

Relationship Characteristics and Dyadic Approaches to HIV Health-Enhancing Behaviours Among a Sample of Same-Sex Male Couples From Three U.S. Cities

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Recent modelling estimates up to two-thirds of new HIV infections among men who have sex with men occur within partnerships, indicating the importance of dyadic HIV prevention efforts. Although new interventions are available to promote dyadic health-enhancing behaviours, minimal research has examined what factors influence partners' mutual engagement in these behaviours, a critical component of intervention success. Actor-partner interdependence modelling was used to examine associations between relationship characteristics and several dyadic outcomes theorised as antecedents to health-enhancing behaviours: planning and decision making, communication, and joint effort. Among 270 male-male partnerships, relationship satisfaction was significantly associated with all three outcomes for actors ($p = .02, .02, .06$ respectively). Latino men reported poorer planning and decision making (actor $p = .032$) and communication (partner $p = .044$). Alcohol use was significantly and negatively associated with all outcomes except actors' planning and decision making (actors: $p = .11, .038, .004$ respectively; partners: $p = .03, .056, .02$ respectively). Having a sexual agreement was significantly associated with actors' planning and decision making ($p = .007$) and communication ($p = .008$). Focusing on interactions between partners produces a more comprehensive understanding

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of male couples' ability to engage in health-enhancing behaviours. This knowledge further identifies new and important foci for the tailoring of dyadic HIV prevention and care interventions.

■ **Keywords:** health disparities, dyad, sexual minority health, MSM

Men who have sex with men (MSM) demonstrate an increased incidence of HIV infection, higher than any other group in the United States (Centers for Disease Control and Prevention, 2015; Hall et al., 2017). The risk of HIV acquisition has traditionally been viewed in terms of risk stemming from casual sexual encounters. Recent modelling work suggests approximately 33–66% of new HIV infections among MSM occur from primary male partners (Goodreau et al., 2012; Sullivan, Salazar, Buchbinder, & Sanchez, 2009). There are several reasons MSM in partnerships may be at greater risk for new HIV diagnosis compared to unpartnered MSM. For example, sexual behaviours in MSM often differ between casual and main partnerships. One model estimated MSM have approximately 10% more sex with main partners than casual partners, resulting in increased sexual contacts and potential exposures to HIV risk if the sex is unprotected (Sullivan et al., 2009). Additionally, MSM in relationships are more likely to engage in unprotected anal intercourse (Goodreau et al., 2012) and receptive anal intercourse (Sullivan et al., 2009) than with casual partners (Centers for Disease Control and Prevention, 2017; Sullivan et al., 2009).

In addition to these sexual behavioural factors, factors indicative of relationship quality are associated with risk for HIV infection. For example, some couples have a sexual agreement, which is a mutually agreed-upon framework for couples to decide what sexual behaviours, if any, are acceptable to engage in outside of the main partnership (Gomez et al., 2012). In one study, couples with more constructive communication styles and higher levels of relationship satisfaction expressed higher levels of investment in their sexual agreements, thereby reducing sexual risk behaviours outside of the relationship and decreasing the potential for HIV infection (Mitchell, 2014a). Additionally, positive relationship characteristics such as increased constructive communication, commitment, and trust may promote equity within the relationship with regard to both forming sexual agreements and communicating dissatisfaction (Gomez et al., 2012). This, in turn, minimises the occurrence of broken agreements, encourages disclosure when agreements are broken, and could ultimately reduce HIV risk (Gomez et al., 2012). Additionally, social support from primary partners has been associated with self-reported HIV medication adherence and self-efficacy (Darbes, Chakravarty, Beougher, Neilands, & Hoff, 2012). This increased HIV-specific support from main partners is hypothesised to decrease risky sexual behaviours by providing a mechanism for stigma management and increased discussion

about HIV (Darbes et al., 2012; Darbes, Chakravarty, Neilands, Beougher, & Hoff, 2014).

In recognising the importance of dyadic interactions to HIV risk and following recommendations from the World Health Organization, dyadic interventions addressing HIV testing, counselling and prevention have become a new focus of HIV research (World Health Organization, 2012). However, central to the success of dyadic interventions is a couple's ability to engage in these together successfully. Dyadic health interventions differ from individually focused efforts in that they require couples to work together cooperatively toward adopting health-enhancing behaviour changes (Lewis et al., 2006). These behaviours may be any number of physical, emotional, or supportive tasks partners can engage in to improve their health, and understanding and working with these conditions is critical to the success of the intervention regardless of the particular health behaviour or outcome of interest. Although current literature explores outcomes and effects of interventions, largely absent is exploration of the ability of couples to engage in health-enhancing behaviours together as a precursor to an intervention's success.

Before dyadic interventions can successfully target male couples, research must first 'identify conditions under which couples interventions might be effective by exploring the optimum mix of individual psychosocial and relationship factors to address for different types of couples' (Karney et al., 2010, p. S191). This includes how couples approach health-enhancing behaviours together to prevent HIV, as well as which factors might exert positive or negative influences on these approaches. Therefore, the aim of this study was to examine partner and relationship characteristics that contribute to the maintenance of dyadic health behaviours to prevent new HIV infection.

Methods

Procedure and Participants

This analysis utilised baseline survey data from Stronger Together, a large, randomised control trial of a dyadic intervention to improve HIV prevention and care among sero-discordant male couples. Centres in three United States cities were involved in data collection: Emory University in Atlanta, the Fenway Institute in Boston, and Lurie Children's/Northwestern University in Chicago. For baseline data collection, potential study participants were recruited using each site's active website, Facebook, Twitter, and social marketing campaigns. Additionally, flyers and posters were displayed in the clinics and at

MSM-targeted venues and publications, and information on the study was displayed prominently at HIV testing sites in each city. Advertising directed potential participants to an online screener for eligibility. Eligibility criteria, which was based on self-report, included: (1) two cisgender men in a relationship for at least 6 months (to reduce relationship dissolution during follow-up); (2) each 18 years or older; (3) current residents of metro Atlanta, Boston, or Chicago for at least three months to improve retention; (4) both individuals not having been tested for HIV in the last six months; and (5) no reported history of intimate partner violence (IPV) or coercion in the last six months of the current relationship. Couples were either sero-concordant negative or sero-discordant at baseline, with the intention of identifying sero-discordant couples to participate in the intervention. A partnership in this study was defined as ‘a relationship with a male partner who you feel committed to above all others’. Study staff at each site contacted eligible couples who had completed online screening. Once couples were contacted, informed consent was provided in person. Consented couples simultaneously completed the self-administered the baseline survey in separate rooms.

Dependent Measures

In the current study of dyadic approaches to health-enhancing behaviours, three outcome variables were considered in the analysis: planning and decision making, communication, and joint effort. These outcomes were measured as sum scores for three subscales of a couple-specific communal coping measure (Salazar, Stephenson, Sullivan, & Tarver, 2013). The construct ‘communal coping’ refers to ‘the utilization of strategies, which are characterized as communal in nature such as couple communication about behaviour change, joint decision-making and planning regarding the behaviour or working together to engage in the behaviour’ (Lewis et al., 2006, p. 1374). The Cronbach alphas for the scales were 0.87, 0.86, and 0.68 respectively. Both face and construct validity have been demonstrated for these measures (Salazar et al., 2013). Each outcome was assessed using seven questions specific to what extent couples interacted regarding HIV-related behaviours. Each of the three scales had the same response options, and participants answered on a 5-point Likert scale ranging from *not at any extent at all* to *to a great extent*. The base for each of the seven questions was specific to the subscale, and therefore included three options: (1) ‘To what extent do you and [partner] make decisions together about . . .?’, (2) ‘To what extent do you and [partner] communicate about . . .?’, and (3) ‘To what extent do you and [partner] work together to . . . [engage in the outcome]?’. The seven questions attached to each base were identical, and included: (1) ‘using condoms when we have sex with each other’, (2) ‘limiting the number of other sex partners’, (3) ‘deciding about either

of us having sex “outside” our relationship’, (4) ‘using condoms when either of us has sex outside our relationship’, (5) ‘getting tested regularly for sexually transmitted infections (STIs) and/or HIV’, (6) ‘being the top or bottom when we have sex with each other’, and (7) ‘being sexually faithful to each other’.

Independent Measures

To understand factors associated with health-enhancing behaviours, the analysis considered predisposing factors of couples hypothesised to influence these behaviours, including demographic data and relationship characteristics. Demographics included race, sexual orientation, HIV status, education, employment status, and yearly income. Alcohol use was also assessed as how often the participant had a drink containing alcohol in the past year (*never, monthly or less, 2–4 times a month, 2–3 times a week, 4–5 times a week, 6 or more times a week*). Drug use was similarly assessed as use within the past year, with answer options including *none, other*, and 16 different drug options. Relationship characteristics were assessed multidimensionally, with questions about relationship length, marital status, relationship type (‘What term best describes your relationship with [partner name]: boyfriend, lover, husband, spouse, partner, “fuck buddy”, hook-up, friends with benefits, we don’t use labels, other?’), the presence of a sexual agreement (Mitchell, 2014b), cohabitation status, length of cohabitation, and time spent together (‘Out of the last 30 days, how many nights have you spent with your partner?’). Relationship characteristics also included measures for IPV (Stephenson & Finneran, 2013), conflict style (Levinger & Pietromonaco, 1989; Salazar et al., 2013), love (Lemieux & Hale, 1999, 2000), depression (Carpenter et al., 1998), and dyadic trust (Larzelere & Huston, 1980). Happiness in the relationship was measured by asking ‘Please indicate your degree of happiness, all things considered, with your relationship with [partner’s name]’ (*extremely unhappy, fairly unhappy, a little unhappy, happy, very happy, extremely happy, perfect*). A Cronbach’s alpha greater than 0.78 has been demonstrated for each of these measures. Face and construct validity have been demonstrated for the conflict style inventory, and discriminant and convergent validity have been demonstrated for the trust measure (Larzelere & Huston, 1980; Levinger & Pietromonaco, 1989; Salazar et al., 2013). This analysis also controlled for stigma, operationalised as the internalised homonegativity scale, which has a demonstrated Cronbach’s alpha of 0.84 (Meyer, Frost, Narvaez, & Dietrich, 2006). Although each of these measures produced an actor and a partner variable because both individuals answered all questions separately, some composite variables were derived by combining data from both partners. These variables were HIV concordance between partners based on both individuals’ serostatus, as well as sexual risk

Table 1

Factor Loadings: Rotated Factor Pattern (Standardised Regression Coefficients)

Variable	Actor			Partner		
	RS	TT	SR	RS	TT	SR
Happiness	47	3	3	59	1	-3
Future together	45	32	2	50	32	0
Love	53	11	-5	54	8	-5
Trust	67	0	-2	63	-3	-6
Problem solving	61	-8	-2	64	-9	-2
Conflict style	11	11	1	57	-6	11
Depression	-42	0	7	-41	-1	7
Intimate partner violence experienced	-50	-5	-4	-44	0	0
Intimate partner violence perpetrated	-42	1	-13	-37	5	-5
Relationship duration	8	50	0	7	53	1
Living together	-5	76	-2	-4	78	-1
Nights together	-5	88	-3	-3	92	-2
Meals together	5	78	8	3	82	6
Days seeing main partner (MP)	-1	86	-2	-1	86	0
Days with contact without seeing MP	10	-82	0	10	-66	9
Condom use with MP and other partners	0	1	91	2	3	91
Condom use, HIV status, top UAI, bottom UAI	-6	-6	91	-5	-2	92
Risky behaviour concordance	5	11	57	—	—	—
HIV concordance	0	1	-94	—	—	—

Note: Risky behaviour concordance and HIV concordance are composite variables utilising data from both partners and were therefore only included in the actor composite to avoid redundancy. RS is relationship satisfaction or factor 1, TT is time together or factor 2, and SR is sexual risk or factor 3.

concordance based on each individual's self-reported sexual behaviours. These self-reported sexual risk behaviours included condom use both within and outside the partnership, and being the receptive or insertive partner during instances of unprotected anal intercourse.

Analysis

Factor analysis Given the large number of variables that could be included in analysis ($N = 59$, including scores for actors and partners and composite variables), exploratory factor analysis was performed for the independent variables using squared multiple correlations as prior communality estimates (O'Rourke & Hatcher, 2013). Exploratory factor analysis was used because the intent was to ascertain latent factors contributing to covariation in the dataset (O'Rourke & Hatcher, 2013). The principal factor method was used to extract factors, followed by a promax rotation to account for correlation between factors (O'Rourke & Hatcher, 2013). A scree test followed by a test for the proportion of common variance indicated that three meaningful factors be retained for rotation. In interpreting the rotated factor pattern, an item was said to load on a given factor if the factor loading was 0.35 or greater for that factor and less than 0.35 for the other factor. As seen in Table 1, these factor loadings can also be assessed as standardised regression coefficients. Factors for actor and partner were loaded separately. Applying these criteria, nine items were loaded onto the first factor, which was subsequently

labelled 'relationship satisfaction', six items were found to load on the second factor, which was subsequently labelled 'time together', and four items were loaded on the third factor, labelled 'sexual risk'. However, only eight items were loaded onto the first factor for actors, as conflict style did not load for actor, but did load for partner. The optimally weighted linear composites for each factor were used as standardised estimates of factor scores for subsequent analysis.

Actor-partner interdependence modelling Actor-partner interdependence modelling (APIM) techniques were used to examine associations between relationship characteristics and each of the three outcomes of interest (planning and decision making, communication, and joint effort). Separate models were run for each of these outcomes in the present analysis. APIM accounts for the nesting of individuals within dyads and therefore can examine two effects simultaneously: an individual's data affects both their own dependent variable score (known as the actor effect) and their partner's dependent variable score (known as the partner effect; Kenny, Kashy, & Cook, 2006; Zvara, Mills-Koonce, Heilbron, Clincy, & Cox, 2015). Although multilevel modelling and structural equation modelling are both appropriate for APIM, multilevel regression models were used because it is recommended for indistinguishable partners, which were present in this dataset (i.e., designation between actor and partner in the dataset is arbitrary and the researcher cannot differentiate members from one another; Kenny

et al., 2006). The use of multilevel modelling also allowed this analysis to control for mixed independent variables that vary between and within dyads, on average from dyad to dyad, and from person to person within each dyad (Kenny et al., 2006). This use of mixed independent variables allows investigation of mutual influence (Kenny et al., 2006).

Results

The complete sample included 398 individuals (199 partnerships). After excluding partners with missing data in key covariates and individuals whose partners had been excluded due to missing responses, the final sample was comprised of 270 individuals that constituted 135 partnerships. Ages of participants ranged from 19 to 69 years. Age differences between the couples ranged from zero to 38 years apart, but partners were generally close in age, with a median difference of 5.4 years. The majority of the sample was White ($n = 215$, 80%), though the sample included participants who identified as Black/African American ($n = 28$, 10%), multiracial, Asian, Pacific Islander, and Native American or Alaskan Native. A small proportion of the sample also identified as Latino ($n = 25$, 10%). Most respondents were educated with college completion or higher ($n = 185$, 69%), and the majority of the sample made at least \$50,000 annually ($n = 154$, 57%). Most partnerships had two sero-negative partners ($n = 194$, 72%); all other partnerships were sero-discordant. Most couples lived together ($n = 213$, 79%), but had not pursued a commitment ceremony or legal marriage ($n = 179$, 66%). Relationship length varied from less than one year ($n = 60$, 22%) to more than 6 years ($n = 76$, 28%), with the longest reported relationship being 26 years. See Table 2.

In the APIM modelling (Table 3), the key covariate factor variable relationship satisfaction was significantly and positively associated with all three outcomes (planning and decision making, communication, and joint effort) for actors ($p = .02$, $.02$, $.06$ respectively). Race was negatively associated with some outcomes whereby relative to White males, Latino males in this sample reported lower planning and decision making and communication scores ($p = .032$ for actors' planning and decision making, $p = .044$ for partners' communication). Alcohol use in the past year was negatively associated with planning and decision making, communication, and joint effort for both actors and partners except for actors' planning and decision making (actors: $p = .11$, $.038$, $.004$ respectively, partners: $p = .03$, $.056$, $.02$ respectively). The presence of a sexual agreement was also positively associated with planning and decision making, and communication for actors ($p = .007$ and $.008$ respectively), but not for joint effort and not for partners. Internalised homophobia was not significantly associated with planning and decision making, communication, or joint effort

for actors ($p = .51$, $.38$, $.88$ respectively) or partners ($p = .43$, $.25$, $.63$ respectively).

Discussion

Based on these results, dyadic interventions can capitalise upon and improve relationship satisfaction to refine interventions for male partnerships, whereby increasing relationship satisfaction holds promise to improve the effects of dyadic interventions. This finding coincides with previous research that suggested other relationship characteristics, such as length, communication, and the presence of sexual agreements, are associated with HIV risk (Darbes, Chakravarty, Beougher, Neilands, & Hoff, 2012; Darbes et al., 2014; Gomez et al., 2012; Hoff, Chakravarty, Beougher, Neilands, & Darbes, 2012; Mitchell, 2014a; Mitchell & Petroll, 2013; Mustanski, Newcomb, & Clerkin, 2011). It may be that relationship characteristics and satisfaction affect couples' ability to engage in health-enhancing behaviours most, whereby a lack of positive relationship characteristics and satisfaction negatively affect a couple's ability to jointly engage in health-enhancing behaviours, and vice-versa. For example, the specificity of the outcome measures to specific HIV-related behaviours indicates those with less positive relationship characteristics would not be able to engage in fruitful discussions around condom use and therefore would be less likely to engage in the behaviour itself. Accordingly, positive relationship characteristics and relationship satisfaction are likely appropriate targets for dyadic interventions to promote joint effort as the antecedent to HIV health-enhancing behaviours within partnerships.

An unanticipated result of this analysis was the lack of association between internalised stigma and couples' outcomes. This lack of association may be a reflection of resilience from this population, whereby constructive relationship characteristics such as love, trust, and lack of IPV are protective and lessen the impact of stigma on relationship effort outcomes. This indicates increased social support found within relationships may also be a positive moderating factor, resulting in increased joint effort outcomes for this population. It is also possible that externalised or structural stigma may be significantly associated with these outcomes, but were not accounted for in analysis. Future analyses should examine multiple types of stigma to explore these possibilities.

In addition to the key finding related to relationship characteristics, there were also findings related to alcohol use, race, and sexual agreements. Alcohol use by the actor was significantly and negatively associated with communication and joint effort, and alcohol use by the partner was negatively associated with all three outcomes. This outcome may be due to the hypothesised causal relationship between minority stressors and risky sexual behaviour wherein substance use acts as a mediating

Table 2
Demographics of Actors and Partners (N = 270 Couples)

	Actor <i>n</i> (<i>n</i> = 135)	Actor %	Partner <i>n</i> (<i>n</i> = 135)	Partner %	Total <i>N</i> (<i>N</i> = 270)	Total %
Age						
18–24	19	14	19	14	38	14
25–34	54	40	52	39	106	39
35–44	30	22	31	23	61	23
45+	32	24	33	24	65	24
Age difference (in years)						
0–5					172	64
6–10	—	—	—	—	64	24
11–15					16	6
16+					18	6
Race						
White	105	78	110	81	215	80
Black/African American	16	12	12	9	28	10
Multiracial/Other	14	10	13	10	27	10
Latino						
No	121	90	124	92	244	90
Yes	14	10	11	8	25	10
Highest education						
High school or less	8	6	11	8	19	7
Some college	39	29	27	20	66	24
College or Higher	88	65	97	72	185	69
Income						
<\$15,000	12	9	10	7	22	8
\$15,001–\$30,000	21	16	18	13	39	14
\$30,001–\$50,000	28	21	27	20	55	20
\$50,001–\$80,000	21	16	29	21	50	19
\$80,000–\$100,000	16	12	15	11	31	11
\$100,000+	37	27	36	27	73	27
HIV status concordance						
Both partners negative	—	—	—	—	194	72
Sero-discordant					76	28
Marital status						
No marriage/ceremony	88	65	91	67	179	66
Legally married	23	17	21	16	44	16
Commitment ceremony	6	4	5	4	11	4
Domestic partnership	6	4	6	4	12	4
Don't know	12	9	12	9	24	9
Relationship length						
Less than 1 year	30	22	30	22	60	22
1–2 years	41	30	42	31	83	31
3–5 years	25	19	26	19	51	19
6+ years	39	29	37	27	76	28
Cohabitation						
No/I don't know	28	21	28	21	57	21
Yes	07	79	107	179	213	79

factor (Hatzenbuehler, Nolen-Hoeksema, & Erickson, 2008; Kaplan et al., 2015). Increased minority stressors require sexual and gender minorities to utilise coping mechanisms. Minority individuals may turn to maladaptive avoidant coping mechanisms to deal with minority stressors (Baiocco, D'Alessio, & Laghi, 2010; Fan et al., 2016; Pachankis, Hatzenbuehler, & Starks, 2014; Peacock, Andrinopoulos, & Hembling, 2015). These coping mechanisms may include risky sexual behaviour, or may indirectly promote risky sexual behaviour through alcohol or substance use (Hatzenbuehler et al., 2008; Kaplan

et al., 2015). Alcohol is also a known barrier to effective communication, one of the joint effort measures (Denes & Afifi, 2014; Hatcher, Colvin, Ndlovu, & Dworkin, 2014). Therefore, alcohol use may be a barrier to joint effort itself, or may point to the existence of latent factors such as externalised stigma and the impact of these latent factors on joint effort.

Similarly, the presence of a sexual agreement was significantly associated with communication and planning and decision making for partners only. It may be that couples who naturally exhibit better communication or planning

Table 3

Results of APIM Multilevel Modelling

Effect	Planning and decision making P-value (CI)	Communication p value (CI)	Joint effort p value (CI)
Internalised homophobia	0.51 (−0.06, 0.13)	0.39 (−0.06, 0.16)	0.88 (−0.12, 0.11)
P Internalised homophobia	0.43 (−0.13, 0.06)	0.25 (−0.18, 0.05)	0.63 (−0.08, 0.14)
Age	0.81 (−0.12, 0.10)	0.51 (−0.17, 0.08)	0.43 (−0.08, 0.19)
P Age	0.32 (−0.16, 0.05)	0.26 (−0.19, 0.05)	0.48 (−0.18, 0.09)
Age difference	0.91 (−0.15, 0.17)	0.32 (−0.09, 0.29)	0.18 (−0.31, 0.06)
Latino	0.03* (−6.29, −0.29)	0.06 (−6.95, 0.18)	0.16 (−6.07, 1.04)
P Latino	0.21 (−5.14, 1.14)	0.04* (−7.54, −0.10)	0.34 (−5.53, 1.93)
Race	0.44 (−0.33, 0.75)	0.30 (−0.30, 0.97)	0.71 (−0.53, 0.78)
P Race	0.19 (−0.96, 0.20)	0.55 (−0.87, 0.47)	0.06 (−1.36, 0.03)
Education	0.10 (−0.63, 0.64)	0.45 (−1.04, 0.46)	0.70 (−0.61, 0.91)
P Education	0.73 (−0.53, 0.75)	0.96 (−0.7, 0.73)	0.44 (−1.06, 0.46)
Income	0.10 (−0.64, 0.68)	0.49 (−0.49, 1.02)	0.97 (−0.82, 0.80)
P Income	0.81 (−0.72, 0.56)	0.57 (−0.95, 0.52)	0.33 (−1.19, 0.40)
Marital status	0.59 (−1.25, 0.72)	0.94 (−1.16, 1.07)	0.53 (−1.61, 0.83)
P Marital status	0.40 (−1.38, 0.56)	0.06 (−2.16, 0.05)	0.66 (−1.47, 0.94)
Alcohol use	0.11 (−1.10, 0.12)	0.04* (−1.44, −0.04)	0.004** (−1.84, −0.36)
P Alcohol Use	0.03* (0.07, 1.26)	0.06 (−0.02, 1.35)	0.02* (0.14, 1.60)
Drug use	0.51 (−2.98, 1.50)	0.40 (−3.75, 1.50)	0.70 (−3.23, 2.17)
P Drug use	0.23 (−3.68, 0.87)	0.09 (−4.99, 0.34)	0.11 (−4.96, 0.53)
Conflict style	0.91 (−0.07, 0.08)	0.82 (−0.10, 0.08)	0.90 (−0.10, 0.09)
Sexual agreement	0.007** (0.99, 6.20)	0.008** (1.12, 7.16)	0.09 (−0.46, 5.87)
P Sexual agreement	0.58 (−3.10, 1.73)	0.31 (−4.27, 1.35)	0.67 (−3.57, 2.31)
Time together [†]	0.46 (−2.35, 5.15)	0.37 (−2.32, 6.13)	0.47 (−2.93, 6.35)
P Time together [†]	0.51 (−5.03, 2.50)	0.45 (−5.89, 2.65)	0.40 (−6.61, 2.67)
Sexual risk [†]	0.58 (−1.61, 0.91)	0.90 (−1.53, 1.35)	0.38 (−2.26, 0.87)
P Sexual risk [†]	0.38 (−0.58, 1.52)	0.71 (−0.99, 1.44)	0.31 (−0.62, 1.94)
Relationship satisfaction [†]	0.02* (0.21, 2.42)	0.02* (0.20, 2.76)	0.06 (−0.06, 2.63)
P Relationship satisfaction [†]	0.78 (−1.44, 1.09)	0.54 (−1.85, 0.97)	0.85 (−1.44, 1.75)

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Bold type without * approaches significance. 'P' before the variable name differentiates partner scores from actor scores. CI = confidence interval. [†]Indicates factor variables.

and decision making without intervention have an easier time discussing and creating sexual agreements. Conversely, making an agreement together bolsters these skills among couples. Therefore, it may not be the agreement itself that affects coping, but rather the underlying skills inherent in making these agreements. Future research could also examine whether the presence of the agreement or factors associated with the agreement produce these effects. For example, satisfaction with the agreement of concordance between partners about what the agreement is may have stronger associations with health-enhancing behaviours than simply the presence of an agreement. Further, existing literature has begun to explore and determine associations between outcomes and specific aspects of agreements, such as satisfaction with the current sexual agreement (Mitchell, 2014a). Specific types and details of agreements should be studied in more detail in relation to couples' mutual engagement in health behaviours.

Additionally, a small but statistically significant effect was found for each of the outcomes for Latino MSM specifically, but not for overall race/ethnicity. Research regarding individuals with both racial/ethnic and sexual

minority identities indicates that stigma or discrimination resulting from intersectional minority identities results in worse health outcomes. These negative outcomes include alcohol use (Gilbert, Perreira, Eng, & Rhodes, 2014), depression and anxiety (Choi, Paul, Ayala, Boylan, & Gregorich, 2013), discomfort expressing affection with other men and psychological distress (Bishop, 2014), and HIV acquisition, an association moderated by psychological distress (Lelutiu-Weinberger, Gamarel, Golub, & Parsons, 2015). These results demonstrate how 'multiple forms of oppression contribute additively and interactively to mental health in this population' (Velez, Moradi, & DeBlaere, 2015, p. 1). However, this research has largely focused on individuals rather than dyads. These associations may also exist for dynamics within ethnic/racial minority relationships, negatively affecting these individuals' ability to cope and participate in HIV preventative behaviours. Although the racial and ethnic minority sample of this study was too small to draw definitive conclusions, future research should examine differences in outcomes between racial and ethnic minority relationships.

Strengths and Limitations

This research should be interpreted in light of several limitations. This study may have limited generalisability due to the largely White and highly educated sample. Additionally, this analysis was unable to examine social support variables due to high rates of missing responses, which would have allowed more robust analysis of theoretical principles. These limitations must be considered relative to two constraints of the data set. First, this data set is cross-sectional, which can determine associations between relationship satisfaction and the outcomes but cannot determine which causes the other or if this relationship is linear. Second, this dataset utilised measures chosen before this analysis was considered. However, steps were taken to ensure the reliability and validity of measures. When reliability and validity measures were not available, survey measures were assessed for specificity to the population of interest (Salazar et al., 2013). To further minimise this limitation, the same theoretical foundation was utilised for the data collection project and this analysis, and measures were assessed for their relation to theoretical principles. The interdependence theory described by Lewis et al. (2006) is a framework appropriate for gay male dyads, and measurements used are an excellent fit with theoretical concepts.

Conclusion

This analysis fills an important gap in the literature through the use of innovative and complex statistical techniques. The use of APIM allows for simultaneous analysis of both partners within a dyad, providing a more nuanced and robust understanding of how the communal nature of dyadic coping truly impacts outcomes. Specifically, this analysis has identified partner effects for relationship satisfaction that validate the previously assumed interaction with a partner score in affecting couple's outcomes regarding approaches to health-enhancing behaviours. By establishing the importance and utility of dyadic level analysis, this study provides further evidence base to support dyadic level interventions. This analysis identifies specific factors that may inform intervention delivery models targeting male couples.

References

- Baiocco, R., D'Alessio, M., & Laghi, F. (2010). Binge drinking among gay, and lesbian youths: The role of internalized sexual stigma, self-disclosure, and individuals' sense of connectedness to the gay community. *Addictive Behaviors, 35*, 896–899.
- Bishop, N.S. (2014). *Internalized oppression, restricted affection, and psychological distress in Asian and Latino men who have sex with men*. Unpublished masters thesis, University of Tennessee.
- Carpenter, J., Andrykowski, M., Wilson, J., Hall, L., Kay Rayens, M., Sachs, B., & Cunningham, L. (1998). Psychometrics for two short forms of the Center for Epidemiologic Studies–Depression Scale. *Issues in Mental Health Nursing, 19*, 481–494.
- Centers for Disease Control and Prevention. (2015). HIV among gay and bisexual men. Retrieved from <http://www.cdc.gov/hiv/group/msm/>
- Centers for Disease Control and Prevention. (2017). HIV among gay and bisexual men. Retrieved from <https://www.cdc.gov/hiv/group/msm/index.html>
- Choi, K.-H., Paul, J., Ayala, G., Boylan, R., & Gregorich, S.E. (2013). Experiences of discrimination and their impact on the mental health among African American, Asian and Pacific Islander, and Latino men who have sex with men. *American Journal of Public Health, 103*, 868–874.
- Darbes, L.A., Chakravarty, D., Beougher, S.C., Neilands, T.B., & Hoff, C.C. (2012). Partner-provided social support influences choice of risk reduction strategies in gay male couples. *AIDS and Behavior, 16*, 159–167.
- Darbes, L.A., Chakravarty, D., Neilands, T.B., Beougher, S.C., & Hoff, C.C. (2014). Sexual risk for HIV among gay male couples: A longitudinal study of the impact of relationship dynamics. *Archives of Sexual Behavior, 43*, 47–60.
- Denes, A., & Affif, T.D. (2014). Pillow talk and cognitive decision-making processes: Exploring the influence of orgasm and alcohol on communication after sexual activity. *Communication Monographs, 81*, 333–358.
- Fan, W., Lu, R., Wu, G., Yousuf, M.A., Feng, L., Li, X., . . . Ruan, Y. (2016). Alcohol drinking and HIV-related risk among men who have sex with men in Chongqing, China. *Alcohol, 50*, 1–7.
- Gilbert, P.A., Perreira, K., Eng, E., & Rhodes, S.D. (2014). Social stressors and alcohol use among immigrant sexual and gender minority Latinos in a nontraditional settlement state. *Substance Use & Misuse, 49*, 1365–1375.
- Gomez, A.M., Beougher, S.C., Chakravarty, D., Neilands, T.B., Mandic, C.G., Darbes, L.A., & Hoff, C.C. (2012). Relationship dynamics as predictors of broken agreements about outside sexual partners: implications for HIV prevention among gay couples. *AIDS and Behavior, 16*, 1584–1588.
- Goodreau, S.M., Carnegie, N.B., Vittinghoff, E., Lama, J.R., Sanchez, J., Grinsztejn, B., . . . Buchbinder, S.P. (2012). What drives the US and Peruvian HIV epidemics in men who have sex with men (MSM)? *PloS One, 7*, e50522.
- Hall, H.I., Song, R., Tang, T., An, Q., Prejean, J., Dietz, P., . . . Mermin, J. (2017). HIV trends in the United States: Diagnoses and estimated incidence. *JMIR Public Health and Surveillance, 3*, e8.
- Hatcher, A.M., Colvin, C.J., Ndlovu, N., & Dworkin, S.L. (2014). Intimate partner violence among rural South African men: Alcohol use, sexual decision-making, and partner communication. *Culture, Health & Sexuality, 16*, 1023–1039.
- Hatzenbuehler, M.L., Nolen-Hoeksema, S., & Erickson, S.J. (2008). Minority stress predictors of HIV risk behavior, substance use, and depressive symptoms: Results from a prospective study of bereaved gay men. *Health Psychology, 27*, 455–462.
- Hoff, C.C., Chakravarty, D., Beougher, S.C., Neilands, T.B., & Darbes, L.A. (2012). Relationship characteristics associated with sexual risk behavior among MSM in committed relationships. *AIDS Patient Care and STDs, 26*, 738–745.
- Kaplan, R.L., Wagner, G.J., Nehme, S., Aunon, F., Khouri, D., & Mokhbat, J. (2015). Forms of safety and their impact on health: An exploration of HIV/AIDS-related risk and resilience among trans women in Lebanon. *Health Care for Women International, 36*, 917–935.

- Karney, B.R., Hops, H., Redding, C.A., Reis, H.T., Rothman, A.J., & Simpson, J.A. (2010). A framework for incorporating dyads in models of HIV-prevention. *AIDS and Behavior, 14*, 189–203.
- Kenny, D.A., Kashy, D.A., & Cook, W.L. (2006). *Dyadic data analysis*. New York, NY: Guilford Press.
- Larzelere, R.E., & Huston, T.L. (1980). The dyadic trust scale: Toward understanding interpersonal trust in close relationships. *Journal of Marriage and the Family, 595*–604.
- Lelutiu-Weinberger, C., Gamarel, K.E., Golub, S.A., & Parsons, J.T. (2015). Race-based differentials in the impact of mental health and stigma on HIV risk among young men who have sex with men. *Health Psychology, 34*, 847–856.
- Lemieux, R., & Hale, J.L. (1999). Intimacy, passion, and commitment in young romantic relationships: Successfully measuring the triangular theory of love. *Psychological Reports, 85*, 497–503.
- Lemieux, R., & Hale, J.L. (2000). Intimacy, passion, and commitment among married individuals: Further testing of the triangular theory of love. *Psychological Reports, 87*, 941–948.
- Levinger, G., & Pietromonaco, P. (1989). *Conflict Style Inventory*. Unpublished scale, University of Massachusetts, Amherst.
- Lewis, M.A., McBride, C.M., Pollak, K.I., Puleo, E., Butterfield, R.M., & Emmons, K.M. (2006). Understanding health behavior change among couples: An interdependence and communal coping approach. *Social Science & Medicine, 62*, 1369–1380.
- Meyer, I.H., Frost, D.M., Narvaez, R., & Dietrich, J.H. (2006). *Project Stride methodology and technical notes*. Unpublished manuscript, Columbia University.
- Mitchell, J.W. (2014a). Between and within couple-level factors associated with gay male couples' investment in a sexual agreement. *AIDS and Behavior, 18*, 1454–1465.
- Mitchell, J.W. (2014b). Characteristics and allowed behaviors of gay male couples' sexual agreements. *The Journal of Sex Research, 51*, 316–328.
- Mitchell, J.W., & Petroll, A.E. (2013). Factors associated with men in HIV-negative gay couples who practiced UAI within and outside of their relationship. *AIDS and Behavior, 17*, 1329–1337.
- Mustanski, B., Newcomb, M.E., & Clerkin, E.M. (2011). Relationship characteristics and sexual risk-taking in young men who have sex with men. *Health Psychology, 30*, 597–605.
- O'Rourke, N., & Hatcher, L. (2013). *A step-by-step approach to using SAS for factor analysis and structural equation modeling*. Cary, NC: SAS Institute.
- Pachanski, J.E., Hatzenbuehler, M.L., & Starks, T.J. (2014). The influence of structural stigma and rejection sensitivity on young sexual minority men's daily tobacco and alcohol use. *Social Science & Medicine, 103*, 67–75.
- Peacock, E., Andrinopoulos, K., & Hembly, J. (2015). Binge drinking among men who have sex with men and transgender women in San Salvador: Correlates and sexual health implications. *Journal of Urban Health, 92*, 701–716.
- Salazar, L.F., Stephenson, R.B., Sullivan, P.S., & Tarver, R. (2013). Development and validation of HIV-related dyadic measures for men who have sex with men. *Journal of Sex Research, 50*, 164–177.
- Stephenson, R., & Finneran, C. (2013). The IPV-GBM scale: A new scale to measure intimate partner violence among gay and bisexual men. *PLoS One, 8*, e62592.
- Sullivan, P.S., Salazar, L., Buchbinder, S., & Sanchez, T.H. (2009). Estimating the proportion of HIV transmissions from main sex partners among men who have sex with men in five US cities. *Aids, 23*, 1153–1162.
- Velez, B.L., Moradi, B., & DeBlaere, C. (2015). Multiple oppressions and the mental health of sexual minority Latina/o individuals. *The Counseling Psychologist, 43*, 7–38.
- World Health Organization. (2012). Guidance on couples HIV testing and counselling including antiretroviral therapy for treatment and prevention in serodiscordant couples: Recommendations for a public health approach. Retrieved from <http://www.who.int/hiv/pub/guidelines/9789241501972/en/>
- Zvara, B.J., Mills-Koonce, W.R., Heilbron, N., Clincy, A., & Cox, M.J. (2015). The interdependence of adult relationship quality and parenting behaviours among African American and European couples in rural, low-income communities. *Infant and Child Development, 24*, 343–363.