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ORIGINAL PAPER

Between and Within Couple-Level Factors Associated with Gay Male Couples' Investment in a Sexual Agreement

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Abstract Sexual agreements are common among gay male couples, and between one-third and two-thirds of gay men acquire HIV while in a same-sex relationship. Studies have assessed whether agreements could be used for HIV prevention yet additional research is needed. By using dyadic data collected from 361 U.S. gay male couples, the present cross-sectional study sought to assess whether certain between and within couple-level relationship characteristics predict a partner's value in, commitment to, and satisfaction with an agreement. On average, couples with higher levels of constructive communication and relationship satisfaction and commitment were associated with partners who had higher levels of investment in the agreement. Within the couple, differences in commitment and investment of the relationship were also found to be negatively associated with partners' investment toward an agreement. Implications are discussed for how sexual agreements may be used to develop new HIV prevention efforts for gay male couples.

Resumen Acuerdos sexuales son comunes entre las parejas de hombres homosexuales, y entre un tercio y dos tercios de los hombres homosexuales contraen el VIH, mientras que en una relación del mismo sexo. Los estudios han evaluado si los acuerdos se podrían utilizar para la prevención del VIH todavía se necesita investigación adicional. Mediante el uso de datos diádicos recogidos de 361 parejas de hombres homosexuales de Estados Unidos, el estudio transversal presente buscó evaluar si determinado entre y dentro de las características de la relación de pareja a nivel predicen valor « a socios, compromiso y satisfacción por un acuerdo sexual. En promedio, las parejas con mayores niveles de comunicación constructiva y de satisfacción de la relación y el compromiso se asociaron con la pareja de que tenían niveles más altos de inversión en un acuerdo. Dentro de la pareja, también se encontraron diferencias en el compromiso y la inversión de la relación que se asocia negativamente con la inversión de los socios hacia un acuerdo. Se discuten las implicaciones de cómo se pueden utilizar los acuerdos sexuales para desarrollar nuevos esfuerzos de prevención del VIH para las parejas de hombres homosexuales.

Keywords Gay male couples · Sexual agreements · Investment in an agreement · Multilevel modeling

Introduction

Over the past two decades, a number of studies have emerged about gay male couples' sexual agreements. Within the context of gay male couples' relationships, a sexual agreement is an explicit mutual understanding between two men about what sexual behaviors they agree to engage in and with whom [1]. Sexual agreements are important to understand and consider for the advancement of HIV prevention because: (1) agreements, by definition, directly affect the couples' sexual health and potentially the satisfaction and stability of their relationships; (2) many gay men acquire HIV while being in a same-sex relationship [2, 3]; and (3) agreements provide an ideal framework to address both partners' sexual and testing behaviors, as well as their needs toward the relationship.

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Prior studies with gay male couples in the U.S., Europe, and Australia have found that sexual agreements appear to be common with reports of those having an agreement ranging between 48 and 98 % [1, 4–24]. The types of sexual agreements that couples form vary. For example, some couples form closed agreements which represent behavioral monogamy, others have 'monogamish' agreements that allow the couple to engage in sex with other partners but only as a couple, while other couples form open agreements which permit one or both partnered men to have sex with others, either with or without guidelines [10, 14]. In Australia, Susan Kippax and colleagues have also described another type of agreement called negotiated safety [18, 25–27]. Negotiated safety permits couples to have unprotected anal intercourse (UAI) within their relationship once the HIV-status of both men has been confirmed to be HIV-negative, and if sex with others is allowed, then safer sex practices must be used (e.g., condoms for anal sex) with all casual partners [25].

To better understand couples' agreements, studies have assessed what motivates gay male couples to form, not adhere to, and disclose (or not) that they had broken their agreements [4, 11, 12]. In addition, studies have also examined the behaviors that couples allow per their type of agreement [4], the relationship characteristics associated with couples' broken agreements [5, 13], and how aspects of these agreements differ according to the couples' HIV-status, race, employment status, education level, and whether they live in an urban or rural environment [4]. Furthermore, other recent research has compared responses between the two partners of the couple to describe discrepancies or to what extent partners concur about different aspects of their agreement, including the formation, type, and adherence [4, 5]. However, additional questions about couples' sexual agreements remain unanswered, which may help advance HIV prevention for at-risk gay male couples, particularly toward intervention development.

Currently, only one HIV prevention intervention has been approved by the Centers for Disease Control and Prevention for same-sex male couples in the United States: couples-based HIV voluntary testing and counseling (CVCT) [28]. Although this testing program is critically important and provides a much needed service, additional prevention interventions must be developed because one-third to two-thirds of men who have sex with men (MSM) acquire HIV from their main same-sex partners (e.g., gay male couples) [2, 3]. Researchers have further noted and described the need to develop HIV prevention programs that address the specific and unique characteristics of gay male couples' relationships [29–32]. To help fill this critical gap in HIV prevention services, additional research is needed to better understand gay male couples' relationship characteristics, including their sexual agreements.

For example, studies have yet to assess whether certain relationship characteristics are associated with couples' investment toward their sexual agreement. Prior research with gay male couples has found that investment toward a sexual agreement has been associated with one or both partners reporting not having had UAI outside of their relationship, thus reducing the couples' risk for acquiring HIV [6, 9, 33]. Couples who report being more invested in their sexual agreements (e.g., value, commitment, and satisfaction toward a sexual agreement) may differ in important ways from couples who are less invested in their sexual agreements. These differences could then be used to help understand how best to build interventions that encourage gay male couples to form and adhere to their sexual agreements that meet the sexual and relational needs of each partner and the couple, while also aiming to reduce their risk for acquiring HIV and other sexually transmitted infections (STIs).

By using dyadic data collected from 361 gay male couples who live throughout the U.S., the present study seeks to assess whether certain relationship characteristics are associated with couples' investment toward their sexual agreement (e.g., value, commitment, and satisfaction toward a sexual agreement). Findings from this assessment may provide a richer understanding of how sexual agreements could be used to bolster gay male couples' sexual health for the prevention of HIV and other STIs. We used a novel online recruitment method to collect dyadic data for our sample, and dyadic and multilevel analyses to characterize the sample from an individual- and couple-level perspective. This approach is necessary to fully assess which relationship characteristics are associated with couples who are more invested in their sexual agreement compared to those who are less invested in their sexual agreement.

Methods

Participants and Recruitment

Recruitment for the present study was conducted through Facebook® banner advertising. During a 10-week recruitment period during 2011, banner advertisements were displayed to Facebook members who had certain demographic characteristics listed in their Facebook profile. Specifically, our study advertisements targeted Facebook members who described themselves as male, being 18 years of age and older, living anywhere in the US, interested in men, and having a current relationship status as either being in a relationship, engaged, or married. All Facebook users whose profiles met this initial eligibility criteria had an equal chance of being shown one of our

three banner advertisements. In total, the banner advertisements were shown 8.5 million times (i.e., impressions) on potential participants' profiles. The advertisements briefly described the purpose of the study and included a picture of a male same-sex couple.

A total of 7,994 Facebook users clicked on at least one of the advertisements and were then directed to the study webpage. The study webpage briefly described the purpose of the study, what a participant could expect if he chose to participate (e.g., be asked to invite his main, male relationship partner to also participate in the study), and asked eligibility questions. Both men in the couple had to have met the following eligibility criteria in order to enroll in our study: be 18 years of age and older; live in the U.S.; be in a sexual relationship with another male and have had either oral and/or anal sex with this partner within the previous 3 months. Eligible participants were asked to complete an electronic consent form. Consenting participants advanced to take the 30–40 min confidential survey.

A partner referral system was embedded in our survey to facilitate data collection from both men in the couple. The partner referral system required a participant to input his own and his main partner's email address. The main partner to the participant was then sent an email inviting him to participate in the study. Email addresses for both men in each couple were also used to link survey responses between the two men, along with other items that were used to verify the couples' relationship post hoc (e.g., relationship duration). Every fifth couple (i.e., 5th, 10th, 15th, etc.) that completed the survey received two modest incentives via email (e.g., $20 electronic gift card for each partner). The Medical College of Wisconsin Institutional Review Board approved the study protocol.

Online Survey

The online survey service provider Survey Gizmo hosted our study webpage, electronic consent form, and confidential, online survey through the use of a secure access portal (i.e., https://). Only the primary investigator of the study and managers at Survey Gizmo had access to the study data. Though we collected each participant's email address, no other personal identifying information was collected. Email addresses were deleted after data collection was completed.

Measures

Outcome Variables

Three individual-level outcome variables were used to assess participants' investment in the sexual agreement they have with their main partner: value, commitment, and satisfaction. Specifically, Neilands and colleagues sexual agreement investment scale (SAIS) was used to assess participants' value, commitment, and satisfaction toward their sexual agreement with their main partner (i.e., investment in the sexual agreement) [34]. This 13-item validated measure has three domains: value of, commitment to, and satisfaction with the sexual agreement. A 5-point Likert-type scale was used to assess the items for each of these domains. Additional information about the domains of SAIS, including the type of scale, number of items, response options, and reliability coefficients are provided in Table 1.

Only participants who reported the existence of a sexual agreement were asked to complete the SAIS. Participant's scores of the items for each of the three domains of SAIS (value, commitment and satisfaction toward the sexual agreement) were then averaged separately to create the outcome variables of participants' value of the sexual agreement, commitment to the sexual agreement, and satisfaction with the sexual agreement, respectively. For analytic purposes, we restricted the outcome variables to only include and represent participants from couples who had both men complete the SAIS.

Table 1 Measures used to assess relationship characteristics of commitment, trust, communication patterns, and investment in a sexual agreement

Measure with subscales	No. of items	Cronbach's α
Investment model[a]	22	0.90
Commitment level	7	0.84
Satisfaction level	5	0.91
Investment size	5	0.74
Quality of alternatives	5	0.80
Trust scale[b]	17	0.89
Predictability	5	0.72
Dependability	5	0.69
Faith	7	0.90
Communication patterns scale[c]	11	
Mutual constructive	3	0.83
Mutual avoidance and withholding	8	0.85
Sexual agreement investment scale[d]	13	0.96
Commitment	4	0.93
Satisfaction	3	0.85
Value	6	0.94

[a] Response scale was a 7-point Likert: "Do not agree" to "Agree completely"

[b] Response scale was a 7-point Likert: "Strongly disagree" to "Strongly agree"

[c] Response scale was a 9-point Likert: "Very unlikely" to "Very likely"

[d] Response scale was a 5-point Likert: "Not at all" to "Extremely"

Independent Variables

A variety of measures were used to assess couples' demographic and relationship characteristics, HIV/STI testing rates and patterns, risk-reduction strategies, and sexual behaviors, including UAI by partner type. Participants were asked about a variety of standard sociodemographic characteristics, including whether they had health insurance. Relationship characteristics assessed included relationship duration, cohabitation duration, and aspects about a sexual agreement.

Aspects of a sexual agreement included the following categorical items: establishment of a sexual agreement, current type of sexual agreement, recent adherence to the sexual agreement (i.e., within 3 months prior to assessment), and ever broken the sexual agreement. Specifically, participants were asked whether they had established a sexual agreement (yes or no) with their main partner, and their current type of sexual agreement. Current type of sexual agreement items were assessed categorically with the following response options, "We only have sex with each other and no one else", "We have sex with each other, and we are allowed to have sex with others under certain guidelines/rules" and "We have sex with each other, and are allowed to have sex with others without any guidelines/rules". Additional items about adherence and non-adherence to the sexual agreement assessed whether a participant and/or his main partner had kept or broken their sexual agreement ever and within the 3 months prior to assessment (yes vs. no).

Men were also asked to report their HIV serostatus, their primary partner's perceived HIV serostatus, engagement of UAI within the relationship (e.g., with main partners), and whether they had had sex with any casual MSM partners within the previous 3 months, including UAI.

Several validated scales were used to assess additional characteristics within gay male couples' relationships, including their levels of trust [35], relationship commitment [36], and communication patterns [37]. Table 1 provides detailed information about these validated scales, including the names of the subscales, response options, and reliability coefficients. These same validated scales have been detailed in-depth elsewhere [6, 13, 33]. Other details about the sample's sexual agreements (e.g., allowed behaviors and discrepancies between partners within the relationship), prior HIV and STI testing rates and patterns, and use of risk-reduction strategies have also been reported in detail elsewhere [4, 38, 39].

Data Analysis

Dyadic data from 361 gay male couples (722 individuals) were analyzed using Stata Version 12 (StataCorp, College Station, TX). Prior to data collection, a minimum sample size of 160 dyads was estimated to provide a minimum power of 0.80 for detecting regression coefficient estimates for the outcome variables pertaining to the investment toward a sexual agreement [40, 41]. To account for the non-independence of dyadic data, data were arranged and prepared in an appropriate format to conduct multilevel modeling analyses [40, 41]. Data were also adjusted accordingly for missing values based on recommendations made by Acock [42].

Several variables were recoded for descriptive purposes. For instance, participant's self-report of race was compared to his partner's self-report of race to create a dummy variable that represented whether the couple was of mixed race (or not). This same format was also used to construct other independent, dummy couple-level demographic and behavioral variables, including: education level of the couple; employment status of the couple; engagement of sex with casual partners outside of the relationship; engagement of UAI within the relationship; and engagement of UAI outside of the relationship. In addition, we compared responses between both partners of the couple and constructed corresponding independent couple-level variables for aspects of their sexual agreements: establishment, type, and adherence. For example, comparison of both partners' responses to having kept their sexual agreement within the prior 3 months to assessment was constructed into a dummy couple-level variable to indicate whether "both partners reported yes", "only one partner reported yes", and "both partners reported no". A similar approach was also used to create other dummy couple-level independent variables for establishment of, type of, and ever broken a sexual agreement.

Descriptive statistics including means, standard deviations, rates, and percentages were calculated, as appropriate, for the measures. To assess how couple-level factors may affect participants' value, commitment, and satisfaction toward the sexual agreement they have with their main partner, we examined a variety of couple-level demographic and relationship characteristics, including relationship commitment, trust, and communication patterns. These particular relationship characteristics were chosen because prior research has found these factors to be associated with gay male couples' risk for acquiring HIV. In detail, relationship characteristics of commitment, trust and communication patterns were assessed in two-specific ways at the couple-level. First, the average of both partners' scores on each relationship factor were calculated and then entered into a multilevel regression model to assess differences that existed *between* couples in the sample regarding participants' value, commitment, and satisfaction toward the sexual agreement he has with his main partner. Second, the absolute difference between the two partners' scores for each of the relationship factors was also calculated to examine differences that existed *within* couples with respect to participants' value, commitment, and satisfaction toward the sexual agreement he was with his main partner (i.e., investment toward the sexual agreement). To account for the

relationship factors differences that may exist between couples, as well as the differences that may exist within couples, we constructed two multilevel regression models for each outcome variable: participants' value, commitment, and satisfaction toward the sexual agreement he has with his main partner. One multilevel regression model specifically included *between* couple-level relationship factors with other couple-level characteristics (e.g., couples' race) while a separate model only included *within* couple-level relationship factors with other couple-level characteristics. Individual-level demographic characteristics were also included in the models (e.g., age of the participant). In total, six final multivariate multilevel regression models were constructed.

To identify which independent variables were significantly associated with each of the three outcome variables, we employed multilevel regression models to explore the relationships between the outcome and independent variables by regressing the independent variables one at a time. Independent couple-level variables that remained statistically significant (i.e., $p < 0.05$) with an outcome variable were then included in the multivariate multilevel regression model with maximum likelihood estimation for that particular outcome variable. For each multivariate multilevel regression model, we used a backward elimination strategy to remove independent variables that remained non-significant until all variables, excluding the pre-determined confounders, had remained significant, including the overall final model (i.e., $p < 0.05$). We included participant's age and education, as well as, couples' race, HIV-status, relationship duration, and engagement of UAI within the relationship as potential confounders for the multivariate multilevel regression models. We report the coefficients, standard errors, and statistical significance for the factors in the multilevel maximum likelihood regression models. We also calculate and report the total variance explained by the covariates in the multivariate multilevel regression models (e.g., R^2) [41]. The intraclass correlation coefficient (ICC) for the unconditional model (i.e., model with no covariates) is also provided for each outcome variable. The ICC is defined as the proportion of variation in the outcome variable that is accounted for by the dyad, and is represented by the level-2 variation divided by the sum of the level-1 and level-2 variation [41].

Results

Characteristics of the Sample

The mean age for individuals and couples was 33.0 years (SD 10.8 and 10.1, respectively). The majority of male couples in the sample ($N = 361$) self-identified as gay (97 %), concordantly HIV-negative (76 %), and/or White (66 %). Many of the couples also had one or both partners who had at least a Bachelor's degree (68 %), were employed (94 %), and/or had health insurance at the time of assessment (88 %). Many reported living in an urban or suburban environment. For geographic location, 32 % of the men reported living in the western region of the U.S., 23 % lived in the Midwest, 29 % in the South, and 17 % stated they lived in the Northeast region.

Most couples practiced UAI within their relationship (84 %). Approximately 31 % of couples had one or both men who reported having had sex with a casual MSM partner within the 3 months prior to assessment. Furthermore, 21 % of couples had one or both men who had UAI with a casual MSM partner during the same timeframe.

On average, couples' relationship duration was 59.2 months (SD 65.8), and among those who lived together (75 %), their mean cohabitation duration was 61.9 months (SD 69.1). With respect to sexual agreements, 57 % ($N = 207$) of couples had both partners who concurred about establishing a sexual agreement, and of these couples, 84 % ($N = 174$) had both partners who concurred about their current type of sexual agreement and 80 % ($N = 140$) who concurred about adhering to the agreement within the 3 months prior to assessment. Further details about characteristics of the sample are presented in Table 2.

On average, the sample of male couples had high levels of commitment, trust and constructive communication patterns with respect to their relationship. Participants, among the couples who had a sexual agreement, also reported having high levels of value of, commitment to, and satisfaction with, the sexual agreement they had with their main partners. However, some differences within the couples (i.e., between partners) were noted about their relationship factors. For example, within couple differences were higher for particular relationship characteristics, including mutual constructive and mutual avoidance communication patterns, predictability and dependability for trust, and investment toward the relationship commitment. Table 3 provides additional information about the individual- and couple-level scores for these particular relationship characteristics.

Several relationship characteristics were significantly associated with a participants' value in, commitment to, and satisfaction with, the sexual agreement he had with his main partner. Details about the specific results from the multilevel models with independent variables examined separately one at a time are presented in Table 4. The results from the final multivariate multilevel maximum likelihood regression models are herein described.

Between Couple-level Factors Associated with Partners' Value in, Commitment to, and Satisfaction with, a Sexual Agreement

After controlling for potential confounding factors, increase in valuing a sexual agreement was associated with

Table 2 Sociodemographic and behavioral characteristics of 361 male couples

Couple-level characteristic	*N*	%
Sexual orientation		
Both men in couple identified as gay	349	97
One or both partners in couple identified as bisexual	12	3
Race		
Mixed	124	34
White	237	66
Education: had a Bachelor's degree or higher		
Both partners	134	37
Only one partner	110	31
Neither partner	117	32
Employment status		
Both partners employed	235	65
Only one partner employed	104	29
Neither partner employed	22	6
Had health insurance at time of assessment		
Both partners reported yes	227	63
Only one partner reported yes	91	25
Both partners reported no	43	12
HIV serostatus		
Concordant negative	275	76
Concordant positive	28	8
Discordant	58	16
Practiced unprotected anal intercourse (UAI) within relationship	304	84
One or both men in couple had sex outside their relationship	113	31
One or both men in couple had UAI with a casual MSM partner	75	21
Establishment of a sexual agreement		
Couple concurred about having an agreement	207	57
Couple disagreed about having an agreement	92	25
Couple did not have an agreement	62	17
Current type of sexual agreement		
Closed agreement[a]	92	44
Open agreement[a]	82	40
Couple disagreed about current type of agreement[a]	33	16
Kept sexual agreement within prior three months to assessment		
Both partners in couple kept agreement	166	80
Only one partner in couple kept agreement	31	15
Both partners broke their agreement	10	5
Ever broken sexual agreement		
One or both partners reported yes	95	46
Both partners reported no	112	54

Couple-level characteristic	Mean	SD
Individual, couple age [range: 18–68 years]	33.0	10.8, 10.1
Relationship duration in months [range: 3–420 months]	59.2	65.8
Cohabitation duration in months [range: 1–380 months]	61.9	69.1

[a] Represents couples with both partners who concurred about having a sexual agreement ($N = 207$ dyads) and the same type of agreement

male couples who, on average: had higher scores of relationship satisfaction ($\beta = 0.10$ (SE 0.05), $p < 0.05$); perceived that alternatives than being in the current relationship had existed ($\beta = 0.07$ (SE 0.03), $p < 0.05$); had higher scores of mutual constructive communication ($\beta = 0.10$ (SE 0.03), $p < 0.01$); and/or had both men

Table 3 Selected individual-level and couple-level scores of sample's relationship characteristics

Characteristic [range]	Couple-level score	
	Between dyads Mean (SD)	Within dyads Mean (SD)
Investment model [0–6]		
Commitment	5.36 (0.71)	0.72 (0.83)
Relationship satisfaction	4.88 (0.95)	0.96 (0.91)
Investment size	4.71 (0.82)	0.96 (077)
Quality of alternatives	3.70 (1.08)	1.16 (1.04)
Trust scale [1–7]		
Predictability	5.31 (0.97)	1.10 (0.87)
Dependability	5.57 (0.85)	1.04 (0.89)
Faith	6.01 (0.84)	0.86 (0.80)
Communication patterns scale [1–9]		
Mutual constructive	7.24 (1.29)	1.36 (1.25)
Mutual avoidance and withholding	3.46 (1.43)	1.33 (1.07)

Characteristic [range]	Individual-level score Mean (SD)
Sexual agreement investment scale [0–4][a]	
Commitment	3.56 (0.48)
Satisfaction	3.24 (0.63)
Value	3.47 (0.50)

Couple-level scores for between dyads represent the average score of both partners reported score for that particular characteristic. Couple-level scores for within dyads represent the difference in scores between the two partners for that particular characteristic

[a] Participants' scores for each of the domains of the sexual agreement investment scale represent their averages and only include participants from couples who had both men reporting having had a sexual agreement in their relationship

recently adhering to their sexual agreement ($\beta = 0.26$ (SE 0.08), $p < 0.01$). No other factors were significantly associated with partners' value in the sexual agreement. Overall, the model explained approximately 36 % of the estimated variance for predicting participants' value in the sexual agreement.

Increase in commitment to the sexual agreement was associated with male couples who, on average: had higher scores of relationship commitment ($\beta = 0.21$ (SE 0.06), $p < 0.001$); had higher scores of mutual constructive communication ($\beta = 0.11$ (SE 0.03), $p < 0.001$); and/or had both men recently adhering to their sexual agreement ($\beta = 0.26$ (SE 0.08), $p < 0.01$). No other factors were significantly associated with partners' commitment to the sexual agreement. Overall, the model explained approximately 31 % of the estimated variance for predicting participants' commitment to the sexual agreement.

Increase in satisfaction with the sexual agreement was associated with male couples who, on average: had higher scores of relationship satisfaction ($\beta = 0.25$ (SE 0.06), $p < 0.001$); had higher scores of mutual constructive communication ($\beta = 0.11$ (SE 0.04); $p < 0.01$); and/or had both men recently adhering to their sexual agreement ($\beta = 0.24$ (SE 0.10), $p < 0.05$). No other factors were significantly associated with partners' satisfaction to the sexual agreement. Overall, the model explained approximately 34 % of the estimated variance for predicting participants' satisfaction with the sexual agreement. Table 5 provides results from these three multivariate multilevel regression models.

Within Couple-level Factors Associated with Partners' Value of, Commitment to, and Satisfaction with, a Sexual Agreement

After controlling for potential confounding factors, less value in the sexual agreement was associated with greater differences between partners' scores regarding their commitment to ($\beta = -0.10$ (SE 0.05), $p < 0.05$), and investment in ($\beta = -0.09$ (SE 0.05), $p < 0.05$) the relationship. Compared to couples who recently adhered to their sexual agreement, less value in a sexual agreement was associated with couples who had one or both men that had broken their agreement ($\beta = -0.16$ (SE 0.07), $p < 0.05$). No other factors were significantly associated with partners' value to the sexual agreement. Overall, this model explained approximately 15 % of the estimated variance for predicting participants' value in the sexual agreement.

Less commitment to the sexual agreement was associated with greater differences between partners' scores regarding their commitment to ($\beta = -0.12$ (SE 0.04), $p < 0.01$) and investment in ($\beta = -0.11$ (SE 0.05), $p < 0.01$) the relationship. Compared to couples who recently adhered to their sexual agreement, less commitment to a sexual agreement was associated with couples who had one or both men that had broken their agreement ($\beta = -0.22$ (SE 0.07), $p < 0.01$). No other factors were significantly associated with partners' commitment to the sexual agreement. Overall, this model explained approximately 22 % of the estimated variance for predicting participants' commitment to the sexual agreement.

Less satisfaction with the sexual agreement was associated with greater differences between partners' scores on communicating constructively ($\beta = -0.11$ (SE 0.04), $p < 0.01$). Compared to couples who recently adhered to their sexual agreement, less satisfaction with a sexual agreement was associated with couples who had one or both men that had broken their agreement ($\beta = -0.30$ (SE 0.08), $p < 0.01$). No other factors were significantly associated with partners' satisfaction to the sexual agreement. Overall, this model explained approximately 14 % of the estimated variance for predicting participants' satisfaction with the sexual agreement. Additional data about these results are provided in Table 6.

Table 4 Selected separate exploratory multilevel regression models of gay male couples' demographic and relationship characteristics with their value, commitment, and satisfaction toward a sexual agreement

Demographic characteristic	Investment toward a sexual agreement		
	Value β (SE)	Commitment β (SE)	Satisfaction β (SE)
Age of participant (years)	0.002 (0.002)	−0.001 (0.003)	0.002 (0.003)
Relationship duration (months)	−0.001 (0.001)	−0.001 (0.001)	−0.001 (0.001)
Race of the couple (mixed vs. white)	0.05 (0.07)	−0.03 (0.07)	0.03 (0.08)
Education level of participant: Had at least a Bachelor's degree (vs. not)	−0.03 (0.06)	−0.09 (0.06)	−0.04 (0.07)
Both men in couple were employed (vs. not)	−0.01 (0.07)	−0.04 (0.06)	−0.04 (0.08)
HIV-status of couple (concordant negative vs. other)	0.12 (0.08)	0.11 (0.07)	0.08 (0.09)
One or both partners had sex outside of their relationship (vs. not)	−0.24 (0.07)***	−0.25 (0.06)***	−0.25 (0.08)**
Unprotected anal intercourse			
Within relationship (vs. not)[a]	0.04 (0.09)	−0.03 (0.08)	0.04 (0.11)
Outside relationship (vs. not)[a]	0.12 (0.14)	0.07 (0.14)	0.17 (0.16)
Aspects of sexual agreement			
Couple concurred about type of agreement (vs. not)	0.09 (0.10)	0.16 (0.09)	0.19 (0.12)
Couple kept agreement within prior 3 months (vs. not)	0.26 (0.09)**	0.33 (0.08)***	0.32 (0.11)**
Couple broke agreement—ever (vs. not)	−0.19 (0.07)**	−0.25 (0.07)***	−0.29 (0.09)**
Between couple-level relationship characteristic	β (SE)	β (SE)	β (SE)
Average age of couple (years)	N.S.	N.S.	N.S.
Investment model			
Commitment level	0.31 (0.05)***	0.30 (0.05)***	0.32 (0.07)***
Satisfaction level	0.24 (0.04)***	0.23 (0.03)***	0.33 (0.04)***
Investment size	0.13 (0.04)**	0.16 (0.04)***	0.21 (0.05)***
Quality of alternatives	0.17 (0.03)***	0.17 (0.03)***	0.19 (0.04)***
Trust scale			
Predictability	0.10 (0.04)**	0.08 (0.03)*	0.10 (0.04)*
Dependability	0.20 (0.04)***	0.17 (0.04)***	0.24 (0.05)***
Faith	0.20 (0.04)***	0.17 (0.04)***	0.25 (0.05)***
Communication patterns scale			
Mutual constructive	0.17 (0.03)***	0.16 (0.02)***	0.18 (0.03)***
Mutual avoidance and withholding	−0.07 (0.02)**	−0.05 (0.02)*	−0.07 (0.03)*
Within couple-level relationship characteristic	β (SE)	β (SE)	β (SE)
Age difference between partners (years)	N.S.	N.S.	N.S.
Investment model			
Commitment level	−0.12 (0.04)**	−0.13 (0.04)**	−0.13 (0.05)*
Satisfaction level	−0.06 (0.04)	−0.05 (0.03)	−0.08 (0.05)
Investment size	−0.13 (0.04)**	−0.15 (0.04)***	−0.10 (0.05)
Quality of alternatives	−0.07 (0.03)*	−0.05 (0.03)	
Trust scale			
Predictability	−0.02 (0.04)	−0.04 (0.04)	−0.01 (0.05)
Dependability	0.01 (0.04)	0.00 (0.04)	−0.01 (0.05)
Faith	−0.11 (0.04)*	−0.09 (0.04)*	−0.08 (0.05)
Communication patterns scale			
Mutual constructive	−0.05 (0.03)	−0.06 (0.03)*	−0.07 (0.03)*

Table 4 continued

Within couple-level relationship characteristic	β (SE)	β (SE)	β (SE)
Mutual avoidance and withholding	−0.04 (0.03)	−0.03 (0.03)	−0.02 (0.04)

Selected results of separate exploratory multilevel regression models with each outcome toward investment in a sexual agreement: value, commitment, and satisfaction

N.S. not significant

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] UAI within the relationship represented couples with one or both men self-reporting that they had UAI with their main male partner within the previous three months compared to couples who had both men reporting not having had UAI within their relationship. UAI outside the relationship was similarly constructed

Discussion

Sexual agreements—by definition—provide an ideal framework for gay male couples to address the sexual and relational needs of both partners in the relationship. Research that assesses aspects of couples' sexual agreements is critically important, timely and significant because many gay male couples form an agreement, are at increased risk for acquiring HIV and other STIs, may experience stigma about their sexuality and relationship status, and/or do not have access to couples-based prevention interventions since few currently exist. Practitioners who directly work with partnered gay men and gay couples may also find the framework of sexual agreements useful when addressing their clients' needs about sex and relationships.

Our study found that several common yet important relationship characteristics were associated with men who reported having higher levels of investment toward their sexual agreement with their main partners. On average, couples who had higher levels of communicating constructively and being satisfied with their relationships were more likely to have partners with higher levels of value and satisfaction toward their sexual agreements. Similarly, couples who, on average, had higher levels of relationship commitment and communicating constructively were more likely to have partners with higher levels of commitment toward their sexual agreements. More investment toward a sexual agreement was also associated with being in a relationship that had both partners who recently kept their sexual agreement.

Within couples, differences in partners' scores on certain relationship characteristics were also noted to affect investment toward a sexual agreement. For instance, greater differences in partners' scores in commitment and investment in their relationship were generally associated with less value and commitment to the sexual agreement. Less investment toward a sexual agreement was also associated with being in a relationship that had one or both partners who recently broke their sexual agreement.

These findings suggest that gay male couples who continue to build their desired relationship may help them remain invested in their sexual agreement. Another possibility is that having a sexual agreement may help both partners of the couple improve their communication and related relationship skills over time, which in turn, may help them have more satisfying and fulfilling relationships. Moreover, couples with partners who struggle to communicate constructively in their relationship, and those who differ about their investment, satisfaction, and/or commitment level in their relationship, may need additional resources to help them mitigate through this transition and possible vulnerable period. Programs that assist gay male couples during periods of transition and vulnerability are necessary for helping them to continue to build and nurture their relationship, and secondarily, to also help reduce both partners' risk for acquiring HIV and other STIs. Prior studies with gay male couples found that men who reported having higher levels of relationship characteristics, including relationship commitment and investment in a sexual agreement, were significantly less likely to have had UAI with a casual partner outside of their relationship [6–8, 33]. Research that aims to develop programs to assist gay male couples with building and maintaining satisfying relationships during the onset of their relationship and when periods of transition and difficulty arise are necessary for HIV prevention. Recently Salazar and colleagues developed HIV-related dyadic measures for partnered gay men (e.g., gay male couples). These measures aim to assess the extent that both men within the couple value and have similar attitudes toward certain health outcomes (e.g., HIV prevention) and self-efficacy for communication and health behavior change [43]. Future studies should consider using HIV-related and relational dyadic measures to help advance HIV prevention efforts, including the development of new and novel programs for gay male couples.

Limitations and Suggestions for Future Research

The use of a cross-sectional study design with dyadic data from a convenience sample precludes us from making casual inferences and generalizing our findings to all gay

Table 5 Association of between couple-level relationship characteristics with gay male couples' value, commitment, and satisfaction toward their sexual agreement

Between couple-level characteristic	Investment toward sexual agreement		
	Value β (SE)	Commitment β (SE)	Satisfaction β (SE)
Investment model			
Commitment level		0.21 (0.06)***	
Satisfaction level	0.10 (0.05)*		0.25 (0.06)***
Quality of alternatives	0.07 (0.03)*		
Communication patterns scale			
Mutual constructive	0.10 (0.03)**	0.11 (0.03)***	0.11 (0.04)**
Aspects of sexual agreement			
Couple kept agreement within prior 3 months (vs. not)	0.26 (0.08)**	0.26 (0.08)**	0.24 (0.10)*
LR $\chi^{2,a}$	63.55***	58.90***	70.26***
Sample size (dyads)	163	172	179
Log likelihood	89.97	108.86	30.79
$R^{2,b}$	0.36	0.31	0.34
ICC[c]	0.19	0.13	0.23

Results of final multivariate multilevel random-effects maximum likelihood regression models. All three models included couples' HIV-status and race, individual's age and education level, relationship duration, as well as UAI within the relationship as potential confounders

[a] LR χ^2 is the likelihood ratio Chi square test that at least one of the predictors' regression coefficient (β) is not equal to zero. A small p value from the LR test would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero

[b] R^2 represents the total variance explained by the covariates; defined by the variance from the unconditional model minus the variance obtained from the model with covariates divided by the variance from the unconditional model

[c] ICC is the intraclass correlation coefficient for the unconditional model (model with no covariates). ICC is the proportion of variation in the outcome measure that is accounted for by the dyad, and is represented by the level-2 variation divided by the sum of the level-1 and level-2 variation

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 Association of within couple-level relationship characteristics with gay male couples' value, commitment, and satisfaction toward their sexual agreement

Within couple-level characteristic	Investment toward sexual agreement		
	Value β (SE)	Commitment β (SE)	Satisfaction β (SE)
Investment model			
Commitment level	−0.10 (0.05)*	−0.12 (0.04)**	
Investment size	−0.09 (0.05)*	−0.11 (0.05)*	
Communication patterns scale			
Mutual constructive			−0.11 (0.04)**
Aspects of sexual agreement			
Sexual agreement recently broken by one or both men of couple (vs. not)	−0.16 (0.07)*	−0.22 (0.07)**	−0.30 (0.08)**
LR $\chi^{2,a}$	20.38***	27.00***	21.34***
Sample size (dyads)	169	167	188
Log likelihood	50.90	73.30	−11.39
$R^{2,b}$	0.15	0.22	0.14
ICC[c]	0.19	0.13	0.23

Results of final multivariate multilevel random-effects maximum likelihood regression models. All three models included couples' HIV-status and race, individual's age and education level, relationship duration, as well as UAI within the relationship as potential confounders

[a] LR χ^2 is the likelihood ratio Chi square test that at least one of the predictors' regression coefficient (β) is not equal to zero. A small p-value from the LR test would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero

[b] R^2 represents the total variance explained by the covariates; defined by the variance from the unconditional model minus the variance obtained from the model with covariates divided by the variance from the unconditional model

[c] ICC is the intraclass correlation coefficient for the unconditional model (model with no covariates). ICC is the proportion of variation in the outcome measure that is accounted for by the dyad, and is represented by the level-2 variation divided by the sum of the level-1 and level-2 variation

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

male couples who live in the United States, as well as those who do and do not use the Internet and/or Facebook. Although we did not collect identifying information, participation, social desirability, and recall biases may have influenced participants to inaccurately report information about their relationship, HIV status, and sexual behaviors. In addition, participants may have completed the survey with their main partners, despite our request for them to complete it independently and separately, and therefore potentially causing some bias. Moreover, the demographic and relationship factors that were assessed for this study are not exhaustive. Other factors, such as intimacy, jealousy and the possible presence of intimate partner violence (IPV), may exist and influence couples' investment toward their sexual agreement, as well as aspects about their agreements (e.g., type). Future research that examines gay male couples' sexual agreements should specifically address these limitations. Despite these limitations, our

study's main strengths are the large geographically diverse sample size of Internet-using gay male couples, the use of dyadic data with multilevel modeling analyses, and ascertaining how relationship characteristics affect couples' investment toward their sexual agreement.

Conclusions

Sexual agreements are one framework that could be used to help develop new HIV prevention efforts for gay male couples in the U.S. Services that help gay male couples establish and maintain their sexual agreements may be particularly important for minimizing their risk for HIV and other STIs. Our study provides support that such services are needed for gay male couples, particularly for those who are experiencing challenges and/or changes within their relationship. Future studies that aim to develop interventions for gay male couples must consider the types of sexual agreements that couples form, how well they communicate about sex, health and other related topics, the characteristics of their relationship, and whether they use other HIV prevention methods (e.g., testing, risk-reduction strategies). Our suggestions for future research on gay male couples' sexual agreements require further inquiry that may be best accomplished by using a mixed methods, longitudinal study design that collects dyadic data. These advances in research will help develop future HIV prevention efforts for gay male couples.

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