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Accuracy of the Stages of Change Algorithm: Sexual Risk Reported in the Maintenance Stage of Change

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Abstract The Transtheoretical Model (TTM), which asserts that health behavior change progresses in stages, is often used to explore health risk behaviors and to target and evaluate health promotion interventions. A four-question staging algorithm is often used to measure an individual's health behavior stage of change (SOC), but its accuracy or appropriateness for tailoring interventions or evaluating outcomes has not been established. The current study utilized data from three studies on HIV sexual risk behavior to compare SOC to reports of sexual risk on more detailed risk assessments, measured concurrently. Within each data set, detailed behavioral risk assessments were compared with SOC, with specific emphasis on maintenance staging, to evaluate the correspondence between SOC and reported behavior. Those classified in the maintenance SOC for condom use should, by definition, report no sexual risk events over the matched time period. Across all three studies, 18% of those classified in the maintenance SOC for condom use reported one or more sexual risk behaviors during the matched time period. Because the SOC algorithm is frequently used in intervention design, targeting, and evaluation, the potential for mis-categorization in the most advanced stage of maintenance raises concerns. Results suggest that intervention inclusion or evaluation strategies that use the maintenance stage as a primary outcome should be further qualified by behavioral data.

Keywords Stages of change · Transtheoretical model · HIV-prevention

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Introduction

The Transtheoretical Model (TTM; Prochaska et al. 1992, 1994) has received considerable attention as an easily understood and applied framework for understanding and evaluating the adoption of health behaviors (e.g., Baker et al. 2004; Banikarim et al. 2003; Etter 2004; Gullette 2004; Horowitz 2003; McEvoy et al. 2004; Prochaska et al. 2005; Semple et al. 2004). Empirical evaluation of strategies used to operationalize the key constructs within this model has received far less attention, despite the fact that such measures are frequently employed in informing intervention inclusion criteria, characterizing intervention needs, and evaluating intervention effectiveness.

The TTM (Prochaska et al. 1992, 1994) asserts that there are distinct stages in the adoption of health behavior change, which individuals cycle through en route to consistent adoption of the health behavior in question.

Prochaska and colleagues (1994) describe five stages of health behavior change: *precontemplation* (no desire for behavior change); *contemplation* (awareness of need for behavior change and consideration of making that change in the next 6 months); *preparation* (preparation to change behavior within 30 days); *action* (implementation of behavior change for more than 1 month but less than 6); and *maintenance* (implementation of behavior change consistently for 6 months or more). Theoretically, it stands to reason that classifying individuals in terms of their readiness to change would be of great value in determining intervention strategies and content appropriate for specific individuals at specific times (e.g., Horowitz 2003; Prochaska et al. 1992, 1994). The nature of an effective intervention would be quite different for an individual planning to implement a health behavior change than for one not yet considering the change. In fact, many interventions have adopted such a matching strategy, in which the individual's stage of change (SOC) is used to assign them to targeted intervention conditions (e.g., Cabral et al. 2004; Collins et al. 1999; Gielen et al. 2001; Rhodes and Malotte 1996).

Measurement of an individual's SOC with respect to a particular behavior traditionally takes place using a staging algorithm (e.g., Grimley et al. 1993a, b). A typical algorithm is depicted in Fig. 1. There are variations on this algorithm, including the currently recommended revised version (Brown-Peterside et al. 2000), in which the first question is modified to ask specifically if individuals have consistently engaged in the behavior for the past 30 days, but the temporal definition used for the action and maintenance stages are typically the same.

Even though this measure is frequently used to assess SOC and to assign, target, and evaluate interventions, few explorations of the accuracy of such algorithms, and thus their appropriateness for use in assigning and evaluating interventions, have been published to date. Measures of constructs related to SOC have been validated (see Horowitz 2003), but there has been little focus on the extent to which the specific classification produced by the algorithm matches with self-report of recent risk events or behavioral intentions and plans regarding risk. An exception is Herzog and Blagg's (2007) recent exploration of the concurrent validity of the SOC algorithm for smoking behavior. They found that the algorithm placed individuals in the precontemplation and contemplation stages despite these individuals reporting intentions, motivation, and plans inconsistent with these stages. These findings suggest a potential mis-match between some of the TTM stages and concurrently reported behaviors or intentions.

Despite the lack of detailed exploration of the staging algorithm's accuracy in most behavioral domains, it is nonetheless widely used in health behavior change research. The algorithm has been used to assess correlates of health risk behavior, as a function of SOC (Bowen and Trotter 1995: Grimley et al. 1993; Gullette 2004; Lauby et al. 1998; Morrison-Beedy et al. 2002; Noar and Morokoff 2002; Noar et al. 2006; Polacsek et al. 1999; Posner et al. 2004; Reddy et al. 2000; Semple et al. 2004; Stark et al. 1998); to assign individuals to interventions, tailored to SOC, that address the presumed needs of individuals at different stages (Cabral et al. 2004; Collins et al. 1999; Gielen et al. 2001; Rhodes and Malotte 1996); and to evaluate the efficacy of interventions designed to promote health behavior change (Banikarim et al. 2003; Brown-Peterside et al. 2000: Gielen et al. 2001; Jamner 1997; Malotte et al. 2000).

Lack of research on the issues pertaining to the concurrent validity of the algorithm raises concerns particularly about its use for intervention tailoring and outcome evaluations. To have some degree of confidence in such applications of the SOC algorithm, one would expect certain stages to have a high degree of correspondence with measures of risk events and behaviors. For example, if

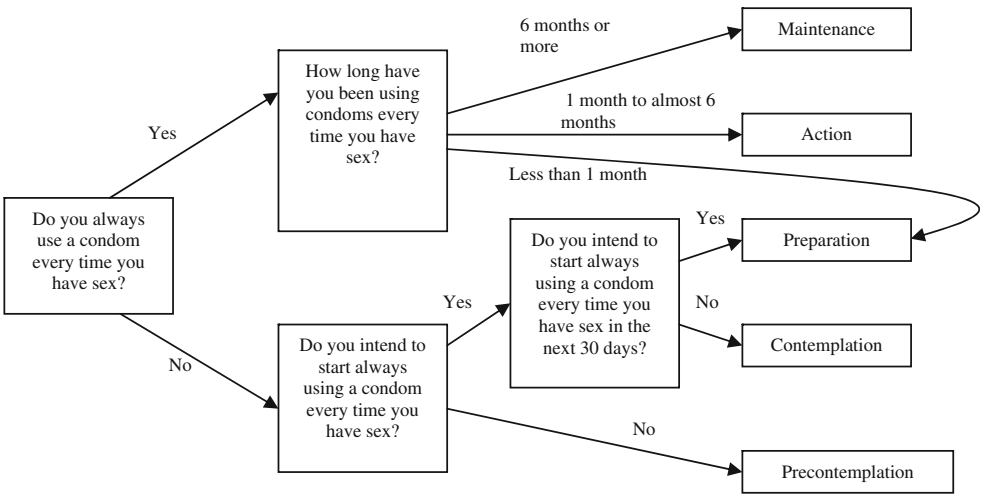

Fig. 1 Sample of four-item algorithm for Stage of Change classification

classification in the maintenance SOC is used to flag minimal need for intervention or to support intervention outcomes, then one would anticipate that those categorized in the maintenance group would report no risk events over at least the last 6-months on all risk-assessment items. With certain applications of the algorithm, one would also anticipate that those classified in the action stage would have reported no risk behavior over the preceding 1-month period. Should either assumption not hold, then the discrepancy between the stage and risk event assessments must be further evaluated, and the appropriateness of using such classification, in the absence of additional risk evaluations, to support positive intervention outcomes becomes questionable.

The purpose of the current study was to assess one aspect of concurrent validity of the SOC algorithm for condom use by evaluating the concordance between classifying participants in the maintenance stage via a SOC algorithm and total risk events reported for a matched time period using events-based risk behavior assessments. While both the risk assessment and responses to SOC algorithm items are both limited by reliance on self-report, when dealing with low-base-rate, high-risk behaviors with little social desirability, the most prudent approach is to assume that the presence of risk on either measure signals the need for further evaluation or exploration. Thus, in cases where the algorithm classifies individuals as having no risk but behavioral risk items indicate the presence of risk, a conservative approach would be to assume that risk is present or, at minimum, requires further evaluation. We therefore hypothesized that individuals classified in maintenance would report no risk events on the risk assessment measures for a matched time period (a maximum of the preceding 6 months). Similarly, for one study included in this review, we hypothesized that those classified in the action stage of change would report no risk events for a preceding 1-month period.

Methods

Existing data from three separate studies assessing SOC and condom use behavior were analyzed. Only individuals who had been sexually active over the assessment period were included, as condom use was the focus of interest. In each study, we evaluated sexual risk self-reported by those classified in the maintenance SOC. Across all studies, risk events reported by those classified in the maintenance stage, using the recommended scoring procedures, were quantified in terms of percentage of maintainers reporting risk and, when possible, total amount of risk reported. No inferential analyses were used, as this exploration was primarily descriptive. According to the theoretical and operational definitions for this stage, maintenance-classified participants should have zero reports of sexual risk events for at least the previous 6-month period. Study 2 also allowed for the review of accuracy in classifying participants in the action stage, where those classified in action should report zero sexual risk events over at least the preceding 1-month period. Because the exact item content and behavioral risk assessments differ by study, each study's methodology is detailed separately.

Study 1 The first data set analyzed was from the Options Project (fully described in Fisher et al. 2004, 2006), a longitudinal intervention outcome study involving HIV-positive individuals. Participants completed a survey at baseline and in 6-month intervals for up to 18 months (4 assessments total). Each assessment included a staging algorithm (see Fig. 1). In this particular algorithm, the item for always using a condom read 'Have you been always using a condom every time you have sex for more than 6 months?' and produced an 'action phase' classification that specified consistent condom use for less than 6 months but not necessarily for an entire 30-day period. The assessment also included event-level questions regarding the specific number of vaginal and anal sexual events engaged in over the past 3-months with HIV-positive, negative, and status unknown partners, and the number of times condoms were used for those events within each partner type. Participant responses to the event-level risk assessment items were summed into total number of unprotected vaginal and anal events across partner types over the past 3 months.

Study 2 Participants in Study 2 were undergraduates at the University of Connecticut who were involved in an intervention outcome study targeting HIV prevention behavior (Kiene and Barta 2006). Participants completed a baseline and 1-month follow-up questionnaire that included a staging algorithm identical to Fig. 1 except that the first question specifically referred to the past 30 days. Participants were presented with two statements to assess sexual risk behavior, "My partner(s) and I have used latex condoms while having sexual intercourse during the past month," and "When you had sexual intercourse during the past month, what percentage of the time were condoms used?" The answer choices were "never," "rarely," "sometimes," "often," "always," and "not applicable." Participants were also asked, "How many different people have you had sexual intercourse with during the last month?" "With how many of these partners were condoms used all the time?" and "When you had sexual intercourse during the past month, what percentage of the time were condoms used?" Risk was calculated relative to the entire item-set as a dichotomous variable reflecting whether or not any unprotected sex took place during the past month. SOC was calculated such that those classified in maintenance

should have reported no risk events in the last 6 months and those classified in action should similarly have reported no risk events for the past month.

Study 3 Study 3 involved Connecticut high school students participating in a study of safer sex practices (Fisher et al. 2002). Sexual risk behavior was assessed with two items: "During the past 2 months, how often have you and your partner used condoms when you had sexual intercourse?" ("always," "almost always," "sometimes," "almost never," "never," or "does not apply") and "During the past 2 months, what percentage of the time did you and your partner use condoms when you had sexual intercourse?" SOC was estimated on the basis of responses to items asking participants whether or not they always used a condom every time they had sex ("always," "almost always," "sometimes," "almost never," "never," and "not applicable"); how long they had consistently been engaging in only protected sex ("never," "less than 1 month," "1-2 months," "3–5 months," "6 months or longer," and "not applicable"); and the items depicted in Fig. 1 regarding whether one was planning or considering the adoption of this behavior.

Results

As previously described, each study used slightly different wording for the staging algorithm and risk assessment procedures, and had varying length of follow-up periods. To allow for targeted evaluation of each unique study, results from the data collected within each study included in the present report are first detailed separately. All studies, however, could be used in concert to summarize absolute presence or absence of any risk, as defined by the specific study's protocol, within the 'maintainer' group through reliance on their baseline data reports. This summary report is also provided, although it is important to keep in mind that this is a 'gross' level summary that collapses across differing measurement strategies.

Study 1 Number of assessment surveys reviewed for each assessment interval, number of participants classified in each stage at each assessment interval, and proportion in the maintenance stage reporting sexual risk are presented in Table 1. The majority of participants completing the assessment were classified by the staging algorithm as being in the maintenance stage. Of those classified in maintenance at baseline, 7% reported that they had engaged in one or more unprotected sexual risk events over the preceding 3-month period. Specific to those classified in maintenance, anal and/or vaginal risk behaviors were reported by 5%, 8%,

Table 1 Study 1: Percentage in each stage relative to full sample, percentage within each stage reporting sexual risk, total number of at risk partners, and total number of risk events for four different assessment intervals

	ASSESSMENT INTERVAL											
	Baseline			Follow-up 1			Follow-up 2			Follow-up 3		
Stage of Change	% (N) of total sample classified in the stage	% in the stage that also reported risk	Number of risk partners and risk events reported by those in each stage	% (N) of total sample classified in the stage	% in the stage that also reported risk	Number of risk partners and risk events reported by those in each stage	% (N) of total sample classified in the stage	% in the stage that also reported risk	Number of risk partners and risk events reported by those in each stage	% (N) of total sample classified in the stage	% in the stage that also reported risk	Number of risk partners and risk events reported by those in each stage
Precontemplation	16% (70)	44%	95, 543	10% (29)	62%	25, 667	15% (31)	61%	24, 317	8% (13)	38%	7, 56
Contemplation	3% (15)	93%	20, 219	3% (9)	56%	5, 53	2% (3)	33%	1, 22	4% (6)	33%	2, 36
Preparation	26% (115)	24%	54, 411	24% (70)	26%	50, 356	11% (23)	26%	6, 34	16% (24)	33%	11, 64
Action	3% (14)	43%	51, 465	4% (13)	23%	3, 6	2% (4)	0%	0, 0	1% (2)	50%	1, 2
Maintenance	51% (221)	7%	44, 146	59% (174)	5%	10, 136	70% (143)	8%	95, 486	71% (108)	12%	117, 1231
Total N classified per assessment interval	435			295			204			153		

and 12% at follow-up assessments 1, 2, and 3, respectively. Table 1 also includes the total cumulative number of partners involved in risk events and number of risk events. Across all intervals, maintainers reported a cumulative total of almost 2000 unprotected sexual events.

Study 2 As indicated in Table 2, for those classified by the algorithm in the maintenance stage at baseline, 35% reported risk on one or more risk-assessment items, and 16% classified as being in the maintenance stage at follow-up also reported sexual risk behavior. Twenty percent of those classified in the action stage at baseline also reported engaging in sexual risk events over the last month and 71% of those classified in action at follow-up also reported risk over the last month.

Study 3 Sexually active participants classified in maintenance should have reported consistent condom use on the behavioral items. As indicated in Table 3, 47% of participants were classified in the maintenance stage at baseline and of these 29% reported sexual risk during the preceding 2 months.

Summary Each of the three studies reviewed assessed stage of change and condom use at various intervals ranging from the last 1 month to the last 3 months. As indicated in Table 4, focusing solely on baseline data reports, across all three studies, a grand total of 403 participants were classified as in maintenance for condom use and 18% of these participants (71) reported risk on behavioral assessments for a matched time period. Conversely, 82% of maintainers reported no risk events on behavioral risk assessments during a matched time period. Between studies, the proportion of those classified in maintenance who also reported risk at baseline assessment was largest in Study 2 (35% in the University student sample recalling risk over the last month), followed by Study 3 (25% of the high school student sample recalling risk over the last 2-months). These were both higher than the mis-classification within Study 1 (only 7% of "maintainers" in the HIV-positive sample recalling risk over the last 6-months). However, this is consistent with overall risk reported by participants in all stages in the three studies; fewer HIV-positive individuals in Study 1 reported risk, regardless of the stage in which they were classified. For the study in which we were able to calculate the validity of classifications within the action stage (Study 2), the accuracy was 80%, such that 20% of those who were classified as being in the action stage also reported sexual risk behavior during the previous month.

Discussion

The TTM has received considerable attention as both a potentially important tool in health behavior change research (e.g., Horowitz 2003) and as a potentially misguided and overly simplified explanation of health behavior change (e.g., West 2005). The current study addresses the use of staging algorithms that place individuals in their respective stage of change. While the current results in terms of relative distribution of risk across the various SOC do appear consistent with the TTM's stages, concerns nonetheless arise over inconsistencies observed between the algorithm and behavioral risk assessments specifically for those classified in the maintenance stage of change. In conjunction with practices that use staging to place individuals into targeted interventions or to evaluate intervention outcomes, the mis-classification of anyone reporting risk into the maintenance stage is concerning. Those classified in maintenance should not report risk events on behavioral risk assessment measures. If a risky individual is classified as *not* risky, as would be implied by a "maintenance" classification, he or she may not be provided appropriate risk reduction intervention. If used as an intervention outcome measure, those classified in mainte-

Table 2 Study 2: Percentage in each stage relative to full sample and percentage within each stage reporting risk for two different assessment intervals

	ASSESSMENT INTERVAL			
	Baseline		Follow-up 1	
Stage of Change	% (N) of total sample classified in the stage	% in the stage that also reported risk	% (N) of total sample classified in the stage	% in the stage that also reported risk
Precontemplation	29% (43)	95%	3% (3)	0%
Contemplation	17% (24)	100%	35% (40)	85%
Preparation	14% (19)	95%	21% (24)	96%
Action	4% (5)	20%	15% (17)	71%
Maintenance	34% (48)	35%	27% (31)	16%
Total N classified per assessment interval	139		115	

Table 3 Study 3: Percentage in each stage relative to full sample and percentage within each stage reporting risk

Stage of change	% (N) of total sample classified in the stage	% in the stage that also reported risk
Precontemplation	10% (29)	97%
Contemplation	4% (13)	100%
Preparation	27% (77)	95%
Action	12% (34)	47%
Maintenance	47% (134)	29%
Total N classified	287	

nance but also reporting risk events would contribute to an inaccurate characterization of an intervention as effective when it was, in fact, not effective in that case.

Assuming that participant reports of risk on behavioral risk assessments signal the need for further exploration, inclusion in risk reduction intervention, and the presence of risk at even a gross level, we considered any report of risk event(s) by those classified in the maintenance stage as indicative of mis-classification. Analyses of data drawn from three separate studies with three different populations indicated that staging algorithms led to misclassification of some 18% of participants ostensibly in the maintenance stage. Specifically, using baseline data from all three studies of condom use behavior, we found that 18% of "maintainers" also concurrently reported one or more unprotected sex event on more detailed risk assessment measures over applicable time intervals. Variability was apparent between studies, where the percentage of "maintainers" also reporting risk ranged from 7% to a high of 35% at baseline, with the lower proportion occurring within the HIV-positive sample in Study 1. The lower rate of "misclassification" in the HIV-positive sample may be reflective of the lower overall proportions of individuals in that sample reporting risk relative to the other targeted populations reviewed. The HIV-positive sample reported substantially less risk overall (21% at baseline, as compared to 72% and 59% at baseline in studies 2 and 3, respectively), which is consistent with other observations of increased condom use associated with HIV diagnosis (e.g., Crepaz and Marks 2002; Sears et al. 2008; Watkins et al. 1993). While it is possible that the HIV-positive sample may have been better characterized by the SOC algorithm, the role of particularly low baserates of risk should be explored in future research. It is important to note that in the HIV-positive sample, though a low number of HIV-positive individuals reported being risky, the actual number of risk behaviors or events was high. While some degree of error will occur with self-report measures, and generally those in the maintenance phase in all three studies did appear to report *lower* amounts of risk in comparison to other stages, there is substantial concern over the degree of discordance between staging algorithm and reports of sexual risk behavior.

The staging algorithm has a consistent history of use in relation to intervention inclusion, tailoring, and outcomes (e.g., Banikarim et al. 2003; Brown-Peterside et al. 2000; Cabral et al. 2004; Collins et al. 1999; Gielen et al. 2001; Jamner 1997; Malotte et al. 2000; Rhodes and Malotte 1996). However, in the current sample, if maintenance staging was used to designate participants *not* in need of

Table 4 Study 1 through 3 baseline data: Percentage in each stage relative to full collapsed sample and percentage within each stage reporting risk

	ASSESSMENT INTERVAL							
	STUDY 1		STUDY 2		STUDY 3		ACROSS ALL STUDIES	
Stage of Change	% (N) of total sample classified in the stage	% (N) in the stage that also reported risk	% (N) of total sample classified in the stage	% (N) in the stage that also reported risk	% (N) of total sample classified in the stage	% (N) in the stage that also reported risk	% (N) of total sample classified in the stage	% (N) in the stage that also reported risk
Precontemplation	16% (70)	31% (44)	29% (43)	95% (41)	10% (29)	97% (28)	16% (142)	80% (113)
Contemplation	3% (15)	93% (14)	17% (24)	100% (24)	4% (13)	100% (13)	6% (52)	98% (51)
Preparation	26% (115)	24% (28)	14% (19)	95% (18)	27% (77)	95% (73)	24% (211)	56% (9)
Action	3% (14)	43% (6)	4% (5)	20% (1)	12% (34)	47% (16)	6% (53)	43% (23)
Maintenance	51% (221)	7% (15)	34% (48)	35% (17)	47% (134)	29% (39)	47% (403)	18% (71)
Total N classified per assessment interval	435	21%	139 (93)	72%	287 (100)	59%	(169)	861

intervention, or in need of an intervention designed to support the continuation of already consistent condom use, 18% of the full sample would have been erroneously excluded from exposure to appropriate health behavior change intervention content. Given the sizable amount of risk reported by such misclassified participants, the current results do not readily support the use of the staging algorithm alone or in lieu of behavioral risk assessments for inclusion/exclusion or stage-of-change-matching intervention decisions that utilize maintenance staging, and to a lesser extent, action staging. Similarly, the current results do not lend support to strategies that use maintenance staging as a single indicator of risk reduction success. While the use of any single indicator of treatment outcome should be avoided (see Catania et al. 1990), using maintenance as a single indicator of success appears to be particularly inappropriate, though many studies adopt this approach (e.g., Banikarim et al. 2003; Brown-Peterside et al. 2000: Gielen et al. 2001; Jamner 1997; Malotte et al. 2000).

While the current study focused on condom use behavior, concerns about the algorithm's misclassifications have been similarly articulated in the smoking cessation domain (Herzog and Blagg 2007). Given that SOC is used in numerous behavioral domains (Baker et al. 2004; Etter 2004; McEvoy et al. 2004; Prochaska et al. 2005), further research is necessary to determine whether mis-classification using SOC is problematic only for highly stigmatized behavior (e.g., condom use/HIV prevention, smoking).

It is worth noting that the shortcomings observed in the staging algorithm may be due to conceptual rather than purely methodological limitations. Certainly, as advocated by the TTM, the tailoring of interventions to meet the specific needs of individuals with varying degrees of intention, commitment, and attainment of a health behavior is attractive for a broad range of behaviors. Interventions for an individual who has no intention of changing health behaviors may involve quite different strategies from those designed for an individual with strong intentions to change but lack of specific abilities for doing so. However, the SOC's strategy of sharply delineating stages may not necessarily be the best means to conceptualize a continuum of change. A SOC approach may artificially break up what is in reality a continuum into discrete stages with arbitrary temporal cutoffs (see Bandura 1998). As West (2005) notes, the distinction between 29 versus 30 days of consistently performing a health behavior (contemplation versus action stages, respectively) is necessarily arbitrary. Moreover, it is unclear whether a SOC classification strategy provides clear advantages over simply asking individuals to report whether or not, or the extent to which, they perform a behavior and their current intentions to change it (West 2005). Consistent with current results, using detailed counts of risk behavior may provide a very different picture than using the four-question staging algorithm. Thus, at minimum, both should be taken into account.

Several limitations in the current research should be noted. To evaluate accuracy in the maintenance stage, and for one study the action stage as well, we used a single staging measure and self-reported assessment of sexual risk behavior. We did not have access to objective measures of risk behavior, as is generally the case in sexual risk research. The inclusion of STI rates may have provided some corroboration of risk reports; however, these kinds of measures are also not definitive indicators (e.g., Cates and Berman 1999; Nahar and Azad 1999). We also did not have access to additional measures of SOC. A more detailed measure for SOC (e.g., Heuts et al. 2005; McConnaughy et al. 1983) may have produced different categorizations. Thus, results are most appropriately viewed in terms of the four-question algorithm employed. Also note that we adopted a view of accuracy that assumes that self-reported risk events on detailed risk assessments are generally accurate, such that participants reporting any unprotected sexual events on the behavioral assessment were considered "risky" even if the staging algorithm placed them in stages characterized by no risk (e.g., maintenance or action). It could be argued that the algorithm was correct, while the events level assessments were "over-reports." As previously noted, with low-base-rate, high-risk behaviors, we adopt a conservative approach where reports of risk on behavioral items are assumed to reflect the presence of risk, or at minimum suggest that maintenance would not be an appropriate characterization. Also of import, the three studies included in the present report used slightly different algorithms and strategies to quantify sexual risk behavior. However, inconsistency in wording for algorithm items is reflective of the body of literature assessing SOC, where a single strategy for staging individuals has not been established (e.g., Littell and Girvin 2002).

The fact that some participants reported sexual risk on detailed assessment items and nonetheless also reported that they have consistently used condoms over the last 6 months suggests that there may be differing demand characteristics or self-report "forgiveness" inherent in the wording and context of the different assessments. Thus, for example, an individual may rate him or herself as a consistent condom user but provide numerical evidence of inconsistency when asked about event- or partner-level occurrences of safer and risky sexual behavior. It would be worthwhile for future research to explore the potential difference in stages assigned with a staging assessment that provides additional fine-grain response options for condom use, as opposed to the dichotomous yes/no format which is generally not recommended for use in condom-use assessments currently employed. An individual who uses condoms frequently may be reluctant to endorse "No" when asked to report on

whether or not they use condoms every time they have sex because they may believe that their response is more "Yes" than "No," and may also take issue with being classified in line with those who never use condoms. Generally, syntheses of research exploring the potential impact of assessment strategies with condom use behavior have largely recommended the avoidance of dichotomous, Yes/No formats (e.g., Noar et al. 2006; Schroder et al. 2003). Intuitively, allowing individuals the opportunity to respond to risk items in a manner that is consistent with their own views of their behaviors may minimize bias due to a disconnect between self-presentational needs and the response options provided. While social desirability is an important issue to attend to in risk assessments (Noar et al. 2006; Zimmerman and Langer 1995) it has not yet been explored in relation to the assessment of SOC.

The current results suggest that SOC, when used for intervention inclusion criteria or outcome criteria, should be accompanied by behavioral risk assessments. Algorithm-identified "maintainers" should not be excluded from prevention interventions and proportion of people in maintenance or action stages of change may overestimate intervention efficacy. Staging algorithms used for targeting and developing stage-tailored interventions or used as indicators of treatment outcome should, at minimum, be augmented with assessments of event- or partner-level behavior.

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