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Cognitive Behavioral Theories Used to Explain Injection Risk Behavior Among Injection Drug Users: A Review and Suggestions for the Integration of Cognitive and Environmental Models

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Abstract

Injection drug users (IDUs) are at risk for HIV and viral hepatitis, and risky injection behavior persists despite decades of intervention. Cognitive behavioral theories (CBT) are commonly used to help understand risky injection behavior. We review findings from CBT-based studies of injection risk behavior among IDUs. An extensive literature search was conducted in Spring 2007. In total 33 studies were reviewed—26 epidemiological and 7 intervention studies. Findings suggest that some theoretical constructs have received fairly consistent support (e.g., self-efficacy, social norms), while others have yielded inconsistent or null results (e.g., perceived susceptibility, knowledge, behavioral intentions, perceived barriers, perceived benefits, response efficacy, perceived severity). We offer some possible explanations for these inconsistent findings, including differences in theoretical constructs and measures across studies and a need to examine the environmental structures that influence risky behaviors. Greater integration of CBT with a risk environment perspective may yield more conclusive findings and more effective interventions in the future.

Keywords

HIV risk behavior; injection drug use; Cognitive Behavioral Theory; literature review

I. Prevalence of Injection Risk Behavior

There are approximately 13 million injection drug users (IDUs) in the world (Aceijas *et al.*, 2004), and IDUs are at risk for a number of negative health outcomes including infection with Human Immunodeficiency Virus (HIV; Centers for Disease Control and Prevention, 2006), and hepatitis C virus (HCV; Centers for Disease Control and Prevention, 1998). Though HIV incidence rates among IDUs in the United States have declined in recent years, (Des Jarlais & Semaan, 2008; Santibanez *et al.*, 2006) injection risk behavior remains an important vector for new infections. For HCV, injection-related risks for transmission are considerable; the majority of new injectors seroconvert to HCV-positive status within 5 years of injection initiation (Garfein *et al.*, 2004; Miller *et al.*, 2002; Miller *et al.*, 2009). With no effective vaccines in production for either HIV or HCV, the need to better understand the predictors of risky injection practices in order to develop more effective interventions persists.

Decreases in risky injection behavior among IDUs, particularly in receptive syringe sharing, have been observed since the beginning of the HIV epidemic in the U.S. (e.g., Des Jarlais *et al.*, 2000; Mehta *et al.*, 2006). Despite these significant declines, risky injection behavior has continued. For example, in the most recent National HIV Behavioral Surveillance System (NHBS) survey of IDUs in 23 U.S. cities, 32% reported sharing syringes, and 33% reported sharing other injection paraphernalia (Centers for Disease Control and Prevention, 2009). A recent study of young out-of-treatment IDUs in five U.S. cities found that 53% of participants reported receptive syringe sharing (Thiede *et al.*, 2007). Among those who did not share syringes, 59% reported other unsafe injection practices such as paraphernalia (i.e., cookers, cotton, or rinse water) sharing or syringe-mediated drug splitting. In another recent sample of syringe exchange program (SEP) participants, up to 38% of IDUs reported receptive syringe sharing and up to 62% reported paraphernalia sharing, with odds of sharing increasing as access to safe injection supplies decreased (Bluthenthal *et al.*, 2007).

Behavioral interventions have demonstrated some success in reducing risk injection practices. Some of the earliest interventions took place within the context of the National Institute on Drug Abuse-funded National AIDS Demonstration Research (NADR) and Cooperative Agreement (CA) projects. Implemented from 1987 through the late 1990's, the NADR/CA interventions demonstrated significant reductions in frequency of injection and receptive syringe and paraphernalia sharing, and increases in needle disinfection and entry into drug treatment (Coyle *et al.*, 1998). In most NADR/CA projects, both enhanced and standard intervention participants significantly reduced risk behaviors. A review of 19 psychosocial interventions implemented during a similar time period (1990 – 1998) found four without serious design limitations that demonstrated significant intervention effects (Gibson *et al.*, 1998). The effective interventions were characterized by intensive and sustained interventions with stable and motivated participants. More recently, a meta-analysis of 49 randomized controlled trials conducted from 1991 to 2004 found that behavioral interventions had more effect on changing some behaviors (e.g., frequency of injection drug use and entry into drug treatment) than others (e.g., syringe sharing; Copenhaver *et al.*, 2006). In a more recent behavioral intervention trial for young IDUs conducted from 2002 to 2004, both the experimental and control conditions significantly reduced injection risk behavior at follow-up (Garfein *et al.*, 2007). While individual measures of injection risk behavior (i.e., receptive syringe sharing, syringe mediated drug splitting, number of injection partners, and sharing cookers, cotton, or water) did not differ significantly between conditions, an overall composite score created from the six risk behavior items did achieve statistical significance – there was a 29% greater decline in overall injection risk among the participants in the experimental condition compared to the control condition. Many of these interventions were theoretically-based and generally report

on their ultimate behavioral outcomes, but far less is known about which constructs are responsible for intervention success and which predict continued risk behavior. Further, the NHBS reports that only 27% of IDUs in 23 U.S. cities reported participating in an HIV behavioral intervention, suggesting that the reach of these interventions is still limited (Centers for Disease Control and Prevention, 2009).

Structural interventions, too, have yielded reductions in risk behavior (Blankenship *et al.*, 2006), and researchers are increasingly focusing on the “risk environment” in which risky injection occurs (Rhodes, 2002). One structural intervention that has been particularly effective in reducing risky injection practices is the provision of sterile injection supplies via SEPs (Ksobiech, 2003). In areas that have adopted this intervention, SEPs have dramatically improved the ability of IDUs to access sterile syringes and may be responsible for observed declines in injection risk behavior and HIV infection (MacDonald *et al.*, 2003). Still, many IDUs do not have sufficient syringes to meet their daily needs and continue to share syringes and other injection paraphernalia (Bluthenthal *et al.*, 2007). Therefore, the need for more effective and widespread prevention interventions for IDUs remains, even among those with access to SEPs (Des Jarlais *et al.*, 2007b; Santibanez *et al.*, 2006).

II. Cognitive Behavioral Theories Used to Explain Injection Risk

Cognitive behavioral theories (CBTs) - focused on properties of the individual - are among the most commonly employed frameworks in the health research and intervention literature (Glanz *et al.*, 1997), including the literature on risky injection behavior (Gibson *et al.*, 1998), and are frequently used as the basis for behavioral intervention design. Among those most frequently used to explain risky injection practices among IDUs are the Health Belief Model (HBM; Strecher & Rosenstock, 1997), the Theory of Reasoned Action (TRA) and its successor the Theory of Planned Behavior (TPB; Ajzen, 1991), Social Learning Theory/Social Cognitive Theory (SLT/SCT; Bandura, 1986) and Protection Motivation Theory (PMT; Rogers, 1983). Additionally, newer theories have been developed specifically to explain HIV-related risk behavior, drawing largely from other CBTs: the stage-based AIDS Risk Reduction Model (ARRM; Catania *et al.*, 1990); the Information, Motivation, Behavioral Skills (IMB) model (Fisher & Fisher, 1992); and Fishbein’s Integrated Model of HIV Risk Behavior (Fishbein, 2000). As has been discussed by others, these theories of health behavior share many constructs and in many cases differ primarily in their operationalization of the constructs and the hypothesized relationships between them (Bandura, 2004; Wallston & Wallston, 1984).

This literature review aims to describe existing findings regarding the influence of constructs from CBTs on injection risk behavior, and to identify areas in need of further research. For this paper, we define injection risk behavior as use of a needle/syringe, cooker, cotton or mix/rinse water that had been previously used by another drug injector. It is likely that a combined approach that integrates both cognitive and environmental models may have the highest probability of eliminating the “residual risk behaviors” (Des Jarlais *et al.*, 2007b) that persist even in the presence of existing intervention schemes (Metzger & Navaline, 2003). We will suggest that a theoretical perspective that integrates individual-level constructs with a measure of environmental correlates of injection risk behavior may provide insight into the persistence of injection risk behavior and provide a basis for the development of interventions that simultaneously address both cognitive and environmental determinants of behavior.

III. Methods

Selection of studies

An extensive literature search was conducted using the online databases PubMed (1950 – 2007) and PsychINFO (1806 – 2007) in Spring, 2007. In the initial search, each Cognitive Behavioral Theory (i.e., Health Belief Model, Protection Motivation Theory, Theory of Reasoned Action, Theory of Planned Behavior, Social Cognitive Theory, Social Learning Theory, AIDS Risk Reduction Model, and Information Motivation Behavioral Skills) was crossed one-at-a-time with each of four terms: injection drug use, HIV, needle/syringe sharing, and intervention. This search strategy yielded 445 hits. Results were limited to articles published in English, studies that identified injection risk behavior (syringe or paraphernalia sharing) as an outcome, and studies that explicitly measured cognitive behavioral constructs. Studies among injection drug users examining only sexual risk behavior and those that were theoretically based without measuring specific constructs were excluded. These exclusion criteria significantly reduced the number of relevant studies; from the initial search, 44 studies were retained.

Upon initial review of the search results, it was evident that this strategy omitted several important studies that, while they employed various theoretical constructs, did not specifically mention the theoretical underpinnings of the study. Rather than consign these studies to the category of “atheoretical” and exclude them from the review, we conducted another search in which the individual theoretical constructs (i.e., self-efficacy, response efficacy, outcome expectancies, outcome expectations, attitudes, perceived severity, perceived seriousness, perceived risk, perceived susceptibility, perceived vulnerability, social norms, knowledge, emotional coping, behavioral skills, behavioral intentions) were crossed with needle/syringe sharing, yielding an additional 249 hits. Again, studies examining only sexual risk behavior and those not published in English were excluded. Fifty-six studies were retained from this second search, yielding a total of 100 studies. Strictly qualitative studies, duplicative findings, studies that did not identify injection risk behavior as the outcome (e.g., studies that identified changes in knowledge or behavioral intentions as the only outcome), and intervention studies that did not examine theoretical mediators were eliminated. In total 33 studies were reviewed – 26 epidemiological and 7 intervention studies. It is important to note that the search strategy yielded several other important intervention studies, however only those reporting specifically on the theoretical mediators were included in this review.

IV. Results – Evidence to Support Cognitive Behavioral Theories of Injection Risk Behavior

Study participants and design

Epidemiological and intervention studies of injection risk behavior employing constructs from CBTs are described in Tables 1 and 2. Sixteen epidemiological studies were conducted in the U.S. or Puerto Rico, while ten were conducted abroad, in areas including: Canada, Hungary, Pakistan, Ireland, Scotland, Thailand, India, Australia, and the Netherlands. Of the 26 epidemiological studies, fifteen were conducted exclusively with not-in-treatment IDUs who were recruited using street-based or agency-based outreach, seven were conducted in drug treatment settings (e.g., methadone maintenance programs (MMP) or detoxification programs), and four combined recruitment locations. One study specifically recruited HIV-positive IDUs, while two restricted enrollment to HIV-negative participants and two restricted enrollment to HCV-negative participants. Two studies enrolled only women, and two studies enrolled only men. The majority of studies used a cross-sectional or observational design (20/26), while six studies employed a longitudinal design with follow-

up periods ranging from 4 to 12 months. Data were collected via self-report instruments that were generally interviewer-administered.

The intervention studies ranged in scale from large, multi-site studies to small, single-site studies. All were conducted in the U.S. or Puerto Rico, though one report did not specify the exact location. Of the seven intervention studies, four targeted in-treatment IDUs, including individuals in MMP or outpatient detoxification programs. One study enrolled only HIV-positive individuals, and one enrolled only HCV-positive individuals. Six of the seven studies randomly assigned participants to either an enhanced intervention condition or a control, consisting of either an attention control or a standard of care. One study was not experimental in nature, and instead employed a single-group, pretest/posttest design. Among the intervention studies, most had follow-up periods ranging from three to 12-months post intervention.

Theories examined

CBTs employed by the 33 studies included IMB, HBM, SLT/SCT, Efficacy Theory, TRA/TPB, PMT, and ARRM. No studies were identified that used Fishbein's Integrated Model. Not all the constructs in the theoretical models were examined by the reviewed studies; constructs that were examined included: self-efficacy, response efficacy, perceived susceptibility, perceived severity, social norms, HIV transmission knowledge, behavioral skills, behavioral intentions, perceived rewards/benefits of risk reduction, and perceived barriers to risk reduction. No studies were found that examined outcome expectancies, outcome expectations, attitudes, or emotional coping responses.

Associations between theoretical constructs and injection risk behavior

Self-efficacy—High self-efficacy for risk reduction (i.e., one's perception of his/her ability to successfully execute a proposed health behavior) was consistently inversely associated with injection risk (Avants *et al.*, 2000; Brown, 1998; Celentano *et al.*, 2002; Falck *et al.*, 1995; Gibson *et al.*, 1993; Longshore *et al.*, 1997; Longshore *et al.*, 2004; Racz *et al.*, 2007; Thiede *et al.*, 2007). A decrease in self-efficacy was found to predict increased syringe sharing at follow-up (Kang *et al.*, 2004). Low self-efficacy for convincing others to inject safely was also positively associated with increased paraphernalia sharing (Cox *et al.*, 2008).

Results of interventions targeting self-efficacy as a means of reducing injection risk behavior have been mixed. A multi-site, secondary prevention intervention trial among young HCV-positive, HIV-negative IDUs demonstrated significant intervention effects on distributive injection risk behaviors. In mediation analyses the experimental condition was significantly associated with increased self-efficacy, which was in turn associated with reduced distributive injection risk behaviors (Latka *et al.*, 2008). An IMB-based, non-experimental intervention among in-treatment IDUs found that self-efficacy to reduce drug-related risk behavior mediated the association between more distal factors (i.e., motivation, social norms, knowledge) and drug risk reduction outcomes (Copenhaver & Lee, 2006). A combined Motivational Interviewing and case management intervention among IDUs in Puerto Rico found a significant intervention effect on self-efficacy to reduce syringe sharing, but not on self-efficacy to stop pooling money to buy drugs or to stop sharing cotton (Robles *et al.*, 2004). Self-efficacy was associated with a reduction in syringe sharing that did not achieve statistical significance. Two small intervention studies among clients in MMP and outpatient drug treatment investigated intervention effects on self-efficacy for avoiding HIV via drug use (Sorensen *et al.*, 1994). Both found effects on self-efficacy to reduce drug-related risk behavior at post-test, but the effects were not sustained at 3-month follow-up. In the second study, however, the intervention effect was in an unexpected direction – a significant increase in self-efficacy was found in the control condition but not the

experimental condition. Overall, the intervention showed few effects on risky injection practices. In an IMB-based intervention, participants in both the control and intervention arms reported relatively high levels of drug-related self-efficacy, but there was no effect of time or condition (Avants *et al.*, 2004).

In sum, 16 studies examined at least one type of self-efficacy. In our review, eleven epidemiological studies noted that self-efficacy to reduce injection risk was inversely associated with injection risk. Findings from interventions designed to change self-efficacy resulted in effects in some domains of self-efficacy, though conclusions regarding the role of improved self-efficacy in mediating intervention effects were somewhat less robust.

Response Efficacy—Response efficacy (i.e., an individual's belief that engaging in a protective behavior will successfully avert the health threat) was examined in six studies. One small cross-sectional study among in-treatment, HIV-positive IDUs found that individuals who engaged in syringe sharing were less confident that not sharing injection equipment reduces HIV risk (Avants *et al.*, 2000), but others have found no association with injection risk behavior (Gibson *et al.*, 1993; Hartgers *et al.*, 1992; Jamner *et al.*, 1996; Longshore *et al.*, 1997; Longshore *et al.*, 2004). No changes in confidence that using new/cleaned needles reduces HIV transmission were detected in an IMB-based intervention study among in-treatment IDUs (Avants *et al.*, 2004). Response efficacy does not appear to be strongly associated with injection risk behaviors.

Perceived Susceptibility—The preponderance of findings suggests that perceptions of high susceptibility to HIV are associated with increased injection risk behavior (Booth, 1994; Falck *et al.*, 1995; Hartgers *et al.*, 1992; Longshore *et al.*, 2004; Racz *et al.*, 2007; Robles *et al.*, 1995). This positive association has been found in both cross-sectional and longitudinal studies. In a structural equation modeling analysis, perceived susceptibility had a positive indirect association with injection risk behavior (Longshore *et al.*, 2004). Though less common, others have found a negative association between perceived susceptibility or perceived risk of HIV and injection risk behavior (Bailey *et al.*, 2007; Smyth *et al.*, 2001; Smyth & Roche, 2007). In still other multivariate analyses, no association was detected between perceived vulnerability (Avants *et al.*, 2000), perceived susceptibility (Gibson *et al.*, 1993), or perceived risk of HIV/AIDS (Brown, 1998; Longshore *et al.*, 1997; Stein *et al.*, 2007) and injection risk behavior. In a study that assessed both personal susceptibility and perceived risk of unsafe sharing, frequency of bleaching injection equipment was associated with the perceived risk of unsafe sharing, but not susceptibility (Jamner *et al.*, 1996). Intervention studies designed to manipulate perceptions of susceptibility or vulnerability have had some success, with few ultimate effects on injection risk behavior (Avants *et al.*, 2004; Sorensen *et al.*, 1994). An evaluation of eight National Institute on Drug Abuse Cooperative Agreement intervention sites found that individuals who perceived a greater than 50% chance of contracting AIDS were more than twice as likely to share syringes at follow-up (Booth *et al.*, 1998). In sum, findings regarding perceptions of susceptibility to HIV/AIDS via drug injection have been mixed. Most studies found a positive association between high perceived susceptibility and injection risk behavior, while fewer found the theoretically-predicted negative association. Others found no association. Importantly, many studies reviewed here used different operational definitions of the construct, which may contribute to the varying results.

Perceived Severity—Perceived severity, or the individual's opinion of the seriousness of the illness in question and its consequences, is an important cognitive variable in several theoretical models, but has been examined by relatively few studies. Most studies have not identified strong associations between the construct and behavior (Brown, 1998; Hartgers *et al.*, 1992; Racz *et al.*, 2007) and no intervention studies reported attempting to manipulate

perceived severity. Longshore and colleagues (2004) did find that fear of AIDS, measured with a single item “Getting AIDS is just about the worst thing that could happen to me” had a significant indirect effect on injection risk behavior in one study, while a similarly worded question had no effect on syringe disinfection in another (Longshore et al., 1997).

Perceived Social or Subjective Norms—Perceived social or subjective norms represent the individual’s perception of his/her associates’ approval or disapproval of a behavior (i.e., normative beliefs), usually weighted by the individual’s motivation to comply with those normative beliefs. Social or subjective norms supporting safer injection practices have been found most frequently to be inversely associated with risky injection (Avants et al., 2000; Bailey et al., 2007; Jamner et al., 1996; Longshore et al., 1997; Longshore et al., 2004). In a sample of young IDUs from five U.S. cities, participants who reported that their peers were neutral or did not oppose syringe sharing were nearly three times as likely to report recent receptive syringe sharing than those whose friends were against syringe sharing (Bailey et al., 2007), and were four times as likely to share paraphernalia than those whose friends did not share (Thiede et al., 2007). Peer norms for sterile equipment use were not associated with injection risk among IDUs in Budapest, Hungary, however those who reported motivation to comply with peer pressure to share injection equipment were seven times as likely to share injection equipment (Racz et al., 2007).

In a large sample of not-in-treatment IDUs, observation of safer behavior among peers (e.g., “Do your shooting buddies always clean their used needles with bleach before shooting with a used needle?”) was associated with both less needle sharing and more needle cleaning in a sample of IDUs from Baltimore, Maryland (Hawkins et al., 1999). However, encouragement from peers to engage in safer behavior (e.g., “How many shooting buddies have encouraged you to clean your needles with bleach?”) was associated with *increased* reports of sharing unsterilized needles. The authors offer possible explanations for this finding, but due to the cross-sectional nature of the study design, these explanations could not be tested. Perceived peer behavior, measured by asking participants whether their shooting buddies clean their injection equipment, could represent SCT’s “observational learning” construct. It could also represent a variety of perceived norm described as a “descriptive norm” (Davey-Rothwell & Latkin, 2007). Though social norms regarding injection practices appear to be important predictors of behavior, attempts to manipulate them alone (Avants et al., 2004) or as part of a higher-order motivation factor (Margolin et al., 2003) have had limited success. The effect of social motivation to reduce drug risk was indirectly associated with risk reduction behavior in one non-experimental trial (Copenhaver et al., 2006).

Knowledge—Knowledge about the risk of HIV or HCV infection via drug injection was found to have a negative association with risk behavior in two studies based in Thailand and Australia (Saelim et al., 1998; White et al., 1994). Young IDUs in five U.S. cities who believed that HIV/HCV transmission via paraphernalia sharing was unlikely were more likely to share paraphernalia than those who believed such transmission was likely (Thiede et al., 2007). No association with injection risk behavior was found in eight other studies based both in the U.S. and abroad (Avants et al., 2000; Celentano et al., 2002; Cox et al., 2008; Gibson et al., 1993; Peters et al., 1998; Sarkar et al., 1995; Smyth et al., 2001; Stein et al., 2007). Some propose that knowledge is a necessary, but not sufficient condition for behavior change and that its effect is mediated by other constructs (Catania et al., 1990; Fisher & Fisher, 1992). In support of this view, three studies based in the U.S. have found indirect associations between knowledge and behavior, mediated by variables such as self-efficacy, personal motivation, and behavioral intentions (Copenhaver & Lee, 2006; Longshore et al., 1997; Longshore et al., 2004). Others have found exposure to AIDS-prevention information to be associated with intentions to clean syringes, but not with the frequency of actually cleaning syringes (Jamner et al., 1996).

In a non-experimental intervention trial among MMP patients, an IMB-based intervention showed significant intervention effects on overall drug-related outcomes, driven primarily by an improvement in knowledge scores (Copenhaver *et al.*, 2007). Two other IMB-based intervention studies have succeeded in changing HIV knowledge, however neither demonstrated a strong intervention effect on injection risk behavior (Avants *et al.*, 2004; Sorensen *et al.*, 1994). Another IMB-based intervention found a marginally-significant Time $\times$ Treatment interaction for effects on HIV transmission knowledge (Margolin *et al.*, 2003). In sum, HIV knowledge appears to be associated with risky behavior in some studies, and analyses that account for indirect or mediated effects may be more likely to detect such an association. Increasing knowledge may be an important component of interventions but may be insufficient to change behavior in the absence of other factors.

Behavioral Skills—The concept of behavioral skills is usually assessed as a combination of actual skills (e.g., communication or assertiveness) and self-efficacy, or one's belief in one's ability to use those skills. Communication skills to negotiate safer behavior and demonstrable risk reduction skills were examined in two observational studies, which found associations between increased behavioral skills and reduced injection risk behavior (Avants *et al.*, 2000; Gibson *et al.*, 1993). Three interventions attempted to manipulate behavioral skills. In the first, in-treatment IDUs assigned to the experimental condition succeeded in increasing needle-cleaning skills compared to a control condition, however there was no intervention effect on injection risk behavior (Avants *et al.*, 2004). In the second, also among in-treatment IDUs, participants in the experimental condition were less likely than controls to report needle sharing and significantly improved both syringe cleaning and condom use skills relative to those assigned to control (Margolin *et al.*, 2003). In the third, syringe disinfection skills improved for both conditions at post-test, but there was no statistically significant intervention effect (Sorensen *et al.*, 1994). In sum, while only examined in a few studies, it appears that interventions may succeed in improving behavioral skills. However, more evidence may be required to support an association between improved behavioral skills and ultimate reductions in risk behavior.

Behavioral Intentions—Behavioral intentions are theorized to be the most proximal predictor of health behavior. Intentions, in turn, are predicted by one's attitudes towards the behavior and subjective norms regarding the behavior.

Behavioral intentions have received mixed support in the literature attempting to explain injection risk behavior. Some investigators have found no effect of intentions on subsequent injection risk behavior (Hartgers *et al.*, 1992; Longshore *et al.*, 1997). Others have found support for a strong negative effect of intentions to reduce risk on subsequent risk behavior (Longshore *et al.*, 2004) and support for the effect of increased motivation (comprised of behavioral intentions and perceived social norms) on self-efficacy for risk reduction (Copenhaver & Lee, 2006). The role of perceived behavioral control as a potential moderator of the effects of intentions on behavior is one possible explanation for inconsistent findings regarding this construct – intentions may only influence behavior if the individual has the ability to perform the behavior (Ajzen, 1991).

Perceived Barriers, Benefits, and Behavioral Control—Perceived barriers to safer behavior represent perceptions of those social or environmental factors that inhibit or constrain the practice of a safer behavior. Perceived benefits, on the other hand, represent an individual's opinion of the efficacy of the recommended health behavior to reduce the threat of disease (Strecher & Rosenstock, 1997). This construct is similar to response efficacy (described above), in which an individual assesses the likelihood that the recommended action will succeed in averting the threat. It is also similar to the construct of outcome expectancies that is described in the SCT as the value placed on a particular outcome

(Bandura, 1986; Baranowski *et al.*, 1997). Perceived behavioral control describes the ability that an individual feels he/she has to perform the behavior in question and to overcome impediments or barriers to its performance (Ajzen, 1991).

The most commonly investigated costs of or barriers to safer injection are difficulty accessing sterile injection supplies and social sanctions for engaging in safer behavior. In a sample of IDUs from Montreal, Canada, difficulty injecting safely due to lack of equipment was associated with syringe sharing (Cox *et al.*, 2008). In the same study another measure of barriers, the detrimental effect of not sharing on personal relationships, was not associated with the behavior in multivariate analysis. In a study employing the HBM, associations were found between inconvenience in accessing sterile syringes and violation of social norms due to a refusal to share and other HBM constructs such as self-efficacy or perceived susceptibility, but not with injection risk behavior (Falck *et al.*, 1995). Others have found no associations between perceived barriers and injection risk behavior in multivariate analysis (Racz *et al.*, 2007; Stein *et al.*, 2007).

In the same Montreal sample, perceived benefits of injecting with sterile equipment were associated with reduced syringe and paraphernalia sharing (Cox *et al.*, 2008). Like perceived barriers, perceived benefits were also associated with other constructs in an HBM-based study, including self-efficacy and perceived seriousness of HIV/AIDS, but not injection risk behavior (Falck *et al.*, 1995). Still others have found no association between perceived benefits and injection risk behavior (Racz *et al.*, 2007; Stein *et al.*, 2007). In one study with exclusively female participants, not feeling in control over the injection episode (perceived behavioral control) was marginally associated with injection risk behavior (Tortu *et al.*, 2003).

In sum, four studies measured perceived barriers and/or benefits. Findings were largely mixed, though in the expected direction when associations were detected. One study examined perceived behavioral control and found a marginal association with injection risk behavior.

V. Discussion

In summary, CBTs contain several constructs that are theorized to predict health behavior. In the context of injection risk behavior, some have received more empirical support than others. We found strong and fairly consistent support for the role of some cognitive constructs in explaining injection risk behavior (e.g., self-efficacy, social norms). For others, we found mixed results (e.g., perceived susceptibility, knowledge, behavioral skills, behavioral intentions, perceived barriers, perceived benefits), while still others have received comparatively less attention (e.g., response efficacy, perceived severity, perceived behavioral control). Overall, findings from intervention studies designed to change these theorized predictors of behavior, when available, were mixed, though some CBT-based interventions did yield significant reductions in injection risk behavior.

Several explanations may be put forth for the mixed findings regarding some constructs. First, there have been inconsistencies in the operationalization of the theories, including theoretical constructs, dependent variables, and the comprehensiveness with which theories are employed. Second, a growing literature emphasizes the need to contextualize findings from CBT studies within the larger “risk environment” in which injection risk behavior is “produced and reproduced” (Rhodes, 2002). No studies we reviewed explicitly controlled for environmental conditions. Under conditions where environmental influences are, relatively speaking, stronger than cognitive behavioral constructs, modest effects of CBT constructs would be expected.

Inconsistencies in the operationalization of theories and theoretical constructs

To some extent, the inconsistencies in findings from the studies reviewed here may have to do with the different ways in which variables are operationalized, assumptions made in the statistical modeling process, or the differing extent to which theoretical models are employed. Several CBTs employ constructs with a large degree of overlap (Bandura, 2004; Wallston & Wallston, 1984). For example, the IMB's concept of "motivation" is comprised of response efficacy, social norms, perceived susceptibility, and perceived rewards. Therefore, it is somewhat difficult to tease out the relative effects of these individual constructs.

Perceived susceptibility, in particular, has yielded inconsistent results. In some studies there appears to be a positive association between high perceived susceptibility to HIV and increased risk behavior (Booth, 1994; Booth et al., 1998; Falck et al., 1995; Hartgers et al., 1992; Longshore et al., 2004; Racz et al., 2007; Robles et al., 1995). In cross-sectional studies, this positive association may demonstrate an accurate assessment of risk (Kowalewski et al., 1997). The HBM theorizes that higher perceptions of susceptibility should predict less risk behavior in the future. However, fewer studies reviewed here found the association in the expected direction (Bailey et al., 2007; Smyth et al., 2001; Smyth & Roche, 2007), and few longitudinal studies have examined the role of perceived susceptibility in changing subsequent behavior. As has been discussed by others (Kowalewski et al., 1997; Strecher & Rosenstock, 1997), the underlying concept of perceived susceptibility has been measured differently, possibly leading to variations in results. Longshore and colleagues (2004) measured both perceived susceptibility and perceived risk of infection. Perceived susceptibility to AIDS was defined as a *general* susceptibility, while perceived risk of infection was defined as the risk associated with *specific behaviors*. In their analysis, perceived susceptibility was associated with weaker risk reduction intentions and greater risk behavior at follow-up, while perceived risk of infection associated with specific behaviors was not associated with risk behavior at baseline or follow-up. Other studies in this review measured perceived risk in terms of a general susceptibility to AIDS (e.g., "How likely are you to develop AIDS?"), while still others operationalized perceived susceptibility as a mix of general and specific questions (e.g., "I am at risk of HIV" and "Due to my injecting drug use I may get HIV"). While clearly an important theoretical correlate of behavior, more work is needed to determine which conceptualization of the construct is most useful.

In addition, differences in the measurement of the dependent variable, injection risk behavior, may contribute to divergent findings. HIV-related injection risk behaviors have been measured multiple ways in the literature, including the use of study-specific items measuring the frequency of individual behaviors on Likert-type response scales (e.g., Longshore et al., 2004), individual items measuring behavior as a series of dichotomous items (e.g., Robles et al., 1995), and scales such as the Risk Behavior Assessment or Risk Assessment Battery, either used in their entirety (e.g., Falck et al., 1995), or as a smaller subset of items (e.g., Stein et al., 2007). The convention of measuring injection risk behavior as a dichotomous "any" versus "no" risk in a specified time period may be particularly difficult, since the injection of some types of drugs (e.g., opioids) occurs many times per day, every day. Given the frequency with which injection drug use occurs, the most proximal predictors of injection risk behavior may vary for each injection episode. Additionally, the statistical distribution of these variables often makes the use of analytic methods assuming normally-distributed variables problematic.

Though seldom investigated, it is also possible that non-linear associations exist between independent and dependent variables. Thresholds after which the independent variable no longer influences injection risk behavior may be an important consideration for future

studies dedicated to fine-tuning our understanding of the influence of cognitive constructs. Though few theories provide guidance for modeling non-linear effects, there are some that provide hypotheses about effect modification (i.e., interactions between constructs) that are also rarely modeled. For example, the PMT hypothesizes an interaction, or “boomerang effect”, between perceived vulnerability and response efficacy (Rogers, 1983).

It is also possible that interactions with other variables such as drug treatment involvement, HIV status, or the perceived (or known) HIV status of injection partners may influence the main effects of cognitive constructs. Of particular interest is the influence of known (or suspected) HIV status on HIV cognitions and risk behavior. While one’s HIV status may influence many of the HIV cognitions discussed here, we will focus specifically on perceived susceptibility for illustrative purposes. It is presumed that someone who knows he/she is infected with HIV will perceive less susceptibility to HIV infection via syringe sharing than someone who believes that he/she is HIV negative. In addition to having different baseline levels of susceptibility, it is also possible that perceptions of susceptibility influence injection risk behavior differently for HIV-positive and HIV-negative individuals, suggesting an interactive effect that has yet to be assessed. Some studies reviewed here restricted enrollment to HIV-negative individuals (Bailey et al., 2007; Hartgers *et al.*, 1992; Longshore et al., 1997; Longshore et al., 2004); two found positive associations, one found a negative association, and one found no association between perceived susceptibility, risk or vulnerability and risk behavior. In the one study that restricted enrollment to HIV-positive IDUs, no association was found between perceived likelihood of transmitting HIV or becoming reinfected and injection risk behavior (Avants et al., 2000). The majority of studies reviewed here enrolled samples with mixed serostatus, and most explicitly controlled for HIV status in multivariate analyses. Of these, five found positive associations, one found a negative association, and four found no association between susceptibility and risk behavior. One factor complicating conclusions is whether participants are aware of their own serostatus. Neither Tortu and colleagues (2003) nor Sarkar and colleagues (1995) found associations between awareness of HIV serostatus and injection risk behavior, though other larger studies have reported reduced transmission behavior among seroaware HIV-positive IDUs (Des Jarlais *et al.*, 2004). Another complicating factor is the known or suspected HIV serostatus of the injection partner; a partner who is known to be HIV positive might be perceived as a greater risk than one whose status is unknown or known to be HIV negative. It appears that the confounding or effect modifying influence of HIV serostatus on the association between HIV cognitions and injection risk behavior remains unclear.

A less significant issue in this stage of the epidemic, but one still relevant for interpreting earlier studies, is confusion surrounding the terms HIV and AIDS. Particularly in the early years of the epidemic, but still true today, many laypeople use the terms interchangeably. Some early studies asked variations of the question, “How likely do you think you are to develop AIDS?” (e.g., Booth, 1994; Robles et al., 1995). This question has a different meaning for someone who believes he/she is HIV-negative, than for someone who believes he/she is HIV-positive. With the success of Highly Active Anti-Retroviral Therapy (HAART) in delaying the onset of AIDS for many years, the time between acquiring HIV infection and developing AIDS has increased dramatically. However, in early studies that assessed the risk of acquiring AIDS and/or HIV, the meaning of the construct may be slightly different. Similarly, studies have found discrepancies between self-reported HIV status and HIV test results among IDUs (Latkin & Vlahov, 1998; Strauss *et al.*, 2001). Underreported HIV infection among HIV-positive IDUs may be due to failure to understand testing results, or failure to obtain previous testing results (Fisher *et al.*, 2007).

While it is to be expected that the definition of concepts and the precision of analyses will improve as the scientific literature grows, it has been noted elsewhere that existing

differences make comparison of the findings from some studies difficult (Kowalewski *et al.*, 1997). Future psychometric studies employing factor analysis methods to more clearly differentiate between various measures of similar constructs, and more sophisticated analysis techniques that account for non-linear associations and effect modification will be required to more precisely model the constructs that are theoretically important in predicting injection risk behavior.

Finally, there is a tendency to selectively employ some, but not all, of the constructs included in CBT models. While many empirical studies cite their theoretical orientation, it is rare to find a study that both measures all the relevant constructs and assesses their associations according to the recommendations of the theory. As such, it is difficult to evaluate whether inconsistent findings are due to a failure of the theory or a failure of study design, and is also difficult to evaluate which theory has the best predictive potential.

Need to integrate social, structural, and environmental context of behavior

More than fifteen years ago, Hartgers et al. (1992) concluded that “social cognitive factors contribute little to the prediction of safe injecting, possibly because, through situational factors and drug use habits...IDUs have little control over their injecting risk behavior.” And, more recently, Rhodes and colleagues (2005) found that individual-level interventions that do not account for environmental influences account for approximately 25% to 40% reductions in injection risk behavior. Though we have observed dramatic decreases in both injection risk behavior and HIV prevalence in some areas since the advent of the HIV epidemic (Des Jarlais & Semaan, 2008), injection risk behavior persists, and the task of developing even more effective interventions remains. It has been proposed that the way forward lies in integrated interventions that account for both individual- and environmental-level factors (Metzger & Navaline, 2003).

Some theories may be more amenable than others to helping researchers integrate cognitive and environmental constructs. For example, SCT, which highlights the “reciprocal determinism” among environment, person, and behavior (Bandura, 1986), provides one framework for this type of understanding. Empirical studies of injection risk behavior employing SCT have generally measured self-efficacy and perceived social norms. Findings from this review suggest that both self-efficacy and perceived social norms are, in fact, strong and consistent correlates of injection risk behavior. The social environment is only one aspect of the broader environmental context in which risk behavior occurs. Others include the physical, economic, and political (Rhodes, 2002). Environmental factors such as legal jeopardy and threat of incarceration for carrying injection supplies (Burris *et al.*, 2004; Friedman *et al.*, 2006; Martinez *et al.*, 2007), drug market conditions that create economic interdependence (Koester *et al.*, 2005; Needle *et al.*, 1998), poverty, and homelessness (Des Jarlais *et al.*, 2007a) have all been shown to influence injection risk behavior, and could be measured in addition to the social environment.

The reinforcing properties of these environmental factors may serve to inhibit or perpetuate injection risk behavior. If they are not included in statistical models designed to determine the association between cognitive constructs and behavior, their influence may confound the association between cognitions and behavior, leading to inconsistencies or difficulties in interpretation. Further, the effects of environmental factors may moderate the association between cognitions and behavior, such that influence of cognitive constructs (e.g., perceived susceptibility) on behavior is only detectable in the presence or absence of certain environmental conditions (e.g. threat of incarceration for carrying syringes). The use of integrative models may hold promise as researchers seek to further elucidate those factors that perpetuate injection risk behaviors in the presence of existing interventions.

V. Conclusions

Evidence for the ability of cognitive constructs to explain the “residual injection risk behavior” (Des Jarlais et al., 2007b) that persists in the third decade of the HIV epidemic is still being accumulated and shows variable success, though there is strong evidence that some cognitions are associated with behavior. At the same time, structural interventions are being discussed as the next wave of intervention possibilities (Blankenship et al., 2006; Rhodes et al., 2005). Future studies will benefit from an explicit integration of individual- and environmental-level constructs, and an attention to the social and structural environmental factors that prohibit IDUs from engaging in risk reduction. The use of theoretical constructs such as perceived social norms and perceived barriers and benefits, which measure the perceived social and structural environment can be one step towards integrating cognitive behavioral and structural or environmental models.

Implications for Practice

This integration has direct implications for the design of interventions that target both cognitive constructs and the risk environment. Comprehensive HIV prevention programs that provide services such as permanent supportive housing, legal advocacy, case management, referrals to drug detoxification and treatment *in addition* to theoretically-based HIV prevention programming for IDUs can simultaneously address HIV-related cognitions, social norms, and environmental barriers to behavior change. For example, an intervention that provided HIV counseling and testing, case management, and motivational interviewing to enhance self-efficacy was effective in increasing entry into drug treatment, discontinuing drug injection, and reducing needle sharing (Robles et al., 2004). Amendments to existing paraphernalia laws or policing tactics that target drug users for harassment, arrest, and incarceration could also remove significant barriers to safer injection. A combination of developing pro-health cognitions via behavioral intervention while simultaneously reducing the environmental barriers to safer behavior and amending perceived social norms is hypothesized to lead to greater intervention effects than either strategy would alone.

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VII. References

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Epidemiological studies using cognitive behavioral theories or theoretical constructs to examine injection risk behavior.

Table 1

Study	Year	Sample	Theoretical Foundation	Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest
Cox et al.	2008	N=321 IDUs in Montreal, Canada (70% male, mean age 33 years)	ARRM	HCV knowledge Severity Susceptibility/vulnerability Peer norms Benefits Barriers Self-efficacy for risk reduction Self-efficacy to convince others to reduce risk	SS, PS	SS associated with: -Difficulty injecting safely due to lack of equipment (+) -Benefits for self and others from injecting safely (-) PS associated with: -Benefits for self and others from injecting safely (-) -Self-efficacy to convince others to inject safely (-)
Bailey et al.	2007	N=2420 young IDUs in 5 U.S. cities (n=568 at follow-up) (69% male; median age 24 years)	IMB SLT	Peer norms Perceived risk of HIV/HCV	SS	SS at baseline associated with: -Perception that peers are neutral or not against SS (+) -Perceived risk of HIV from SS (-) SS at follow-up associated with: -Perception that peers were not against SS (+) -Perceived risk of HCV from SS (-)
Racz et al.	2007	N=150 IDUs in Budapest, Hungary (75% male; mean age 23 years)	HBM TRA/TPB	Perceived susceptibility Perceived severity Perceived benefits Perceived barriers to obtain sterile needles Self-efficacy Perceived peer norms Motivation to comply with peer norms	SS, PS	SS associated with: -Perceived susceptibility (+) -self-efficacy for sterile equipment use (-) -Motivation to comply with peer norms for SS (+).
Stein et al.	2007	N=59 HCV-negative IDUs in Rhode Island, U.S.A (75% male; mean age 34 years)	HBM	HCV knowledge (including severity) Social network benefit Perceived personal risk (susceptibility) Emotional pressure to share (barrier) Perceived access to clean needles (barrier)	SS, PS	In multivariate analysis, no individual predictors associated with risk behavior.
Thiede et al.	2007	N=1438 young IDUs in 5 U.S. cities (55% male; median age 15-19 years)	SLT IMB	Knowledge of HIV/HCV transmission Self-efficacy for avoiding PS Peer norms for PS	PS	PS associated with: -Having friends who shared (+) -Low self-efficacy for avoiding sharing (+) -Knowledge of HIV/HCV transmission (-)
Parviz et al.	2006	N=242 IDUs in Karachi, Pakistan	none stated	HIV knowledge	SS	SS associated with:

Study	Year	Sample	Theoretical Foundation	Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest
Smyth & Roche	2007	(100% male) N=246 in-treatment, HCV-negative IDUs in Dublin, Ireland (60% male; median age 22 years)	none stated	Perceived risk of SS with acquaintances Social distance	SS Preparedness to share in the future	-HIV transmission knowledge (-) SS associated with: -Perceived risk of SS (-) -Less social distance from partner Preparedness to share in the future associated with: -Perceived risk in borrowing from sex partners and close friends (-)
Kang et al. §	2004	N=952 IDUs and crack smokers in New York City, New York, U.S.A. (n=617; 70% male; mean age 39 years) and Bayamon, Puerto Rico (n=335; 78% male; mean age 34 years).	SCT	Self-efficacy for risk behavior (change over time)	Receptive SS Distributive SS PS	SS at follow up associated with: -Negative change in self-efficacy (+, vs. no or positive change in self-efficacy).
Longshore, Stein, and Conner§	2004	N=294 in-treatment HIV-IDUs (70% male; mean age 45 yrs)	AARM	AIDS Knowledge Perceived susceptibility to AIDS (due to past behavior) Fear of AIDS Peer norms for risk reduction Perceived risk of infection (from specific behaviors) Response efficacy Self-efficacy Intended risk reduction	Injection Risk Behavior (syringe-mediated drug splitting, PS, SS)	Risk behavior associated with risk reduction intention (-) Indirect effects on risk behavior: -Susceptibility (+) -Knowledge (-) -Fear of AIDS (-) -Peer norms (-) -Self-efficacy (-)
Tortu et al.	2003	N=185 IDUs in New York City, New York, U.S.A. (0% male; median age 39 years)	TRA*	Perceived Barriers Perceived Control	SS, PS Syringe-mediated drug splitting	Unsafe injection associated with: -Lack of control over injection (+, p=0.06) Association between perceived barriers and unsafe injection not assessed.
Celentano et al. §	2002	N=792 IDUs in Baltimore, Maryland, U.S.A. (79% male; median age 38 years)	ARRM	Self-efficacy for cessation and safer injection HIV knowledge	Frequency of injection SS, PS Shooting gallery use Disinfection of injection equipment	Self-efficacy for cessation associated with follow-up outcomes: -Any drug injection (-) -Daily injection (-, p=0.06) -SS (-, p=0.05)
Smyth, Barry & Keenan	2001	N=246 in-treatment IDUs	none stated	Perceived risk of SS with acquaintances.	SS	SS associated with: -Perceived risk in borrowing from

Study	Year	Sample	Theoretical Foundation	Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest
		in Dublin, Ireland (60% male; median age 22 years)		HCV knowledge.		acquaintances (-, extremely dangerous vs. not).
Avants et al.	2000	N=50 in-treatment, HIV+ IDUs in Connecticut, U.S.A. (74% male; mean age 42 years)	IMB	Risk reduction intention HIV risk knowledge Motivation: -Response efficacy -Social norms -Perceived likelihood of transmitting or becoming reinfected -Pleasurability of condoms Behavioral skills: -Observation of skills -Difficulty level of risk-reduction behavior Self-efficacy Stage of Change	SS, PS	In bivariate analysis, drug risk behavior since learning of HIV+ status associated with: -Response efficacy (-) -Social norms (-) -Self-efficacy for negotiating safe injection (-). In multivariate analysis: Drug risk in past 30 days associated with: -Behavioral skills (-) -Motivation (-)
Hawkins et al.	1999	N=642 IDUs in Baltimore, Maryland, U.S.A. (83% male; median age 40 years)	SCT Social Network Theory	Peer norms (verbal persuasion) Perceived peer behavior (modeling; observed behavior)	SS Syringe cleaning	SS associated with: -Peer encouragement to clean needles (+, males) -Perceived peer behavior (-, males and females) Syringe cleaning associated with: -Perceived peer behavior (+, males and females)
Brown	1998	N=140 in-treatment or SEP-attending IDUs in New York City, New York, U.S.A. (0% male; mean age 35 years)	HBM SCT	AIDS risk perception Perceived seriousness of HIV Drug use self-efficacy Social support	SS Risky injection location	SS and injecting in risky location associated with: -Self-efficacy for safer drug use (-)
Peters, Davies, & Richardson	1998	N=480 in- and out-of-treatment IDUs in Edinburgh, Scotland (72% male; median age 27 years)	none stated	HIV knowledge	Receptive SS Distributive SS Inadequate disinfection	SS not associated with HIV knowledge.
Saelim et al.	1998	N=298 in-treatment IDUs in southern Thailand	none stated	Attitude towards risk of HIV infection	SS	SS associated with: -HIV knowledge (-)

Study	Year	Sample	Theoretical Foundation	Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest
Longshore, Stein, and Anglin [§]	1997	(100% male) N=136 in-treatment, HIV- IDUs in Los Angeles, California, U.S.A. (47% male; mean age = 38 years)	ARRM	HIV knowledge Perceived infection risk Aversive emotion about AIDS External cues to action Peer norms for risk reduction AIDS knowledge Response efficacy Self-efficacy for risk reduction Behavioral intention (needle cleaning)	Syringe disinfection	-Carefree attitude towards HIV risk (-) Syringe disinfection at follow-up associated with: -Self-efficacy (+) Self-efficacy associated with: -Perceived infection risk (-) -Peer norms for risk reduction (+) -Knowledge (+)
Janner, Corby & Wolitski	1996	N=443 IDUs in Long Beach, California, U.S.A. (62% male; modal age 31-40 years)	TRA/TPB * IMB *	Attitudes towards bleaching Social Norms Perceived behavioral control Perceived susceptibility Response efficacy Perceived risk of unsafe sharing Exposure to AIDS prevention information	Intentions to bleach Frequency of bleaching	Intentions and frequency of bleaching associated with: -Attitudes (+) -Social norms (+) -Perceived behavioral control (+) -Perceived risk of unsafe sharing (+). Intention (but not frequency) associated with: -Exposure to AIDS-prevention information (+)
Falck et al.	1995	N=118 IDUs in Columbus and Dayton, Ohio, U.S.A. (76% male; median age 31- 40 years)	HBM	Perceived Susceptibility Seriousness Benefits Barriers Self-efficacy	Frequency of drug injection and syringe use behaviors	Safer injection associated with: -Self-efficacy (+) -Susceptibility (-)
Robles et al. [§]	1995	N=1740 IDUs in Puerto Rico (80% male; median age 25- 34 years)	none stated	Perceived risk of AIDS	SS, PS Injection in shooting galleries Syringe disinfection	High perceived risk of getting HIV prospectively associated with: -Sharing syringes (+) -Sharing cookers (+) -Using shooting galleries (+)
Sarkar et al.	1995	N=488 in- treatment or incarcerated IDUs in Manipur, India (99% male; median age 26 years)	none stated	HIV knowledge	SS	SS not associated with knowledge of HIV transmission or serostatus
Booth	1994	N=378 IDUs in Denver, Colorado, U.S.A. (69% male; mean age 38 years)	HBM*	Perceived chance of getting AIDS (susceptibility) Exposure to AIDS interventions	SS	SS associated with: -Perceived chance of getting AIDS (+) -Exposure to AIDS interventions (-)
White et al.	1994	N=193 in- treatment IDUs	none stated	HIV knowledge	Risky injection	Risky injection associated with: -HIV knowledge (-)

Study	Year	Sample	Theoretical Foundation	Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest
Gibson et al.	1993	in Australia N=226 in- and out-of-treatment IDUs (67% male; median age 30-39 years)	HBM	AIDS knowledge AIDS anxiety Perceived susceptibility Self-efficacy Response efficacy Communication skill in negotiating safe syringe practices	SS	SS associated with: -Self-efficacy (-)
Hartgers et al. §	1992	N=92 HIV-IDUs in Amsterdam, Netherlands (60% male; mean age 33 years)	PMT	Perceived severity of HIV Perceived vulnerability to HIV Response efficacy Self-efficacy Behavioral intention to inject safely	Injection risk: Borrowed syringe but did not disinfect Borrowed and disinfected Did not borrow	Safe injection associated with: -Participation in SEP (+) -Perceived vulnerability (-)

* Theoretical foundation not stated, but implied by selection of constructs

§ Note: Demographic summaries provided where available. Study design is cross-sectional unless noted. HIV serostatus of sample is mixed, unless noted in sample description. SS = Receptive Syringe Sharing. PS = Paraphernalia Sharing.

Table 2

Intervention studies using cognitive behavioral theories or theoretical constructs to change injection risk behavior.

Study	Year	Sample	Study Design	Theoretical Foundation	Relevant Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest and Drug-related Outcomes
Latka et al.	2008	N=418 HIV+ and HCV+ IDUs in 3 U.S. cities (77% male, mean age 27 years)	RCT, with assignment to 6-session peer mentoring or attention control conditions.	SCT	Behavioral skills HCV knowledge Engaging in peer mentoring Self-efficacy	Injection risk behavior (distributive SS, syringe re-use, PS, injection drug use)	At 3-month follow-up, experimental condition associated with reduction in: -Distributive SS ($p=0.07$) -Syringe re-use -PS -Cessation of injection Only PS sustained at 6-month follow-up. Intervention associated with increased self-efficacy, which was associated with less distributive risk behavior at 3-month follow-up.
Copenhaver & Lee Copenhaver et al.	2006 2007	N=226 in-treatment IDUs in New Haven, Connecticut, U.S.A. (51% male; mean age 39 years)	Non-experimental, intervention pre-post with no control group.	IMB	HIV-risk reduction knowledge Motivation: Behavioral intentions Perceived social norms Self-efficacy	Frequency of IDU SS, PS Syringe cleaning	Significant intervention effects on drug-related risk reduction outcomes, driven by improvements in knowledge. In SEM analysis, drug-risk reduction associated with self-efficacy (+) Personal motivation associated with self-efficacy (+) Social motivation (social norms) to reduce drug risk (+) and information (knowledge) (+) associated with personal motivation.
Avants et al.	2004	N=220 in-treatment IDUs (~67% male; mean age ~37 years)	RCT with assignment to standard care or 12-session Harm Reduction Group (HRG)	IMB	HIV transmission Knowledge Motivation: Intentions to reduce risk -Social norms for using bleach -Perceived difficulty of difficulty of bleaching -Response efficacy -Perceived vulnerability Behavioral skills: -Observed skills -Self-efficacy	Drug use SS, PS Re-use of syringes	Intervention associated with: -Abstinence from cocaine -Drug-related HIV risk reduction knowledge -Improvement in syringe cleaning skills No intervention effects for SS or self-efficacy. Perceived difficulty of using sterile needles decreased in both groups, and vulnerability to HIV increased in both groups. Intention to use sterile syringes increased in both groups. No change in importance of using sterile needles in social network (social norms), or response efficacy of using sterile needles.
Robles et al.	2004	N=557 out-of-treatment IDUs in Vega Baja,	RCT with assignment to 2-session HIV counseling/testing	none stated	Self-efficacy to change Self-efficacy to avoid needle or	SS, PS, Discontinuation of drug use Drug treatment	Experimental condition associated with: -Greater entry into drug treatment -Greater discontinuation of drug

Study	Year	Sample	Study Design	Theoretical Foundation	Relevant Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest and Drug-related Outcomes
Margolin et al.	2003	Puerto Rico (89% male; modal age 25-34 years)	only, or HIV counseling/testing plus 6-session Motivational Interviewing and case management intervention.	IMB	sexual risk behavior	entry Pooling money to buy drugs	injection -Reduction in SS among those who continued to inject -Increased self-efficacy to refuse to share needles Self-efficacy to refuse to share needles associated with non-significant reduction in SS ($p>0.05$) Experimental condition (HHRP+) associated with: -Greater reductions in rates of overall sex and drug risk behaviors -Greater improvements in sex and drug-related behavioral skills -Lower rates of non-adherence to antiretroviral therapy -Greater reduction in addiction severity -Greater reduction in opiate use Marginal intervention effect on drug-related knowledge, no effect on motivation.
Booth, Kwiatkowski & Stephens	1998	N=3743 IDUs from eight U.S. cities (71% male; mean age 39 years)	RCTs with assignment to NIDA/CA standard intervention, or the standard intervention plus site-specific enhanced intervention.	HBM Communication Theory Efficacy Theory	Perceived risk of getting AIDS HIV serostatus Exposure to prior HIV interventions	Cessation of injection Frequency of injection Injection SS, PS Entry into drug treatment	Significant reductions in: -frequency of injection -SS -PS Intervention associated with: -Cessation of injection -Entry into drug treatment Perceived risk of getting AIDS associated with maintaining or increasing high-risk behaviors.
Sorensen et al.	1994	Study 1: N=50 in-treatment IDUs in San Francisco, California, U.S.A. (66% male; mean age 41 years) Study 2: N=98 in-treatment IDUs in San Francisco, California, U.S.A. (65% male; mean age 37 years)	RCT with assignment to 6-session small group Psychoeducational intervention or information condition.	Health psychology	AIDS knowledge: -Factual knowledge -Knowledge of AIDS risk reduction Susceptibility to AIDS Anxiety about AIDS Response efficacy Self-efficacy Communication skills Demonstrable skills	SS Frequency of drug use Use of sterilized needles	Study 1: At post-test, intervention associated with: -Factual knowledge about AIDS -Drug-related self-efficacy At 3-month follow-up, intervention associated with: -Factual knowledge about AIDS -AIDS anxiety Both groups maintained low rates of drug use and SS Study 2: At post-test, intervention associated with: -Factual knowledge of AIDS -Self-efficacy (comparison > experimental) At 3-month follow-up, intervention associated with: -Perceived susceptibility to AIDS

Study	Year	Sample	Study Design	Theoretical Foundation	Relevant Theoretical Constructs	Main Drug-related Outcome	Significant Findings Related to Theoretical Constructs of Interest and Drug-related Outcomes
-No effect on SS. However, two outliers strongly influenced results.							

Note: Demographic summaries provided where available; HIV status of sample is mixed unless noted in demographic summary. SS = Receptive Syringe Sharing. PS = Paraphernalia Sharing. RCT = Randomized Controlled Trial. Only constructs and outcomes relevant to injection-related risk are shown.