
Intervention (1=No, 2=Yes)	-0.205	-0.122	-0.134	-0.257**	-0.115
STI content (1=No, 2=Yes)	0.020	-0.154	-0.012	-0.088	0.007
Features of experimental condition					
Focus STD (0=No, 1=Yes)	n/a	n/a	[-0.612]$^{(*)}$	n/a	[0.170]
Focus pregnancy (0=No, 1=Yes)	0.034	0.155	-0.184†	-0.010	-0.012
Face to face (1=No, 2=Yes)	0.202*	[-0.068]	-0.185	0.097	-0.130
Additional theories[c] (1=No, 2=Yes)					
ANY	0.155	[0.013]	-0.183	0.027	0.158†
SCT	0.037	0.128	-0.060	0.043	-0.045
IB	n/a	[-0.166]	[-0.322]$^{(*)}$	[-0.062]	[0.094]
TTM	-0.226	n/a	n/a	n/a	n/a
HBM	[0.211]	n/a	n/a	[0.218]	n/a
ARR	[-0.024]	[-0.153]	[-0.094]	n/a	[-0.141]
IMB	[-0.024]	[-0.153]	n/a	n/a	[-0.141]
Behavior change techniques (0=No, 1=Yes)					
T01	0.069	0.080	-0.083	-0.050	-0.156$^{(*)}$
T02[d]	[0.394]$^{(*)}$	n/a	n/a	n/a	n/a
T03[d]	0.037	-0.083	0.096	-0.025	0.038
T04[d]	-0.030	[-0.009]	0.121	0.184†	0.110
T05	0.079	-0.014	-0.221$^{(*)}$	-0.118	-0.047
T06	n/a	n/a	n/a	n/a	n/a
T07	[0.211]	n/a	n/a	[0.218]	n/a
T08	-0.018	0.198	-0.003	0.145†	0.010
T09	[0.020]	[0.128]	[0.007]	0.122	0.055
T10	n/a	n/a	n/a	n/a	n/a
T11	[-0.283]$^{(*)}$	[-0.153]	[-0.094]	n/a	[-0.141]
T12	-0.047	[-0.174]	[-0.262]	[-0.174]	[-0.267]
T13	n/a	[0.051]	[0.062]	[-0.047]	[0.117]
T14	0.004	[-0.003]	0.134	0.214	0.142
T15	n/a	n/a	n/a	n/a	n/a

	Condom use/ protected sex	Knowledge	Attitudes	Perc'd Control	Intentions
T16	n/a	[0.051]	[0.062]	[-0.047]	[0.117]
T17	0.123	-0.068	0.107	0.028	0.002
T18	-0.113	n/a	n/a	n/a	n/a
T19	0.239**	-0.086	0.039	0.043	-0.035
T20	[0.211]	n/a	n/a	[0.218]	n/a
T21	n/a	n/a	n/a	n/a	n/a
T22	n/a	n/a	n/a	n/a	n/a
T23	[-0.024]	[-0.153]	[0.094]	n/a	[-0.141]
T24-T26	n/a	n/a	n/a	n/a	n/a

[†]$p<.10$, *$p<.05$, **$p<.01$, ***$p<.001$. Brackets around the asterisks (e.g., [(*)]) are used to indicate that the predictor was significant when it was the only predictor entered into the model but not significant when other significant predictors were entered.

Notes:

[a]Coefficients shown in [brackets] are based on regressions in which three or fewer studies provided effect sizes for one level of the predictor. Coefficients are recorded as n/a when no studies provided effect sizes (i.e., the same level of the predictor applied to all studies).

[b]As recommended by Cochrane studies at high or unclear risk of bias (=1) were tested against studies at low risk of bias (=0) (www.cochrane-handbook.org)

[c] ARR – AIDS risk reduction model (Catania, Kegeles, & Coates, 1990); EPPM – Extended Parallel Process Model (Witte, 1992); HBM – Health Belief Model (Becker, 1974); IB – Triandis' Theory of Interpersonal Behavior (Triandis, 1980); IMB - Information, Motivation, Behavior Skills Model (Fisher & Fisher, 1992); SLT – Social Learning Theory (Bandura, 1977); SCT – Social Cognitive Theory (Bandura, 1986); TTM – Transtheoretical Model (Prochaska & DiClemente, 1983)

[d] Abraham and Michie (2008) mapped these techniques onto the TRA or TPB.

(A) Keyword search [(meta-analysis OR meta-analytic OR meta analysis OR meta analytic OR systematic review) AND (theory of planned behavior OR theory of planned behaviour OR theory of reasoned action)] of Web of Knowledge (incl. Web of Science with Conference Proceedings/Medline) (k=176), Pubmed (k=133), Embase (k=27), Cinahl (k=44)
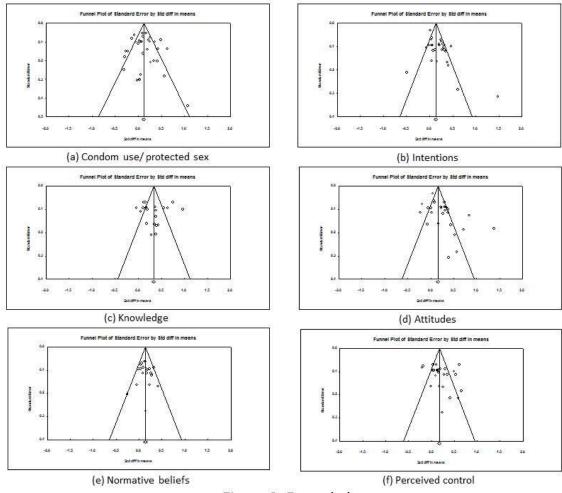
(B) Keyword search [(planned behavior OR planned behaviour OR ajzen OR fishbein OR reasoned action) AND (intervention OR trial) AND (condom* OR sex* OR contraceptive OR STD OR HIV OR AIDS OR pregnancy OR partner*)] of Web of Knowledge (incl. Web of Science with Conference Proceedings/Medline) (k=3190), Pubmed (k=329), Embase (k=114), CINAHL (k=144)

Review titles and abstracts to identify papers which review EITHER the TPB/TRA literature in contexts which might include sexual risk behaviors (k=27) OR report a systematic review or meta-analysis published since 2000 of interventions to prevent HIV/STDs or pregnancy (k=10)

Examine titles, abstracts and full-text of papers identified by both keyword searches (A and B) and cited in the reviews identified in (A) for interventions that meet inclusion criteria (k=32)

Hand search of health psychology and public health journals 2006-2013 (e.g., Psychology and Health, AIDS and Behavior, Health Education Research, Health Psychology) (no further papers identified)

Key authors and experts contacted for relevant research (e.g., Jemmott, Abraham, Armitage) (no further papers identified)

Figure 1: Search strategy flowchart

(a) Condom use/ protected sex

(b) Intentions

(c) Knowledge

(d) Attitudes

(e) Normative beliefs

(f) Perceived control

Figure 2. Funnel plots