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Adolescent Reproductive and Sexual Coercion: Measurement Invariance in a Population-Based Sample of Male and Female High School Students

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Abstract

Purpose.—Though researchers have documented that adolescents are vulnerable to coercion focused on reproductive and sexual autonomy, measures to assess this type of coercion for both adolescent females and males have not been validated in a population-based sample.

Method.—The present study used secondary data collected from high school students across Kentucky (n=16,137 from two independent samples in 2010 and 2014) to 1) determine if five items measuring adolescent reproductive and sexual coercion (ARSC) are appropriate for use among both females and males; and 2) estimate prevalence of identified ARSC factors by sex.

Results.—For both male and females, given measurement items, the results supported a two-factor model of ARSC comprised of 1) verbal relationship manipulation and 2) contraceptive interference. Measurement invariance by sex was also supported. Additional findings indicated the high prevalence of ARSC and its associated subscales. Approximately 4 in 10 females and 3

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in 10 males reported experiencing ARSC in the previous year, with almost all of those reporting contraceptive interference also reporting verbal relationship manipulation.

Conclusions.—Findings suggest verbal relationship manipulation and contraceptive interference (together forming ARSC) may restrict the autonomous sexual and reproductive decision-making of both female and male adolescents.

Keywords

adolescents; reproductive coercion; verbal relationship manipulation; contraceptive interference; measurement invariance by sex

Adolescence is a time of significant physical, cognitive, social, emotional, and sexual development. The onset of puberty initiates a youth's transition from childhood to early adolescence, typically between the ages of 11 to 13. Middle adolescence (ages 14–16) is marked by continued physical development, an emerging sex drive, feelings of desire and sexual attraction, and increasing interest in intimate relationships. Middle adolescence is a time when peer relationship influence can take hold and have an impact on behavior affecting health—including experimentation with drugs or sexual activity. However, it is common to see further and more widespread experimentation with such activities in late adolescence (ages 17–19). The intensification of focus on romantic relationships happens at this time and sexual exploration and activity is a normal part of development (McNeely & Blanchard, 2009). Although sexual experimentation and relationship formations are typical during adolescence, some teens are more likely to experience the negative health outcomes that can come through engagement with sexual activities (Martin, Hamilton, Osterman, Driscoll, & Drake, 2018).

Health impact of adolescent sexual activity.

Over the past decade, increased use of abstinence and improved contraceptive use have helped to lower teen pregnancy and birth rates among adolescents in the United States (Santelli, Lindberg, Finer, & Singh, 2007; Sedgh, Finer, Bankole, Eilers, & Singh, 2015). In 2017, 194,377 babies were born to females 15–19 in the U.S., a birth rate of 18.8 births per 1,000 females ages 15–19, representing an all-time low (Martin, Hamilton, Osterman, et al., 2018). Despite overall gains, racial, economic, and regional disparities in teen pregnancy and birth rates have persisted. For instance, in comparison to White, non-Hispanic females, American Indian or Alaska Native females experience birth rates triple that of White, non-Hispanic female adolescents, while Black and Hispanic females are two times more likely to give birth than their White peers (Martin, Hamilton, & Osterman, 2018). From 2005–2017, teen birth rates were higher for teens living in rural counties (30.9 live births per 1,000) than for teens living in urban counties (18.5 live births per 1,000) (Hamilton, Rossen, & Branum, 2016). Teen pregnancy and parenting are significant contributors to high school dropout rates, and children born to teen mothers are also more likely to have lower school achievement, increased health problems, increased incarceration during adolescence, and increased likelihood of giving birth as teens themselves (Hoffman, 2008).

While teen pregnancy and birth rates have been on the decline, both male and female adolescents experience a burden of the 20 million newly acquired sexually transmitted infections (STIs) in the United States each year—with those aged 15–24 acquiring half of all new STIs (Satterwhite et al., 2013). Between 2013–2017, reported cases of several consequential sexually transmitted infections have increased for both females and males ages 15–19. For instance, in this timeframe, for males and females, respectively, reported cases of chlamydia have risen by 27.9% and 6.4%, gonorrhea by 44.8% and 20.4%, and primary and secondary syphilis by 13.5% and 68.4% (Centers for Disease Control and Prevention, 2018). As both pregnancy and STI acquisition can contribute to diminished education and health outcomes for adolescents with the potential for intergenerational transmission of health disparity, continuing to identify contributors to teen pregnancy, STI acquisition, and their prevention are necessary and consequential.

Reproductive and sexual coercion have been shown to impact both teen pregnancy and STI outcomes. The American College of Obstetricians and Gynecologists defines reproductive and sexual coercion ("Reproductive and sexual coercion. Committee Opinion No. 554," 2013):

> Reproductive and sexual coercion involves behavior intended to maintain power and control in a relationship related to reproductive health by someone who is, was, or wishes to be involved in an intimate or dating relationship with an adult or adolescent. This behavior includes explicit attempts to impregnate a partner against her will, control outcomes of a pregnancy, coerce a partner to have unprotected sex, and interfere with contraceptive methods (p. 411).

Two concentric bodies of literature, namely verbal sexual coercion and reproductive coercion, are helpful to our understanding of the way in which reproductive and sexual coercion may be operating in adolescent relationships. Table 1 provides a review of selected studies involved in the progression of the measurement of verbal sexual coercion and reproductive coercion, including information about study sampling design and measures. In addition, considerations regarding the past measurement of reproductive coercion motivating the current study are presented.

The measurement of verbal sexual coercion in intimate relationships.

Pugh and Becker (2018) reviewed literature on the measurement and study of verbal sexual coercion and its impact, when present, on young women's ability to provide active consent to sexual activity. They trace the measurement of verbal sexual coercion as far back as Koss and Oros's development of the Sexual Experiences Survey (SES) to measure "sexual intercourse associated with various degrees of coercion, threat, or force" among college students (Koss & Oros, 1982). The SES includes several items related to verbal pressure to engage in sex, namely items tied to a partner saying things they didn't mean, pressuring to have sex through arguments, and threatening to end the relationship (Koss & Oros, 1982). The study of verbal sexual coercion was further refined by qualitative work by Livingston, Buddie, Testa and VanZile-Tamsen in 2004. Livingston and colleagues interviewed a community sample of 114 women ages 18 to 30 years old. Their primary findings revealed that in situations where women had never had sex with their current partner, sweet talk and

promises of further relationship commitment were the primary forms of coercion used to manipulate women to acquiesce to unwanted sex. Whereas, when women had engaged in prior sexual relations, negative persuasion including direct threats to the relationship were used (Livingston, Buddie, Testa, & VanZile-Tamsen, 2004).

Although most of the measurement of verbal sexual coercion has been conducted among young adults, French, Suh, and Arterberry (2017) recently conducted exploratory factor analysis on the Sexual Coercion Inventory (SCI) (Waldner, Vaden-Goad, & Sikka, 1999) for which they modified (SCI-R) among a sample of 514 high school and college students. French and colleagues analysis revealed a two-factor model provided the best parsimony and theoretical fit (French, Suh, & Arterberry, 2016). A factor they named manipulation included both positive verbal persuasion ("A partner has said things that later proved to be untrue (e.g., 'I love you')") and "A sexual partner has made false promises (e.g. 'We'll get married')") in addition to other more negative forms of verbal persuasion, supporting Livingston and colleagues' prior findings. Of consequence to the reduction of health disparities resultant from unintended pregnancy and STI acquisition, women reporting verbal sexual coercion history reported higher rates of sexual risk behaviors compared to those without such history (Benson, Gohm, & Gross, 2007; Gilmore et al, 2014; Messman-Moore et al., 2008; Testa & Dermen, 1999).

The measurement of reproductive coercion in intimate relationships.

Named initially by Miller and colleagues (Miller et al., 2010; Miller et al., 2007), reproductive coercion is generally defined as a male partner's interference with autonomous decision-making of a woman with regard to her reproductive health (Katz, Poleshuck, Beach, & Olin, 2017; Miller et al., 2010; Miller et al., 2007). Grace and Anderson (2018) systematically reviewed 27 articles that focused on reproductive coercion perpetrated by male intimate partners. Their review included the history of the measurement of reproductive coercion, as well as primary findings regarding male partner's use of reproductive coercion in three domains: 1) pregnancy coercion, 2) birth control sabotage, and 3) abortion coercion. They highlighted the wealth of knowledge created in the last decade regarding reproductive coercion and the opportunities within the field for measurement validation of these concepts.

Reproductive coercion has been studied with increasing intensity following Miller et al.'s seminal work (Grace & Anderson, 2018; Miller et al., 2010; Miller et al., 2007). The majority of this work involves the measurement of reproductive coercion using questions created by or modified from the measurement items first proposed by Miller following qualitative exploration (Grace & Anderson, 2018). Parallel to the publishing of Grace and Anderson's review, McCauley and colleagues completed a psychometric investigation to refine Miller's measures (Miller et al., 2010; Miller et al., 2014) into the Reproductive Coercion Scale (McCauley et al., 2017). McCauley and colleagues presented a series of five measurement questions covering two subscales: pregnancy coercion and condom manipulation (McCauley et al., 2017). To our knowledge, McCauley's work is the only published study to document psychometric properties and construct refinement of the measurement items used to collect information regarding reproductive coercion. Although

a foundational step for the measurement of reproductive coercion, there are limits to the generalizability of McCauley et al. (2017)'s Reproductive Coercion Scale and the measurement of reproductive and sexual coercion in adolescents more broadly.

First, communication of verbal sexual coercion have been included, to some degree, in the measurement of reproductive coercion over time, however its measurement has not been consistent (See Table 1). For instance, Miller et. al. used three measurement items for pregnancy coercion focused on verbal demands, including: "Has someone you were dating/going out with ever told you not to use any birth control, said he would leave you if you did not get pregnant and told you he would have a baby with someone else if you didn't get pregnant" (Miller et al., 2010) which were similar to the measurement items used in her 2014 survey, as well. The Reproduction Coercion Scale retained one verbal item under the subdomain of pregnancy coercion: "In the past 3 months, has someone you were dating/going out with told you not to use birth control" (McCauley et al., 2017). However, none of Katz et al's (2018) items focus on communicated demands.

Second, McCauley's construct validation work was based on the measure of these constructs by convenience sample among females ages 16–29 years old seeking services in family planning clinical settings, and adolescents and young adults were combined for analysis. Given the tremendous developmental change that occurs in these stages of life, construct validation is warranted in a sample of exclusive adolescents.

Third, to date, in addition to those studies mentioned in Table 1, studies of reproductive coercion rely for the most part on clinical samples from adolescent and young adult women seeking reproductive health services or in domestic violence shelter (Miller et al., 2010; Northridge, Silver, Talib, & Coupey, 2017; Thiel de Bocanegra, Rostovtseva, Khera, & Godhwani, 2010). For example, Northridge et al. (2017) surveyed sexually-active high school girls living in high poverty neighborhoods awaiting medical care in a clinical setting. Consequently, there is no measurement validation study published that assesses the fit of reproductive coercion measures for use among population samples of adolescents and young adults in either community or school settings.

Finally, as the concept of reproductive coercion arose in family planning clinical settings, the framing of these original measurement items was gendered and focused on a male partner's interference with pregnancy outcomes of his female partner. Although McCauley's final measurement items are gender neutral in terms of the sex of the partner using coercive tactics, the measurement items still focus on tactics enacted to cause pregnancy. Therefore, the Reproductive Coercion Scale makes sense conceptually for use only in populations of females or trans-men as victims. And the scale has not been validated for use with trans-men. With two exceptions (Cook-Craig et al., 2014; Dick et al., 2014), males have been excluded from studies of reproductive coercion victimization. However, as research suggests that adolescent males are targets of other forms of relationship violence (Bonomi et al., 2012; Bonomi, Anderson, Nemeth, Rivara, & Buettner, 2013), it is plausible that males and trans-women may be the target of coercion impacting autonomous reproductive and sexual health choice; therefore, it is necessary to move forward construct validation work in samples which include both females and males. As Table 1 illustrates,

following the measurement work of McCauley, Katz and colleagues used gender-neutral measurement items in their work; however, because their sample was a convenience sample of undergraduate females, it is unknown how these measurement items would function in a population-based sample of male and female adolescents.

The Present Study

Our work adds to knowledge regarding the measurement of reproductive and sexual coercion in adolescent relationship by conducting invariance testing by student sex (i.e., male versus female). Although most studies of coercion impacting the reproductive and sexual autonomy of adolescents and young adults involved in sexual or romantic relationships have relied on measures derived from Miller's gender-specific work, one exception is a population-based survey of high school aged male and female adolescents, which utilized gender-neutral measurement items (Cook-Craig et al., 2014). Cook-Craig and colleagues collected five indicators of what they have termed contraceptive interference from two independent samples of high school students across Kentucky (N = 16,509 in 2010, N = 13,588 in 2014). The present study conducted a secondary data analysis to identify the factor structure of adolescent reproductive and sexual coercion (ARSC), determine their appropriateness for use among both females and males, and estimate the prevalence of identified ARSC factors by sex.

Method

Data Source and Sample

Analysis were conducted using "Green Dot Across the Blue Grass" de-identified data provided by investigators at the University of Kentucky. Data was originally collected to evaluate the effectiveness of the Green Dot bystander intervention program to reduce sexual and related forms of interpersonal violence in 26 high schools over five years throughout Kentucky (Coker et al., 2014). These data were collected cross-sectionally and at time points starting in early 2010 and every spring for four subsequent years using an anonymous self-administered paper-pencil survey taken during the school day. The study was approved by the University of Kentucky's Office of Research Integrity's Institutional Review Board. More detailed data collection procedures are presented elsewhere. (Cook-Craig et al., 2014)

The current analysis used data from two non-overlapping time periods to ensure that no student was included twice; the initial, baseline cross-sectional sample collected in 2010 served as our model development sample and the final cross-sectional sample collected in 2014 served as our model validation sample. In 2010, 16,509 adolescents participated in the survey; in 2014, 13,588 did so. For the purposes of the sub-group invariance testing analyses, samples were restricted to adolescents who reported they had been in a dating or romantic relationship within the past 12 months (15,390 "daters" in 2010 survey, 11,993 "daters" in the 2014 survey). An additional 165 and 135 adolescents were excluded from the 2010 and 2014 samples, respectively, because they did not provide valid responses on their sex or sexual attraction (15,225 in 2010 survey and 11,858 in 2014 survey). An additional 298 and 273 adolescents did not provide a valid response to one or more of the indicators of reproductive and sexual health coercion. Excluding these students (462 and

408, respectively) resulted in analytic sample sizes of N = 14,927 (2010 survey) and N = 11,585 (2014 survey).

As chi-square test statistics in invariance testing using CFA can be impacted by large same size, and to assure comparison between samples of the same size, datasets were created containing a random sample of 500 female and 500 male participants from each of the 2010 and 2014 analytic samples (Schumacker & Lomax, 2016; Wolf, Harrington, Clark, & Mille, 2013). All CFA were performed on these datasets containing a random sample of the larger analytic samples.

Measures

Adolescent reproductive and sexual coercion (ARSC).—ARSC was measured using five survey items that captured a range of coercive verbal and physical tactics. Please note the variable name used in analysis, and reported in text, tables, and figures throughout, are provided next to each measurement item in parentheses. Participants were asked: In the last 12 months, how many times has a current or previous boyfriend/girlfriend said to you: 1) “You want us to use birth control or condoms so you can sleep around with other people” (UCR); 2) “If we have a baby, you will never have to worry about me leaving you. I will always be around” (BLEVR); and 3) “You would have a baby with me if you really loved me” (BLOVR)? Participants were also asked: In the past 12 months has a current or previous boyfriend or girlfriend 4) not allowed you to use birth control or condoms when you wanted to (BCR); and 5) forced you to have sex when you were not using birth control or condom (BC2R)? Response options for all items included: 0 times, 1–2 times, 3–5 times, 6 or more times, “Yes, this happened before, but not in the past 12 months,” and “Not in a dating or romantic relationship in the past 12 months.”

Recoding response options.—For purpose of analysis, responses of “1–2 times” were coded as 1, “3–5 times” were coded as 3, and “6 or more times” were coded as 6. The response “Yes, this happened before, but not in the last 12 months” was recoded to 0 since those who selected this response did not experience the described behavior in the last 12 months.

Other demographic measures.—Sociodemographic measures were collected, including 1) sex (female or male), 2) current grade in school (9th, 10th, 11th, 12th, ungraded or other grade) 3) racial/ethnic description (American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino/a, White, Other), 4) socio-economic status as indicated by free or reduced price school lunch eligibility (no or yes), and 5) sexual attraction (only attracted to females, mostly attracted to females, equally attracted to female and males, mostly attracted to males, only attracted to males, and not sure). Sexual attraction was dichotomized for analysis: males indicating only attraction to females and females indicating only attraction to males were categorized as exclusively heterosexual; all others were classified as not exclusively heterosexual.

Analysis

Subgroup invariance analysis processes were modeled after procedures outlined by Dimitrov and by Bowen, who provides further clarification on CFA modeling with ordinal data as was used here (Bowen & Masa, 2015; Dimitrov, 2010). Invariance testing was used to determine the validity of using the same measurement items to assess underlying ARSC subscales across female and male subgroups of the population. Following standard processes for invariance testing, confirmatory factor analysis (CFA) was first used to determine best fitting latent factor models of ARSC for females and males, separately. Then invariance testing models were fit as a function of student sex (male versus female), and a series of nested models were run and compared to determine the validity of the use of the same ARSC measurement items across the two subgroups of the population. This process was repeated using two different cross-sectional samples, collected at 26 Kentucky high schools four years apart (2010 and 2014), to determine if invariance test findings could be replicated. Only if measurement invariance was found to be present between males and females, our second aim was to report prevalence estimates of ARSC by sex.

Method of estimation and statistical software used.—The two random sample datasets were entered into PRELIS to obtain polychoric correlation and asymptotic covariance matrices, necessary for analysis of ordinal data (Wang & Cunningham, 2005), which were subsequently uploaded into LISREL 9.30 (Jöreskog & Sörbom, 2013). Due to ordinal data analysis, baseline model building and subgroup invariance testing were conducted using CFA using Diagonally Weighted Least Squares (DWLS) method of estimation in LISREL 9.30 (Tolman, Striepe, & Harmon, 2003; Wang & Cunningham, 2005). Data cleaning and descriptive statistics were calculated in SAS (SAS 9.4m5 [Computer Software], 2017).

Baseline model creation.—Best fitting models were first built separately for males and females using correlation and covariance matrices generated from the datasets containing a random sample of 500 participants from the 2010 development analytic sample. As this was secondary data analysis, our measurement of factors of reproductive and sexual coercion were limited to the items in the dataset. In preparation for model building and invariance testing, we performed a cursory exploratory factor analysis (EFA) with the entire analytic 2010 dataset, and determined the plausibility of a two-factor model, with three items clustering around a factor focused on verbal sexual coercion (French et al., 2016; Koss & Oros, 1982; Livingston et al., 2004) and another on contraceptive interference (Katz et al., 2017; McCauley et al., 2017; Miller et al., 2010; Miller et al., 2007; Northridge et al., 2017). Based both on this cursory data analysis along with prior measurement evidence, two types of models were considered when creating female and male best fitting baseline models: one-factor (with all measurement items loading onto one factor) and two-factor (with three measurement items loading onto one factor and two loading onto another). Baseline models were built using the following steps: 1) 1-factor and 2-factor models were generated by subgroup, with no measurement covariance estimated. 2) A determination was made to move forward with either 1 factor or 2-factor modeling based on comparison of fit criteria between the 1-factor and 2-factor models by subgroup, with no measurement covariance estimated (e.g. Satorra-Bentler Scaled Chi-Square >.05, Non-normative Fit Index >.96, and

Standardized Root Mean Residual <.08) (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999). In both cases it was determined to proceed with 2-factor model building. 3) Model fit improvement criteria concerning measurement covariance estimation were considered and additional models were estimated until the best fitting model was created for both female and male subgroups. 4) Best fitting female and male model were moved forward to subgroup invariance analysis.

Subgroup invariance testing.—Invariance between female and male subgroups was determined using CFA through fitting a series of nested models with increasing number of parameter constraints across groups and determining if there was deterioration in model fit between the constrained model compared to the more naïve model with fewer parameter estimates (Bowen & Masa, 2015). Here, as well, models were built using correlation and covariance matrices generated from the male dataset and the female dataset containing a random sample of 500 participants, each, from the 2010 development analytic sample.

Configural invariance was found when the same measurement items loaded onto the same specified factors across groups (Bowen & Masa, 2015). Here, we loaded the three verbal relationship manipulation items (UCR, BLEVR, BLOVR) onto one latent variable (EXPECT) and the other two contraceptive interference items (BCR & BC2R) onto a second latent variable (UNPROSEX) (See Figure 1). Configural invariance was determined to exist if the unconstrained multiple group model met fit criteria (Bowen & Masa, 2015). Apriori, it was determined that the model had acceptable fit if the Satorra-Bentler Scaled Chi-Square (S-B Scaled x^2) was non-significant (p>.05). Only once configural invariance was supported was it acceptable to move forward to metric invariance testing.

Metric or weak invariance between subgroups was found when there were statistically equivalent factor loadings across groups (Bowen & Masa, 2015). Instead of letting the model estimate unique factor loadings for the female and male subgroups, as was the case with configural testing, a metric model was estimated constraining factor loadings to be equal across groups--meaning we forced the model to estimate the same factor loading parameters for both the female and male subgroups within the same model. Then to determine if metric invariance was supported a chi-square difference test was conducted comparing the metric to the configural model fit (Bowen & Masa, 2015). Apriori, it was determined metric invariance would be determined to be supported if model fit was acceptable (S-B Scaled x^2 p>.05 and if CFI was .95 or higher) and if the Original Scaled Normal Weighted Last-Squares Chi-square Difference Test (Scaled NTWLS Δx^2) was non-significant (p>.05). Only if metric invariance was found, was it appropriate to retain the model with constrained factor loadings and proceed to scalar invariance testing.

Scalar or strong invariance was defined by the presence of invariant intercepts (i.e. in the equations relating latent factors to observed measurement items) in additional to invariant factor loadings and the same pattern of item loadings across factors (Bowen & Masa, 2015). Instead of letting the model estimate unique threshold estimates for the male and female subgroups, as was the case in metric invariance testing, a scalar model was estimated forcing the model to estimate the same threshold estimate parameters for both female and male subgroups within the same model. Scalar invariance is necessary to compare factor

means, variances and covariances in either research or practice (Bowen & Masa, 2015). A scalar model was estimated constraining all thresholds to be equal across groups. Then to determine if scalar invariance was supported a chi-square difference test was conducted comparing the scalar model to the metric model, using the same model fit criteria as in prior analysis. Only once scalar invariance was determined was it appropriate to present prevalence estimates for ARSC by sex for the sake of comparison (Bowen & Masa, 2015).

Validation of findings in second sample.—As is recommended practice in CFA, models and invariance testing results were validated in a second sample. Here, analysis was replicated using the datasets containing a random sample of 500 females and 500 males from the 2014 validation analytic sample.

Results

Sample characteristics for both the 2010 development sample and the 2014 validation sample are presented in Table 2. Similar distribution of sociodemographic characteristics are noted across samples.

Baseline Models for both Females and Males

For both female and male subgroups, a two-factor latent variable model of ARSC among high school youth was selected as the best fitting model, with measurement items loading onto factors identically for both groups. Please note the variable name for the measurement items and latent variables used in analysis, and reported in text, tables, and figures throughout, are provided in parenthesis below. As was theoretically anticipated, the three measurement items related to communicated statements regarding sexual expectations loaded onto the same latent factor, a subscale we have labelled Verbal Relationship Manipulation (EXPECT) (French et al., 2016; Livingston et al., 2004). This included questions as to if a current or previous girlfriend/boyfriend in the past 12 month expressed concern over use of birth control or condoms in order to sleep around with other people (UCR), promises of never leaving if couple would have a baby together (BLEVR), and statement concerning having a baby if “real love” (BLOVR). The other two measurement items, past 12-month denial of birth control or condoms (BCR) and forced sex without birth control or condoms (BC2R), loaded onto the second latent factor, a subscale we have labelled Contraceptive Interference (UNPROSEX). The path diagram for the 2-factor model is presented in Figure 1 and 1 factor versus 2-factor goodness-of-fit comparisons are presented in Table 3. With the female 2-factor model, no additional modifications were suggested so the 2-factor model without covariance estimates was chosen as the best fitting model. With the male 2-factor model, however, model fit improvements were suggested, so additional models were built including measurement covariance estimations until the best model fit was achieved. In addition to factor loadings, best fitting models for males also included measurement covariance estimates for BCR & UCR as well as for BC2R & UCR. Best fitting models developed using the datasets containing a random sample of 500 females and 500 males from the 2010 developmental analytic sample were validated using the datasets containing a random sample of 500 females and 500 males from the 2014 validation analytic sample (also presented in Table 3).

Female and Male Subgroup Invariance Testing in the 2010 Development Sample

Goodness-of-fit statistics for subgroup invariance analysis between males and females in the 2010 development sample can be found in Table 4.

Configural Invariance.—The large p-value for the global chi-square test statistic value (Satorra-Bentler (1988) Scaled Chi-Square (C3) 3.442 (p = 0.7516)) implied that the data supported the configural invariance of the measurement model across both 2010 female and male groups. The same items loaded onto the same factors across groups.

Metric or Weak Invariance.—Fit criteria for both the configural model and the metric model are similar when comparing female and male models from the 2010 data. The Satorra-Bentler Scaled χ^2 indicated acceptable fit for both models—the change in χ^2 per change in *df* was nonsignificant (Scaled NTWLS $\Delta\ \chi^2$=0.370 $_{(3)}$, 0.90>*p*>0.95). CFI was the same across models (1.000). It was appropriate to retain constrained factor loadings and proceed to scalar invariance testing.

Scalar or Strong Invariance.—The scalar model did not converge so there are no model fit indices to report. Scalar invariance was not supported.

Confirmation of findings in the 2014 Validation Sample

Fit statistics for the sequence of invariance testing models used for model comparison testing between males and females in the 2014 validation sample can be found in Table 5. In addition to validating the presence of configural and weak/metric invariance between female and male subgroups, and unlike in the 2010 dataset, strong/scalar invariance was also supported in the 2014 dataset. The Satorra-Bentler Scaled χ^2 indicated acceptable fit for configural, weak/metric and strong/scalar models. The change in χ^2 per change in *df* was non-significant when comparing the metric to the configural model (Scaled NTWLS $\Delta\ \chi^2$=−0.080 $_{(3)}$, *p*>0.99) and when comparing the scalar to the metric model (Scaled NTWLS $\Delta\ \chi^2$=−5.42501 $_{(3)}$, *p*>0.99). Construct validation of the ARSC measures, as two distinct subscales, was supported for males and females in the 2014 validation sample.

Estimates of Adolescent Reproductive and Sexual Coercion by Sex in the 2014 Sample

As scalar invariance between females and males was only demonstrated using the 2014 dataset, prevalence estimates regarding ARSC by sex are presented only for the 2014 dataset. Whereas 30.6% of high school males reported having experienced any kind of past year sexual health coercion, 41.8% of females experienced past year ARSC. Although the same proportion of females and males experienced past year forced or coerced unprotected sex (19.1% for both females and males), differences were noted by sex in relationship to verbal relationship manipulation. Here, a larger percentage of females than males reported having experienced past year ARSC through verbal relationship manipulation (39.9% in females versus 28.7% in males). Among all youth in the sample, most youth reporting contraceptive interference victimization also reported verbal relationship manipulation in the past 12 months. Whereas, 17.5% of the sample reported exposure to both, only 1.9% of the sample reported exposure to contraceptive manipulation without verbal relationship

manipulation. However, 18.0% of the sample reported exposure to only verbal relationship manipulation.

Discussion

Results presented support the measurement invariance of ARSC between males and females using a theoretically grounded two-factor structure with underlying subscales of verbal relationship manipulation and contraceptive interference. Consequently, the ARSC measurement items loaded onto the same underlying subscales, and it is appropriate to use these items to make direct comparisons of male and female subpopulations in research and practice.

Adolescent males, like females, report experiences of contraceptive interference at similar rates. However, in the past 12 months, more females (4 in 10) reported experiencing verbal relationship manipulation. Specifically, more frequent exposure to a boyfriend or girlfriend stating, “If we have a baby, you will never have to worry about me leaving you. I will always be around” among female adolescents appears to be driving this apparent difference in experiences of verbal manipulation (see Table 6). This finding supports what others studying adolescent dating violence have found, namely that females experience higher rates of sexual pressure due to persistent begging or threats than do males (Bonomi et al., 2012). Experience of sexual pressure is also gendered and relies on a social context with double relationship standards for females and males. Because sexual fidelity is valued more for females in heterosexual relationships than for males (Nye, 1998) and the material consequences of being left by a partner when pregnant or parenting are particularly great, the promise of sexual commitment creates vulnerability for girls and women. This type of verbal manipulation regarding sexual fidelity and gendered expectations of sexual interactions, if left unchallenged, creates the context in which utterance of sexual fidelity can lead to severe acts of physical and sexual violence in adulthood, including felonious domestic violence and abuse to cause spontaneous abortion (Chester & DeWall, 2018; Nemeth, Bonomi, Lee, & Ludwin, 2012).

In reflection of our findings in relation to the larger literature on the use of coercion in intimate relationships, we found it helpful to reflect on the work of Dutton and Goodman (2005). They present a model of coercion in intimate partner violence relationships where communicated relationship commitment request (e.g. sweet talk and promises) and demand (e.g. threat) is foundational to the disruption of autonomous reproductive and sexual health decision making for those in abuse relationships. This conceptualization is similar to our finding that most participants reporting contraceptive interference were also experiencing verbal relationship manipulation, but not vice versa. This finding has implications for prevention education as well as in clinical practice, suggesting promises and threats to relationship commitment should be a focus of inquiry in their own right as they may indicate the presence or future possibility of contraceptive interference.

While this work indicated the measurement validity of ARSC for both adolescent males and females, an important next step is that of determining how ARSC may impact a variety of sexual health outcomes, including adolescent pregnancy and sexual transmitted disease

infection. It is our anticipation that although reproductive and sexual coercion exposures appear similar between females and males, sexual health outcomes may differ considerably (Tolman et al., 2003). Other studies have found that similar teen dating violence exposure resulted in different health outcomes for female and male adolescents (Bonomi et al., 2013). For instance, in Bonomi et al.'s (2013) study of teen dating violence exposure, whereas females with physical/sexual dating violence victimization were at increased risk of smoking, depressive symptoms, eating disorders, vomiting to lose weight, and frequent risky sexual behavior, compared to non-exposed females, there were no health differences observed for males experiencing physical/sexual dating violence compared to those who did not. As work in this area is expanded to explore the way in which reproductive and other forms of sexual health coercion are functioning in populations of adolescents and adults across sex and sexuality, it would also be important to conduct invariance testing with current measurement items between sexual majority and minority populations—a next step for our study team. As well, new measurement items may need to be developed to address unique needs of sexual minority populations, due to the heteronormative social context in which coercion impacting the autonomous decision making of sexual partners takes place.

To the best of our knowledge, this is the first published study to establish measurement invariance of reproduction and sexual health coercion in a population-based sample of high school adolescents, including characterizing the underlying constructs of verbal relationship manipulation and contraceptive interference for both females and males. Measurement invariance (i.e. configural, weak/metric, strong/scalar) is a necessary first step to use the same measurement items to make comparisons across groups. Thus, this measurement invariance allows for future researchers to use these items to either compare exposure between females and males or to determine if these exposures impact key outcomes of interest for both females and males. An extension of this current work is to determine if exposure to ARSC is associated with detrimental sexual health outcomes for both females and males, which could include unintended pregnancy for the couple, but could also include HIV and other STI infection rates.

Limitations and Future Directions

The present study has several limitations. First, prior literature on the use of coercion in relationships demonstrates that implicit threats of future pain and violence, not just explicit relationship manipulation, are a salient power and control tactic (Pence & Paymar, 1993). As this analysis was limited by the measures contained within the secondary data set, we were not able to study the potential role of implicit threats within reproductive and sexual coercion among adolescents. Future measurement researchers should consider adding implicit threat items to future surveys alongside the verbal relationship manipulation and contraceptive interference studied here to determine if implicit threats hang with either construct identified or comprise a separate construct altogether.

Second, as strong/scalar invariance was only supported in the 2014 validation sample, and not in the 2010 sample, it would be scientifically prudent to replicate strong/scalar invariance testing between females and males in yet a third sample—as model replication in a second dataset is recommended practice. Therefore, although we were justified in

presenting prevalence estimates for ARSC for the 2014 sample, caution should be given in assuming constrained intercepts across groups when considering females and males in research analysis and practice without further replication. Further validation of these measurement items in another sample containing females and males would be welcomed. It should be noted that strong/scalar invariance in the 2010 sample was not supported because the model itself did not converge. Therefore, there were no parameter estimates or goodness-of-fit indicators generated that could be used to determine invariance. There are several reasons why models may not converge including both insufficient sample size as well as the possibility that key items contributing to the explanation of variance and covariance in the data were absent from the measurement model (Schumacker & Lomax, 2016). Here, as 20 observations per measurement item for each subgroup is considered sufficient in confirmatory factor analysis, a sample of 500 for each dataset is considered sufficiently powered for this analysis (Schumacker & Lomax, 2016). Therefore, and as noted above, it might be possible that the strong/scalar invariance model did not converge in the 2010 dataset due to limited indicators explaining variance and covariance in the data (e.g. implicit threats). If given future opportunities for data collection on reproductive and sexual coercion in adolescence, we think it would be prudent to include additional measurement items that tap a wider range of reproductive and sexual coercion tactics.

Third, although we tested the two-factor model for both males versus females, we did not consider participant sexual orientation in conjunction with sex. The five items in our modeling of ARSC are heteronormative in nature (e.g., forced sex without using birth control) and may not accurately reflect ARSC in sub-groups of sexual orientation minorities. That is, the measures may not capture larger issues of sexual health coercion beyond a heteronormative context where pregnancy and parenting are central. Future research is needed to validate the present study's two-factor model in sub-groups of men and women differing in sexual orientation (e.g., heterosexual, homosexual) if ARSC is going to be reported and compared in samples of non-heterosexual females or males. Relatedly, future research should consider incorporating other items in an ARSC measure, perhaps more specific to men and non-heterosexual females, as a "one size fits all" approach may not be appropriate for this measure. Finally, although retrospective assessment of violence within relationships is the field standard, it is possible that recall bias may have impacted findings as adolescents were asked to number exposure to each measure of ARSC in the past 12 months.

Implications and Conclusion

The findings of the present study have implications for future research looking to include a standardized measurement of ARSC among both females *and* males. This invariance analysis supports the use of the same five measurement items, loading onto the same two latent variables, for both females and males. Our findings indicate that adolescent high school students are experiencing significant coercion from boyfriends or girlfriends impacting their autonomous decisions regarding sexuality, relationships, and reproduction. Both verbal relationship manipulation and contraceptive interference should be included in studies focused on adolescent reproductive and sexual health for both females and males.

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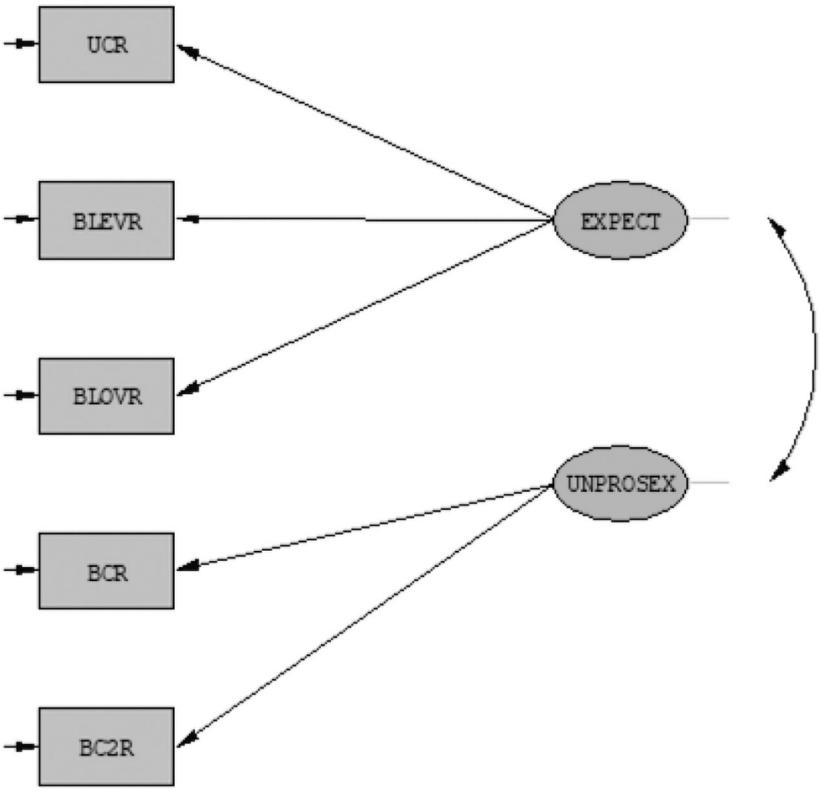

Figure 1.
Two factor latent variable model for Adolescent Reproductive and Sexual Coercion (ARSC).

Table 1.

Review of studies involved in progression of measurement of reproductive and sexual coercion and current study considerations

Sampling Design, Constructs and Subscales				Measurement Considerations for Current Study		
First author, Year of publication	**Sampling design (n=)**	**Primary construct**	**Subscales**	**Population-based sample of adolescents**	**Coercive communication measured**	**Gender neutral measurement items**
Measurement of verbal sexual coercion						
Koss, 1982	A representative school-based sample of female and male college students ages 18–45 (n=3,862)	Sexual intercourse associated with various degrees of coercion, threat and force	None	No	Yes, three of thirteen measurement items on Sexual Experiences Survey	No, however, heteronormative measurement items were developed for both females and males, separately
Livingston, 2004	A representative community sample of females 18–30 living in Buffalo, NY (n=114)	Role of sexual precedence in verbal sexual coercion	Positive messages with no sexual precedence & negative persuasion with sexual precedence	No	Yes, though qualitative analysis	n/a
French, 2017	Female and male high school and college students ages 14–26 years of age from a Midwestern public rural and urban high school and a public university (n=118 high school and 394 college students)	Sexual Coercion	Manipulation & Substance Use and Aggression	Yes, however analysis conducted on merged dataset containing young adults, as well	Yes, five of the six measurement items within the manipulation subscale	Yes, focus on sexual partner
Miller-based measurement of reproductive coercion in samples of women						
Miller, 2010	Females ages 16–29 seeking care at 5 California family planning clinics (n=1,278)	Reproductive Control	Pregnancy Coercion & Birth Control Sabotage	No	Yes, within pregnancy coercion domain Not as separate subscale	No, focus on female target of male partner
Miller, 2014	Females ages 16–29 seeking care at 24 Pennsylvania family planning clinics (n=3,539)	Reproductive Coercion	Pregnancy Pressure & Birth Control Sabotage	No	Yes, within pregnancy prompting behaviors Not as a separate subscale	No, focus on female target of male partner
McCauley, 2017	Young women aged 16–29 years seeking services in 24 Pennsylvania and 5 California family planning clinics. Data were pooled (n=4,674)	Reproductive Coercion	Pregnancy Coercion & Condom Manipulation	No	Yes, one item within pregnancy coercion	Yes, but validation study exclusively female
Northridge, 2017	Sexually active females ages 1417 seeking services in primary care and subspecialty clinics, a high- school based clinic, and the inpatient service and emergency room, all affiliated with an academic children's hospital in Bronx County, New York (n=149)	Reproductive Coercion	None	No	Yes, within reproductive coercion Not as a separate subscale	No, focus on female target of male partner
Katz, 2018	Female undergraduates aged > 18 and were previously involved in a sexual	Partner Contraceptive Interference	None	No	No	Yes, but sample is exclusively female

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Sampling Design, Constructs and Subscales				Measurement Considerations for Current Study		
First author, Year of publication	**Sampling design (n=)**	**Primary construct**	**Subscales**	**Population-based sample of adolescents**	**Coercive communication measured**	**Gender neutral measurement items**
	relationship with a male partner in the past month were recruited through a voluntary psychology department subject pool from 1 college (n=146)					
Alternative measure of reproductive and sexual health used in current study						
Cook-Craig, 2014	Population-based sample of students enrolled at 26 high schools in Kentucky (n =~ 18,000 per year; 5 years)	Contraceptive Interference	None	Yes	Yes, as part of the primary construct of contraceptive interference	Yes

Table 2.

Sample characteristics

	2010 Development Sample	2014 Validation Sample
Total sample, n	16,509	13,588
Sex, n (%)	16,503	13,581
Female	8,973 (54.4%)	7,841 (57.7%)
Male	7,530 (45.6%)	5,740 (42.3%)
Grade, n (%)	16,509	13,588
9	5,017 (30.4%)	4,101 (30.2%)
10	4,565 (27.7%)	3,845 (28.3%)
11	4,201 (24.4%)	3,239 (23.8%)
12	2,696 (16.3%)	2,385 (17.6%)
Other	30 (0.2%)	18 (0.1%)
Free and Reduced Lunch, n (%)	16,443	13,545
Yes	7,062 (43.0%)	6,619 (48.9%)
No	9,381 (57.1%)	6,926 (51.1%)
Sexual Attraction, n (%)	16,503	13,581
Exclusively Heterosexual	14,292 (86.6%)	11,452 (84.3%)
Not Exclusively Heterosexual	2,211 (13.4%)	2,129 (15.7%)
Race, n (%)	16,509	13,588
American Indian or Alaska Native	183 (1.1%)	160 (1.2%)
Asian	228 (1.4%)	199 (1.5%)
Black or African American	1351 (8.2%)	967 (7.1%)
Hispanic or Latino/a	399 (2.4%)	469 (3.5%)
White	13,766 (83.4%)	11,289 (83.1%)
Other	582 (3.5%)	504 (3.7%)

Table 3.

Baseline Model Fit Comparison Table by Subgroup—1 factor vs. 2 factor determined first, and then additional models estimated with measurement covariance if suggested and improved model fit

	Female			Male			
Dataset	**2010**	**2010**	**2014**	**2010**	**2010**	**2010**	**2014**
Model	**1 Factor**	**2 Factor**	**2 Factor**	**1 Factor**	**2 Factor**	**2 Factor**	**2 Factor**
	none	**none**	none	none	none	**BC2R& UCR**	BC2R& UCR
Measurement Covariance Estimated	---	---	---	---	---	**BCR & UCR**	BCR & UCR
Satorra-Bentler Scaled x^2	14.567	**2.297**	4.906	8.080	4.996	**1.421**	1.421
df	5	**4**	4	5	4	**2**	2
p-value *	.0124	**.6813**	.2971	.152	.288	**.492**	.492
Non-Normed Fit Index (NNFI) *	.985	**1.003**	.998	.996	.998	**1.002**	.999
Standardized RMR *	.0883	**.0312**	.0373	.0547	.0422	**.0173**	.0173
Selected as Best Baseline Model		**Yes**				**Yes**	

* Acceptable model fit: Satorra-Bentler Scaled x^2 >.05, NNFI >.96, Standardized RMR <.08

Table 4.

Fit Statistics for Sequence of Invariance Testing Models and Model Comparisons for Female versus Male in 2010 Development Sample

Test	*df*	Maximum Likelihood Ratio x^2	Brown's (1984) ADF	Satorra-Bentler Scaled x^2	S-B Scaled x^2 p-value	CFI	RMSEA	90%CI
Configural	6	91.643	80.715	3.442	0.752	1.000	0.169	0.139,0.200
Weak/Metric	9	123.394	75.739	6.791	0.659	1.000	0.160	0.135, 0.185
Strong/Scalar	Did not converge							

	Scaled NTWLS* $\Delta x^2(df)$	p-value	Test Result
Metric vs. Configural	0.370(3)	0.90>p>0.95	Metric Invariance Supported

* normal weighted least-squares

Table 5.

Fit Statistics for Sequence of Invariance Testing Models and Model Comparisons for Female versus Male in 2014 Validation Sample

Test	*df*	Maximum Likelihood Ratio x^2	Brown's (1984) ADF	Satorra-Bentler Scaled x^2	S-B Scaled x^2 p-value	CFI	RMSEA	90%CI
Configural	6	147.835	131.805	7.351	0.290	1.00	0.218	0.188, 0.249
Weak/Metric	9	199.681	132.522	14.765	0.0976	0.998	0.206	0.182, 0.231
Strong/Scalar	12	669.047	94.629	11.162	0.5151	1.000	0.331	0.310, 0.353

	Scaled NTWLS* $\Delta x^2(df)$	p-value	Test Result
Metric vs. Configural	−0.080(3)	>0.99	Metric Invariance Supported
Scalar vs. Metric	−5.42501(3)	>0.99	Scalar Invariance Supported

* normal weighted least-squares

Table 6.

Adolescent Reproductive and Sexual Coercion prevalence exposure by sex in 2014 validation sample

		Females (n= 7,841)	Males (n=5,740)	Chi-Square Test Statistic	
Any Reproductive and Sexual Coercion in Adolescents, in past 12 months n(%)		3,222 (41.8%)	1,717 (30.6%)	174.278	***
Verbal Relationship Manipulation, past 12 months (VERBAL), n(%)		3,069 (39.8%)	1,613 (28.7%)	176.047	***
Current or previous boyfriend or girlfriend said to you, "You want us to use birth control or condoms so you can sleep with other people." (UCR)	0 times n(%)	6,485 (84.4%)	4702 (83.7%)	17.241	**
	1–2 times n(%)	197 (2.6%)	144 (2.6%)		
	3–5 times n(%)	61 (0.8%)	64 (1.1%)		
	6 or more times n(%)	69 (0.9%)	88 (1.6%)		
	Yes, this happened before but not in past 12 months n(%)	35 (0.5%)	22 (0.4%)		
	Not in past 12 months dating or romantic relationship n(%)	841 (10.9%)	596 (10.6%)		
Current or previous boyfriend or girlfriend said to you, "If we have a baby, you will never have to worry about me leaving you. I will always be around." (BLEVR)	0 times n(%)	4,681 (60.8%)	4,168 (74.2%)	333.256	***
	1–2 times n(%)	1,263 (16.4%)	485 (8.6%)		
	3–5 times n(%)	350 (4.6%)	138 (2.5%)		
	6 or more times n(%)	405 (5.3%)	173 (3.1%)		
	Yes, this happened before but not in past 12 months n(%)	144 (1.9%)	50 (0.9%)		
	Not in past 12 months dating or romantic relationship n(%)	857 (11.1%)	604 (10.8%)		
Current or previous boyfriend or girlfriend said to you, "You would have a baby with me if you really loved me." (BLOVR)	0 times n(%)	6,264 (81.3%)	4,552 (80.9%)	12.251	*
	1–2 times n(%)	331 (4.3%)	241 (4.3%)		
	3–5 times n(%)	87 (1.1%)	76 (1.4%)		
	6 or more times n(%)	104 (1.4%)	114 (2.0%)		
	Yes, this happened before but not in past 12 months n(%)	57 (0.7%)	32 (0.6%)		
	Not in past 12 months dating or romantic relationship n(%)	865 (11.2%)	612 (10.9%)		
Contraceptive Interference, past 12 months (UNPROSEX), n(%)		1,471 (19.1%)	1,071 (19.1%)	0.001	
In the past 12 months has a current or previous boyfriend or girlfriend not allowed you to use birth control or condoms when you wanted to? (BCR)	0 times n(%)	6,364 (82.6%)	4,638 (82.4%)	16.484	**
	1–2 times n(%)	250 (3.2%)	174 (3.1%)		
	3–5 times n(%)	69 (0.9%)	75 (1.3%)		
	6 or more times n(%)	74 (1.0%)	85 (1.5%)		

		Females (n= 7,841)	Males (n=5,740)	Chi-Square Test Statistic	
	Yes, this happened before but not in past 12 months n(%)	46 (0.6%)	25 (0.4%)		
	Not in past 12 months dating or romantic relationship n(%)	905 (11.7%)	631 (11.2%)		
In the past 12 months has a current or previous boyfriend or girlfriend forced you to have sex when you were not using birth control or condoms? (BC2R)	0 times n(%)	6,377 (82.7%)	4,667 (83.1%)	40.850	***
	1–2 times n(%)	239 (3.1%)	148 (2.6%)		
	3–5 times n(%)	58 (0.8%)	65 (1.2%)		
	6 or more times n(%)	65 (0.8%)	88 (1.6%)		
	Yes, this happened before but not in past 12 months n(%)	77 (1%)	21 (0.4%)		
	Not in past 12 months dating or romantic relationship n(%)	891 (11.6%)	625 (11.1%)		

Note: Only modest amounts of data were missing. For each indicator of sexual health coercion, between 1.5% and 2.5% of respondents were missing data. For such cases, estimates of sexual health coercion prevalence exposure use pairwise deletion and assume responses are missing at random.

* $p < .05$.

** $p < .01$.

*** $p < .001$.