PROJECT TDV X 3 – AN INTEGRATIVE DATA ANALYSIS

by

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ABSTRACT

IRIS F. MCMILLAN. Project TDV x 3 – An integrative data analysis. (Under the direction of DR. JENNIFER LANGHINRICHSEN-ROHLING and DR. ERIKA MONTANARO)

Teen dating violence (TDV) affects an alarming number of adolescents in romantic or dating relationships (Niolon et al., 2015), with sexual minority youth (SMY) at the greatest risk for TDV (Petit et al., 2021). Yet, most available measures of TDV and related risk factors (e.g., attitudes about violence) have been developed for and validated with heterosexual youth only. Similarly, frequently used theories identifying youth at risk for TDV perpetration (e.g., intergenerational transmission of violence framework) have not been tested for SMY. This three-article dissertation addresses these gaps by examining the equivalence of theories and measures foundational for TDV prevention programming leveraging advanced quantitative methods related to psychometric modeling and data aggregation. Article one examined the measurement equivalence of the Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001) across heterosexual and SMY. Article two investigated differential item functioning of acceptance of dating violence items across heterosexual and SMY. Article three examined the relationship between exposure to family violence and TDV perpetration, and the extent to which relational violence accepting attitudes mediate this association across studies and among heterosexual and SMY. Findings draw attention to and challenge heteronormativity in dating violence research via the use of novel advanced quantitative methods and implications for future research and practice are discussed within a social-justice oriented framework for quantitative research.

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LIST OF ABBREVIATIONS

ACVS	Acceptance of Couple Violence Scale
ADV	Acceptance of dating violence
CADRI	Conflict in Adolescent Dating Relationships Inventory
CDC	Center for Disease Control and Prevention
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence interval
CRT	Critical race theory
DIF	Differential item functioning
ICC	Item characteristic curve
ICPSR	Inter-University Consortium for Political and Social Research
IDA	Integrative data analysis
IRT	Item response theory
KMO	Kaiser-Meyer-Olkin
LGBTQ+	Lesbian, Gay, Bisexual, Trans, Queer, plus
M	Mean
MNLFA	Moderated nonlinear factor analysis
NICHD	National Institute of Child Health and Human Development
QuantCrit	Quantitative critical framework

RMSEA	Root mean square error of approximation
SD	Standard deviation
SM	Sexual minority
SMY	Sexual minority youth
SRMR	Standardized root mean squared residual
STRiV	National Survey of Teen Relationships and Intimate Violence
TDV	Teen dating violence
TLI	Tucker Lewis Index
WLSMV	Weighted least estimators mean- and variance

CHAPTER 1 – INTRODUCTION

Teen dating violence (TDV) is commonly considered to be a precursor of adult intimate partner violence (e.g., Shorey et al., 2019). Like adult intimate partner violence, TDV consists of a variety of types of abuse, including sexual violence, physical violence, psychological aggression, and stalking perpetrated by a current or former partner through electronic means (e.g., social media, texts) and/or in-person (Niolon et al., 2015). According to the Centers for Disease Control and Prevention (CDC), sexual violence entails the forcing or attempted forcing of a partner to partake in any sex act (including sexual touching) without the partner's consent and/or at times when the partner cannot give consent. More recently, this widely accepted definition has been broadened to also include non-physical sexual behaviors such as non-consensual sharing of sexual pictures as well as sending unsolicited sexually explicit messages and images (Center for Disease Control and Prevention, 2021). Comparatively, physical TDV includes behaviors where one (former) partner hurts or tries to hurt the other partner through kicking, hitting, or the use of other types of physical force. Verbal and non-verbal communication directed towards a (former) partner with the intent to cause mental or emotional harm and/or to exert control over the current or former partner constitutes what the CDC defines as psychological aggression, broadly known as psychological violence. Finally, stalking, which has been most recently included under the TDV umbrella, is defined as "a pattern of repeated, unwanted attention and contact by a partner that causes fear or concern for one's own safety or the safety of someone close to the victim" (CDC, 2021).

While many of the different forms of violence can manifest throughout lifespan, a distinguishing feature of TDV (relative to intimate partner violence in adulthood) is the developmental context in which it takes place. Unlike adult romantic/dating relationships, difficulties navigating romantic experiences including conflict resolution and communication are developmentally expected in romantic relationships of adolescents (Mulford & Giordano, 2008). At the same time, a general lack of relationship experience paired with underdeveloped interpersonal conflict resolution skills does increase the likelihood of engaging in and experiencing unhealthy relationship dynamics including the use of fear and intimidation tactics (i.e., coercion), and physical violence (Giordano et al., 2010; Vivolo-Kantor et al., 2016). Moreover, from a neurodevelopmental perspective, adolescent brain structures and neurotransmission processes are still developing, contributing to increased risk during this age period. Numerous developing brain regions have been shown to be involved in violence and aggression behaviors, including cortical areas such as the ventromedial prefrontal cortex, orbitofrontal cortex, and anterior cingulate cortex, as well as areas in the limbic system (i.e., amygdala and hippocampus). For instance, the ongoing maturation of brain regions associated with the integration of cognitive and emotional processes (e.g., the ventromedial prefrontal cortex), decision-making and expectations (e.g., the orbitofrontal cortex), reward (e.g., nucleus accumbens), emotion processing (e.g., amygdala) and emotion regulation (e.g., anterior cingulate cortex), have been shown to increase threat/fear activation (Stenson et al., 2021) and inhibition difficulties (Vara et al., 2014). This maturation process is further exacerbated by pubertal changes in sex hormones that particularly impact emotion-processing brain regions and contribute to increased emotional reactivity during these

years (Gingnell et al., 2019). Taken together, adolescence represents a developmental period of greater biopsychosocial vulnerability and subsequently a window of opportunity for the emergence of poorly regulated behaviors such as dating violence.

Youth at Risk for Teen Dating Violence

Existing research suggests that almost 80% of dating middle and high school students are either a victim and/or perpetrator of psychological TDV, while approximately 50% have had physical dating violence experiences (victimization, perpetration, or both). Relatedly, approximately 20% of high school youth disclose having experienced sexual coercion (as victim, perpetrator, or both; Patton et al., 2020). Nationally, representative lifetime prevalence rates are similar with approximately 70% of 12–18-year-old youth reporting lifetime TDV victimization while 63% report lifetime perpetration, irrespective of racial and ethnic identity and geographic region (Taylor & Mumford, 2016). Compared to heterosexual youth, sexual minority youth (i.e., youth who are not exclusively heterosexual) are more likely to be both victims and perpetrators of TDV (Reuter et al., 2015). Similarly, sexual minority youth (SMY) have been shown to evidence higher (lifetime) victimization rates relative to their heterosexual peers (Mennicke et al., 2021; Olsen et al., 2020; Palmer et al., 2021; Petit et al., 2021; Schwab-Reese et al., 2021); these youth also have higher rates of depression and binge drinking, and lower levels of academic performance relative to their heterosexual peer victims of TDV (Edwards, 2018).

Disparities in TDV prevalence and consequences across sexual orientation identities are likely the result of an accumulation of risk factors. In fact, many of the

consequences of TDV victimization (e.g., substance use or depression) have been shown to also serve as risk factors for TDV perpetration (Lawrence et al., 2023; Petit et al., 2021). Other risk factors shown to increase the likelihood of violence perpetration include exposure to family violence, and violence accepting attitudes (Clarey et al., 2010; Ruel et al., 2020; Temple et al., 2013). While nearly 70% of research examining relationship violence among LGBTQ+ people has focused on victimization experiences (Kim & Schmuhl, 2021), research examining TDV perpetration and its risk factors has mostly utilized heterosexual samples (Callan et al., 2021; Caputi et al., 2020; Petit et al., 2021; Swiatlo et al., 2020).

Considering meta-analytic findings emphasizing the role of sexual minority-specific risk factors for TDV perpetration (e.g., Badenes-Ribera et al., 2019; Kimmes et al., 2019; Longobardi & Badenes-Ribera, 2017), it is important to acknowledge that SMY experience TDV in the context of heteronormativity (i.e., societal preference for heterosexuality and devaluation of other experiences of sexuality/romantic attraction). This societal systematic marginalization and oppression is also reflected in the study of TDV, where much of existing research and prevention programming has historically relied on measures of TDV (and associated constructs) developed under assumptions of heteronormativity and not validated for SMY (Kim & Schmuhl, 2021). Subsequently, the scientific study of TDV requires the use of 1) theoretical frameworks that address risk factors for violence in relationships of heterosexual and sexual minority (SM) youth, and 2) measures of TDV (and related constructs) that are free of heteronormativity bias and have the same meaning across heterosexual and SM youth (i.e., measurement equivalence). The following section critically reviews the current state of TDV research

as it pertains to issues of heteronormativity in conceptualization and measurement operationalization.

Heteronormativity in Conceptualization and Operationalization of TDV

Prominent theoretical frameworks used to understand TDV perpetration include social learning and intergenerational transmission theories, as well as sociocultural theories. Prevention programs building on such frameworks frequently fail to explicitly address risk factors faced by SMY, perhaps due to lack of theoretical integration and/or research support. For instance, social learning and intergenerational theories (e.g., Widom & Wilson, 2015) highlight the role of exposure to family violence and the learning of violence accepting attitudes in the family of origin, thereby facilitating the identification of at-risk youth as well as highlighting potential prevention and intervention targets. Although SMY experience consistently higher rates of all forms of childhood abuse (McGeough & Sterzing, 2018), the intergenerational transmission of violence has not been specifically tested for SMY perpetrating TDV. Furthermore, the theory itself does not consider important nuances related to the transfer of heteronormative scripts about relationship violence from the parental model to adolescents experiencing other-gender relationships.

Sociocultural theories on the other hand explicitly acknowledge the social structures associated with the emergence of teen dating violence. For instance, the Internal Power Theory of Interpersonal Violence (Wagers, 2015) suggests that individuals who experience low internal power (i.e., knowledge, skill, money, or cultural autonomy) may use physical violence and coercive control tactics in their romantic

relationships to regain a sense of power and control over negative feelings (Wagers, 2015; Wagers et al., 2021). Similarly, Disempowerment Theory (e.g., McKenry et al., 2006) posits that feelings of inadequacy or a lack of self-efficacy underlies the motivation for individuals to perpetrate relationship violence as a form of power assertion. Pursuant to both theories, feelings of inadequacy or lack of self-efficacy tied to experiences of systematic marginalization and oppression may create unique stressors for SMY that place them at a heightened risk to perpetrate relationship violence as an extreme form of power assertion.

Neither social learning/intergenerational theories nor sociocultural theories specifically outline risk factors and/or pathways that could explain the increased vulnerability of SMY for TDV. Instead, potential explanations for the disproportionately high rates of TDV among SMY can be derived from Minority Stress Theory (Meyer, 2003), which outlines potential pathways through which minority status interacts with majority values that within a broader social context put SMY at increased risk for violence. Specifically, increased risk for TDV is thought to be the result of stigma-related stressors, such as internalized homophobia or enacted stigma. For instance, internalized homophobia has been linked to TDV perpetration among men who have sex with men (Stephenson & Finneran, 2017), whereas enacted stigma (e.g., experiences of heterosexist microaggressions) has been shown to be uniquely associated with sexual minority specific forms of TDV perpetration (Swann et al., 2022). Despite research findings emphasize the importance of minority-stress informed frameworks for TDV conceptualization among sexual minority youth, such framing is infrequently implemented.

Most of the existing research and prevention programming has been conducted through the lens of a structural feminist paradigm (and concepts of power and control), thereby not only governing decades of programming and research, but also policy and practice. For instance, structural feminist theories such as *The Duluth Model* (Pence & Paymar, 1993) postulate that relationship violence is predominantly perpetrated as male-to-female violence, with males being assumed to use violence to exert power and to force females to be submissive (Ali & Naylor, 2013). In other words, theories rooted in structural feminism heavily focus on the role of patriarchal masculinity in heterosexual presenting relationships, accompanied by assumptions of male-perpetrated violence against females for power and control (Cannon & Buttell, 2016). Gender congruence within romantic relationships (e.g., same gender relationships) has not typically been considered within structural feminist theories, therefore providing little insight on the occurrence of relationship violence in gender-symmetric romantic relationships (Bohall et al., 2016) and silencing the experiences of relationship violence among a subset of LGBTQ+ people. In the spirit of a structural feminist paradigm, many measures of dating and/or relationship violence explicitly or implicitly assume heterosexuality and at times, exclusively focus on male-perpetration (see McMillan et al., 2023 for a more detailed discussion).

Moreover, relational experiences, including experiences of dating violence may differ across sexual orientation identities. For instance, a form of psychological violence specific to SMY is identity abuse where a dating partner may threaten to disclose the other partner's sexual orientation identity (i.e., out them) or uses homophobic/biphobic slurs to insult the other partner (Woulfe & Goodman, 2020). Similarly, an overlap of

experiences of sexual violence and heterosexist experiences has been documented (Martin-Storey et al., 2022). Although progress has been made as reflected in the development of minority specific intimate partner violence measures (e.g., Peitzmeier et al., 2019; Woulfe & Goodman, 2021), TDV research continues to lag in this area. A recent systematic review evaluating methodological and measurement property quality of TDV measures indicated that structural validity (i.e., the degree to which item scores adequately reflect the dimensions of a given construct) has been explicitly tested for less than one third of TDV measures (Tarriño-Concejero et al., 2023). Moreover, the effects of TDV prevention programs have been shown to vary based on the use of specific outcome measures (Piolanti & Foran, 2022) and prevention programs have been shown to be less effective for SMY (Coker et al., 2020). Conducive to better understanding differences in prevention program outcomes, measurement equivalence testing is an important prerequisite for meaningful group comparisons and to contextualize program effectiveness (Han et al., 2019). Hence, measurement research examining the extent to which existing measures accurately capture TDV and its risk factors in SMY is of tantamount importance.

TDV Research Through a Social Justice Lens

This dissertation project builds on a quantitative critical framework (QuantCrit; Gillborn et al., 2018) with the overall goal to critically examine theories and measures of TDV to ultimately support equitable and inclusive TDV prevention. At its core, QuantCrit presents a framework for social-justice oriented quantitative research that is rooted in ideas and principles of critical social theory (Collins et al., 2021), critical race

theory (CRT; Crenshaw, 1995), and Black Feminist scholarship (including intersectional feminism; Crenshaw, 2013). Through the application of five key tenets, QuantCrit outlines ways through which researchers can engage in rigorous, continuous, self-reflexivity throughout the research process to dismantle systems of oppression as they relate to the phenomena being researched (Suzuki et al., 2021). The first tenet of QuantCrit is tied to its origins in CRT and emphasizes the centrality of racism (and other systems of oppression) at the core of society as well as scientific research (Gillborn et al., 2018). Tenet two rejects the idea that numbers "are neutral" (Suzuki et al., 2021) or "speak for themselves" (Garcia et al., 2018), drawing attention to ways in which assumptions about the so-called neutrality of numbers has contributed to decontextualization of statistical findings, especially to support the interests of white supremacy and other systems of oppression (Gillborn et al., 2018). Related to the "non-neutrality of numbers", QuantCrit also emphasizes the importance of critically evaluating the use of categories in statistical analysis with categories "never being natural", which underscores the dynamic nature of social identities (Gillborn et al., 2018). Additionally, the centering of counternarratives and critiquing of dominant narratives is considered vital as highlighted by QuantCrit's fourth tenet, with insight, expertise, and lived experiences of marginalized groups and communities informing the critical analysis and interpretation of data that cannot speak for itself (Gilbar et al., 2020; Suzuki et al., 2021). Finally, QuantCrit postulates that although quantitative research does not compare to qualitative research when it comes to its ability to amplify marginalized narratives and lived experiences, statistical analyses conducted and interpreted within a quantitative critical framework do have the potential to advance social justice.

The current dissertation project builds on QuantCrit tenet two (non-neutrality of numbers) and QuantCrit tenet four (critiquing the dominant narratives) by using advanced quantitative methods to critically examine the applicability of theories and measures of TDV perpetration and related risk factors for sexual minority youth. Specifically, the current dissertation project draws attention to the overreliance on a heteronormative lens through which TDV research continues to be conducted with most available measures of TDV and related risk factors (e.g., attitudes about violence) having been developed and validated for heterosexual youth only. Additionally, the intergenerational transmission of violence has been foundational for decades of TDV research and prevention programming, yet its mechanism has not been tested in SMY. That is, although SMY experience substantially higher rates of family violence (McGeough & Sterzing, 2018), the extent to which exposure to family violence is predictive of TDV and associated risk factors among SMY is not understood. Thus, examining the equivalence of theories and measures foundational for TDV prevention programming across heterosexual and SMY is of importance and well-aligned with QuantCrit tenet two.

Dissertation Research - Using Quantitative Methods in the Spirit of QuantCrit

An important first step towards greater inclusivity of counternarratives in the field of violence prevention is the testing of the equivalence of outcome-focused measures across heterosexual and sexual minority youth. Relatedly, identifying and characterizing conditions under which the intergenerational transmission of violence occurs is a second step towards inclusivity in theoretical frameworks. To address these goals, this three-

article dissertation (entitled Project TDV x3) utilized integrative data analysis, a relatively novel approach which integrates existing individual-level data from multiple sources to increase sample size, maximize statistical power, and manage between-study heterogeneity (Curran & Hussong, 2009). In the study of TDV among SMY, the integration of existing datasets is particularly advantageous as it allows researchers to simultaneously consider the effect of study, group, and individual level characteristics while also increasing the sample size for hard-to-reach populations (i.e., SMY). Applied to Project TDV x 3, the integration of multiple datasets was used to address three research questions that hinge on SMY representation:

1. Does the Conflict in Adolescent Relationship Inventory (CADRI; Wolfe et al., 2001) measure TDV perpetration similarly across heterosexual and SMY?
2. Do heterosexual and sexual minority youth respond similarly to commonly used items assessing acceptance of dating violence?
3. Are there differences in the relationships between exposure to family violence, violence accepting attitudes, and TDV perpetration for heterosexual and sexual minority youth?

Significance. This three-article dissertation project contributes a series of novel quantitative advances in the field of social and behavioral sciences with relevance for injury and violence prevention efforts during the critical period of adolescence. Specifically, this project utilizes integrative data analysis (IDA), a set of techniques that capitalizes on conceptual overlap between diverse data sources to (1) pool multiple

sources of information and strengthen the generalizability of findings, and (2) to investigate the origin of observed effect variability for both predictors and subgroups in the context of mixed research results. As an up-and-coming coordinated process of pooled raw-data analysis, IDA can provide information and answer questions that meta-analysis currently cannot answer. Rather than relying on the availability of effect size measures and summary statistics in comparable units, IDA uses a measurement alignment process to pool individual-level data from datasets with diverging measures of a given construct, subsequently producing a valid and reliable scale score to be used across studies. This allows researchers to create harmonized scale scores for a given participant based on all available items from contributing studies, while accounting for potential differences in both the latent factor and the individual items as a function of between-study differences. This, in turn, presents a novel way to combat the limitations of the traditional meta-analytic approach that stems from its reliance on aggregate effect sizes. Moreover, pooling individual level data from several contributing studies increases the overall number of observations available to estimate model specific parameters, thereby increasing the statistical power and stability of the estimates and strengthening the internal validity of the obtained effect. As such, the use of IDA allows the identification of points of convergence and divergence, as well as subgroup effects and has the potential to answer complex research questions, particularly for populations that have been historically excluded from prevention research (i.e., sexual minority youth). Put differently, by leveraging advanced quantitative methods related to psychometric modeling and data aggregation, this dissertation project makes a critical contribution

toward dismantling heteronormativity and oppression in TDV theory and measurement by increasing sexual minority representation through data harmonization.

Positionality Statement. This research project was conducted within the context of existing power structures. Therefore, the identities which confer power to me and influence my understanding of reality hold relevance and are discussed in the following. I am a cisgender woman in a long-term committed heterosexual presenting relationship, and I do not have any lived experiences closely linked to my research topic. To attend to this concern, I critically examined how my own identities and experiences influenced my research and perceptions and read qualitative research centering the voices and lived experiences of dating violence of LGBTQ+ community members. Other identities influencing my understanding of reality and my approach to this research project include being a quantitative psychologist and clinical health psychologist. My background in quantitative psychology has afforded me advanced statistical modeling skills to critically examine existing measurement and to apply novel statistical models to answer complex research questions. In the current research project, this has led to the selection of cutting-edge quantitative frameworks and statistical models that allow the identification of points of convergence and divergences in theory and measurement across groups. As a clinical health psychologist (in training), I have built a clinical specialty in adolescent sexual and gender minority mental health. In this work, I have been able to gain greater insight into the relationship experiences of current generations of LGBTQ+ youth which I reflected on when interpreting my results. Lastly, one of my values as a clinical health psychologist and scientist-practitioner-advocate is to advance diversity, equity, and

inclusion in research and practice. In the current research project, this value shaped the project's research questions, the quantitative frameworks and methodologies used to answer the research questions, as well as my approach to the interpretation of data analysis results.

CHAPTER 2 – QUEERING THE CONFLICT IN ADOLESCENT DATING RELATIONSHIPS INVENTORY: AN EXAMINATION OF THE CONFLICT IN ADOLESCENT DATING RELATIONSHIPS INVENTORY PERPETRATION SCALE'S MEASUREMENT INVARIANCE ACROSS HETEROSEXUAL AND SEXUAL MINORITY YOUTH

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Abstract

Teen dating violence (TDV) is a public health concern with sexual minority (SM) youth (i.e., adolescents who are not exclusively heterosexual) experience disproportionately high rates of TDV. Yet, measures of TDV such as the Conflict in Adolescent

Relationships Inventory (CADRI; Wolfe et al., 2001) have been developed without considering sexual identity with items and instructions frequently anchored in heterosexual romantic relationships. Examination of measurement equivalence across heterosexual and SM youth has only begun recently with existing research examining the CADRI' victimization scales measurement invariance providing empirical support for invariance across heterosexual and SM youth. However, no prior research has examined the measurement invariance of the CADRI perpetration scales across heterosexual and SM youth. The current study fills this gap by examining the CADRI perpetration scales measurement invariance across heterosexual and SM youth. Using multigroup confirmatory factor analysis responses from 1,143 adolescents (M_{age} = 15.88, SD = 2.49) to the CADRI perpetration items were examined across heterosexual (n = 922) and SMY (n = 218). Results confirmed the five-factor structure of the CADRI perpetration scales, providing empirical support for the appropriateness of the use of CADRI perpetration scale's scores across heterosexual and SM youth broadly. However, findings of partial scalar measurement invariance on the emotional/verbal abuse perpetration scale raise questions about the appropriateness of mean-score comparisons on this particular subscale. Areas of potential revisions of emotional/verbal abuse perpetration scale are discussed to facilitate meaningful comparisons among heterosexual and SM youth and to substantiate program evaluation results by groups.

Introduction

Teen dating violence (TDV) is an umbrella term frequently used to describe a continuum of abuse perpetrated by a current or former romantic partner, including acts of sexual violence (e.g., non-consensual sexual touching or forced sex), physical violence

(e.g., hitting, scratching, biting), psychological aggression (e.g., communicating threats, controlling behaviors), and stalking/monitoring of activities (Niolon et al., 2015). Lifetime prevalence rates indicate that approximately 63% of 12–18-year-old US youth perpetrate some form of TDV at some point in their life (Taylor & Mumford, 2016). Such high lifetime prevalence rates are alarming as TDV has many negative consequences for its victims, including higher levels of heavy episodic drinking, substance use, depression, and suicidal ideation (Edwards, 2018; Smith et al., 2020). Additionally, victims of TDV not only experience a greater number of health complaints but are also at a greater risk for physical injuries requiring medical care (Haynie et al., 2013), posing a substantial burden on healthcare systems and the economy (Tharp et al., 2017). Considered a preventable public health concern, disparities in TDV exist among sexual minority youth (i.e., youth who are not exclusively heterosexual), who experience significantly higher rates of TDV compared to heterosexual youth (Edwards, 2018, Martin-Storey et al., 2021, Ray et al., 2022). However, many studies examining dating violence among sexual minority populations rely on measures not validated for this population and predominantly focus on victimization (Kim & Schmuhl, 2021). The use of TDV measures with unknown reliability and validity for sexual minority youth, paired with the marked focus on dating violence victimization is concerning as it reinforces heteronormative scripts about dating violence perpetration. Moreover, to examine the effectiveness of TDV perpetration and victimization prevention efforts among sexual minority youth, reliable and validated measurement of prevention program outcomes is of tantamount importance. Furthermore, without TDV perpetration measures validated for sexual minority youth, conclusions about program effectiveness cannot be drawn. The

current study aims to contribute to translational prevention science by examining the degree to which inferences about TDV perpetration derived from the Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001), a frequently used measure of TDV, are generalizable across heterosexual and sexual minority youth.

The Conflict in Adolescent Dating Relationships Inventory (CADRI)

The Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001) was one of the first measures specifically developed to capture the complexity of dating violence occurring in adolescent romantic relationships; it has served as a foundation for decades of TDV research (Exner-Cortens, 2018). Although measure development was partially informed by the adult intimate partner violence literature, the CADRI conceptualizes TDV to be distinct from violence occurring in adult relationships, with adolescent abusive behaviors viewed to be multidimensional, involving distinct subtypes/subscales (Wolfe et al., 2001). More specifically, the CADRI frames TDV as abusive or violent behaviors that manifest as five distinct types, namely emotional/verbal abuse (e.g., speaking in a hostile tone of voice), physical abuse (e.g., kicking, hitting, or punching), sexual abuse (e.g., forcing sex), relational aggression (e.g., spreading rumors), and threatening behaviors (e.g., threatening to destroy something). To date, this TDV framing has been very appealing to many researchers and a large body of research has relied on the CADRI both to study predictors of TDV (e.g., Temple et al., 2013) and to examine the effectiveness of TDV prevention programs (e.g., Peskin et al., 2019). Nevertheless, adolescents' sexual identity was not considered in the initial measure development which is concerning in a multitude of ways. First, it is important to recognize that TDV is not an exclusively heterosexual phenomenon. In fact, physical,

sexual, and threatening TDV were shown to occur at higher prevalence and recurrence rates among sexual minority youth relative to heterosexual youth (Petit et al., 2021). Secondarily, the CADRI was developed under assumptions of heteronormativity which is reflected in the original item wording. Specifically, the original items of the CADRI assume that respondents are involved in heterosexual relationships with sex-specific versions inquiring about abusive behavior towards the other-gender romantic partner. For example, CADRI items developed for females ask about abusive behaviors towards their boyfriends while the male versions ask about abusive behaviors towards their girlfriends (Wolfe et al., 2001). While the identical item structure across both sex specific versions is beneficial from a psychometric perspective, the anchoring of items and instructions in heterosexual romantic relationships raises concerns about the equivalence of measurement properties for sexual minority respondents.

The most examined and reported psychometric properties of the CADRI are its internal consistencies (i.e., the degree to which the CADRI items relate to the same type of abusive behavior), which have supported the use of the CADRI in racially and ethnically diverse samples of high school students (Niolon et al., 2015). While such information supports the reliability of the CADRI in a given sample, measures of internal consistency cannot support the equivalence of a construct and its scores across groups. Yet, the internal consistencies of the CADRI subscales continue to present the most frequently examined psychometric property whereas its subscale structure has been subject to few replication attempts. As such, research identifying violations of construct validity using psychometric techniques (e.g., measurement invariance) to examine the equivalence of the CADRI perpetration scales for heterosexual and sexual minority youth

is of tantamount importance and serves as an important foundation for ongoing intervention and prevention programming.

To date, only a couple of studies have explicitly examined the CADRI's measurement structure (e.g., Shorey et al., 2019; Rivas-Koehl et al., 2023). One pivotal study examined the CADRI perpetration scales measurement invariance across sex, race/ethnicity, and time (six waves) using a sample of high school students (Shorey et al., 2019). Findings supported the CADRI perpetration scales factor structure (i.e., the presence of five distinct subscales) as well as its invariance over time, providing support for the measures' use throughout developmental transitions (i.e., from adolescence to young adulthood). Additionally, Shorey et al. (2019)'s results supported the broad equivalence of the latent factor structure across sex and race/ethnicity, with partial invariance evident for both sex and race/ethnicity during adolescence but not young adulthood. Items showing partial invariance included items assessing sexual abuse (i.e., forced sex, coercion of sex, non-consensual kissing) as well items assessing relational abuse (e.g., spreading rumors; Shorey et al., 2019). A second, even more recent study examined the measurement equivalence of the CADRI victimization scales across time and between heterosexual and sexual minority youth (Rivas-Koehl et al., 2023). Using longitudinal data from a sample of high school students, the results suggest that the CADRI victimization scales are invariant across time and sexual minority status, providing support for comparability of the victimization scales (Rivas-Koehl et al., 2023). Taken together, existing research examining the measurement invariance of the CADRI provides empirical support for invariance over time, as well as invariance of the perpetration scales across sex and race/ethnicity and invariance of the victimization

scales across heterosexual and sexual minority youth. However, no prior research has examined the measurement invariance of the CADRI perpetration scales across heterosexual and sexual minority youth. The current study fills this gap.

Measurement Invariance

Measurement invariance, also commonly referred to as measurement equivalence, is a psychometric property of quantitative measures that provides information about the degree to which item responses are similarly related to a given construct across different populations. Information about a measure's equivalence is crucial to gauge appropriateness of use in different populations and to support inferences based on scale scores across different groups. Correspondingly, the degree to which the CADRI perpetration subscales can be compared across heterosexual and sexual minority youth depends on the respective level of measurement invariance. Specifically, measurement invariance is tested and established in an iterative, stepwise process with most tests of measurement invariance including tests of configural, metric, and scalar invariance (Putnick & Bornstein, 2016). On a conceptual level, configural invariance provides information about the degree to which the CADRI perpetration subscales hold up across heterosexual and sexual minority youth. In other words, it tests the replicability of the five types of TDV developed in heterosexual samples for sexual minority youth. Once configural invariance is established, metric invariance can be tested which examines the equivalence of item factor loading across heterosexual and sexual minority youth. Metric invariance answers the question of whether items of a respective subscale are equally important for the subscale across both groups. If equality of factor loadings is established, scalar invariance testing can be conducted which provides information about the degree

to which mean differences in the latent construct are captured in the shared variance of the items. In other words, tests of scalar invariance provide information about the degree to which group differences in CADRI subscale scores are the result of true differences in perpetration and not due to differences in scale properties. Such evidence is ultimately needed to support inferences about scale scores such as the comparison of TDV prevalence rates across heterosexual and sexual minority youth. If measurement equivalence is not established, observed group differences on the CADRI are more likely the result of measurement invariance (i.e., performance differences in measurement across groups) than true between-group differences. Therefore, invariance testing provides important information about the degree to which inferences about TDV perpetration as measured by the CADRI are generalizable across heterosexual and sexual minority youth.

The Current Study

Utilizing Queer Theory (Butler, 1990) as an overarching conceptual framework to critically examine the privileging on heterosexuality social science scholarship, this study examined the Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001) perpetration scales' measurement invariance for heterosexual youth and sexual minority youth. To increase the stability of estimates, the current study leveraged individual item level-data from three secondary datasets with the overall goal to increase the total number of sexual minority youth responses included in the study sample. Moreover, the current study utilized multi-group confirmatory factor analysis to test the configural, metric, and scalar equivalence of the CADRI's perpetration scales factor structure across heterosexual and sexual minority youth.

Methods

Procedure

Following the recommendations of Dowrick et al. (2009), existing data sources were combined to increase representation of hard-to-reach groups (i.e., sexual minority youth). To identify existing datasets for the purpose of this study, a scoping review (i.e., an examination of the extent, range, and nature of available datasets) was conducted from July 2021 to November 2021 following a modified version of Arksey and O'Malley (2005)'s methodological framework[1]. Using this approach, three restricted access datasets were identified and obtained via a restricted data use agreement from The Inter-University Consortium for Political and Social Research (ICPSR). All datasets were associated with studies investigating predictors of teen dating violence in the United States. Specifically, data from a cross-sectional survey research study examining adolescents at risk for teen dating violence was included (*Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY*; Livingston et al., 2016). The second dataset was the third wave of a longitudinal panel research study examining the changing nature of adolescent dating relationships in a nationally representative sample of youth (*The National Survey of Teen Relationships and Intimate Violence*; Taylor et al., 2016)[2]. Finally, wave six of a longitudinal cohort study (*The Bullying,*

[1] Please see chapter 4 for detailed information on the scoping review and for a detailed description of contributing datasets.

[2] The decision to data from the third wave of STRiV study was based on the availability of information pertaining to participants sexual orientation as newer waves of data collection either omitted questions about participant's sexual orientation (i.e., wave 4) or were not released (i.e., waves 5 and 6) at the time data was obtained.

Sexual, and Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States; Espelage et al., 2014) examining individual characteristics and environmental contexts associated with dating violence and bullying was included[3].

Sample

Survey responses from 1,979 participants were obtained from datasets stored by The Inter-University Consortium for Political and Social Research (ICPSR). Participants' ages ranged between 11 and 21 years with the average age being 15.88 years (*SD* = 2.49). Approximately 52% of the participants were female (*n* = 1,022). Most identified as non-Hispanic (81.8%) and White (71.3%) Approximately 15% (*n* = 305) of participants identified as sexual minority youth.

Measures

Conflict in Adolescent Dating Relationships Inventory. The Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001) perpetrator version consists of 25 items scored on a four-point scale ranging from *never* to *often.* Items load onto five different subscales, each representing distinct types of teen dating violence: threatening behavior (4 items; e.g. “I deliberately tried to frighten him/her”), relational abuse (3 items; e.g., “I spread rumors about him/her”), physical abuse (4 items; e.g., “I kicked, hit, or punched him/her”), sexual abuse (4 items; e.g., “I forced him/her to have sex when he/she didn’t want to”), and emotional/verbal abuse (10 items; e.g., “I threatened to end the relationship”). Past research examining measurement invariance of the CADRI across sex and race/ethnicity in an adolescent sample reported variable internal consistencies across multiple waves of data collection with some subscales

[3] The decision to include this particular wave was based on the availability of the focal measure.

evidencing consistently low internal consistencies (e.g., sexual abuse and relational abuse with Cronbach's alpha ranges of .15 to .56 and .54 to .65 respectively) whereas other subscales consistently evidenced higher internal consistencies (e.g., physical abuse Cronbach's alpha range = .76 to .86, threatening behavior Cronbach's alpha range = .61 to .76 and emotional/verbal abuse with an Cronbach's alpha range of .78 to .85; Shorey et al., 2019). In the current study, subscales evidenced slightly higher levels of internal consistency across all subscales with Cronbach's alpha = .85 for physical abuse, Cronbach's alpha = .70 for threatening behaviors, Cronbach's alpha = .60 for sexual abuse, Cronbach's alpha = .71 for relational aggression, and Cronbach's alpha = .87 for verbal/emotional abuse perpetration.

Sexual Minority Status. Participants' responses to survey items about sexual orientation were used to characterize the sample and to categorize respondents into sexual minority and heterosexual youth groups. As such, participants' responses to the sexual orientation items were dichotomized to indicate sexual minority group status. All participants identifying as either gay, lesbian, bisexual, something else, or not sure were considered to be sexual minorities (i.e., not strictly heterosexual).

Control Variables. Secondary data sets differ in the measurement of sexual orientation with some asking about romantic attraction (i.e., "Choose the description that best fits how they [you] think about themselves [yourself]" with response options such as "Mostly heterosexual (straight), but somewhat attracted to people of your own sex"), with others requiring participants to self-label (i.e., "What is your sexual orientation?"), or asked about dating behaviors (i.e., "Do you most often go out with …girls, boys, or both"). Consequently, in line with best practice recommendations (e.g., Steenkamp &

Maydeau-Olivares, 2020), a two-level fixed factor for measurement of sexual orientation (i.e., methods factor) was created to control for the potential effect of measurement of sexual orientation on group assignment and group differences.

Statistical Analysis

Missing data patterns were visually inspected and assessed using Little's MCAR test. Sensitivity analysis was conducted to examine mean differences in scale scores by sexual orientation. Descriptives for the CADRI subscales were obtained, including their association with demographic variables and potential covariates (including measurement of sexual orientation).

Given the scarcity of research examining the psychometric properties of the CADRI perpetration scale for sexual minority youth (Exner-Cortens, 2018), an exploratory multi-group confirmatory factor analysis was conducted in RStudio using the package *lavaan* (Rosseel, 2012). The estimation method was selected based on item-response distributions and ordinal-level measurement (i.e., four-point frequency scale). The five continuous latent factors representing the TDV components (threatening behavior, relational abuse, physical abuse, sexual abuse, and verbal/emotional abuse) were specified to load onto a higher-order factor that represents TDV perpetration more broadly. Model fit was assessed using Chi-square fit statistics, the comparative fit index (CFI) and root mean square error of approximation (RMSEA) with accompanying 90% confidence intervals (CIs). As recommended by Hu and Bentler (1999), a CFI value greater than .95 and RMSEA values below .05 were considered indicative of good model fit (Hu & Bentler, 1999). Likelihood ratio tests were used to evaluate the goodness of model fit of the different measurement models.

To test the hypothesis that the five different subtypes of TDV perpetration measured by the CADRI function equivalently across heterosexual and sexual minority youth, the equivalence of the CADRI's factor structure and differences in the magnitude of non-invariance as a function of sexual orientation were compared. Configural invariance was examined by estimating parameters of the measurement model separately for each group. Metric invariance was tested through constraining factor loadings to equality across both groups. To examine scalar invariance, factor loadings and intercepts were constrained to equality across groups. To control for differences related to the combination of secondary datasets, an alternative model including covarying variables was estimated and compared to the final multi-group CFA model.

Results

CADRI responses from a total of 1,979 participants were examined. Approximately 42% of the sample (n = 837) did not answer any of the 25 CADRI perpetration items and were therefore excluded from the analysis. Of the 1,143 participants providing responses on the CADRI, 95.3% (n = 1089) provided responses on all items. As expected, CADRI item responses were non-normally distributed with low-base rates prevalent across items. Participants with more than 40% missing item responses (n = 3) on the CADRI were excluded (Graham, 2009), yielding a final sample of 1,140 participants[4]. Roughly 20% (n = 218) of the final sample identified as sexual

[4] Compared to the initial sample described earlier, the final sample was on average one year older (M_{age} = 16.77, SD = 2.19) and slightly less balanced regarding sex (54.2% girls); however, racial, and ethnic representation did not differ.

minority youth. Consequently, both group and sample power were adequate for multigroup CFA (Kline, 2023). Please see Table 1 for sample descriptives.

Table 1

Sample Demographics (*N*=1,140)

	n	%
Sex		
Male	522	45.8
Female	618	54.2
Race		
Asian	5	0.5
Black/African American	172	18.5
Multiracial	59	6.4
White	653	70.3
Other	40	4.3
Ethnicity		
Hispanic/Latinx	179	16.2
Non-Hispanic/Non-Latinx	926	83.8
Sexual Orientation		
Heterosexual/Straight	922	80.9
Gay or Lesbian	52	4.6
Bisexual	156	13.7
Questioning	7	0.6
Other non-heterosexual (e.g., asexual)	3	0.3

Missing data patterns were visually inspected and indicated that three items assessing sexual abuse perpetration (i.e., unwanted sexual touch, communication of threats to elicit sex, and forced sex) were the most frequently missing items. Little's Missing Completely at Random (MCAR) Test was conducted using the expectation-maximization (EM) algorithm with likelihood functions requested from Student's t-distribution (df = 24) to account for non-normality of item response distributions. The results of Little's MCAR test indicated that data was not missing completely at random, χ^2 = 1415.95, df = 661, p = .001. Subsequently, Student's t-tests were conducted to examine differences between complete and missing item responses across demographic

variables. There was a significant effect for age for 12 of the CADRI items and a significant effect for race for three CADRI items (see Appendix A – CADRI T-Test Results). Missing data mechanism appeared to be most consistent with missing at random (MAR, i.e., missing data pattern is accounted for by the effect of age and race) given that correlates of missingness were identified using Student's t-tests and taking into consideration the influence of non-normality on Little's MCAR test (Little, 1988). Subsequently, per recommendations of Little and Rubin (1987), the missing data mechanism was considered to be ignorable, and robust weighted least estimators mean- and variance adjusted (WLSMV) estimation method with listwise deletion was deemed appropriate (Sass et al., 2014). Chi-square difference testing was conducted using the Satorra-Bentler scaled chi-square (Satorra & Bentler, 2001).

Sensitivity Analysis

A sensitivity analysis was conducted to examine mean differences in scale scores by sexual orientation. Levene's test was used to test the equality of variances across heterosexual and sexual minority youths for each CADRI subscale. The results of Levene's test indicated that variances were not equal across groups for physical abuse, $F(1, 1138) = 174.58$ $p < .001$, threatening behavior, $F(1, 1138) = 153.37$ $p < .001$, sexual abuse, $F(1, 1138) = 5.08$ $p = .024$, relational aggression, $F(1, 1138) = 37.98$ $p < .001$, and emotional/verbal abuse, $F(1, 1138) = 30.24$ $p < .001$. As such, a Mann-Whitey U tests were conducted to determine whether there were differences in CADRI perpetration subscale scores of heterosexual and sexual minority youths. Results suggested significant differences in CADRI perpetration subscale scores. Specifically, youths identifying as heterosexual evidenced higher physical abuse ($Z = -8.66$, $p < .001$), threatening behaviors

(Z = -4.08, p < .001), relational aggression (Z = -3.95, p < .001), and emotional/verbal abuse (Z = -5.58, p < .001) CADRI perpetration scores relative to sexual minority youth. There were no significant differences in CADRI sexual abuse scores by group. Across all participants, average subscale scores were highest for the emotional/verbal abuse perpetration scale and lowest for the relational aggression perpetration scale. Scale means and item means are displayed in Table 2.

Table 2

Means and Standard Deviations CADRI Scales and Items (n = 1,140)

			Range	
	M	*SD*	*Possible*	*Actual*
Physical Abuse Perp. Scale	**0.82**	**0.29**	**0-3**	**0-3**
Threw something	0.09	0.36		
Kicked, hit, or punched	0.08	0.34		
Slapped or pulled hair	0.08	0.37		
Pushed, shoved, or shook	0.08	0.35		
Threatening Behavior Abuse Perp. Scale	**0.07**	**0.23**	**0-3**	**0-2**
Destroyed or threatened to destroy	0.05	0.28		
Deliberately tried to frighten	0.09	0.35		
Threatened to hurt them	0.05	0.25		
Threatened to hit or throw something	0.07	0.33		
Sexual Abuse Perp. Scale	**0.04**	**0.16**	**0-3**	**0-2**
Unwanted sexual touching	0.05	0.26		
Forced sex	0.02	0.15		
Threating them to have sex	0.01	0.13		
Unwanted kissing	0.09	0.33		
Relational Aggression Abuse Perp. Scale	**0.04**	**0.19**	**0-3**	**0-2**
Tried to turn friends against them	0.04	0.26		
Said things to friends to turn them against	0.03	0.22		
Spread rumors about them	0.05	0.26		
Emotional/Verbal Abuse Perp. Scale	**0.30**	**0.44**	**0-3**	**0-3**
Table 2 *continued*				
Did something to create jealousy	0.33	0.64		
Brought up something done in the past	0.37	0.69		
Said things to make them angry	0.31	0.63		
Spoke in hostile or mean tone of voice	0.32	0.66		
Insulted them with putdowns	0.14	0.43		

Ridiculed them in front of friends	0.09	0.35
Blamed them for problems	0.37	0.70
Kept track of them	0.40	0.77
Threatened to end relationship	0.32	0.66
Accused them of flirting	0.38	0.73

Descriptive Statistics

Associations between demographic variables such as age, grade level, and sexual orientation and CADRI subscale scores were examined using Spearman correlations and Chi-square test. As seen in Table 3, there was a small, positive significant correlation between the perpetration of sexual and emotional/verbal abuse and age as well as grade level. Moreover, sexual orientation was significantly and positively correlated with the perpetration of threatening behaviors, relational aggression, and emotional/verbal abuse. Additionally, the results of Chi-square tests indicated a significant relationship between sex and physical abuse, χ^2 (12, 1140) = 65.64; $p < .001$, threatening behaviors χ^2 (11, 1140) = 22.31; $p = .002$, and emotional/verbal abuse, χ^2 (33, 1137) = 72.23; $p < .001$. Similarly, race was significantly associated with CADRI scores on four subscales, namely physical abuse, χ^2 (44, 929) = 120.15; $p < .001$, sexual abuse, χ^2 (24, 919) = 36.95; $p = .044$, emotional/verbal abuse, χ^2 (128, 926) = 169.44; $p = .008$, and threatening behaviors, χ^2 (44, 929) = 98.89; $p < .001$. Chi square tests were not significant for ethnicity and there was no significant relationship between CADRI subscale scores and the study's measurement of sexual orientation.

Table 3

CADRI Scales Spearman Correlations

Variable	1	2	3	4	5	6	7
1. Age	-			-			

2. Grade	0.89**	-					
3. CADRI - PA	0.06	0.01	-				
4. CADRI - TB	0.02	-0.02	0.53**	-			
5. CADRI - SA	0.07*	0.06*	0.27**	0.28**	-		
6. CADRI - RA	-0.02	-0.04	0.27**	0.29**	0.24**	-	
7. CADRI - EVA	0.07*	0.07*	0.42**	0.40**	0.30**	0.31**	-

Notes. PA = Physical Abuse Scale. TB = Threatening Behavior Scale. SA = Sexual Abuse Scale. RA = Relationship Abuse Scale. EVA = Emotional/Verbal Abuse Scale. * $p < .05$. ** $p < .001$.

Multigroup Confirmatory Factor Analysis

To examine the CADRI's measurement invariance across heterosexual youth and sexual minority youth, multigroup invariance testing was conducted.

Configural Invariance. As a first step, the fit of the hypothesized model was analyzed separately for each group (i.e., configural invariance). Using a testing approach from least restrictive to most restrictive, the first step of the testing for multigroup equivalence was to establish configural invariance, where the same number of factors and their loading pattern being estimated freely for heterosexual and sexual minority youths. The configural model demonstrated good model fit, χ^2= 388.87, df =530, $p < .001$, CFI = .969, TLI = .969, RMSEA = .024 [90% .017 to .030], SRMR = .086, indicating that the CADRI perpetration factor structure has an equal model fit across heterosexual and sexual minority youth. In other words, the multidimensional construct measured by the CADRI is the same construct across both groups. Subsequently, the factorial invariance of the measurement model (i.e., metric invariance) was tested by constraining the factor loadings to equality.

Metric Invariance. As displayed in Table 4, the metric invariance model fit the data well and showed improvements in model fit, $\Delta\chi^2 = 17.508$, $\Delta df = 20$, $p = .620$. This suggests that the CADRI not only measures the same multidimensional construct across heterosexual and sexual minority youth but also that the specific statistical relationships

between the CADRI items and their associated latent factors (i.e., types of abuse) are the same across both groups. As such, metric invariance was established and the next level of measurement invariance (i.e., scalar invariance) was tested by constraining both factor loadings and intercepts to equality.

Table 4

Measurement Invariance Testing/Multigroup CFA Results

Model	χ^2	df	*p*	CFI	TLI	RMSEA [Cis]	SRMR	$\Delta\chi^2$	p
Model 1	388.87	530	<.001	0.97	0.97	0.03 [0.02 - 0.03]	0.09		
Heterosexual	247.19								
SM	141.69								
Model 2	449.34	550	0.010	0.97	0.97	0.02 [0.01 – 0.03]	0.09	17.51	0.620
Heterosexual	267.91								
SM	181.43								
Model 3	479.43	570	0.006	0.97	0.97	0.02 [0.01 – 0.03]	0.09	52.27	<0.001
Heterosexual	275.65								
SM	203.78								
Model 3.1	463.20	568	0.010	0.97	0.97	0.02 [0.01 – 0.03]	0.09	25.38	0.115
Heterosexual	271.24								
SM	191.96								

Note. SM = Sexual minority. $\Delta\chi^2$ = Satorra-Bentler scaled chi-square difference test statistic. Model 1 = Configural model (no equality constraints imposed). Model 2 = Metric invariance (all factor loadings constrained equal). Model 3 = Scalar invariance (all factor loadings and intercepts constrained equal). Model 3.1 = Partial scalar invariance (like scalar invariance but intercepts freely estimated for jealousy item and putdowns/insult item).

Scalar Invariance. The scalar invariance model demonstrated good model fit, however, the metric invariance model showed greater parsimony as indicated by likelihood ratio test results, $\Delta\chi^2 = 52.271$, $\Delta df = 20$, $p < .001$. Sources of local misfit were explored by examining modification indices in order to test for a model of partial scalar invariance. Modification indices suggested that freeing the intercepts of the emotional/verbal abuse items “I did something to make him/her jealous” and “I insulted him/her with putdowns” across groups would improve model fit.

Partial Scalar Invariance. When both intercepts were left to vary freely between groups, the difference in model fit between the metric invariance model and partial scalar invariance model were in the recommended range with $\Delta\chi^2 = 25.384$, $\Delta df = 18$, $p = .115$, providing support for partial scalar measurement invariance. This finding indicates that the multidimensional TDV perpetration construct captured by the CADRI is measured on the same scale with the same statistical relationships between the CADRI items and their associated latent factors (i.e., types of abuse) across heterosexual and sexual minority youth. It also indicated that all subscales, except for emotional/verbal abuse have the same latent means across groups. The scalar non-invariance of the intercepts of two emotional/verbal abuse CADRI items assessing jealousy and insults/putdowns suggests that sexual minority youth report more frequent perpetration of jealousy (i.e., doing something to make the partner jealous) and heterosexual youths report greater perpetration of insults/putdowns (i.e., insulting partner with putdowns). For neither group were items indicating increased perpetration of jealousy and insults/putdowns related to greater emotional/verbal abuse perpetration

Alternative Model Including Covariates. To control for differences related to operationalization of sexual orientation (i.e., romantic attraction vs. self-label) across datasets[5], an alternative model was estimated and compared to the final multi-group CFA model. In the alternative model an observed fixed factor for the measurement of sexual orientation was regressed onto each of continuous latent factor (i.e., abuse types). The alternative model showed adequate model fit was that was comparable to the partial scalar measurement invariance model, $\chi^2 = 416.23$, $df = 570$, $p = .000$, CFI = 0.97, TLI =

[5] Other between-study differences were not examined due to multicollinearity to reduce Type II error (Grewal et al., 2004).

0.96, RMSEA = .025 [90% .018 to .031], SRMR = .084, indicating that the operationalization of sexual orientation did not significantly change the fit of the partial scalar invariance model.

Discussion

The current study examined the equivalence of a measure of TDV perpetration (i.e., the Conflict in Adolescent Dating Relationships Inventory; CADRI; Wolfe et al., 2001) across heterosexual and sexual minority youth. With 70% of existing dating violence research focusing on violence victimization among sexual minority youth (e.g., Kim & Schmuhl, 2021), the current study makes important contributions through its explicit focus on TDV perpetration. Except for the perpetration of sexual abuse, differences in prevalence rates across heterosexual and sexual minority youth were evident with youths identifying as heterosexual self-reporting perpetrating higher rates of physical abuse, threatening behaviors, relational aggression, and emotional/verbal abuse relative to sexual minority youth. However, the results of measurement invariance testing caution an examination of mean scores differences across heterosexual and sexual minority youth on the CADRI emotional/verbal abuse subscale due to partial scalar invariance.

Specifically, the results of multi-group invariance testing suggest that apart from the verbal/emotional abuse perpetration scale, the underlying latent factor structure of the remaining CADRI perpetration scales can be interpreted similarly across heterosexual and sexual minority youth. Put differently, meaningful comparisons of CADRI subscale scores are possible for most subscales except for emotional/verbal abuse, where partial

invariance emerged. More precisely, two emotional/verbal abuse items pertaining to the perpetration of insults and putdowns were shown to exhibit invariance across heterosexual and sexual minority youth. However, the overall percentage of items showing invariance across groups was low (less than 20%) and thereby should have minimal impact on the use of the scale (Dimitrov, 2010). Broadly speaking, the five-factor structure of the CADRI (i.e., physical, threatening, sexual, relational, and emotional/verbal abuse) appeared to hold up well and were comparable across heterosexual and sexual minority youth. As such, results of the current study support prior research on the factor structure of the CADRI broadly (e.g., Shorey et al., 2019) and its conceptual equivalence for sexual minority youth specifically (e.g., Rivas-Koehl et al., 2023).

At the same time, the current findings, if replicated, and considered within the extent of minority stress research, also provides important directions for potential revisions of the CADRI to promote greater inclusivity of sexual minority specific experiences. One particular avenue for revisions is rooted in the findings of partial invariance of emotional/verbal abuse items. These items seem to underlie the intersection of dating violence and identity-based violence. A salient form of psychological dating violence specific to individuals identifying members of the LGBTQ+ community is identity abuse, where systemic oppression (i.e., heterosexism) is leveraged to perpetrate psychological harm or exert control over current or former dating partners (Woulfe & Goodman, 2021). Manifestations of identity abuse include use of pejorative name calling, insults/putdowns that undermine and belittle partners' identities (e.g., “not being gay enough” or “not being a real lesbian”), as well as threats to out the dating partner.

Although recently linked to psychological violence perpetration (Swann et al., 2022), identity abuse itself is frequently not considered within TDV conceptualization and measurement. Based on the findings of the current study, inclusivity of the CADRI could be bolstered either through revisions aimed at the inclusion of items assessing identity-based emotional/verbal abuse tactics or through the addition of a sixth factor/subtype assessing identity-based abuse more broadly. Additionally, as recent research has highlighted the role of minority stress for heightened cyber dating abuse perpetration and victimization rates among sexual minority population (e.g., Yang et al., 2023), the inclusion of additional cyber dating abuse items may support a continuous use of the measure for a general adolescent population while also capturing the unique experiences of sexual minority youth. Such efforts may be combined with other ongoing validation work to ensure that inferences drawn from the CADRI reflect contemporary perspective on TDV perpetration as well as the lived experience of present-day youth.

Outside of measure development, the findings of the current study are also of great relevance for prevention program evaluation and development. Not only does the omission of identity abuse fail to consider sexual minority specific forms of TDV but the use of the CADRI in non-majority populations has the potential to skew prevalence rates (Exner-Cortens, 2018). Given that research has relied on the prevalence rates reported in the initial measurement development and validation study as norms to gauge clinical significance of community-based dating violence prevention programs (e.g., Wolfe et al., 2003), accurate and sensitive measurement of TDV is of great importance to effectively prevent TDV. With a recent meta-analysis encouraging ongoing focus on the prevention of TDV perpetration (over victimization; Lee & Wong, 2020), it is important for TDV

perpetration scales to capture the continuum of violence, including the broad range of emotional abuse and threatening behaviors and their intended appraisal from a developmental perspective (Cascardi et al., 2022). Moreover, as evidence based TDV prevention program such as *Safe Dates* undergo adaptations to include sexual minority specific risk factors (e.g., psychoeducation about identity abuse; Wesche et al., 2020), ongoing accumulation and synthesis of research examining the appropriateness, meaningfulness, and usefulness of TDV perpetration measures for sexual minority youth is needed to substantiate program evaluation results by group.

Constraints on Generalizability

Although this study is one among a few that are "queering methodology" to become more inclusive (Han et al., 2019), its results should be considered in light of several limitations. The current study used secondary data combining participant level data from existing research studies. Despite efforts to increase statistical power through the integration of three data sources, approximately 42% of the cumulative sample were missing all responses on the CADRI and therefore had to be excluded from the analysis. Relatedly, although this study pooled data from multiple contributing studies containing small subsamples to increase statistical power and representation, roughly one fifth of the participants providing CADRI responses were identified as sexual minority youth which may limit the generalizability of the findings and does not represent all members of the LGBTQ+ community equally. Nevertheless, the combination of three secondary datasets allowed greater representation of sexual minority youth relative to existing individual studies. In future research, the combination of multiple LGBTQ+ samples/datasets may allow researchers to further extend the findings of the current study to examine

measurement invariance across LGBTQ+ subgroups as well as intersectional identities (e.g., LGBTQ+ youth of color) which will further advance measurement and prevention programming.

As it pertains to generalizability more broadly, it is noteworthy that although responses from adolescents ages eleven through 21 were obtained and both males and females were equally represented, findings were constrained in their generalizability across racial and ethnic groups, as well as gender identities. Racial and ethnic minorities including African American/Black, Asian, Native American/Indigenous and Latinx participants were underrepresented, and findings warrant replication in more racially and ethnically diverse samples. At the same time, taking into consideration the strengths of the existing datasets that were utilized, findings may extend to a broad range of U.S. adolescents as one of the included datasets indeed was a nationally representative sample. Moreover, as existing data sources were combined to increase representation LGBTQ+ adolescents, individuals from school-based samples and high-risk samples (i.e., with documented exposure to adverse childhood experiences) were included in the final sample. As such, findings have the potential to apply to an expansive group of U.S. adolescents. Although the combination of existing data sources presents a strength of the current study, secondary data did limit generalizability. Across datasets only information about participants sex was available and gender identity was not assessed., precluding tests of measurement equivalence across trans- and gender diverse (including gender expansive and gender nonconforming) youth. Relatedly, as relationship partners gender identities shape sexual orientation identity (i.e., labels of emotional, romantic, and/or sexual attraction; Bowling et al., 2023) and considering diverging measurement of sexual

orientation across datasets, nuanced and accurate measurement of these concepts is a crucial aspect of inclusive methodology.

Conclusion

This is the first study to examine the measurement invariance of the CADRI perpetration scale across heterosexual and sexual minority youths, with only one existing study examining measurement invariance across groups for the victimization scales (Rivas-Koehl et al., 2023). As such, while the current findings echo those of prior research emphasizing the need for a greater focus on measure development and adaptation to represent lived experiences of diverse youth (including sexual and gender minority youths), findings support the use of CADRI for TDV prevention programs adapted for LGBTQ+ populations.

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CHAPTER 3 – ATTITUDE IS EVERYTHING: EXAMINING ACCEPTANCE OF VIOLENCE ITEMS FOR DIFFERENTIAL ITEM FUNCTIONING ACROSS HETEROSEXUAL AND SEXUAL MINORITY YOUTH

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Abstract

Acceptance of dating violence is a cognitive risk factor for violence perpetration and a common target of prevention programs. However, frequently used items assessing acceptance of dating violence (ADV) are characterized by heteronormative item wording and limited research has evaluated the degree to which ADV items function equivalently for both heterosexual and sexual minority youth (SMY). The current study sought to determine if there are differences in the way heterosexual and sexual minority youth respond to acceptance of dating violence survey items. Secondary data from a total of 2,014 adolescents (M_{age} = 16.78) were used to examine differences in ADV. Results of DIF analysis indicated non-uniform differential item functioning for two of eight ADV items, with heterosexual youth being more likely to express strong levels of agreements with 1) female-perpetrated physical violence in response to male-perpetrated violence and 2) female-perpetrated violence against males broadly, relative to sexual minority youths. Although these differences were of negligible magnitude and only resulted in minimal differences in overall expected average scores, heterosexual youth were more likely to strongly accept female-perpetrated dating violence compared to SMY. Findings highlight differences in ADV item response patterns across heterosexual and sexual minority identifying youth and provide preliminary evidence for group differences in acceptance of female-perpetrated dating violence. Implications for prevention programming based on current findings include greater focus on measure adaptation and development as well as more consensus on the necessity of preventing female-perpetrated violence.

Introduction

Unfortunately, dating violence is a common experience among adolescents in dating or romantic relationships with more than half of adolescents between the ages of 12 and 18 experiencing teen dating violence (TDV) at some point during adolescence (e.g., Exner-Cortens et al., 2021). Sexual minority youth (SMY; i.e., youth who are not exclusively heterosexual) have been shown to experience remarkably high rates of both TDV perpetration and victimization (Reuter et al., 2015), as well as higher rates compared to heterosexual youth (Martin-Storey, 2015). Yet, TDV prevention programs are just starting to acknowledge and consider SMY's experiences of dating violence, which are potentially distinct from the TDV of non-SMY youth (e.g., different actions, contexts, impacts, motivations, and societal responses). Grounded in models of behavior change (e.g., Theory of Planned Behavior; Ajzen, 1991), many currently available TDV prevention programs target cognitive risk factors predictive of dating violence, including violence accepting attitudes (e.g., *Me & You*, Peskin et al., 2019). However, empirical support surrounding the effectiveness of changing attitudinal acceptance of TDV to ultimately reduce TDV reduction is mixed (De La Rue et al., 2017; Evans et al., 2021). Available research on the criterion-related validity of violence accepting attitudes suggests that acceptance of dating violence may not be as potent of a predictor as behavior change as theory may suggest. Importantly, prevention-programs related to attitude change are not as successful for SMY as for heterosexual youth (e.g., Coker et al., 2020). Still, conclusions about effective attitude change can only be drawn if the validity and reliability of violence accepting attitude self-report measures have been established for both heterosexual and SMY. Besides, widely used measures of acceptance

of dating violence appear to only apply to heterosexual presenting relationships[6], raising concerns about the field's ability to accurately understand ADV among SMY. For example, the Acceptance of Couple Violence Scale (ACVS; Forshee et al., 1998) assesses attitudes about dating violence using items such as "A boy angry enough to hit his girlfriend must love her very much." Therefore, the current study sought to examine the concurrent validity of commonly used acceptance of dating violence items and the extent to which items function equivalently for heterosexual youth and SMY.

Background

In prevention programs, sets of items rather than established scales are most frequently used to assess acceptance of dating violence with many of them predominantly focused on the acceptance of physical violence (Exner-Cortens et al., 2016). For instance, items initially proposed by Foshee et al. (2001) measuring prescriptive dating violence norms are frequently used to assess acceptance of TDV in prevention programs (e.g., Foshee et al., 2012; Meiksin et al., 2020; Peskin et al., 2019); yet their criterion-related validity (i.e., the degree to which ADV items relate to an independent external criterion measure such as TDV perpetration) is infrequently determined (Exner-Cortens et al., 2016). One of the more frequently reported subtypes of criterion-related validity is predictive validity, which provides empirical support for ADV item scores predicting future TDV perpetration reported (Karlsson et al., 2018; Shorey et al., 2018). Although less frequently examined, the concurrent validity of ADV items/scores is also important as it establishes the relationship between theoretical risk factors (i.e., ADV) and

[6] Heterosexual presenting relationships are defined as romantic relationships that align with societal expectations of heterosexuality (i.e., a romantic relationship between a male and a female individual) irrespective of relationship partners sexual orientation identity.

behavioral outcomes (i.e., TDV perpetration). Only few studies have examined ADV items concurrent validity providing moderate support for its theoretical underpinning (Courtain & Glowatz, 2019; Reyes et al., 2016). As such, the current study sought to add to existing research by examining the concurrent validity of ADV items.

Above and beyond limited support for the concurrent validity of ADV items, there appears to be a lack of uniformity within- and across disciplines on the best ways to measure violence accepting attitudes among diverse youth. Across available measures and items assessing acceptance of dating violence, many appear heteronormative (i.e., assume heterosexuality), making items only applicable to heterosexual presenting romantic relationships (Meiskin et al., 2023). An example highlighting the extent to which assumptions about heterosexuality have shaped item wording is "It is ok for a girl to hit a boy if he hit her first" (Attitudes towards Female Violence Scale; Price et al., 1999), which only captures female-perpetrated violence in heterosexual presenting relationships. Such prevailing heteronormative item wording is characteristic for many ADV items and fails to holistically consider the dynamics of relationships that do not fit the prevailing heteronormative description (Hamel, 2020). The failure to consider gender congruence within romantic relationships (e.g., same gender-relationships) not only continues to minimize the violence occurring in sexual minority dating relationships but also raises concerns about the field's ability to accurately understand TDV in SMY and ultimately create effective prevention programs.

For current prevention program development, an examination of item property equivalence across heterosexual youth and SMY is particularly important given that heteronormative item wording has the potential to introduce item bias which in turn can

have repercussions for program evaluation. One way to investigate group differences in response probabilities is Differential Item Functioning (DIF) analysis. DIF occurs when measurement properties such as item difficulty or item discrimination parameters differ across groups after overall construct-level group differences have been accounted for. For example, an individual who strongly agrees with the item “It is ok for a boy to hit his girlfriend if she did something to make him mad” will likely report overall higher levels of violence acceptance relative to those who strongly disagree. This would be reflected in the item difficulty parameter, whereas the item discrimination parameter provides information about the degree to which the item discriminates between individuals who are highly accepting of violence and those who have a low tolerance/acceptance of dating violence. As such, items that are only strongly endorsed by individuals with high acceptance of dating violence can distinguish between high and low accepting individuals. Statistical item bias which can present as group differences in measurement properties (e.g., item difficulty) further limits the validity of ADV measures and information about item difficulty and discrimination is important for measurement efficacy and precision. Subsequently, information about the reliability and validity of ADV measurement can not only help contextualize the mixed evidence of prevention programs but can also guide future systematic adaptations of efficacious TDV prevention programs for SMY. In other words, it is important to examine whether SMY interpret or respond to heteronormative violence acceptance items in different ways, beyond any actual differences in their overall acceptance of dating violence. To date, no existing research has evaluated the degree to which heterosexual and sexual minority youth

respond to acceptance of dating violence items similarly, thus, the current study fills this critical gap.

The Current Study

To better understand the degree to which violence accepting attitudes are endorsed in adolescent heterosexual and sexual minority relationships and their relevance for other prevention program outcomes, the current study sought to examine the psychometric properties of commonly used ADV items. Given that examination of psychometric properties is largely dependent on sample size while also taking into consideration the frequent underrepresentation of SMY in TDV research (Evans et al., 2021), the current study combined secondary data from two existing each studies containing small subsamples of SMY to provide answers to two research questions:

1. To what degree are ADV items related to other TDV prevention program outcomes, namely physical TDV perpetration? (Concurrent validity)
2. Do heterosexual and sexual minority youth respond differently to commonly used items assessing acceptance of dating violence? (Differential item functioning)

Methods

Sample

Survey responses from 2,033 adolescents were obtained from datasets stored by The Inter-University Consortium for Political and Social Research (ICPSR). On average, participants were 16.78 years of age (*SD* = 1.04). As displayed in Table 5, both boys and

girls were equally represented in the sample. As it pertains to racial and ethnic identification, approximately half of the sample (*n* =850) identified as Black/African American and 6.6% of the sample identified as Hispanic/Latinx. In terms of sexual orientation, most participants identified as heterosexual with 9.7% (*n* =197) identifying as sexual minority. Sexual minority participants most frequently identified as bisexual (*n* =156).

Table 5

Sample Demographics

	n	%
Sex		
Male	1,000	49.2
Female	1,031	50.8
Race		
Asian	50	2.9
Black/African American	850	49.2
Multiracial	9	0.5
White	694	40.1
Other	126	7.3
Ethnicity		
Hispanic/Latinx	121	6.6
Non-Hispanic/Non-Latinx	1,726	93.4
Sexual Orientation		
Heterosexual/Straight	1,836	90.3
Gay or Lesbian	41	2.0
Bisexual	156	7.7

Procedure

Two restricted access datasets were obtained from The Inter-University Consortium for Political and Social Research (ICPSR). Datasets contained deidentified participant responses from studies investigating predictors of teen dating violence in the United States. Specifically, data (*n* = 185) from a cross-sectional survey research study

examining adolescents at risk for teen dating violence were included (*Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY*; Livingston et al., 2016). The second dataset (*n* = 1,162) was the sixth wave of a longitudinal cohort study (*The Bullying, Sexual, and Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States*; Espelage et al., 2014) that examined individual characteristics and environmental contexts associated with dating violence and bullying[7].

Measures

Acceptance of Dating Violence (ADV). Across both datasets, adolescents' acceptance of dating violence was assessed using the following eight items: (1) "It is ok for a boy to hit his girlfriend if she did something to make him mad", (2) "It is ok for a boy to hit his girlfriend if she insulted him in front of friends", (3) "Girls sometimes deserve to be hit by the boys they date", (4) "Boys sometimes deserve to be hit by the girls they date", (5) "Sometimes boys have to hit their girlfriends to get them back under control", (6) "A girl who makes her boyfriend jealous on purpose deserves to be hit", (7) "It is ok for a boy to hit a girl if she hit him first", and (8) "It is ok for a girl to hit a boy if he hit her first". Items were scored on a four-point scale ranging from 1 = Strongly Disagree to 4 = Strongly Agree. Item responses are averaged across all items to create an ordinal outcome score ranging between 1 and 4 with higher scores indicating greater acceptance of dating violence.

Sexual Minority Status. Participants' responses to survey items inquiring about sexual identity were used to categorize respondents into sexual minority and heterosexual

[7] The decision to include this wave was based on the availability of the focal measure.

youth groups. All participants identifying as either gay/lesbian, bisexual, or not sure were designated as sexual minority youth (SMY). Similarly, participants dating partners of other sex-only were considered heterosexual youth or non-SMY, whereas participants indicating that they were dating partners of either their sex or who endorsed dating partners of both their and other sex were considered sexual minority youth.

Physical Teen Dating Violence Perpetration. The Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001) perpetrator version was used to assess physical teen dating violence perpetration in both datasets. The measure consists of 25 items scored on a four-point scale ranging from *never* to *often.* Items load onto five different subscales, one of them being physical abuse (4 items; e.g., "I kicked, hit, or punched him/her"), which has evidenced high internal consistencies in past research (Shorey et al., 2019; Cronbach's alpha = 0.86). In the current study, the CADRI physical abuse perpetration scale also showed good internal consistency with Cronbach's alpha being 0.88.

Control Variables. In line with best practice recommendations (e.g., Nixon & Carpenter, 1996), categorical predictor variables (i.e., fixed factors) were created to determine if between study differences resulted in statistically different ADV item scores. The first fixed factor reflected study design time frame and consisted of two levels (cross sectional design and longitudinal design). The second fixed factor reflected differences in data collection methods and consisted of two levels (paper-pencil school survey and computer assisted interviewing).

Statistical Analysis

Missing data patterns were visually inspected and assessed using Little's MCAR test. Univariate and bivariate distributions were examined and covariance, mean structures (means, variances, covariances), and correlations were obtained. Concurrent validity was established by correlating participants' average dating violence acceptance scores with their reported physical TDV perpetration as measured by the CADRI (Wolfe et al., 2001). To determine between-study differences in ADV items across contributing datasets, Mann-Whitney U tests with Bonferroni correction were conducted. As unidimensionality is required for differential item functioning, confirmatory factor analysis was conducted to confirm the unidimensional structure of the attitudinal dating violence acceptance construct. Bartlett's test of Sphericity was conducted to test the intercorrelation of the dating violence acceptance items and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was estimated as a statistical test of factorability, with a minimum acceptable KMO value being 0.60 (Dziuban & Shirkey, 1974). Confirmatory factor analysis with eight observed indicators/items loading onto a single factor and the factor loading of item 1 fixed to 1 was estimated.

Ordinal logistic regression differential item (DIF) analysis was conducted using the *lordif* R package (Choi et al., 2011). Within this framework, a total of three nested models were estimated for each item with explanatory variables of item functioning (i.e., latent trait and grouping variable) incorporated following a hierarchical approach. Specifically, the first ordinal logistic regression (model 1) included estimated latent ADV scores as the only predictor, whereas the second ordinal logistic regression model (model 2) also included group membership (i.e., heterosexual or sexual minority status) in

addition to the main effect of latent ADV scores. The third ordinal logistic regression model (model 3) included an interaction term (group membership x latent ADV scores), as well as the main effects of the latent ADV scores and group membership. IRT theta estimates (i.e., person parameters reflecting individual's latent trait) were used as conditioning variables and DIF items were identified using likelihood ratio χ^2 statistics with a corresponding flagging criterion of $\alpha < 0.05$. Uniform DIF was identified by comparing the log likelihood values for model 1 and model 2, while non-uniform DIF was identified via comparisons of model 2 and model 3. McFadden's pseudo R^2 was used to assess the magnitude of item functioning discrepancies.

Results

Missing Data

Out of the 2,033 participants, 96.9% (n = 1969) provided responses to all eight items with less than one percent (n = 14) omitting responses to all eight items. Participants with more than 40% missing item responses (n = 19) were excluded (Graham, 2009), yielding a final sample of 2,014 participants. Missing data patterns were visually inspected. The item "It's ok for a girl to hit a boy if he hit her first" was most frequently missing. Little's Missing Completely at Random (MCAR) Test was conducted using the expectation-maximization (EM) algorithm with likelihood functions requested from Student's t-distribution (df = 7) to account for non-normality of item response distributions. The results of Little's MCAR test indicated that data were not missing completely at random, X^2 = 135.41, df =74, $p < .001$. Subsequently, Student's t-tests were conducted to examine differences between complete and missing item responses across

demographic variables. There was a significant effect for age for three of the acceptance of dating violence items and a significant effect for race for one acceptance of dating violence item (see Appendix B – ADV Items T-Test Results), providing empirical support for data being missing at random (MAR). To determine if an examination of potential between-study DIF was warranted, Bonferroni corrected Mann-Whitney U tests were conducted. Results indicated that there were no significant differences in ADV item ratings across study design and data collection method.

Descriptive Statistics

Focal variables univariate and bivariate distributions were examined, and mean structures and correlations were obtained. As displayed in Table 6, sex assigned at birth was negatively correlated with seven out of eight ADV items. There was a small positive correlation between ethnicity and the ADV item “It is ok for a girl to hit a boy if he hit her first.” The same item evidenced a small negative correlation with race while most other ADV items showed small positive correlations with race. Sexual orientation did not significantly correlate with a majority of ADV items except for “Sometimes boys have to hit their girlfriends to get them back under control” and “It is ok for a boy to hit a girl if she hit him first” where small significant positive correlations were found.

Table 6

Descriptives and Spearman Correlations for ADV Items

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sex	--												
2. Ethnicity	-.02	--											
3. Race	.02	.05*	--										
4. Sexual Orientation	.16**	-.01	.04	--									
5. CADRI PA	.17**	.02	.10**	.19**	--								
6. ADV item 1	.01	.06*	-.06**	.03	.17**	--							
7. ADV item 2	-.05*	.03	.09**	.04	.23**	.32**	--						
8. ADV item 3	-.10**	-.02	.05*	.04	.19**	.19**	.48**	--					
9. ADV item 4	-.07**	.01	.09**	.04	.22**	.20**	.53**	.69**	--				
10. ADV item 5	-.08**	.04	.08**	.03	.18**	.24**	.57**	.60**	.54**	--			
11. ADV item 6	-.07**	.04	-.01	.01	.20**	.48**	.51**	.31**	.32**	.38**	--		
12. ADV item 7	-.08**	.01	.07**	.05*	.20**	.26**	.55**	.61**	.58**	.58**	.39**	--	
13. ADV item 8	-.07**	.04	.02	.06**	.18**	.57**	.45**	.37**	.40**	.36**	.33	.45**	--
M (SD)	--	--	--	--	--	1.78 (1.15)	1.16 (0.52)	1.08 (0.38)	1.10 (0.42)	1.10 (0.41)	1.36 (0.76)	1.10 (0.42)	1.34 (0.74)

Note. CADRI PA = Physical Abuse Perpetration Scale of the Conflict in Adolescent Relationship Inventory. ADV item 1 = It is okay for a boy to hit a girl if she hit him first. ADV item 2 = Girls sometimes deserve to be hit by the boys they date. ADV item 3 = It is okay for a boy to hit his girlfriend if she insulted him in front of friends. ADV item 4 = It is okay for a boy to hit his girlfriend if she did something to make him mad. ADV item 5 = A girl who makes her boyfriend jealous deserves to be hit. ADV item 6 = Boys sometimes deserve to be hit by the girls they date. ADV item 7 = Sometimes boys have to hit their girlfriends to get them back under control. ADV item 8 = It is okay for a girl to hit a boy if he hit her first.

Concurrent Validity

As displayed in Table 6, all ADV items evidence a significant positive correlation with physical dating violence perpetration and were of moderate effect size; thus. supporting concurrent validity.

Differential Item Functioning Analysis

To examine the unidimensional structure of the attitudinal dating violence acceptance construct, Bartlett's test of Sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (i.e., strength of partial correlations) were conducted. The results of Bartlett's test of Sphericity were statistically significant, $\chi 2$ (28) = 7471.25, $p <$ .001 suggesting that item intercorrelations of the dating violence acceptance items were sufficiently intercorrelated for the application of factor analysis. Similarly, the obtained KMO value of .83 indicated reasonable factorability also supporting the use of the eight items for factor analysis. Next, a confirmatory factor analysis with eight observed indicators/items loading onto a single factor and the factor loading of item 1 fixed to 1 was estimated using robust weighted least estimators (WLSMV). The unidimensional model demonstrated acceptable model fit, χ^2= 620.25, *df* =20, $p < .001$, CFI = .910, TLI = .874, RMSEA = .070 [90% .066 to .075], SRMR = .130, indicating that the attitudinal dating violence acceptance items load onto a single factor.

To determine if heterosexual and sexual minority youth displayed different patterns of item response when rating their level of agreement with the acceptance of dating violence items, an ordinal logistic regression differential item functioning (DIF) analysis using IRT theta estimates as the conditioning variable was conducted. Using likelihood ratio χ^2 statistics with a corresponding flagging criterion of $\alpha = 0.05$, DIF items

were identified. As displayed in Table 7, differential item functioning was detected for two ADV items. The item "It's okay for a girl to hit a boy if he hit her first" showed non-uniform DIF, indicating that even when heterosexual and SMY are equally accepting of dating violence (i.e., they have the same average ADV score), true score differences are evident at both high and low levels of dating violence acceptance. More precisely, heterosexual youth were more likely to endorse higher levels of agreement with this item when overall (i.e., average level) acceptance of dating violence was high whereas sexual minority youth were slightly more likely to express lower levels of agreement with this specific item. An examination of absolute differences in item characteristic curves (ICCs) for the two groups suggests that differences in item true scores are mainly observed at high levels of ADV (high theta). Moreover, although item response function estimators (slopes and category thresholds) varied slightly across groups, overall item responses followed comparable patterns (see Figure 1). McFadden's pseudo R^2 indicated that the detected non-uniform DIF is of negligible effect size when weighted by trait distribution (R^2 change = .02).

Table 7

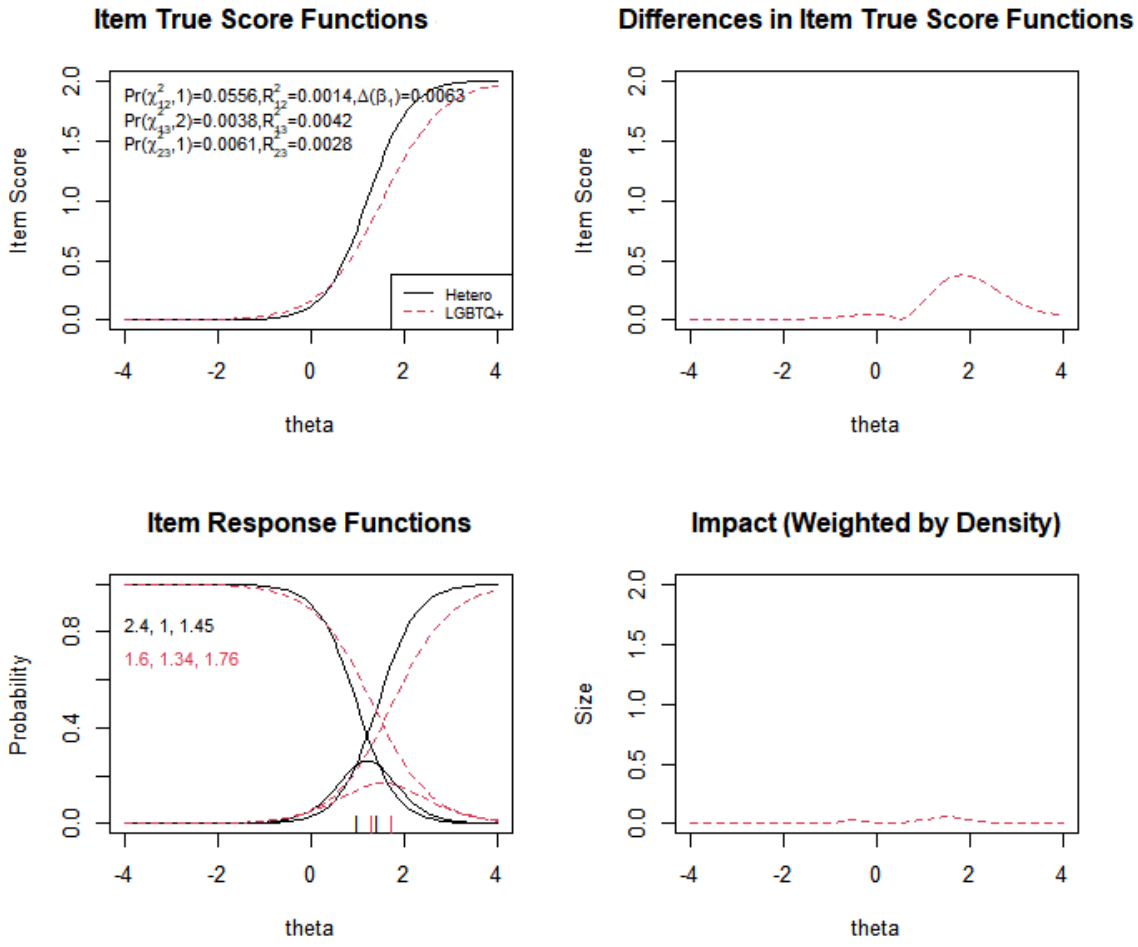
DIF Analysis Group Specific Item Parameters

	a	*b1*	*b2*	*b3*	$\chi^2_{1,2}$	$\chi^2_{1,3}$	$\chi^2_{2,3}$	$R_{1,2}$	$R_{1,3}$	$R_{2,3}$
It is okay for a boy to hit a girl if she hit him first.					0.81	0.76	0.48	.0000	.0005	.0004
Heterosexual Youth	3.60	1.65	2.16	NA						
Sexual Minority Youth	5.11	1.58	2.01	NA						
It is okay for a boy to hit his girlfriend if she insulted him in front of his friends.					0.94	0.15	0.05	.0000	.0046	.0046
Heterosexual Youth	4.22	1.75	NA	NA						
Sexual Minority Youth	20.86	1.64	NA	NA						
Girls sometimes deserve to be hit by the boys they date.					0.89	0.98	0.90	.0000	.0000	.0000
Heterosexual Youth	4.54	1.37	1.77	NA						
Sexual Minority Youth	3.98	1.43	1.77	NA						
A girl who makes her boyfriend jealous deserves to be hit.					0.54	0.26	0.13	.0001	.0023	.0019
Heterosexual Youth	4.29	1.60	2.06	NA						
Sexual Minority Youth	7.33	1.63	1.90	NA						
Boys sometimes deserve to be hit by the girls they date.					**0.06**	**0.01**	**0.04**	**.0014**	**.0042**	**.0028**
Heterosexual Youth	2.36	1.01	1.47	NA						
Sexual Minority Youth	1.59	1.38	1.82	NA						
Sometimes boys have to hit their girlfriends to get them back under control.					1.00	0.18	0.06	.0000	.0029	.0029
Heterosexual Youth	5.02	1.59	1.95	NA						
Sexual Minority Youth	3.42	1.63	2.20	NA						
It is okay for a boy to hit a girl if she hit him first.					0.14	0.14	0.17	.0008	.0014	.0007
Heterosexual Youth	2.40	1.11	1.62	2.36						
Sexual Minority Youth	1.67	1.11	1.72	2.53						
It is okay for a girl to hit a boy if he hit her first.					**0.92**	**0.32**	**0.01**	**.0000**	**.0021**	**.0021**
Heterosexual Youth	1.77	0.59	0.92	1.52						
Sexual Minority Youth	1.11	0.69	1.15	1.87						

Notes. Bold indicates α values of $\alpha < .05$ which is a flag for identifying items potentially demonstrating DIF.

Figure 1

ICCs for ADV Item "It's okay for a girl to hit a boy if he hit her first."

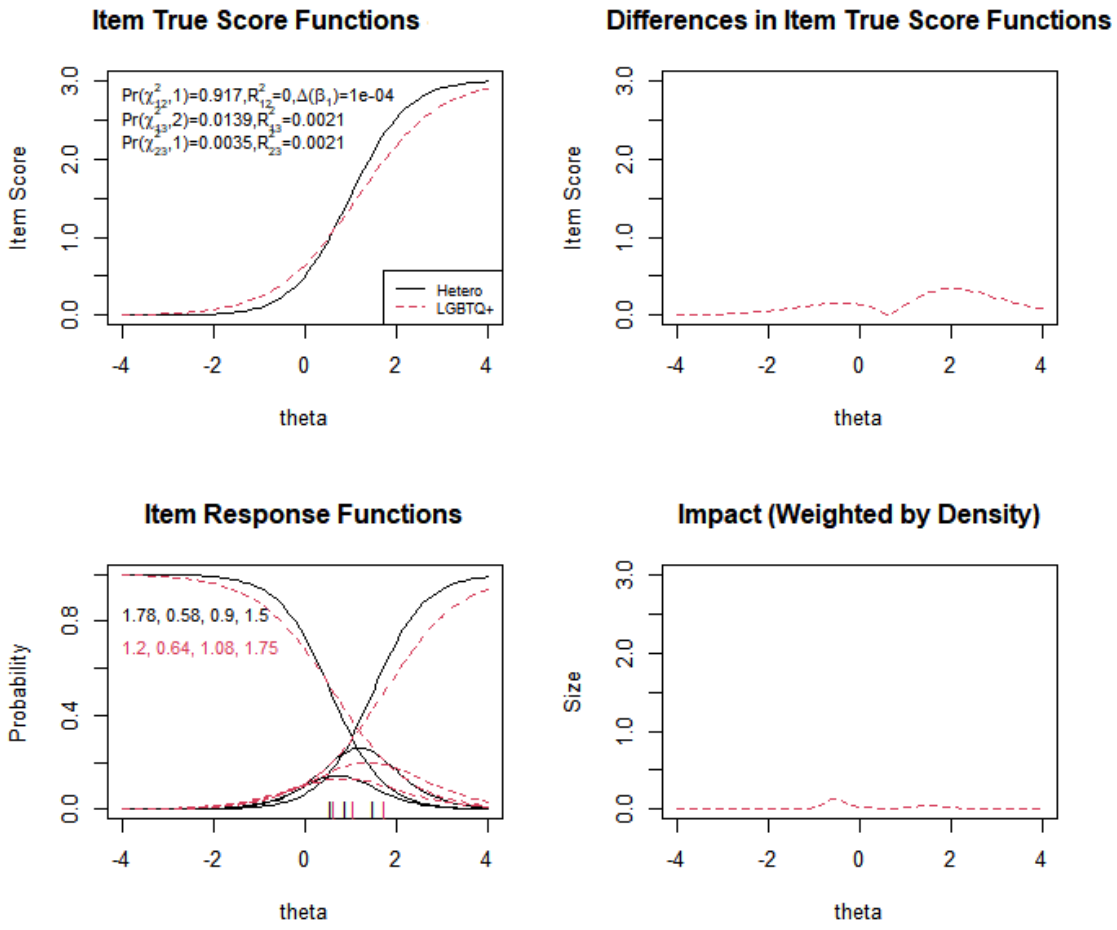


The second item showing differential item functioning was the item "Boys sometimes deserve to be hit by the girls they date " and followed a non-uniform pattern. This suggests that even when ADV is equal across heterosexual and sexual minority youth (i.e., same average score), true score differences are evident at both high and low levels of dating violence acceptance with heterosexual youth have a greater probability of high item ratings when there is strong acceptance of dating violence whereas sexual minority youth are slightly more likely to express strong disfavor for this item. Like the first described item, absolute differences in the ICCs for the two groups indicated that

differences in item true score functions occurred at high levels of ADV (high theta). Item response function estimators (slopes and category thresholds) also varied slightly across groups with one response category (“strongly agree”) not being endorsed by any of the participants in either group. Moreover, SMY were less likely to provide moderate response options and showed more polarized item response patterns (Figure 2). However, the detected non-uniform DIF was of negligible effect size when weighted by trait distribution (R^2 change = .02).

Figure 2

ICC for ADV Item "Boys sometimes deserve to be hit by the girls they date."



Taken together, the results of logistic ordinal DIF analysis suggest differential item functioning for two of eight ADV items with heterosexual youth with high levels of dating violence acceptance being more likely to express strong levels of agreements with 1) female-perpetrated physical violence in response to male-perpetrated violence and 2) female-perpetrated violence against males broadly, relative to sexual minority youths. At the same time, those differences were of negligible magnitude and only resulted in minimal differences in overall expected average scores at any level of attitudinal acceptance of dating violence.

Discussion

In line with the models of behavior change, many effective TDV prevention programs target attitudes related to ADV, a common risk factor for TDV violence perpetration. Recent research suggests greater ADV among youth with multi-gender attraction/partners (Petit, Blais, & Hébert, 2021), yet outcomes of prevention efficacy research are mixed for sexual minority youth (Edwards et al., 2020). This may be in part due to the overreliance on a heteronormative lens through which programming and research continue to be conducted, with most available measures of TDV and related risk factors (e.g., attitudes about violence) having been developed and validated for presumed in heterosexual youth. Moreover, ADV measures have failed to incorporate sexual diversity in item wording and the degree to which such heteronormative item wording introduces statistical item bias when assessing ADV among SMY is not well understood. The current study sought to fill a critical gap by examining differential item functioning (i.e., the degree to which item response probabilities differ across heterosexual and sexual minority youth), as well as concurrent validity of ADV items. The results of the current

study support the concurrent validity of ADV items for physical TDV perpetration with greater endorsement of ADV being associated with more physical TDV perpetration. The effect size of the association between ADV and physical TDV perpetration was moderate in the current study, which was slightly higher than effect sizes reported elsewhere (e.g., Calvete et al., 2018). Moreover, SMY were shown to be less likely to agree with statements that normalized female-perpetrated violence in heterosexual presenting dating relationships compared to heterosexual youth, even when their overall acceptance of dating violence was the same.

Collectively, results suggest that heterosexual youth are more likely to strongly accept dating violence compared to SMY. A possible explanation for this may lay within the heteronormative wording of the items, as items only focused on violence occurring between other gender partners. As such, it is plausible that a misalignment between item wording and SMY's conceptualization of dating violence may have contributed to significant latent mean differences. At the same time, existing research in college samples suggests that gender identity has a bigger impact on ADV relative to sexual orientation (Crittenden et al., 2017). Accordingly, current findings require replication and underscore the need for more research examining differential item functioning of ADV items.

Study findings also indicated that heterosexual youth were more likely to strongly agree with statements about female-perpetrated violence against males being acceptable relative to SMY, despite being similar on the level of the latent trait (i.e., overall ADV). Although the effect size of the found differences was of small magnitude, findings align with existing research documenting greater tolerance of female-perpetrated TDV (relative to male-perpetrated TDV) in late adolescence/early adulthood (Courtaine & Glowacz,

2021; Ruel et al., 2020, Liu et al., 2022). Moreover, viewing these findings through the lens of the traditionally gendered conceptualization of violence perpetration (White, 2009), connections to gender symmetry emerge. Specifically, differences between heterosexual and SMY found in the current study provide support for the influence of gender roles and stereotypical behaviors as it pertains to ADV (Shorey et al., 2008) and extend existing research emphasizing the importance of gender roles for ADV among LGBTQ+ college students (Jacobson et al., 2015). With gender symmetry most frequently studied in IPV research focusing on (young) adult romantic relationships, the current findings add developmental context and shed light on potential precursors of such symmetry. In other words, the current study provides evidence for attitudinal differences that have the potential to influence prevalence rates in a gender symmetrical way. However, longitudinal research is needed to provide additional support for such gender symmetry across lifespan.

Limitations

The findings of the current study should be viewed in light of study limitations, such as the representation of diverse identities in the current sample. Although the representation of Black/African American adolescents in the current sample is considered a strength of the current study, Hispanic/Latinx youth were underrepresented limiting generalizability. Consequently, findings warrant replication with Hispanic/Latinx heterosexual and sexual minority youth. Relatedly, the use of secondary data prevented an examination of gender minorities (including transgender and gender-nonbinary gender identities), with findings warranting replication for sexual and gender minority adolescents. Prior work (e.g., Crittenden et al., 2017) suggests considering the

intersection of sexual and gender identity as it has provided more pronounced differences in ADV for gender minority youth. Moreover, the current study did not consider differences in item functioning across intersectional identities (e.g., within and between racial and ethnic groups and LGBTQ+ people), which will be an important area of future research. Additionally, existing research suggests that exposure to family violence shapes ADV (Langhinrichsen-Rohling et al., 2004), and could have influenced item response probabilities. However, a test of this was beyond the scope of the current study and is subject to future research.

Future Directions

The results of the current study raise important questions regarding the continued use of gendered paradigms that not only conceptualize dating violence as a male-perpetrated phenomenon, but also marginalizes victimization experiences that do not fit into the paradigm. Specifically, the widespread focus on traditional sex and gender roles/patriarchy as attitudinal risk factors for dating violence minimizes the experience of victims of female-perpetrated violence and those experiencing violence within their LGBTQ+ relationships. Therefore, effective prevention of TDV must address attitudes condoning all dating violence, including dating violence towards male and LGBTQ+ partners that is frequently overlooked in research and program development (e.g., Laskey et al., 2019). Similarly, prevention programs may also focus on the promotion of mutual respect in romantic relationships as well as alternatives to violence.

Applied to the findings of the current study, implications include ADV item adaptations to at least use gender neutral language (i.e., partner instead of boy/girl) as well as ongoing measure development considerations. Specifically, measures divergence

from current demographic cohorts' lived experiences of TDV and attitudes towards TDV, as well as their perceived outdated wording (Taylor et al., 2021) may have contributed to observed small effect sizes and emphasize the importance of ongoing measure development. The use of mixed methods approaches (including focus groups) appears to be particularly suited to develop and refine ADV items that center the voices of diverse youth. Inclusive ADV measurement in turn is not only important to support ongoing prevention efforts aimed at the adaptation of evidence based TDV prevention programs for SMY but would benefit youth in general.

Conclusions

The results of the current study show differences in response probabilities across heterosexual and SMY to items assessing acceptance of teen dating violence. Relative to SMY, heterosexual youth were more likely to strongly endorse items assessing the acceptance of female-perpetrated violence, whether it be in self-defense or more broadly, even when controlling for construct-level differences in ADV across both groups. Potential explanations for such differences in response probabilities include the use of gender-specific heteronormative language as well as overall differences as well as theoretical underpinnings of gender symmetry in relationship violence. As such, findings of the current study raise important questions about the degree to which current ADV measures provide an equivalent assessment of attitudes putting adolescents at risk for violence perpetration. Albeit an overall small effect size of differential item functioning, ADV measures heteronormative item wording may not resonate with youth identifying as sexual minorities or with other gender partners. Moreover, TDV is not limited to physical acts of violence and can be psychological and sexual in nature as well as perpetrated

online. Consequently, the development and validation of a low-burden, standardized approach for assessing the attitudinal acceptance of physical, psychological, sexual, and cyber dating violence reflective of contemporary adolescents' relationship experiences and constellations would bolster violence prevention efforts.

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CHAPTER 4 – TESTING THE INTERGENERATIONAL TRANSMISSION OF VIOLENCE FOR HETERSEXUAL AND SEXUAL MINORITY YOUTH USING INTEGRATIVE DATA ANALYSIS

Planning to submit to *Journal of Family Violence* (Springer).

Abstract

The intergenerational transmission of violence is a framework in teen dating violence (TDV) prevention programs. It postulates that youth exposed to violence in their family of origin are at increased risk for violence perpetration due to violence accepting attitudes (e.g., Kwon & You, 2023; Ruel et al., 2020). However, most research examining this mechanism has been conducted is heterosexual samples and to date, only one known study has examined the intergenerational transmission of violence among sexual minority youth assigned female at birth (Messinger et al., 2021). The current study sought to fill an important gap examining the synergistic interplay of personal violence history (i.e., exposure to family violence) and sociocultural factors (i.e., acceptance of dating violence) for TDV perpetration across heterosexual and sexual minority youth. To accomplish this, the current study integrated secondary data from existing research studies utilizing integrative data analysis, a relatively novel approach which integrates existing individual-level data from multiple sources to increase sample size, maximize statistical power, and manage between-study heterogeneity (Curran & Hussong, 2009). Five operationally different datasets were pooled (N = 19,063) and universally equivalent scale scores were estimated using moderated nonlinear factor analysis. Results of multigroup mediation analysis indicated that exposure to family violence was predictive of greater acceptance of dating violence. However, the degree to which acceptance of dating violence served as a mediating mechanism differed across heterosexual and sexual minority youth. Results of additional exploratory analysis further elucidated differences in direct and indirect effects across different types of violence perpetration, highlighting the importance of tailored prevention programming.

Introduction

Decades of research has examined the intergenerational transmission of violence, with most research providing empirical support that youth exposed to interparental violence are more likely to perpetrate dating violence in adolescence and early adulthood (Dhruve & Oliveros, 2022; Lichter & McCloskey, 2004; Livingston et al., 2021; Oliveros & Coleman, 2021; Ruel et al., 2020; Smith et al., 2011). At the heart of these findings is the premise that relational violence is learned behavior, activated by dysfunctional attitudes and memories that operate in conjunction with affect, motivation, and physiological responses to promote violent behavior. However, systematic reviews of empirical research on the intergenerational transmission of violence yield mixed support for the direct link between exposure to family violence and teen dating violence (TDV) perpetration, as well as the role of violence accepting attitudes as a mediating mechanism for the intergenerational transmission of violence (e.g., Kwon & You, 2023). Moreover, the extent to which the intergenerational transmission of violence unfolds in the romantic relationships of sexual minority youth (i.e., youth who are not exclusively heterosexual) is insufficiently understood. To date, only one known study has examined the intergenerational transmission of violence among sexual minority (SM) youth, providing preliminary evidence for the applicability of this particular theory in a sample of sexual minority youth (SMY) and young adults assigned female at birth (Messinger et al., 2021). As such, the current study sought to fill an important gap examining the synergistic interplay of personal violence history (i.e., exposure to family violence) and sociocultural factors (i.e., acceptance of dating violence) for TDV perpetration across heterosexual and SM youth.

Literature Review

Research evidence for the direct effect of exposure to family violence on TDV perpetration is mixed. For instance, among adolescents, witnessing family violence was shown to consistently predict dating violence perpetration (Cadely et al., 2019; Cheung & Huang, 2023; Emanuels et al., 2022), whereas other research suggests that witnessing interparental violence was not predictive of adolescent's perpetration of any forms of TDV (Karsberg et al., 2019). While the direct effect of exposure to family violence in TDV is reported to be of small to moderate effect size (Cadely et al., 2019; Emanuels et al., 2022; Karsberg et al., 2019), most existing research on the intergenerational transmission of violence and its mechanisms has focused on exposure to physical violence and violence perpetration in heterosexual relationships later in life (Kimber et al., 2018). Few studies have examined the intergenerational transmission of violence for SMY, with available research mirroring the mixed results reported earlier. Specifically, some research suggests that SM adolescents and young adults assigned female at birth are at an increased risk for dating violence perpetration and victimization when interparental violence was witnessed during childhood (Messinger et al., 2021; Stroem et al., 2021; Whitton et al., 2021). Conversely, Reuter et al. (2015) found that exposure to family violence did not result in a greater risk for TDV perpetration among male and female SMY. Among SM college students, exposure to interparental violence was not significantly associated with psychological dating violence perpetration (Taylor & Neppl, 2020).

Acceptance of Dating Violence. Acceptance of dating violence (ADV) is a commonly studied mediating mechanism that links exposure to family violence with

TDV perpetration, with correlational research suggesting stronger dating violence acceptance among individuals exposed to family violence (Evans et al., 2022). Dating youth who are more accepting of dating violence in turn were shown to be more likely to perpetrate TDV (Ybarra & Langhinrichsen-Rohling, 2019), especially when exposed to family violence (Mennicke et al., 2022). Research explicitly examining the mediating mechanism of ADV however has produced mixed results. For instance, some research suggests that exposure to family violence does not significantly contribute to violence accepting attitudes (Liu et al., 2023; Morris et al., 2015) and that violence accepting attitudes are not predictive of TDV perpetration over time (Wolfe et al., 2004). Yet, other findings support the mediating role of the violence accepting attitudes for TDV perpetration when interparental violence has been witnessed (Clarey et al., 2010; Ruel et al., 2020; Temple et al., 2013). Finally, this mediating mechanism has not yet been examined for SMY.

In sum, there appear to be three salient issues evident in current empirical research and literature. Primarily, the degree to which pathways and mechanisms of intergenerational transmission of violence are comparable across heterosexual and sexual minority youths remains unknown. Likewise, the extent to which violence accepting attitudes is the universal mechanism of the intergenerational transmission of violence is not clear. Finally, although significant variability in methodology and small sample sizes generally complicate evidence synthesis (Evans et al., 2021; Haselschwerdt et al., 2019), the degree to which methodological variability and small sample sizes impact empirical findings on the intergenerational transmission of violence is not well understood. The

current study seeks to address these challenges by integrating secondary data from existing research studies utilizing integrative data analysis.

Integrative Data Analysis - A Novel Approach to Examine the Intergenerational Transmission of Violence

Integrative data analysis (IDA) is a set of techniques that capitalizes on conceptual overlap between diverse data sources to pool multiple sources of information and strengthen the generalizability of findings, and to investigate the origin of observed effect variability for both predictors and subgroups in the context of mixed research results (Park & Kim, 2018). As a relatively novel process of pooling raw-data analysis, IDA can provide a nuanced assessment of diverse methodologies, study designs and their influence on between study variance and their influence on predictors and outcomes. At its core, IDA provides a framework to systematically combine existing individual-level data from multiple studies to obtain effect size estimates. It also utilizes a measurement alignment process that not only allows a broad conceptual comparison and replication at the construct level (e.g., comparing different studies using different measures of TDV) but also accounts for the effect of diverse methodologies on effect size estimates. More specifically, the issue of incompatible measures of the same construct across studies is resolved by scaling multi-sample item-level data to one common metric using harmonizing methods such as moderated nonlinear factor analysis (MNLFA; Bauer & Hussong, 2009). In other words, translating item responses (i.e., parameters) across studies into one “common” language (i.e., a harmonized scale score) creates parameter effect sizes across studies that are sensitive to between study differences while also

obtaining person-specific scores within an IDA framework, thereby enabling cross-study hypothesis testing.

Applied to research focused on the intergenerational transmission of violence among heterosexual and SM youth, IDA has several advantages. First, IDA can provide important insights on the effect of construct operationalization (e.g., attitudes towards dating violence) on prevalence rates and effect estimates. Specifically, pooling individual level data from several contributing studies not only increases the overall sample size but also the statistical power underlying the main analysis, thereby strengthening the internal validity of the obtained effect. Additionally, increased statistical power is associated with greater stability of effect size estimates, which is particularly important for comparisons of groups where one is traditionally underpowered. For instance, research suggests that traditional risk factors of TDV (e.g., exposure to interparental violence) fail to predict TDV among SMY (Reuter et al., 2015). However, it is unclear whether this is truly due to an absence of an effect or the result of low statistical power/underrepresentation of SMY as only 22% of Reuter et al. (2015)'s sample identified as sexual minority. Relatedly, even though IDA does not yield different base-rate estimates relative to individual studies, it allows researchers to collect more observed cases engaging in low base-rate behaviors such as sexual TDV perpetration, thereby, reducing the overall influence of extreme observations on effect size estimates. As such, combining individual level data from existing research study not only increases the overall number of observations available, but the number individuals engaging in low base-rate behaviors (e.g., sexual TDV perpetration) as well as the size of subsamples (e.g., SMY).

Additionally, IDA enables researchers to critically examine the role of measurement for between-study heterogeneity (Curran et al., 2008; Curran & Hussong, 2009), that is the effect of discrepancies in the operationalization of constructs on prevalence rates and effect estimates. This is particularly important for research on the intergenerational transmission of violence, which is characterized by inconsistent construct definitions and operationalization, that are further limiting cross-study comparisons (Evans et al., 2021; Haselschwerdt et al., 2019). For example, some studies conceptualize exposure to family violence as parental intimate partner violence (Ehrensaft et al., 2003), while others include physical violence towards the child (Grasso et al., 2016; Wolf & Foshee, 2003). Relatedly, there appears to be great variability in the conceptualization of TDV, including definitions of the type of dating relationships assessed (e.g., boyfriend/girlfriend, a relationship involving sex) and differences in language used to refer to dating dyad members (e.g., dating partner, romantic partner, steady dating partner, boyfriend/girlfriend; Ricks et al., 2023). Measures assessing acceptance of dating violence show even more variability in content and approach, with some being limited to attitudes towards physical violence only while others often include coercive attitudes and peer pressure (Exner-Cortens et al., 2016).

Beyond conceptual discrepancies, the operationalization of exposure to family violence, violence accepting attitudes, and teen dating violence appears to be equally variable. For example, the measurement of exposure to family violence ranges from the use of one or two single items (e.g., Latzman et al., 2015) to validated measures such as the Conflict Tactics Scale – Revised (CTS2; Straus et al., 1996). Relatedly, there is variability in the measurement of attitudinal acceptance of relationship violence with

many items commonly assessing physical violence and are characterized by heteronormative language (i.e., item wording that assumes heterosexuality and binary gender identity). Validated measures of TDV also greatly differ in the extent to which they assess specific types of violence. For example, some measures use several items to assess distinct acts of physical violence (e.g., slapping, kicking, choking) while others combine these acts into singular items (Ricks et al., 2023). Additionally, many widely used TDV measures such as the CADRI have been developed without taking into consideration the experiences of SMY (e.g., McMillan et al., 2023). This is not only concerning from a conceptual perspective but also in the context of measurement equivalence and potential of differential item functioning as SMY may interpret or respond to the same item in different ways, beyond any actual differences in the underlying construct. Therefore, a nuanced understanding of the influence of conceptual and operational discrepancies in measurement across studies and subpopulations is important not only to better understand the influence of measurement on between-study heterogeneity, but also to allow for meaningful group-comparisons of effect size estimates. Both of which can be accomplished using IDA.

The Current Study

The overall goal of the current study was to examine the synergistic interplay of personal violence history (i.e., exposure to family violence) and sociocultural factors (i.e., acceptance of dating violence) for TDV perpetration and the extent to which the intergenerational transmission of violence differs between heterosexual and SMY. Utilizing IDA as an overarching framework, the current study integrates existing datasets and estimates universally equivalent scale scores (i.e., commensurate scores) via

moderated nonlinear factor analysis (an item harmonizing method that allows researchers to statistically account for between-study heterogeneity in measurement and across studies) prior to hypothesis testing. To test for group differences in the intergenerational transmission of violence across heterosexual and sexual minority youth, a multigroup mediation model was postulated and the direct effect of exposure to family violence for TDV perpetration as well as the indirect effect of violence accepting attitudes were examined across secondary data sets.

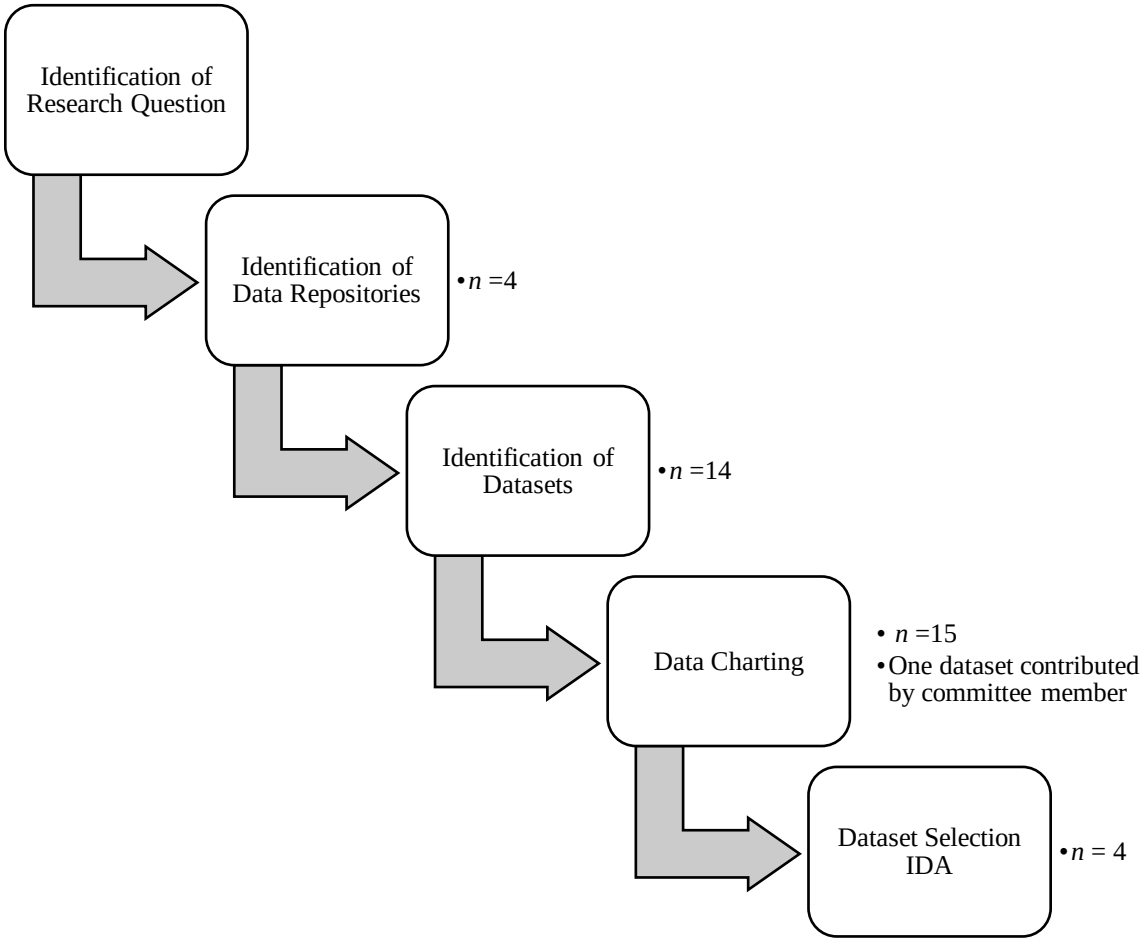
Methods

Identification of Secondary Data

To identify existing datasets, a scoping review (i.e., an examination of the extent, range, and nature of available datasets; Figure 3) was conducted following a modified version of Arksey & O'Malley (2005)'s methodological framework. Specifically, key phases guiding the review included 1) identification of the research question, 2) identification of relevant data repositories, 3) identification of relevant datasets, 4) charting of the datasets to identify points of convergence, and 5) dataset selection for each proposed study. The review was guided by the research question "What existing datasets on teen dating violence are publicly available?". The initial search was implemented from July 2021 to November 2021 and the following data repositories were searched: The Inter-university Consortium for Political and Social Research (ICPSR), The NICHD Data and Specimen Hub (DASH), The Love Consortium Dataverse, and Harvard Dataverse.

Figure 3

Scoping Review Process to Identify Contributing Datasets/Studies



Across data repositories, a total of 14 datasets were identified using the following selection criteria: a) public availability of the dataset (including restricted-use datasets), b) study sample comprised of adolescents (i.e., between 12 and 18 years of age), c) inclusion of constructs of interest (i.e., exposure to family violence, attitudes or beliefs

about dating violence, and teen dating violence perpetration and victimization, information about sexual orientation), and d) data collection occurred within the last 15 years. Datasets from intervention studies were excluded unless all constructs of interest were assessed at baseline and the aforementioned criteria were met. One additional dataset unavailable in data repositories but containing the constructs of interest was offered by a committee member in November 2021 and was included in the project pool upon meeting selection criteria. Using publicly available codebooks, charting of the datasets was completed in December 2021. Points of convergence were identified, and contributing datasets were selected based on available items with overlapping content for each of the focal constructs. Brief descriptions of each study/dataset are provided in Table 8.

Table 8

Description of Studies/Contributing Datasets

	Study 1 (*n* = 1,162; Espelage et al., 2014)	Study 2 (*n* = 185; Livingston et al., 2016)	Study 3 (*n* = 1,640; Taylor et al., 2016)	Study 4 (*n* = 16,509; Coker et al., 2017)
Study Characteristics				
Study Aim	To examine the interplay of individual characteristics and environmental contexts as it pertains to the promotion or prevention of dating violence victimization and perpetration as well as bullying.	To examine the etiological pathways to teen dating violence in a sample of adolescents who had been followed since infancy and were at high risk due to parental alcohol problems.	To examine the changing nature of adolescent dating relationships.	To examine the effects of the Green Dot bystander-based violence prevention program for high schoolers.
Study Design	longitudinal	cross-sectional	longitudinal	longitudinal
Study Period	2007-2013	2013-2015	2013-2017	2010-2014
Year of Wave used	2012	NA	2015	2010 (baseline)

Table 8 *continued*

Data Collection Method	paper-pencil survey at school	computer-assisted interviewing	online survey	paper-pencil survey at school
Geographical Region	Midwest US	Northeast US	US Nationwide	Midwest US
Measures				
Exposure to Family Violence	Student Health and Safety Survey (CDC, 2004) item	Single item (no validated measure referenced)	Single item (no validated measure referenced)	Single item (no validated measure referenced)
Teen Dating Violence Perpetration	Conflict in Adolescent Dating Relationships Inventory (Wolfe et al., 2001)	Conflict in Adolescent Dating Relationships Inventory (Wolfe et al., 2001)	Conflict in Adolescent Dating Relationships Inventory (Wolfe et al., 2001)	National Intimate Partner and Sexual Violence Survey items
Acceptance of Dating Violence	Set of items (no validated measure referenced)	Set of items (no validated measure referenced)	Set of items (no validated measure referenced)	Acceptance of Couple Violence Scale
Sexual Orientation	self-label	dating behaviors	self-label	self-label

Notes. Study 1 = Bullying & Sexual Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States (Espelage et al., 2014). Study 2 = Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY (Livingston et al., 2016). Study 3 = National Survey of Teen Relationships and Intimate Violence (Taylor et al., 2016). Study 4 = Green Dot Prevention Program (Coker et al., 2017).

Measures

Demographic Information. Participants were asked to provide information on sex, race, ethnicity, grade, and sexual orientation across individual contributing studies. Participants' responses to survey items pertaining to sexual orientation were used as descriptors and dichotomized (0 = strictly heterosexual, 1 = not strictly heterosexual) to assess for group differences between sexual minority and heterosexual youth.

Exposure to Family Violence. The assessment of exposure to family violence varied across studies with some studies (e.g., Study 4; Coker et al., 2017) using one item to assess exposure to family violence whereas other studies (e.g., Study 3; Taylor et al.,

2016) used a variety of items to assess exposure to different types of family violence (e.g., physical and psychological violence).

Violence Accepting Attitudes. Amongst contributing studies, only a few used validated measures to assess violence accepting attitudes. For example, Study 4 (Coker et al., 2017) utilized the Acceptance of Couple Violence scale (Foshee et al., 1998) to assess both the acceptance of female-to-male and male-to-female violence (e.g., "A girl who makes her boyfriend jealous deserves to be hit"). Other studies (e.g., Study 1- Espelage et al. (2014); Study 2 - Livingston et al. (2016)) did not use an established measure but employed a comparable set of items.

Teen Dating Violence Perpetration. Amongst contributing studies, Study 1-3 utilized the Conflict in Adolescent Dating Relationships Inventory (CADRI; Wolfe et al., 2001) whereas Study 4 used a set of revised survey items from the National Intimate Partner and Sexual Violence Survey (Coker et al., 2017).

Between-study differences. A categorical predictor variable (i.e., fixed factor) was created to reflect between-study differences (i.e., contributing dataset).

Analytic Approach

Preliminary descriptive analysis of the data was conducted for each contributing study independently and included an examination of univariate and bivariate distributions, as well as pattern of missingness. Following the analytic steps outlined by Curran et al. (2014) and Cole et al. (2023), common items were identified for each construct of interest prior to conducting moderated-nonlinear factor analysis.

Moderated Nonlinear Factor Analysis. To obtain commensurate scale scores via moderated nonlinear factor analysis (MNLFA), the R Package *aMNLFA* (Gottfredson

et al., 2019) was utilized. Graphical and descriptive analyses of individual items were conducted to identify potential study trends in the individual items. Specifically, item frequencies were plotted as a function of study membership. Next MNLFA were conducted for each focal construct (i.e., exposure to family violence, relationship violence accepting attitudes, physical TDV perpetration, psychological TDV perpetration, sexual TDV perpetration), which involved evaluating factor (mean and variance) and item (intercept and factor loading) differences as a function of study membership/data origin. Unless stated otherwise, all models were estimated using maximum likelihood estimation.

To examine latent factor mean, variance, and item functioning differences, two sets of models were estimated using the pooled sample. The first set of models examined whether the data origin (i.e., between study differences) significantly predicted mean and variance differences in the latent factor of each construct. The second set of models tested whether between study differences/data origin predicted intercept and factor loading differences (DIF effects) in the specific items after accounting for factor differences using differential item functioning (DIF) analysis. After an optimal combination of the set of predictors for each individual item and factor parameter was identified, a full model including all covariate effects for all items was estimated simultaneously to form the final scoring model that accounts for both DIF and impact effects. Next, significant non invariance terms for factor loadings were trimmed using either Bonferonni or the Benjamini Hochberg procedure as adjustment methods. Adjustment methods and corresponding number of tests were identified through visualization of DIF effects as a function of trimming criteria. Finally, scale scores were estimated taking into

consideration all significant mean and impact terms adjusted for Type-I error and the quality of the final scale scores was evaluated by plotting the obtained factor score estimates against the study membership variable.

Model Testing. Utilizing the factor score estimates obtained using MNLFA, structural equation modeling was conducted to examine the mediating effect of violence accepting attitudes on the association between exposure to family violence and TDV perpetration. Specifically, a mediation model testing the direct effect of exposure to family violence on TDV perpetration (latent factor observed as physical, psychological, and sexual violence perpetration), as well as the indirect effect of acceptance of dating violence (ADV) was specified. Grade level (as a proxy for age) was included as a covariate to control for potential developmental influences[8]. This model was first fitted to the entire sample and then estimated separately for both heterosexual youth and SMY (i.e., multigroup mediation analysis). Prior to model testing, missing posterior factor score data was imputed, and robust maximum likelihood estimation method was employed to address non-normality of predictors and outcomes. Model fit was assessed using Chi-square fit statistics, the comparative fit index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Squared Residual (SRMR). Criteria for good model fit were based on conventions reported by Hu and Bentler (1999): CFI > .95, TLI >.94, RMSEA < .06 and SRMR <.06. All mediation models were estimated using MPlus Version 8.1.

[8] Grade level was chosen as a covariate because all studies had grade level recorded but did not have age.

Results

Pooled Sample Descriptives

The combination of participant-level data from four contributing studies/datasets did yield a pooled sample of 19,063 participants. Slightly more than half of the participants were female (53.8%) and 97.5% of the participants attended high school at the time data was collected. Approximately 12% of the sample identified as African American or Black and 3.5% identified as Hispanic/Latinx. Heterosexual youth made up most of the sample, with 11.8% of participants identifying as sexual minority. More detailed sample characteristics across individual contributing studies and for the pooled sample are displayed in Table 9.

Table 9

Demographic Information for Individual Studies and Pooled Sample

	Study 1 (*n* = 1,660)	Study 2 (*n* = 150)	Study 3 (*n* = 744)	Study 4 (*n* = 15,609)	Pooled Sample (*N* = 19, 063)
Sex					
Female	842 (50.8%)	74 (49.3%)	359 (48.3%)	8,973 (54.4%)	10,248 (53.8%)
Male	816 (49.2%)	76 (50.7%)	385 (51.7%)	7,530 (45.6%)	8,807 (46.2%)
Race					
Asian	31 (1.9%)	0 (0%)	0 (0%)	228 (1.4%)	259 (1.4%)
African American/Black	770 (46.4%)	5 (3.3%)	53 (9.1%)	1,351 (8.4%)	2,189 (12.0%)
Native American	0 (0%)	0 (0%)	0 (0%)	183 (1.1%)	183 (1.0%)
Multiracial	0 (0%)	10 (6.7%)	50 (8.6%)	0 (0%)	60 (0.3%)
Other	108 (6.5%)	0 (0%)	16 (2.8%)	582 (3.6%)	706 (3.9%)
White	429 (29.6%)	135 (90%)	454 (77.9%)	13,766 (85.5%)	14,847 (81.4%)
Ethnicity					
Hispanic/Latinx	106 (6.4%)	3 (2%)	161 (21.6%)	399 (2.4%)	669 (3.5%)
Non-Hispanic/Non-Latinx	1,401 (84.4%)	142 (98%)	583 (78.4%)	16,110 (97.6%)	18,241 (95.7%)
Grade					
7th Grade	0 (0%)	0 (0%)	31 (0.1%)	0 (0%)	31 (0.2%)
8th Grade	0 (0%)	0 (0%)	20 (2.7%)	0 (0%)	20 (0.4%)
9th Grade	10 (0.6%)	0 (0%)	32 (4.3%)	5,017 (30.4%)	5,087 (26.7%)
10th Grade	557 (33.6%)	0 (0%)	64 (8.1%)	4,565 (27.7%)	5,206 (27.3%)
11th Grade	568 (34.3%)	49 (32.7%)	60 (8.1%)	4,201 (25.4%)	4,900 (25.7%)
12th Grade	521 (31.5%)	64 (42.7%)	84 (14%)	2,696 (16.3%)	3,385 (17.8%)
Post High School	0 (0%)	34 (22.7%)	378 (52.1%)	0 (0%)	131 (1.2%)
Other	0 (0%)	3 (2.0%)	86 (11.6%)	0 (0%)	134 (0.7%)
Sexual Orientation					
Bisexual	225 (13.5%)	12 (8.0%)	58 (6.7%)	690 (5.8%)	662 (3.5%)
Gay/Lesbian	37 (2.2%)	6 (4.0%)	15 (2.0%)	1,344 (8.1%)	1,396 (7.3%)
Heterosexual	1,380 (83.1%)	132 (88%)	661 (88.8%)	14,292 (86.6%)	16,782 (88.2%)
Questioning	0 (0%)	0 (0%)	7 (0.9%)	177 (1.1%)	184 (1.0%)
Other	0 (0%)	0 (0%)	3 (0.4%)	0 (0%)	3 (0.0%)

Note. Study 1 = Bullying & Sexual Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States (Espelage et al., 2014). Study 2 = Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY (Livingston et al., 2016). Study 3 = National Survey of Teen Relationships and Intimate Violence (Taylor et al., 2016). Study 4 = Green Dot Prevention Program (Coker et al., 2017).

The contributing studies had at least one item assessing the construct of interest which in turn were used to link the observed items across studies to the same underlying latent factor (see Appendix C – Linking Items Across Studies). Univariate and bivariate distributions, as well as patterns of missingness were examined across items/constructs. As expected, response distributions followed a non-normal pattern and data was missing at random for each of the four contributing studies.

Moderated Nonlinear Factor Analysis

For each focal construct (exposure to family violence, acceptance of dating violence, physical TDV, sexual TDV, and psychological TDV), item frequencies were plotted as a function of study membership/data origin and frequencies plots indicated potential impact of between-study differences/data origin for each construct. Covariate effects on factor mean and variance as well as DIF effects for item loadings and item intercept were tested for each construct/item. The MNLFA model results on the structural relation between covariate (study membership) and latent factor means and variances can be found Table 10.

Table 10

Effect of Between Study Differences on Factor Means and Variances with Model Fit

Factor	AIC	BIC	SBIC	Estimate (SE)	*p*
Exposure to Family Violence Factor					
Factor Mean	19571.80	19626.22	19603.97	0.02 (0.01)	0.007
Factor Variance	**19530.77**	**19592.96**	**1 9567.54**	**-0.91 (0.04)**	**<0.001**
Acceptance of Dating Violence Factor					
Factor Mean	**140688.73**	**141199.34**	**140992.77**	**0.39 (0.01)**	**<0.001**
Factor Variance	190579.36	191105.68	190892.76	0.08 (0.04)	0.054

Table 10 *continued*

Physical TDV Perpetration Factor					
Factor Mean	**13307.47**	**13589.49**	**13475.08**	**-0.05 (0.01)**	**<0.001**
Factor Variance	13384.40	13674.26	13556.67	-0.018 (0.03)	0.539
Sexual TDV Perpetration Factor					
Factor Mean	19384.15	19627.65	19529.14	0.01 (0.02)	0.907
Factor Variance	19360.81	19612.17	19510.48	0.03 (0.03)	0.232
Psychological TDV Perpetration Factor					
Factor Mean	**95154.03**	**95790.30**	**95532.89**	**-0.11 (0.01)**	**<0.001**
Factor Variance	**95134.86**	**95778.99**	**95518.39**	**0.12 (0.02)**	**<0.001**

Note. AIC = Akaike Information Criterion. BIC = Bayesian Information Criterion. SBIC = Sample-Size Adjusted BIC. Significant effects retained in the simultaneous model are **bolded.**

Next, all marginally significant mean and variance impact terms as well as DIF effects with $p < .05$ were included to test all impact and DIF effects simultaneously. The simultaneous model of the family violence construct was estimated using maximum likelihood estimation with standard errors based on the first-order derivatives (MLF) as recommended by Asparouhov and Muthen (2012). The simultaneous models of all other constructs were estimated using maximum likelihood estimation. In the simultaneous model of the family violence construct, all mean, variance, and DIF effects were non-significant and trimming of nonsignificant invariance terms was therefore not necessary. For the remaining constructs (i.e., acceptance of dating violence, physical TDV, sexual TDV, and psychological TDV), DIF effects were visualized as a function of trimming criteria to identify corresponding adjustment methods. Bonferroni correction was identified as Type-I error adjustment method for acceptance of dating violence and physical TDV, whereas Benjamini Hochberg procedure was best suited to adjust for Type-I error for sexual TDV and psychological TDV (see Appendix D – Visualization of DIF Effects). Scale scores accounting for significant invariance terms were estimated

using the corresponding adjustment methods in the final MNLFA model. A summary of effects identified for each construct and incorporated in the final MNLFA model is displayed in Table 11.

Table 11

Summary of MNLFA Results by Construct/Factor

Construct	Mean Impact	Variance Impact	Intercept DIF	Loading DIF
Exposure to Family Violence Factor	no	no	no	no
Acceptance of Dating Violence Factor	**yes**	no	**yes**	**yes**
Physical TDV Perpetration Factor	**yes**	no	**yes**	**yes**
Sexual TDV Perpetration Factor	no	no	**yes**	**yes**
Psychological TDV Perpetration Factor	**yes**	**yes**	**yes**	**yes**

Note. Yes = Significant invariance term included in the final model. No = Not significant and therefore not included in the final model. **Bolded** = significant effect.

There was no significant effect of study membership/dataset origin on the intercept and factor loading of the exposure to family violence construct. However, significant effects of study membership/dataset origin on factor loadings of ADV items indicate study membership/dataset origin was positively associated with factor scores on items assessing attitudes male-perpetrated violence against females (e.g., items justifying violence in instances where girls make boys mad, insult boys, make boyfriends jealous, cheat on their boyfriends, and hit boys first) and negatively associated with factor scores on items assessing attitudes about female perpetrated violence against males (e.g., items justifying violence in instances where boys make girls mad, insult girls, and make girlfriends jealous). Additionally, study membership/dataset origin was negatively associated with factor scores on items assessing ADV broadly. For physical TDV, significant effects of study membership/data origin on factor loadings were observed for two items. Specifically, study membership/data origin was positively associated with

factor scores of the kicking/punching item and negatively associated with factor scores of the item assessing slapping/pulling hair. Moreover, significant effects of study membership/dataset origin on factor loadings of sexual TDV perpetration items indicated that study membership/dataset origin was negatively associated with factor scores on the items assessing coerced and drugged sex. Furthermore, significant effects of study membership/data origin on factor loadings of seven psychological TDV perpetration items as well as a significant impact of study membership/ data origin on psychological TDV factor mean emerged. More precisely, study membership/data origin was positively associated with factor scores on the items assessing hostile communication, insults, and attempts to frighten the partner and negatively associated with factor scores on items assessing monitoring, jealousy, and yelling. See Table 12 for detailed results.

Table 12

DIF Effect of Between-Study Differences on Item Intercept and Factor Loadings

Item/Syntax Label	Item Stem	Intercept (SE)	Loading (SE)
Exposure to Family Violence (FAM)			
Physical IPV/FAM1	Before you were 9 years old, did you ever see or hear one of your parents or guardians being hit, slapped, punched, shoved, kicked or otherwise physically hurt by their spouse or partner?	*ns*	*ns*
Sibling abuse/FAM2	At any time in the last 12 months, did you SEE a parent hit, beat, kick, or physically hurt your brothers or sisters, not including a spanking on the bottom?	*ns*	*ns*
Psychological IPV/FAM3	At any time in the last 12 months, did one of your parents, because of an argument, break or ruin anything belonging to another parent, punch the wall, or throw something?	*ns*	*ns*
Acceptance of Dating Violence (ADV)			
Makes mad boy/ ADV1A	It is ok for a boy to hit his/her girlfriend if she did something to make him/her/her mad.	2.83 (0.44)	-1.35 (0.33)
Makes mad girl/ ADV1B	It is okay for someone to hit their girlfriend because she made him or her mad.	-8.13 (1.60)	*ns*
Insulted boy/ ADV2A	It is ok for a boy to hit his/her girlfriend if she insulted him/her/her in front of friends.	5.04 (0.69)	-2.35 (0.46)
Insulted girl/ ADV2B	It is okay for someone to hit their girlfriend because she insulted him or her in front of friends.	-8.58 (1.70)	*ns*
Deserving girl/ ADV3A	Girls sometimes deserve to be hit by the boys they date.	*ns*	*ns*
Deserving boy/ ADV3B	Boys sometimes deserve to be hit by the girls they date.	*ns*	*ns*
Makes jealous boyfriend/ ADV4A	A girl who makes her boyfriend jealous on purpose deserves to be hit.	2.93 (0.19)	*ns*
Makes jealous girlfriend/ ADV4B	It is okay for someone to hit their girlfriend because she made him or her jealous on purpose.	-13.38 (4.51)	-1.55 (0.15)
Regain control/ ADV5	Sometimes boys have to hit their girlfriends to get them back under control.	*ns*	*ns*
Girl hit first/ ADV6A	It is ok for a boy to hit a girl if she hit him/her/her first.	1.08 (0.12)	-0.39 (0.11)
Boy hit first/ ADV6B	It is ok for a girl to hit a boy if he hit her first.	-0.32 (0.09)	*ns*
Cheating boyfriend/ ADV7A	It is okay for someone to hit their boyfriend because he was cheating.	-1.00 (0.15)	*ns*
Cheating girlfriend/ ADV7B	It is okay for someone to hit their girlfriend because she was cheating.	-4.19 (0.65)	*ns*
Violence is okay/ ADV8	There are times when dating violence between couples is okay.	-0.09 (0.03)	*ns*
Violence to express feelings/ ADV9	Sometimes violence is the only way to express your feelings.	-0,48 (0.08)	*ns*

Table 12 *continued*

Violence to solve problems/ ADV10	Some couples have to use violence to solve their problems.	-0.55 (0.08)	*ns*
TDV Perpetration – Physical Violence			
TDV threw/ TDV6	I threw something at him/her.	*ns*	*ns*
TDV kicked/ TDV17	I kicked, hit, or punched him/her/her.	1.29 (0.24)	-1.06 (0.17)
TDV slapped/ TDV20	I slapped him/her or pulled his/her hair.	-0.60 (0.20)	*ns*
TDV pushed/ TDV24	I pushed, shoved, or shook him/her.	*ns*	*ns*
TDV knife threat/ TDV26	I threatened him/her with a knife or gun (including waving or pointing a knife).	*ns*	*ns*
TDV chocked/ TDV27	I choked him/her.	*ns*	*ns*
TDV scratched/ TDV28	I scratched him/her and/or bent his/her fingers.	*ns*	*ns*
TDV bit/ TDV29	I bit him/her.	*ns*	*ns*
TDV used knife/ TDV30	You used a knife or a gun against your partner.	*ns*	*ns*
TDV burned/ TDV31	You burned your partner.	*ns*	*ns*
TDV Perpetration – Sexual Violence			
TDV touched/ TDV1	I touched him/her sexually when he/she did not want me to.	*ns*	*ns*
TDV forced sex/ TDV9	I forced him/her to have sex when he/she didn't want to.	-0.39 (0.33)	0.30 (0.15)
TDV threatened sex/ TDV10	I threatened him/her in an attempt to have sex with him/her.	5.85 (3.16)	-2.64 (1.38)
TDV kissed/ TDV12	I kissed him/her when he/she didn't want me to.	0.87 (0.34)	-0.55 (0.24)
TDV coerced sex/ TDV32	In the past 12 months how frequently did you have sexual activities with a high school student because you either threatened to end your relationship if they didn't or because you pressured the other person by arguing or begging?	-1.48 (0.12)	*ns*
TDV drugged sex/ TDV33	In the past 12 months how frequently did you have sexual activities because she/he was drunk or on drugs?	-0.39 (0.33)	*ns*
TDV Perpetration – Psychological Violence			
TDV turned friends/ TDV2	I tried to turn his/her friends against him/her.	-0.32 (0.16)	*ns*
TDV jealous/ TDV3	I did something to make him/her feel jealous.	*ns*	-0.34 (0.10)
TDV destroyed sth/ TDV4	I destroyed or threatened to destroy something he/she valued.	*ns*	*ns*
TDV bad past/ TDV5	I brought up something bad he/she had done in the past.	*ns*	*ns*
TDV made angry/ TDV7	I said things just to make him/her angry.	*ns*	-0.30 (0.13)
TDV hostile tone/ TDV8	I spoke to him/her in a hostile or mean tone of voice.	0.46 (0.13)	-0.32 (0.13)
TDV insults/ TDV11	I insulted him/her with put-downs.	0.78 (0.11)	*ns*
TDV bad talked/ TDV13	I said things to his/her friends about him/her/her to turn them against him/her/her.	*ns*	*ns*
TDV ridiculed/ TDV14	I ridiculed or made fun of him/her/her in front of others.	*ns*	*ns*

Table 12 *continued*

TDV monitored/ TDV15	I kept track of who he/she was with and where he/she was.	-0.50 (0.04)	0.15 (0.03)
TDV blamed/ TDV16	I blamed him/her/her for the problem.	*ns*	*ns*
TDV accused flirting/ TDV18	I accused him/her of flirting with another girl/guy	-0.42 (0.07)	*ns*
TDV frightened/ TDV19	I deliberately tried to frighten him/her.	0.71 (0.19)	-0.45 (0.16)
TDV threatened injury/ TDV21	I threatened to hurt him/her.	*ns*	*ns*
TDV breakup threat/ TDV22	I threatened to end the relationship.	*ns*	*ns*
TDV threatened hitting/ TDV23	I threatened to hit him/her or throw something at him/her.	*ns*	*ns*
TDV rumors/ TDV25	I spread rumors about him/her	*ns*	*ns*
TDV shouted/ TDV34	In the past 12 months how frequently did you shout, yell, insult, or swear at a current or previous girlfriend or boyfriend?	-0.44 (0.04)	*ns*

Note. ns = non-significant. This table includes item labels matching the syntax provided in Appendix F – MNLFA Syntax.

Finally, the distribution of estimated posterior scores was visually examined across study membership/data origin for each construct (see Appendix E – Visualization of Estimated Factor Scores). Estimated posterior scores for family violence, acceptance of dating violence and sexual TDV were similarly distributed across contributing datasets. For physical TDV, the overall endorsement of physical violence perpetration was low across datasets with estimated posterior scores showing most variability for participants from the Green Dot study (perhaps due to overall sample size). There was variability in estimated posterior scores for psychological TDV in the Green Dot's score distribution whereas similar average posterior scores emerged for the remainder of the datasets.

Across 19,063 participants in the pooled sample, less than 8% were missing factor score estimates, with exposure to family violence missing most frequently. Incomplete factor score data was the result of missing item responses in individual contributing studies and missing at random. As such, multiple imputation was deemed appropriate. Following the recommendations of Graham et al., (2007) a total of 10 imputed datasets were created and analyzed for hypothesis testing.

Hypothesis/Model Testing

To test the mediating effect of violence accepting attitudes on the association between exposure to family violence and TDV perpetration broadly (mediation model) and for heterosexual and SMY youth specifically (multigroup mediation model), two models were estimated utilizing the factor score estimates obtained via MNLFA. The first mediation model examining the mediating effect of violence accepting attitudes on the association between exposure to family violence and TDV perpetration evidenced good

model fit, χ^2 [6] = 12.59, CFI = .99, TLI = .98, RMSEA = .01 and SRMR = .01. After controlling for grade level, there was a significant direct effect of exposure to family violence on violence accepting attitudes (b = 0.11, p < .001). No other significant effects emerged. This suggests that although greater exposure to family violence does predict more violence accepting attitudes, it does not significantly predict TDV perpetration.

The multigroup mediation model evidenced acceptable model fit, with χ^2 [18] = 275.20, CFI = .92, TLI = .87, RMSEA = .04 and SRMR = .03. After controlling for grade level, results indicated a significant direct effect of exposure to family violence on violence accepting attitudes for heterosexual youth (b = 0.10, p < .001). However, exposure to family violence was not significantly related to TDV perpetration, directly nor indirectly. Conversely, the direct and indirect effects of exposure to family violence were significant for SMY, with greater exposure to family violence being associated with more TDV preparation (b = 0.07, p < .001), and violence accepting attitudes mediating the association between exposure to family violence and TDV perpetration (ab = 0.02, p =.002, *CI* = .01, .03). The full results of both mediation models are displayed in Table 13.

Additional analyses were conducted to examine group differences in the mediating effect of violence accepting attitudes on the association between exposure to family violence, and each form of TDV (physical, psychological, and sexual TDV perpetration). These were estimated for heterosexual and SM youth separately and controlled for grade level differences. Results are displayed in Table 14 and reported in the following for each violence type.

Table 13

Mediation Effects of ADV on the Relationship between Exposure to Family Violence and TDV Perpetration

	β	*S.E.*	*p*
Model 1. Mediation Model			
Direct Effects			
Exposure to Family Violence on TDV Perpetration	-0.08	0.07	0.257
Exposure to Family Violence on Acceptance of Dating Violence	0.10	0.01	<0.001
Acceptance of Dating Violence on TDV Perpetration	1.00	0.05	<0.001
Total Effects			
Exposure to Family Violence on TDV Perpetration (including ADV as mediator)	0.04	0.11	0.694
Indirect Effects			
Indirect effect of Exposure to Family Violence on TDV Perpetration via ADV with bootstrapped 95% CI [a]		0.10* [-0.17; 0.52]	
Model 2. Multigroup Mediation Model			
Heterosexual Youth			
Direct Effects			
Exposure to Family Violence on TDV Perpetration	0.08	0.05	0.103
Exposure to Family Violence on Acceptance of Dating Violence	0.09	0.01	<0.001
Acceptance of Dating Violence on TDV Perpetration	-1.00	0.01	<0.001
Total Effects			
Exposure to Family Violence on TDV Perpetration (including ADV as mediator)	-0.01	0.05	0.870
Indirect Effects			
Indirect effect of Exposure to Family Violence on TDV Perpetration via ADV with bootstrapped 95% CI [a]		-0.09* [-0.10; -0.07]	
Sexual Minority Youth			
Direct Effects			
Exposure to Family Violence on TDV Perpetration	0.12	0.02	<0.001
Exposure to Family Violence on Acceptance of Dating Violence	0.10	0.02	<0.001
Acceptance of Dating Violence on TDV Perpetration	0.32	0.30	<0.001
Total Effects			
Exposure to Family Violence on TDV Perpetration (including ADV as mediator)	0.15	0.03	<0.001

Table 13 *continued*

Indirect Effects	
Indirect effect of Exposure to Family Violence on TDV Perpetration via ADV with bootstrapped 95% CI [a]	0.03* [0.02; 0.06]

Note. β = standardized coefficient; *CI* = confidence interval. * $p < 0.001$.*)*

[a] Is the effect of exposure to family violence on TDV perpetration when ADV introduced as a mediator.

Table 14

Mediation Effects of ADV on the Relationship between Exposure to Family Violence and TDV Perpetration by Violence Subtype

	β	***S.E.***	***p***
Heterosexual Youth			
Direct Effects			
Exposure to Family Violence on Physical TDV Perpetration	-0.01	0.01	0.218
Exposure to Family Violence on Psychological TDV Perpetration	0.01	0.01	0.172
Exposure to Family Violence on Sexual TDV Perpetration	0.01	0.00	0.007
Exposure to Family Violence on Acceptance of Dating Violence	0.09	0.01	<0.001
Acceptance of Dating Violence on Physical TDV Perpetration	0.13	0.06	0.027
Acceptance of Dating Violence on Psychological TDV Perpetration	0.01	0.00	<0.001
Acceptance of Dating Violence on Sexual TDV Perpetration	0.01	0.01	0.142
Total Effects			
Exposure to Family Violence on Physical TDV Perpetration (including ADV as mediator)	-0.01	0.01	0.779
Exposure to Family Violence on Psychological TDV Perpetration (including ADV as mediator)	0.01	0.01	0.137
Exposure to Family Violence on Sexual TDV Perpetration (including ADV as mediator)	0.01	0.01	0.007
Indirect Effects			
Indirect effect of Exposure to Family Violence on Physical TDV Perpetration via ADV with bootstrapped 95% CI [a]		0.01 [0.00; 0.02] *	
Indirect effect of Exposure to Family Violence on Psychological TDV Perpetration via ADV with bootstrapped 95% CI [a]		0.01 [0.00; 0.01] **	
Indirect effect of Exposure to Family Violence on Sexual TDV Perpetration via ADV with bootstrapped 95% CI [a]		0.01 [0.00, 0.01]	
Sexual Minority Youth			
Direct Effects			
Exposure to Family Violence on Physical TDV Perpetration	0.14	0.03	<0.001
Exposure to Family Violence on Psychological TDV Perpetration	-0.01	0.01	0.261
Exposure to Family Violence on Sexual TDV Perpetration	0.09	0.02	<0.001
Exposure to Family Violence on Acceptance of Dating Violence	0.10	0.02	<0.001
Acceptance of Dating Violence on Physical TDV Perpetration	0.26	0.03	<0.001
Acceptance of Dating Violence on Psychological TDV Perpetration	0.02	0.01	<0.001
Acceptance of Dating Violence on Sexual TDV Perpetration	0.25	0.03	<0.001
Total Effects			
Exposure to Family Violence on Physical TDV Perpetration (including ADV as mediator)	0.16	0.03	<0.001
	-0.01	0.01	0.316

Table 14 *continued*

Exposure to Family Violence on Psychological TDV Perpetration (including ADV as mediator)			
Exposure to Family Violence on Sexual TDV Perpetration (including ADV as mediator)	0.11	0.02	<0.001
Indirect Effects			
Indirect effect of Exposure to Family Violence on Physical TDV Perpetration via ADV with bootstrapped 95% CI [a]		0.24 [0.12; 0.22] **	
Indirect effect of Exposure to Family Violence on Psychological TDV Perpetration via ADV with bootstrapped 95% CI [a]		0.01 [0.00; 0.01] **	
Indirect effect of Exposure to Family Violence on Sexual TDV Perpetration via ADV with 95% CI [a]		0.03 [0.01; 0.04] **	

Note. β = standardized coefficient; *CI* = confidence interval. * $p < 0.05$. ** $p < 0.001$.
[a] Is the effect of exposure to family violence on TDV perpetration when ADV introduced as a mediator.

Psychological TDV Perpetration. There was a significant direct effect of exposure to family violence on violence accepting attitudes (b = 0.10, p < .001), as well as a significant direct effect of violence accepting attitudes on psychological TDV perpetration (b = 0.36, p = .001) for heterosexual youth. Violence accepting attitudes was shown to fully mediate the association between exposure to family violence and psychological TDV perpetration among heterosexual youth (ab = 0.03, p = .011, CI = .01, .06). However, the observed variance explained by exposure to family violence and violence accepting attitudes was less than 1% (R^2 =<0.01). No statistically significant direct or indirect effect emerged for psychological TDV perpetration among SMY.

Physical TDV Perpetration. For SMY, there was a significant direct effect of exposure to family violence physical TDV (b = 0.13, p < .001) perpetration, as well as violence accepting attitudes (b = 0.11, p < .001). There was also a significant direct effect of violence accepting attitudes on physical TDV (b = 0.21, p < .001). The association between exposure to family violence and physical TDV perpetration was fully mediated by violence accepting attitudes (ab = 0.02, p =.001, CI = .01, .04). Approximately 9% of the observed variance in physical TDV perpetration was explained by exposure to family violence and violence accepting attitudes (R^2 = 0.09). No statistically significant direct and indirect effects were observed for physical TDV perpetration among heterosexual youth.

Sexual TDV Perpetration. There was a significant direct effect of exposure to family violence on sexual TDV (b = 0.35, p < .001), as well as significant direct effect of violence accepting attitudes on sexual TDV (b = 0.86, p < .001) perpetration among SMY. Moreover, the association between exposure to family violence and sexual TDV

perpetration was fully mediated by violence accepting attitudes (*ab* = 0.09, *p* <.001, *CI* = .04, .14) for SMY. Approximately 8% of the observed variance in sexual TDV perpetration were explained by the effects of exposure to family violence and violence accepting attitudes (R^2 = 0.08). No significant direct and indirect effects were observed for sexual TDV perpetration among heterosexual youth.

Taken together, post hoc analyses indicated that exposure to family violence is associated with higher levels of psychological TDV perpetration among heterosexual youth and higher levels of physical and sexual TDV perpetration among SMY. Violence accepting attitudes were shown to mediate the association between exposure to family violence and at least one different type of violence perpetration for both heterosexual youth and SMY. However, exposure to family violence and violence accepting attitudes predicted less than 10% of the observed variance in TDV perpetration.

Discussion

The current study utilized integrative data analysis and multigroup mediation modeling to test the intergenerational transmission of violence for heterosexual and sexual minority youth (SMY). Consistent with results of systematic reviews (e.g., Evans et al., 2021), findings showed that exposure to family violence was predictive of greater acceptance of dating violence. However, the degree to which acceptance of dating violence served as a mediating mechanism differed across heterosexual and sexual minority youth. Specifically, for heterosexual youth, exposure to family violence was shown to directly increase acceptance of dating violence but was not significantly related to TDV perpetration. For SMY, greater exposure to family violence was shown to predict both, more TDV perpetration, as well as greater acceptance of dating violence, with

violence accepting attitudes shown to mediate the association between exposure to family violence and TDV perpetration. Results of additional exploratory analysis further elucidated differences in direct and indirect effects across different types of violence for heterosexual and sexual minority youth. Specifically, as it pertains to the direct effect of family violence, perpetration of psychological TDV was the only type of TDV that was positively and significantly predicted by exposure to family violence for heterosexual youth. While this effect was of statistical significance, perhaps due to large sample size, it did not explain any of the observed variance in TDV perpetration among heterosexual youth. As such, there might not be a linear relationship between exposure to family violence, violence accepting attitudes, and psychological TDV perpetration for heterosexual youth. For SMY, exposure to family violence was linked to higher levels of both sexual and physical TDV perpetration. Violence accepting attitudes mediated the association between exposure to family violence, sexual and physical violence perpetration among SMY. However, the strength of these effects was rather small, explaining less than 10% of the variance in physical and sexual TDV perpetration among SMY.

Collectively, the results of the current study contextualize prior research on the intergenerational transmission of violence broadly and add to the growing body of sexual minority dating violence specifically. In light of mixed support for the direct effect of exposure to family violence on dating violence perpetration (e.g., Lichter & McCloskey, 2004; Temple et al., 2013; Wolfe et al., 2004) and the mediating effects of violence accepting attitudes (e.g., Clarey et al., 2010; Morris et al., 2015; Ruel et al., 2020; Temple et al., 2013), the current findings provide important nuance for whom and under what

circumstances the intergenerational transmission might occur. As it pertains to violence perpetration broadly, the effect of exposure to family violence was of small magnitude for both heterosexual and SM youth. However, examining the intergenerational transmission of violence for different types of dating violence showed greater variability in its mechanisms. More precisely, the current findings suggest that for heterosexual youth, the direct effect of exposure to family violence on psychological TDV perpetration is more pertinent than the very small indirect effect of violence accepting attitudes. Thus, violence accepting attitudes appear to have little to no effect on the perpetration of psychological violence among heterosexual youth exposed to violence in their family of origin. As it related to TDV perpetration among sexual minority youth, the results of the current study extend prior research on the direct link between exposure to family violence and violence perpetration (Davis et al., 2019; Martin-Storey & Fromme, 2021a, 2021b; Messinger et al., 2021). This direct effect was stronger for sexual violence perpetration relative to physical TDV. However, violence accepting attitudes only had a small indirect effect on both sexual and physical TDV perpetration among SMY. This suggests for sexual minority youth exposed to family violence, violence accepting attitudes contribute to the intergenerational transmission of violence, yet only explain a small amount of variability in outcomes.

Although current findings extend those of individual research studies, findings are contrary to the moderately sized positive effect of exposure to family violence (i.e., witnessed inter-parental violence) on TDV perpetration found in meta-analysis (Park & Kim, 2018). This perhaps may be due to methodological differences stemming from the use of integrative data analysis. While both traditional meta-analysis and integrative data

analysis represent ways to use data-analytic approaches to synthesize findings from existing studies and/or datasets, they are fundamentally different in their approach to data synthesis. In the current study, moderated nonlinear factor analysis was used to create harmonized scale scores for a given participant based on all available items from contributing studies. This in turn allowed accounting for potential differences in both the latent factor and the individual items as a function of between-study differences, resulting in parameter effect sizes that are sensitive to between study differences. Using this approach also allowed for expanded psychometric coverage, especially for constructs with inconsistent conceptualization and measurement such as family violence (Evans et al., 2021; Jouriles et al., 2012). For example, the current study conceptualized exposure to family violence as interparental physical and psychological violence, as well as parental violence towards other siblings. However, much of existing empirical work has conceptualized exposure to family violence as a monolithic phenomenon entailing either parental intimate partner violence (Ehrensaft et al., 2003) or parental violence towards the child (Grasso et al., 2016), with physical aspects of family violence being most commonly assessed when examining the intergenerational continuity of violence (Kimber et al., 2018). Put differently, through the use of integrative data analysis and moderated nonlinear factor analysis, this study was able to expand psychometric coverage, especially for constructs with inconsistent conceptualization and measurement such as family violence and violence accepting attitudes (Evans et al., 2021; Exner-Cortens et al., 2016; Jouriles et al., 2012). Relatedly, pooling data from multiple contributing studies containing small subsamples of sexual minority youth not only resulted in an overall sample greater sample size of a traditionally underrepresented group but also increased

the statistical power to detect effects for low base rate phenomena including exposure to family violence and TDV perpetration. As a result, integrative data analysis creates the opportunity to move beyond replication questions answered by meta-analysis (i.e., “Does the hypothesized effect exist?”) to identify from whom and in what context the intergenerational transmission of violence occurs.

Implications

Given that teen dating violence is a pervasive public health concern, the current findings provide important implications for prevention programming. Grounded in frameworks such as the intergenerational transmission of violence, youth exposed to family violence are frequently considered to be at high risk for TDV perpetration (e.g., Laporte et al., 2011), which has resulted in the integration of family context factors into prevention programming (e.g., Foshee et al., 2015). However, the results of the current study suggest that the intergenerational transmission of violence is not a monolithic phenomenon. In fact, the specific mechanism through which exposure to family violence directly impacts TDV perpetration were shown to differ across forms of violence and sexual identity orientation. For heterosexual youth, exposure to family violence and violence accepting attitudes were shown to be weak predictors of TDV perpetration. Among sexual minority youth, there was a small effect of exposure to family violence and violence accepting attitudes on TDV perpetration and direct effects were strong for the perpetration of sexual TDV and moderate for the perpetration of physical TDV. This suggests that the intergenerational transmission of violence is less of a universal pathway than previously assumed.

Applied to TDV prevention programs this suggests that a narrow focus on reducing risk factors for TDV such as attitudinal acceptance of dating violence may not reduce and prevent different types of TDV perpetration equally. Instead, sexual orientation identity is an important consideration when examining the intergenerational transmission of violence and beyond. While this study was one the first to examine the intergenerational transmission of violence for sexual minority youth, its implications echo broader efforts to individually tailored prevention programs across socio-ecological levels. The results of the current study highlight the need to develop prevention programming for our most vulnerable youth, sexual minority adolescents exposed to family violence. Prevention efforts will require multimodal interventions across ecological levels, including explicit efforts to overcome challenges resulting from marginalization (Levine et al., 2013) and greater focus on motivation to perpetrate (Langhinrichsen-Rohling et al., 2012). Successful efforts will also require an explicit focus on measure development. Finally, integrative data analysis presents a novel and ecological way to inform the development of bridging studies that link together existing TDV outcome prevention research and to identify what prevention program components are effective for whom and under what conditions (Curran & Hussong, 2009; Hussong et al., 2013).

Limitations

The results of the current study need to be viewed in light of several limitations. While the current study focused on TDV perpetration, it is important to acknowledge that TDV often occurs bi-directionally (Fernández-González et al., 2020). Perpetrators of TDV are also frequently victims of dating violence (Niolon et al., 2015) and exposure to

family violence has been shown to predict both TDV perpetration and victimization (Cheung & Huang, 2023; Laporte et al., 2011). Moreover, the current study focused on sexual minority youth and did not consider the differential effect for youth identifying as sexual and gender minorities as contributing datasets did not provide information about participants gender identity. Taking into consideration multiple marginalization and minority stress theory (e.g., Frost & Meyer, 2023), greater focus on the intersectionality of identities is needed when examining the intergenerational transmission of violence and beyond. Additionally, the sample consistent exclusively of youth attending public schools and youth receiving instructions in homebound or home school settings were not included. As such, future research may benefit from expanding recruitment efforts to include youth in alternative educational settings. Finally, this study used novel analytical techniques in a cross-sectional context. Ideally, future research would capitalize on the use of integrative data analysis to test the intergenerational transmission of violence in a longitudinal framework to better understand temporal relationships of theoretically causal mechanisms.

Conclusion

The current study used a novel way of data aggregation/integration to systematically examine the intergenerational transmission of violence across sexual identity orientation and study design differences. Exposure to family violence was shown to predict greater acceptance of dating violence but specific effects differed across heterosexual and sexual minority youth and for different types of TDV.

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CHAPTER 5 – INTEGRATIVE DISCUSSION

Teen dating violence (TDV) is a public health concern impacting an alarming number of adolescents (Niolon et al., 2015), with sexual minority youth (SMY; youth who are not exclusively heterosexual) systematically impacted at higher rates (Reuter et al., 2015). Successful prevention of TDV requires careful consideration of theory and measurement properties to develop effective programming for youth disproportionately impacted by TDV. This means that commonalities and differences in TDV experiences across sexual orientation identities need to be incorporated in theories and measures of TDV and its associated risk factors. Moreover, the developmental context in which TDV occurs warrants specific considerations, in both conceptualization and operationalization. For instance, dating and romantic relationship experiences are an important aspect of adolescents' development of identity, including sexual orientation and gender identity. However, there is substantial variation in the developmental timing and pacing of these milestones across sexual orientation identities (Bishop et al., 2020), further contributing to variability in TDV experiences. Adolescents' relationships may occur in complex interpersonal and community systems of friendships, romantic relationships, and other temporary or more permanent connections that shape their attitudes and behaviors during a critical period of identity formation. Yet, a universal lens is frequently employed to conceptualize, operationalize, and prevent TDV.

In fact, decades of research on interpersonal violence have been guided by an overarching heteronormative approach (e.g., Javaid, 2018). A heteronormative approach is characterized by an explicit focus on heterosexuality as the main relational frame in which interpersonal violence occurs, as indicated by the wealth of measures explicitly

assessing the occurrence of violence in heterosexual presenting relationships. This is problematic in that it marginalizes the experience of youth in same gender and/or multi gender romantic relationships, with sexual and/or gender minority youth being at an increased risk for experiences of dating violence (Norris et al., 2020). This increased risk is best explained by mediating factors that increase the vulnerability to dating violence such as discrimination (e.g., Martin-Storey & Fromme, 2021). The Minority Stress Model (Meyer, 2003) provides an overarching framework that further elucidates the various mechanisms increasing risk and vulnerability for sexual and gender minority youth. Specifically, experiences of minority stress (i.e., stress associated with stigmatized minority status including experiences of prejudice against sexual and gender minority people) are of great centrality as it related to the experience of interpersonal and social problems, as well as risk factors for cognitive processes conferring risk for psychopathology (Frost & Meyer, 2023). However, minority stress has not been considered in mainstream conceptualization and operationalization of teen dating violence. Moreover, social norms pertaining to prejudice are major drivers of discriminatory and violence behaviors (Sankar et al., 2019). As such, sociocultural norms heavily shape dating relationships scripts, including enactment of gender and sexual orientation identity in dating relationships. As a result, current theories often fail to consider the impact of minority stress on relationship dynamics, including dating violence perpetration, among sexual and gender minority youth. Thus, it is of tantamount importance to broaden conceptualizations of TDV and associated risk factors (e.g., ADV) using an intersectional lens that considers gender identity, sexual orientation identity, and other identities in the experience of dating violence perpetration and victimization.

Beyond conceptualizations of TDV, research examining the degree to which assumptions about gender expression and heteronormativity are reflected in mainstream operationalization of constructs is crucial to effectively target violent behaviors and identify youth at risk.

The goal of this three-article dissertation project was to 1) critically examine the degree to which existing measures of TDV and its associated risk factors function equivalently across heterosexual and sexual minority youth, and 2) to identify and characterize the conditions under which the intergenerational transmission of violence occurs among heterosexual and sexual minority youth. To address these two primary goals innovative analytical and statistical methods were applied across diverse data sources. Specifically, integrative data analysis (IDA) was utilized to increase sample size to answer the research questions of focus in three separate articles. The first article (presented in chapter two) examined the measurement equivalence of the Conflict in Adolescent Relationship Inventory (CADRI; Wolfe et al., 2001) perpetration scales, with findings indicating that CADRI perpetration scale scores can be used for mean-score group comparisons across heterosexual and sexual minority youth (McMillan, Montanaro, et al., 2023). The only exception to this was the emotional/verbal abuse perpetration subscale, in which partial scalar measurement invariance emerged. The second article (presented in chapter three) tested the differential item functioning for commonly used acceptance of dating violence (ADV) items, with findings pointing to differences in ADV item response patterns across heterosexual and sexual minority identifying youth, specifically for items assessing the acceptance of female-perpetrated dating violence. Finally, the third article (presented in chapter four) tested the synergistic

interplay of personal violence history (i.e., exposure to family violence) and sociocultural factors (i.e., acceptance of dating violence) for TDV perpetration across heterosexual and SMY. Results suggested a differential impact of exposure to family violence on ADV and TDV perpetration across heterosexual and sexual minority youth, especially in the direct and indirect effects across different types of violence perpetration. In the following section, the implications of these research findings for research and practice will be discussed.

Implications for Research

To accurately determine the prevalence and scope of TDV, to identify and understand its precursory processes, and to assess the degree to which prevention programs effectively reduce TDV perpetration, accurate and sensitive measurement is important (Krauss et al., 2020). Unfortunately, research conducted around TDV, including measure development and prevention program development, is rarely conducted with the diverse population it is intended to serve (De La Rue, 2019). This dissertation project critically examined the degree to which assumptions about heteronormativity are reflected in the operationalization of teen dating violence and associated risk factors. The results of article one and two point towards heteronormativity bias, showing factorial and item-level bias in measures of TDV perpetration and violence accepting attitudes. Specifically, the results of article one suggest that the mean scores of the CADRI can be broadly used to assess and compare TDV perpetration access heterosexual and sexual minority youth. However, CADRI emotional/psychological abuse items assessing the perpetration of insults and putdowns are skewed towards heterosexual youth whereas doing something to make the partner jealous are swayed

towards SMY. Although statistically significant group differences did not reach practical significance (i.e., were of small effect size), the findings raise important questions regarding the degree to which measures capture the very specific intersection of minority stress on relationship dynamics. For instance, identity abuse is a form of psychological/emotional abuse where heterosexism and other types of systemic oppression are leveraged to perpetrate psychological harm or exert control over current or former dating partners (Woulfe & Goodman, 2021). Moreover, cyber abuse (i.e., dating violence perpetrated through electronic means) is highly prevalent among middle- and high school students (Hinduja & Patchin, 2021) and frequently experienced by sexual and gender minority youth (Dank et al., 2014). As such, future research should center the inclusion of items assessing identity-based and cyber abuse to broaden the measurement of TDV for a broad adolescent population while maintaining responsiveness to TDV experiences systematically impacting sexual and gender minority youth.

Moreover, the findings of item analysis in article two indicated some degree of heteronormativity bias in items assessing acceptance of dating female-to-male perpetrated dating violence, with heterosexual youth being more likely to endorse items more strongly than SMY, even when overall construct-level group differences have been accounted for. Such differential item functioning could not only result in possible range restrictions that complicate evaluating the effectiveness of prevention programs but also raises concerns regarding the sensitivity and specificity of ADV items for SMY. There is a pressing need to generate additional items that are representative of violence accepting attitudes in sexual minority youth. This should include a focus on attitudes towards all forms of violence, including psychological and sexual violence, as well as identity and

cyber abuse. For SMY specifically, attitude measures should incorporate minority stressors such as internalized homophobia and identity concealment as these have been shown to be related to TDV perpetration (Edwards & Sylaska, 2013). Reliable and valid measurement of violence accepting attitudes is of particular importance given that ADV not only presents a risk factor for TDV but also a barrier to help seeking, therefore playing a twofold role in prevention programming.

Collectively, the results of articles one and two emphasize the need for TDV and ADV measures that explicitly incorporate minority stress. Validated measures such as the CADRI would benefit from revision and adaptation to include subtypes of violence disproportionately experienced by sexual and gender minority youth. These efforts should also include an explicit focus on terminology to ensure that language and wording aligns with contemporary youth and address heteronormativity bias by replacing gendered language (e.g., he/him and she/her pronouns, boyfriend/girlfriend) with gender-inclusive language (e.g., they/them pronouns, significant other/dating partner). Adaptations also need to be bolstered by broader conceptual efforts aimed at increasing inclusivity and representation of lived experiences, including those of youth holding multiple marginalized identities. Moreover, given that there are no existing measures of violence accepting attitudes that have been developed and validated for sexual and gender minority youth (Ricks et al., 2023), there is a great need for the development of attitude measures. These measures should include minority stressors linked to violence accepting attitudes (e.g., Reyes et al., 2023) and center the voices and lived experiences of sexual and gender minority youth (Gillum & DiFulvio, 2012). Ideally, the development of new measures would represent a collaborative approach that actively involves the use of focus

groups and cognitive interviewing alongside differential item functioning and measurement invariance testing to bolster both content and construct validity.

Implications for Practice

The synergistic interplay of personal violence history (i.e., exposure to family violence) and sociocultural factors (i.e., acceptance of dating violence) for TDV perpetration is frequently considered in prevention programming but has not been specifically tested for SMY perpetrating TDV. Although SMY are systematically more likely to be exposed to or victims of violence in their family of origin (e.g., Friedman et al., 2011) and experience higher rates of TDV relative to their heterosexual peers (e.g., Mennicke et al., 2021), the degree to which violence accepting attitudes function unclear the specific mechanism through which exposure to family violence directly impacts TDV perpetration for SMY is not well understood. The third dissertation article sought to fill this gap and examined the synergistic interplay of exposure to family violence and acceptance of dating violence for TDV perpetration across heterosexual and sexual minority youth. Results indicated diverging mechanisms through which exposure to family violence directly impacts TDV perpetration across forms of violence and sexual identity orientation. Specifically, exposure to family violence was shown to be associated with higher levels of psychological TDV perpetration among heterosexual youth and higher levels of physical and sexual TDV perpetration among SMY. Moreover, violence accepting attitudes were shown to mediate the association between exposure to family violence and at least one different type of violence perpetration for both heterosexual youth and SMY. This suggests that TDV prevention programs need to be tailored to the specific needs of youth exposed to additional harms, including those subjected to

minority stressors and with lived experiences of violence in the home. Prevention programs modeled taking a precision medicine approach may be most effective to accomplish this by addressing the unique needs of populations exposed to additional harms. This may entail supplementing universal prevention programs with tailored components specifically addressing risk factors such as exposure to family violence and minority stress. The use of responsive and adaptive survey designs may be particularly suited to evaluate the effectiveness of programs taking a precision medicine approach as it allows tailoring measures to capture sexual and gender- minority specific risk factors and outcomes. Relatedly, web-based prevention programs are suitable to deliver tailored content (e.g., Gilmore et al., 2022) and can strengthen programs effectiveness with virtual opportunities for interactive skill practice (e.g., Li et al., 2020). Early prevention efforts targeting cohorts of early adolescents (e.g., middle schoolers) may be further bolstered by program delivery within a gamification framework (e.g., Schoech et al., 2013).

Using Integrative Data Analysis in A QuantCrit Framework

As discussed in prior sections, effective prevention of TDV will require a critical examination of frameworks and measures. This dissertation project was guided by QuantCrit (Gillborn et al., 2018), a social-justice oriented framework for quantitative research. This framework outlines five principles/tenets through which researchers can engage in rigorous and self-reflexive research aimed at dismantling systems of oppression (Suzuki et al., 2021). These tenets are 1) the centrality of racism (and other systems of oppression), 2) numbers are not neutral, 3) categories are not natural, 4) data cannot speak for itself, and 5) a social justice/equity orientation. To address QuantCrit's second tenet (numbers are not neutral), the current three-article dissertation project used

integrative data analysis (IDA) as a novel approach to synthesize existing individual-level data. IDA was selected as the overall guiding methodological framework as it allows the combination of individual level data from multiple datasets, even when the operationalization of the same focal constructs differs. Additionally, the pooling of multiple large datasets was important to increase overall sample size and to aid greater representation of sexual minority youth, who are usually underrepresented in research on TDV perpetration. For article one and two, the operationalization of focal constructs was identical and therefore did not require any additional adjustments. For article three, the issue of incompatible measurement was resolved with moderated nonlinear factor analysis (MNLFA; Bauer & Hussong, 2009), which allowed the creation of harmonized scale scores accounting for potential differences in both the latent factor and the individual items as a function of individual and between-study differences. Therefore, the effect of study, group, and individual level characteristics on effect size estimates were explicitly modeled and accounted for in the examination of the intergenerational transmission of violence.

While the combination of existing datasets also bears economic advantages, reduced direct involvement in the research process brings challenges alongside opportunities in secondary data analysis. While researcher identity is generally thought to inherently influence the research process (Mantzoukas, 2005), secondary data analysis is not protected against researcher bias (Baldwin et al., 2022). Thus, it is important for researchers conducting secondary analysis to consider who collected the original data and for what goal as a first step in challenging the non-neutrality of numbers. Unfortunately, quantitative research follows behind qualitative work as it relates to positionality

statements discussing the identities, values, and perspectives of researchers involved in the data generation. As such, it is difficult to directly consider the influence of researcher's positionalities as it pertains to the datasets at hand. Although such lack of direct involvement in the research process poses challenges exposing more specific assumptions that influenced the original research/data collection, available information suggests that the datasets (and associated research projects) combined for the purpose of this dissertation project aimed at either identifying risk factors for dating violence or at testing the effectiveness of a teen dating violence program. Therefore, violence prevention may have been a shared value across researchers.

Notwithstanding the ways in which the use of secondary data made it difficult to address the non-neutrality of numbers from a positionality perspective, research questions of article one and two, as well as associated methodological approaches, explicitly challenged the assumption that secondary data is free of researcher bias. That is, both articles utilized novel methods to critically examine equality of scale values across groups. Moreover, the creation of harmonized scale scores (as demonstrated in manuscript three/chapter four) provided a window of opportunity for transparency as the logical and analytical harmonization of items across datasets requires many decisions that need to be documented and justified on theoretical grounds (Cole et al., 2023). Finally, while it may be tempting to consider harmonized scores as unbiased estimates that incorporate both variability within- and between- study samples (Curran et al., 2008), it should be emphasized that these scores are everything but neutral. The numeric value of the harmonized scale scores and therefore the obtained effect sizes of article three are an artifact of researcher decision making. A description of this decision-making process

alongside syntax are provided with the corresponding article for complete transparency. Nevertheless, the findings of this dissertation project need to be considered through the lens of existing power and value structures (see positionality statement on pg. 24) but also considering several limitations.

Limitations & Future Directions

Although IDA represents a novel tool to combat issues of sample size that often prevent researchers from disaggregating minority groups, it is important to critically evaluate the use of categories/groups as it pertains to this dissertation project (see QuantCrit tenet three; Gillborn et al., 2018)). For this dissertation project, the equivalence of theories and measures was examined across heterosexual and sexual minority youth (two categories) and this dichotomous group comparison has several downfalls. Primarily, all three research questions compared minoritized populations to a majority group, namely heterosexual youth. This comparison is risky as comparison group choices can reinforce harmful ideologies, including heteronormativity and systemic ideas of group superiority. In the current dissertation project, this specific group comparison was chosen taking into consideration minority stress theory and the centrality of heteronormativity in theories and operationalization of constructs. Relatedly, it is important to acknowledge that sexual minority youth are not a monolithic group. In fact, group distinctions are subjective and fluid at times, with up to 21% of adolescents shown to experience shifts in other- and same-sex attractions (Stewart et al., 2019). That being the case, the use of a dichotomous group approach to compare heterosexual and not-exclusively heterosexual youth may have the potential to capture directionality (e.g., towards sexual minority orientation) that would have gotten lost in a multigroup approach

centering sexual orientation identity labels (i.e., comparison of gay, lesbian, bisexual, and heterosexual youth).

Moreover, as sexual orientation identity was inconsistently measured across datasets (ranging from romantic attraction to dating behaviors), a more broad, dichotomous approach was chosen to circumvent issues related to inconsistent measurement of sexual orientation in data aggregation studies. The issue of inconsistent measurement/construct operationalization was not only central in the analytic approach of article three but reflected in the group assignments of all three articles. Specifically, the measurement of sexual orientation was highly variable across contributing studies, complicating parsimonious group assignments. While the measurement of sexual orientation has historically varied across settings, at its core it is assumed to be a multidimensional construct, consisting of the three dimensions behavior, attraction, and identity (National Academies of Sciences, Engineering, and Medicine, 2022). Across contributing studies, sexual orientation identity was the most frequently measured domain of sexual orientation. Within sexual orientation identity, measurement further varied in breadth of response options and their specific wording. For example, some contributing studies asked study participants to select from a set of sexual orientation identity labels or terms (e.g., lesbian, straight, bisexual) while others provided a set of response options that reflected a combination of sexual orientation identity and attraction terminologies (e.g., “mostly heterosexual, but somewhat attracted to members of the same sex”). One contributing study did not measure sexual orientation identity and exclusively assessed sexual behavior, which has been a common approach in studies aimed to inform public health epidemiological surveillance (National Academies of

Science, Engineering, and Medicine, 2022). Subsequently, dichotomous grouping became the most parsimonious solution to examine concordance and discordance in theory and measurement at the cost of further exacerbating inequities. Thus, disaggregation represents an important next step as identities represented among sexual minority people, including various sexual orientation identities and intersectional identities, are more heterogeneous than homogeneous. Furthermore, identities occur in interpersonal and larger community context, and individuals are commonly part of complex networks of interdependent friendships, relationships, and other interpersonal connections that likely shape their identity experiences, attitudes, and consequent behaviors. Put differently, the findings of this three-article dissertation require extension to and replication across and within sexual orientation identities to further center the unique experiences of power, privilege, oppression, and discrimination within the LGBTQ+ community.

Conclusions

This dissertation project aims to draw attention to and challenge heteronormativity in dating violence research via the use of novel advanced quantitative methods to identify measurement bias and theoretical equivalence. By leveraging advanced quantitative methods related to psychometric modeling and data aggregation, this dissertation project offers a critical contribution toward reducing disparities in TDV by dismantling heteronormativity and oppression in measurement and research.

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APPENDICES

Appendix A – CADRI T-Test Results

Student's t-tests were conducted to examine differences between complete and missing item responses across demographic variables. There was a significant effect for age for 12 of the CADRI items (Table 15) and a significant effect for race for three CADRI items (Table 16).

Table 15

Mean Differences between Missing and Complete CADRI Item Responses – Age

CADRI Item	*t*	*df*	*p*	$M_{missing}$	$M_{complete}$
Threw something	**3.5**	**348.8**	**.001**	**0.03**	**0.09**
Kicked, hit, or punched	**6.1**	**858.2**	**.000**	**0.01**	**0.09**
Slapped or pulled hair	**7.4**	**999.0**	**.001**	**0.09**	**0.00**
Pushed, shoved, or shook	**4.8**	**550.0**	**.000**	**0.01**	**0.09**
Destroyed or threatened to destroy	**6.2**	**999.0**	**.000**	**0.00**	**0.06**
Deliberately tried to frighten	0.8	172.2	.403	0.07	0.09
Threatened to hurt them	**6.2**	**1001.0**	**.000**	**0.00**	**0.05**
Threatened to hit or throw something	**7.6**	**1003.0**	**.000**	**0.00**	**0.08**
Unwanted sexual touching	1.2	197.9	.234	0.03	0.05
Forced sex	**4.0**	**994.0**	**.000**	**0.00**	**0.02**
Threating them to have sex	**3.6**	**994.0**	**.000**	**0.00**	**0.02**
Unwanted kissing	-0.8	147.1	.418	0.12	0.08
Tried to turn friends against them	**2.5**	**346.20**	**.015**	**0.01**	**0.05**
Said things to friends to turn them against	1.7	279.5	.095	0.01	0.04
Spread rumors about them	**6.0**	**1000.0**	**.000**	**0.00**	**0.05**
Did something to create jealousy	1.0	182.8	.315	0.29	0.34
Brought up something done in the past	**-2.9**	**155.30**	**.004**	**0.56**	**0.34**
Said things to make them angry	-0.3	165.0	.746	0.32	0.30
Spoke in hostile or mean tone of voice	-1.3	160.6	.203	0.40	0.31
Insulted them with putdowns	-0.70	160.7	.457	0.17	0.14
Ridiculed them in front of friends	1.7	279.5	.095	0.07	0.10
Blamed them for problems	-1.5	156.6	.135	0.47	0.35
Kept track of them	**-3.4**	**147.3**	**.001**	**0.69**	**0.36**
Threatened to end relationship	**2.5**	**198.2**	**.012**	**0.21**	**0.34**
Accused them of flirting	-0.8	158.9	.438	0.43	0.37

Note. CADRI item score range = 0-3. Significant effects are **bolded.**

Table 16

Mean Differences between Missing and Complete CADRI Item Responses – Race

CADRI Item	*t*	*df*	*p*	$M_{missing}$	$M_{complete}$
Threw something	**2.0**	**470.0**	**.043**	**0.05**	**0.09**
Kicked, hit, or punched	0.9	337.6	.353	0.06	0.08
Slapped or pulled hair	0.0	317.1	.996	0.08	0.08
Pushed, shoved, or shook	0.2	304.8	.859	0.04	0.05
Destroyed or threatened to destroy	0.3	374.0	.924	0.05	0.05
Deliberately tried to frighten	**-2.2**	**256.6**	**.026**	**0.15**	**0.08**
Threatened to hurt them	**-0.8**	**260.3**	**.410**	**0.06**	**0.04**
Threatened to hit or throw something	-0.3	283.4	.794	0.08	0.07
Unwanted sexual touching	-0.1	306.4	.919	0.05	0.05
Forced sex	-1.2	239.6	.237	0.03	0.01
Threating them to have sex	-0.9	251.0	.367	0.02	0.01
Unwanted kissing	0.1	328.7	.898	0.09	0.09
Tried to turn friends against them	-0.5	278.4	.643	0.05	0.04
Said things to friends to turn them against	-0.5	249.6	.593	0.04	0.03
Spread rumors about them	0.2	304.8	.859	0.04	0.05
Did something to create jealousy	-1.0	308.4	.332	0.37	0.32
Brought up something done in the past	0.7	332.7	.479	0.34	0.37
Said things to make them angry	0.3	308.7	.785	0.30	0.31
Spoke in hostile or mean tone of voice	2.1	346.2	.040	0.24	0.34
Insulted them with putdowns	0.2	303.5	.824	0.14	0.14
Ridiculed them in front of friends	-0.3	289.3	.759	0.10	0.09
Blamed them for problems	0.7	331.6	.472	0.34	0.37
Kept track of them	1.4	338.5	.157	0.34	0.41
Threatened to end relationship	-0.4	297.0	.666	0.34	0.32
Accused them of flirting	0.3	308.3	.745	0.36	0.38

Note. CADRI item score range = 0-3. Significant effects are **bolded.**

Appendix B – ADV Items T-Test Results

Student's t-tests were conducted to examine differences between complete and missing item responses across demographic variables. There was a significant effect for age for four of the eight ADV items (Table 17) and a significant effect for race for one of the three ADV items (Table 18).

Table 17

Mean Differences between Missing and Complete ADV Item Responses - Age

ADV Item	*t*	*df*	*p*	$M_{missing}$	$M_{complete}$
It is okay for a girl to hit a boy if he hit her first	**-6.2**	**155.4**	**.000**	**2.40**	**1.73**
Girls sometimes deserve to be hit by the boys they date	**4.1**	**216.3**	**.000**	**1.06**	**1.17**
It is okay for a boy to hit his girlfriend if she insulted him in front of friends	**4.0**	**315.5**	**.000**	**1.02**	**1.08**
It is okay for a boy to his girlfriend if she did something to make him mad	**3.9**	**266.2**	**.000**	**1.04**	**1.11**
A girl who makes her boyfriend jealous on purpose deserves to be hit	1.1	177.4	.272	1.07	1.10
Boys sometimes deserve to be hit by the girls they date	-0.2	162.1	.816	1.37	1.39
Sometimes boys have to hit their girlfriends to get the back under control	1.2	174.1	.237	1.07	1.11
It is ok for a boy to hit a girl if she hit him first	0.1	167.6	.937	1.33	1.34

Note. ADV item score range = 1-4. Significant effects are **bolded.**

Table 18

Mean Differences between Missing and Complete ADV Item Responses - Race

ADV Item	*t*	*df*	*p*	$M_{missing}$	$M_{complete}$
It is okay for a girl to hit a boy if he hit her first	**2.3**	**441.9**	**.024**	**1.65**	**1.80**
Girls sometimes deserve to be hit by the boys they date	0.1	415.8	.888	1.16	1.16
It is okay for a boy to hit his girlfriend if she insulted him in front of friends	-0.5	398.0	.623	1.09	1.08
It is okay for a boy to his girlfriend if she did something to make him mad	0.2	409.8	.841	1.10	1.10
A girl who makes her boyfriend jealous on purpose deserves to be hit	0.5	425.0	.602	1.09	1.10
Boys sometimes deserve to be hit by the girls they date	0.5	413.0	.651	1.34	1.36
Sometimes boys have to hit their girlfriends to get the back under control	-0.2	399.9	.843	1.11	1.10
It is ok for a boy to hit a girl if she hit him first	1.5	444.0	.136	1.28	1.34

Note. ADV item score range = 1-4. Significant effects are **bolded.**

Appendix C – IDA Linking Items

Table 19

Measurement of Exposure to Family Violence Across Studies

	Study 1	**Study 2**	**Study 3**	**Study 4**
Instructions	For each of the following questions, choose how often these things happened at home	The following questions are about how often you have seen your parents doing different things. Please select the answer that best fits you.	This is a list of things that might happen when you have differences. Please mark whether your partner did them in the past year.	
Response Scale	Never (=0), Seldom (=1), Sometimes (=2), Often (=3), Always (=4)	Never (=1), Rarely (=2), Occasionally (=3), Often (=4), Daily (=5)	Yes (=1), No (=2)	Never (=1), 1 time (=2), 2-5 times (=3), 6-10 times (=4), more than 10 times (=5)
Items	**Before you were 9 years old, did you ever see or hear one of your parents or guardians being hit, slapped, punched, shoved, kicked or otherwise physically hurt by their spouse or partner?**	**How often have you ever seen your mother hit your father?**	**At any time in the last 12 months, did you HEAR a parent get pushed, slapped, hit, punched, or beat up by another parent, or their boyfriend or girlfriend?**	**In your family how often did you see or hear one of your parents or guardians being hit, slapped, punched, shoved, kicked, or otherwise physically hurt by their spouse or partner?**
		How often have you ever seen your father hit your mother?	**At any time in the last 12 months, did you SEE a parent get pushed, slapped, hit, punched, or beat up by another parent, or their boyfriend or girlfriend?**	

Table 19 *continued*

		At any time in the last 12 months, did one of your parents, because of an argument, break or ruin anything belonging to another parent, punch the wall, or throw something?
		At any time in the last 12 months, did you SEE a parent hit, beat, kick, or physically hurt your brothers or sisters, not including a spanking on the bottom?
	How often is there yelling, quarreling, or arguing in your household?	
	How often are there physical fights in the household, like people hitting, shoving, or throwing things?	

Note. Linking items are **bolded**. Study 1 = Bullying & Sexual Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States (Espelage et al., 2014). Study 2 = Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY (Livingston et al., 2016). Study 3 = National Survey of Teen Relationships and Intimate Violence (Taylor et al., 2016). Study 4 = Green Dot Prevention Program (Coker et al., 2017).

Table 20

Measurement of ADV across Studies

	Study 1	**Study 2**	**Study 3**	**Study 4**
Instructions	How strongly do you agree or disagree with the following statements	Please rate how strongly you agree or disagree with the following statements.	Please choose whether you strongly agree, agree, disagree, or strongly disagree with the following statements.	Please rate how strongly you agree or disagree with the following statements.
Response Scale	Strongly Disagree (=1), Disagree Somewhat (=2), Agree Somewhat (=3), Strongly Agree (=4)	Strongly Disagree (=1), Disagree Somewhat (=2), Agree Somewhat (=3), Strongly Agree (=4)	Strongly agree (=1), Agree (=2), Disagree (=3), Strongly Disagree (=4)	Strongly Disagree (=0), Disagree Somewhat (=1), Agree Somewhat (=2), Strongly Agree (=3)
Items	Girls sometimes deserve to be hit by the boys they date	Girls sometimes deserve to be hit by the boys they date		
	A girl who makes her boyfriend jealous on purpose deserved to be hit	**A girl who makes her boyfriend jealous on purpose deserves to be hit**	**It is OK for someone to hit their girlfriend because she made him or her jealous on purpose**	**A girlfriend or boyfriend who makes their girlfriend or boyfriend jealous on purpose deserves to be hit**
	Boys sometimes deserve to be hit by the girls they date	Boys sometimes deserve to be hit by the girls they date.		
				There are times when dating violence between couples is okay
			It is OK for someone to hit their boyfriend because he made her or him jealous on purpose	
				Sometimes violence is the only way to express your feelings
				Some couples have to use violence to solve their problems

Table 20 *continued*

			Violence between couples is a private matter and others should not get in the way or get involved
It is okay for a boy to his his/her girlfriend if she did something to make him/her mad	It is ok for a boy to hit his girlfriend if she did something to make him mad.	It is OK for someone to hit their girlfriend because she made him or her mad	
It is okay for a boy to hit his/her girlfriend if she insulted him/her in front of friends	Its ok for a boy to hit his girlfriend if she insulted him in front of friends	It is OK for someone to hit their girlfriend because she insulted him or her in front of friends	
Sometimes boys have to hit their girlfriends to get them back under control	Sometimes boys have to hit their girlfriends to get them back under control		
It is okay for a boy to hit a girl if she hit him/her first	Its ok for a boy to hit a girl if she hit him first	It is OK for someone to hit their girlfriend because she hit him or her first	
It is okay for a girl to hit a boy if he hit her first	Its ok for a girl to hit a boy if he hit her first		
		It is OK for someone to hit their boyfriend because he made her or him mad	
		It is OK for someone to hit their boyfriend because he insulted her or him in front of friends	
		It is OK for someone to hit their girlfriend because she was cheating	

Table 20 *continued*

		It is OK for someone to hit their boyfriend because he was cheating	
		It is OK for someone to hit their boyfriend because he hit her or him first	

Note. Linking items are **bolded**. Study 1 = Bullying & Sexual Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States (Espelage et al., 2014). Study 2 = Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY (Livingston et al., 2016). Study 3 = National Survey of Teen Relationships and Intimate Violence (Taylor et al., 2016). Study 4 = Green Dot Prevention Program (Coker et al., 2017).

Table 21

Measurement of TDV Perpetration across Studies

Physical TDV Perpetration

	Study 1	**Study 2**	**Study 3**	**Study 4**
Instructions	Estimate how often you did the following to someone you were dating	Estimate of how often these things have happened with your current or most recent boyfriend/girlfriend in the past year	The following questions ask you about how often things may have happened with [PARTNER NAME] within the past year.	In the past 12 month, how frequently
Response Options	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	0 times (=0), 1–2 times (=1), 3–5 times (=3), 6 to 9 times (=6), 10+ times (=10)
Items	I scratched him/her or bent his/her fingers		You scratched [PARTNER NAME] and/or bent HIS/HER fingers.	
	I slapped him/her or pulled him/her hair	I slapped him/her or pulled his/her hair	You slapped [PARTNER NAME] or pulled HIS/HER hair.	
	I kicked, hit or punched him/her	**I kicked, hit, or punched him/her**	**You kicked, hit, or punched [PARTNER NAME].**	**Hit, slapped, or physically hurt a current or previous boyfriend or girlfriend on purpose?**
	I chocked him/her		You choked [PARTNER NAME].	
	I pushed, shoved, or shook him/her	I pushed, shoved, or shook him/her	You pushed, shoved, or shook [PARTNER NAME].	
	I threw something at him/her	I threw something at him/her	You threw something at [PARTNER NAME].	
			You used a knife or fired a gun.	

Table 21 *continued*

Sexual TDV Perpetration

	Study 1	**Study 2**	**Study 3**	**Study 5**
Instructions	Estimate how often you did the following to someone you were dating	Estimate of how often these things have happened with your current or most recent boyfriend/girlfriend in the past year.	The following questions ask you about how often things may have happened with [PARTNER NAME] within the past year.	In the past 12 month, how frequently did you
Response Options	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	0 times (=0), 1–2 times (=1), 3–5 times (=3), 6 to 9 times (=6), 10+ times (=10)
Items	I touched him/her sexually when he/she didn't want me to	I touched him/her sexually when he didn't want me to.	You touched [DOV_PARTNER_NAME] sexually when HE/SHE didn't want you to.	
	I forced him/her to have sex when he/she didn't want to	**I forced him/her to have sex when he/she didn't want to**	**You forced [PARTNER NAME] to have sex when HE/SHE did not want to.**	**Have sexual activities with another high school student by threatening to use or used physical force (twisting their arm, holding them down)?**
	I kissed him/her when he/she didn't want to	I kissed him/her when he/she didn't want me to.	You kissed [PARTNER NAME] when HE/SHE didn't want you to.	
		I used continual arguments and pressure to get him/her to have sex		
				Have sexual activities because you either threatened to end your romantic relationship if they didn't or because you pressured the other person by arguing or begging?

Table 21 *continued*

				Have sexual activities because she/he was drunk or on drugs? (Alcohol or drug facilitated sex)
		Have you ever used verbal pressure (e.g., arguing, begging, making her/him feel bad) to convince your boyfriend/girlfriend to do something sexual when s/he did not want to? (Yes =1, No =2)		
Psychological TDV Perpetration				
	Study 1	**Study 2**	**Study 3**	**Study 4**
Instructions	Estimate how often you did the following to someone you were dating	Estimate of how often these things have happened with your current or most recent boyfriend/girlfriend in the past year	The following questions ask you about how often things may have happened with [PARTNER NAME] within the past year	In the past 12 month, how frequently did you
Response Options	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	Never (=1), Seldom (=2), Sometimes =3), Often (=4)	0 times (=0), 1–2 times (=1), 3–5 times (=3), 6 to 9 times (=6), 10+ times (=10)
Items	I destroyed or threatened to destroy something that he/she valued	I destroyed or threatened to destroy something she/he valued	You destroyed or threatened to destroy something [PARTNER NAME] valued	Damage something on purpose that was important to a boyfriend or girlfriend?
	I threatened to end the relationship	I threatened to end the relationship	You threatened to end the relationship.	

Table 21 *continued*

I did something to make him/her feel jealous	I did something to make him/her feel jealous	You did something to make [PARTNER NAME] feel jealous.	
I blamed him/her for the problem	I blamed him/her for the problem	You blamed [PARTNER NAME] for the problem.	
I threatened to hurt him/her	**I threatened to hurt him/her**	**You threatened to hurt [PARTNER NAME].**	**Threaten to hurt a current or previous boyfriend or girlfriend?**
I kept track of who he/she was with and where he/she was	I kept track of who he/she was with and where he/she was.	You kept track of who [PARTNER NAME] was with and where	Try to control a current or previous girlfriend or boyfriend by always checking up on them, telling them who their friends could be, or telling them what they could do and when?
I brought up something bad he/she had done in the past		You brought up something bad [PARTNER NAME] had done in the past	
Tried to turn my friends against him/her	I tried to turn his/her friends against him/her	You tried to turn [PARTNER NAME]'s friends against HIM/HER	
I said things just to make him/her angry	I said things just to make him/her angry	You said things just to make [PARTNER NAME] angry	
I spoke to him/her in a hostile or mean tone of voice	I spoke to him/her in a hostile or mean tone of voice.	You spoke to [PARTNER NAME] in a hostile or mean tone of voice	
I insulted him/her with put-downs	I insulted him/her with put-downs	You insulted [PARTNER NAME] with put- downs	Shout, yell, insult, or swear at a current or previous girlfriend or boyfriend?

Table 21 *continued*

I said things to him/her friends about him/her to turn them against him/her	I said things to his/her friends about him/her to turn them against him/her	You said things to [PARTNER NAME]'s friends about [PARTNER NAME] to turn them against HIM/HER
I made fun of him/her in front of others	I ridiculed or made fun of him/her in front of others.	You ridiculed or made fun of [PARTNER NAME] in front of others
I accused him/her of flirting with another girl/guy	I accused him/her of flirting with another girl/boy	You accused [PARTNER NAME] of flirting with another girl or guy
I spread rumors about him/her	I spread rumors about him/her	You spread rumors about [PARTNER NAME]
I deliberately tried to frighten him/her	I deliberately tried to frighten him/her	You tried to frighten [PARTNER NAME] on purpose
I threatened to hit him/her or throw something at him/her	I threatened to hit him/her or throw something at him/her	You threatened to hit [PARTNER NAME] or throw something at HIM/HER

Note. Linking items are **bolded**. Study 1 = Bullying & Sexual Dating Violence Trajectories From Early to Late Adolescence in the Midwestern United States (Espelage et al., 2014). Study 2 = Developmental Pathways of Teen Dating Violence in a High Risk Sample, Erie County NY (Livingston et al., 2016). Study 3 = National Survey of Teen Relationships and Intimate Violence (Taylor et al., 2016). Study 4 = Green Dot Prevention Program (Coker et al., 2017).

Appendix D – Visualization of DIF Effects

Figure 4

Visualization of ADV Intercept DIF Effects as a Function of Trimming Criteria

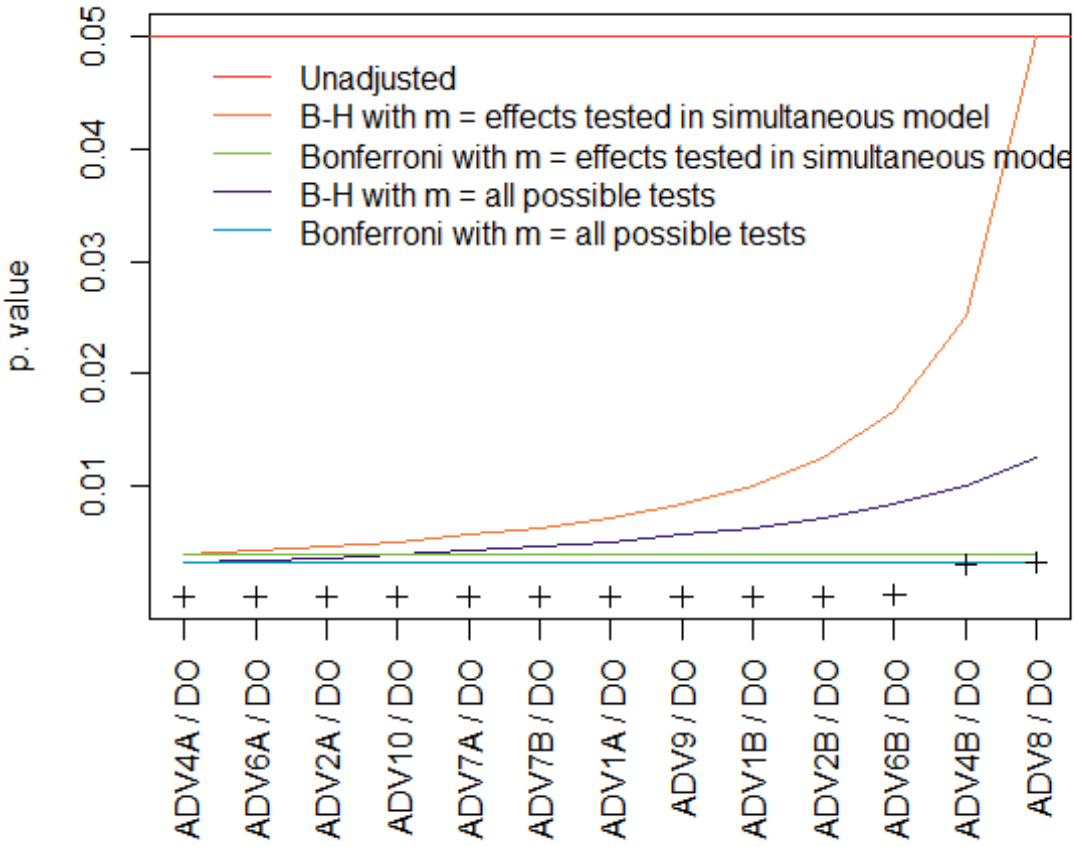


Figure 5

Visualization of ADV Loading DIF Effects as a Function of Trimming Criteria

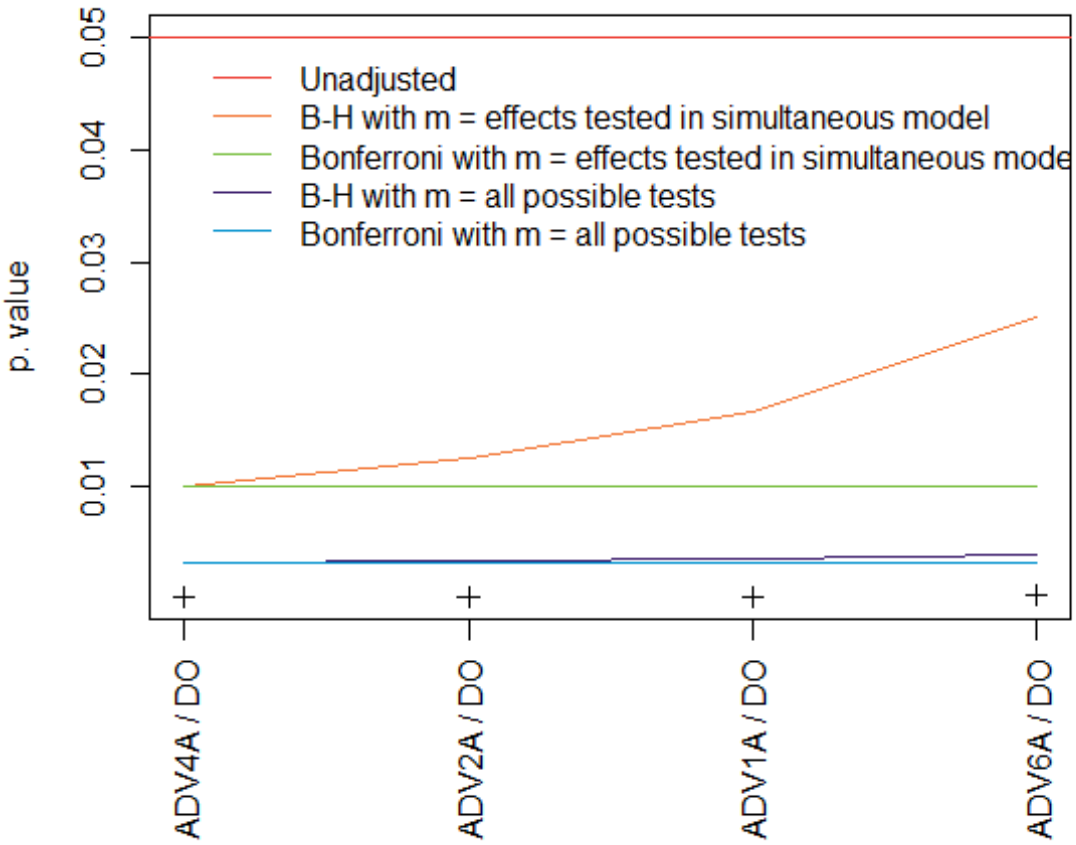


Figure 6

Visualization of Physical TDV Perpetration Intercept DIF Effects as a Function of Trimming Criteria

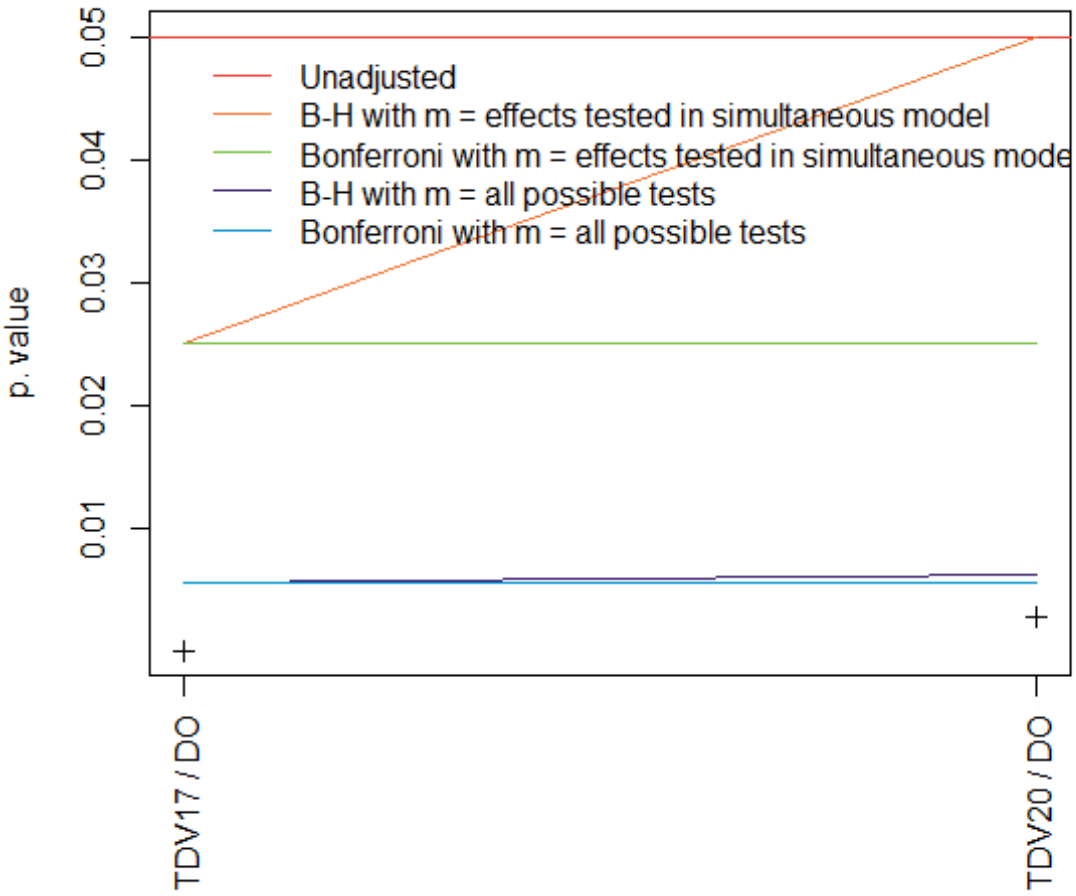


Figure 7

Visualization of Physical TDV Perpetration Loading DIF Effects as a Function of Trimming Criteria

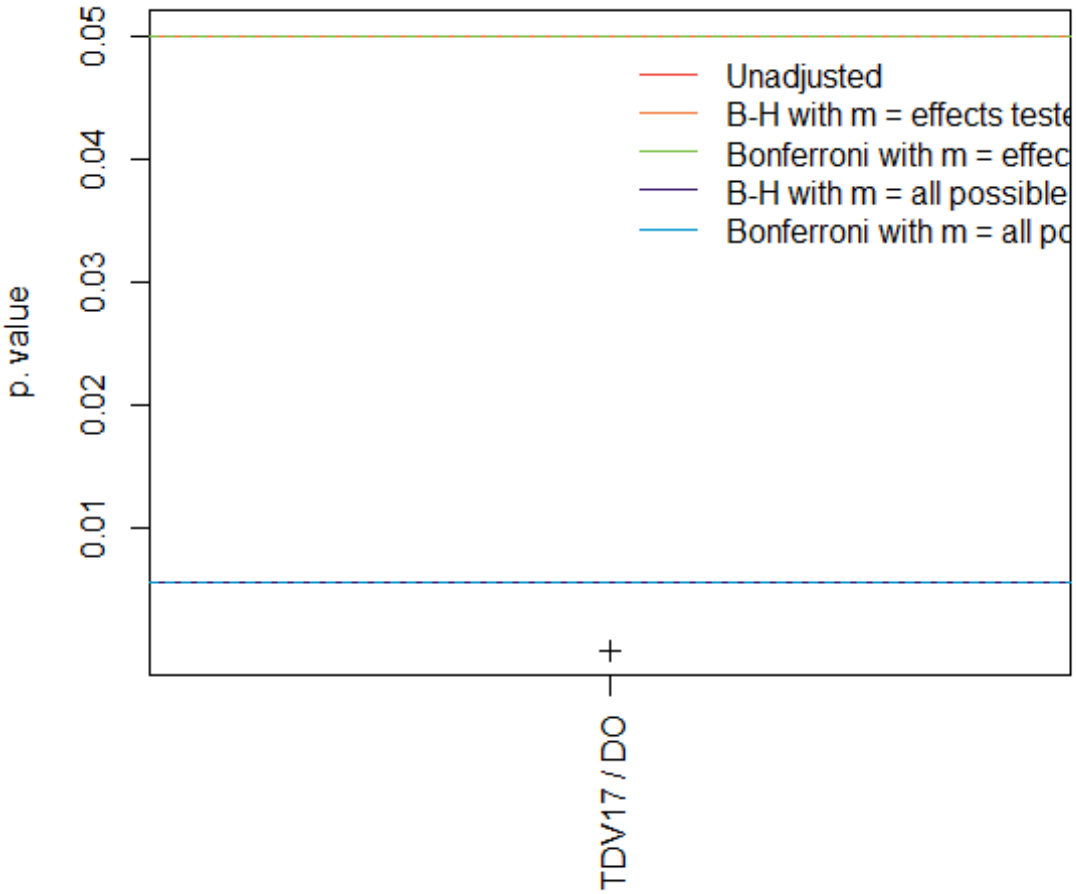


Figure 8

Visualization of Psychological TDV Perpetration Intercept DIF Effects as a Function of Trimming Criteria

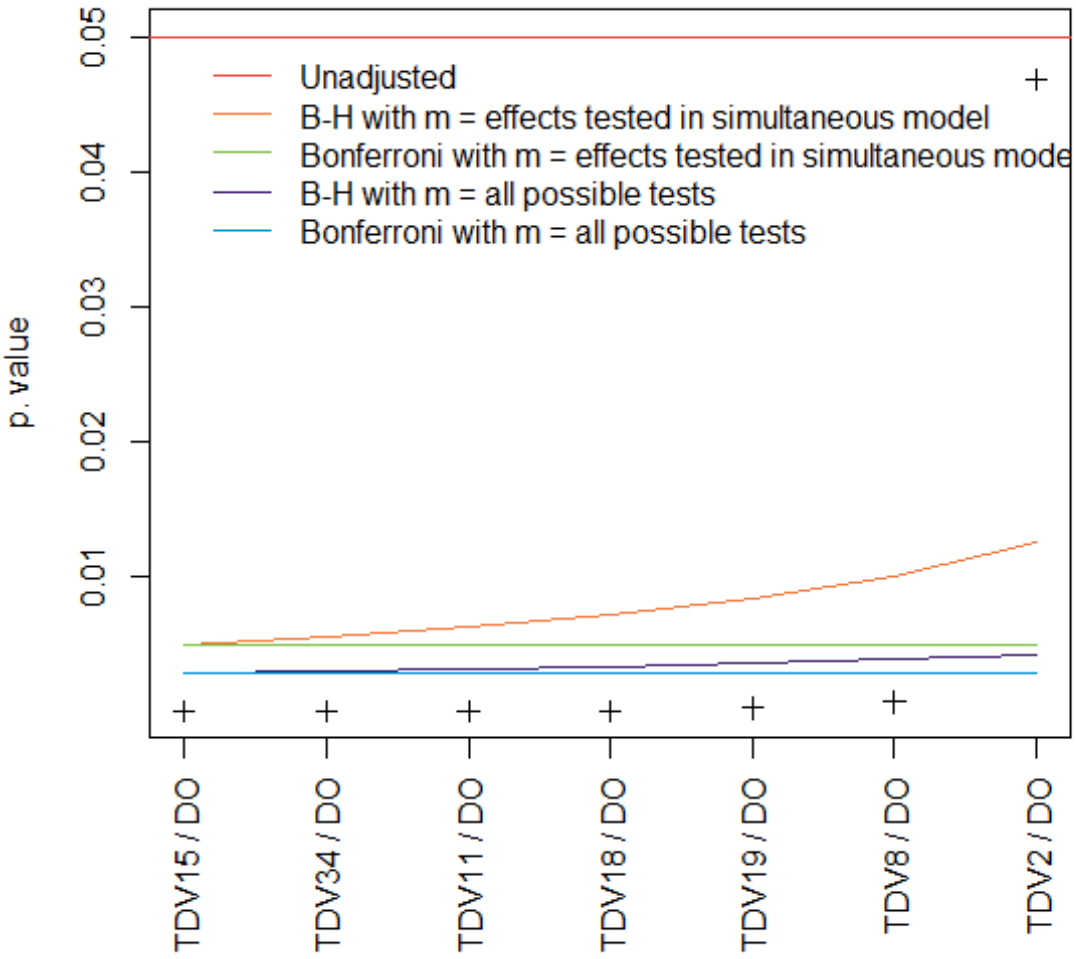


Figure 9

Visualization of Psychological TDV Perpetration Loading DIF Effects as a Function of Trimming Criteria

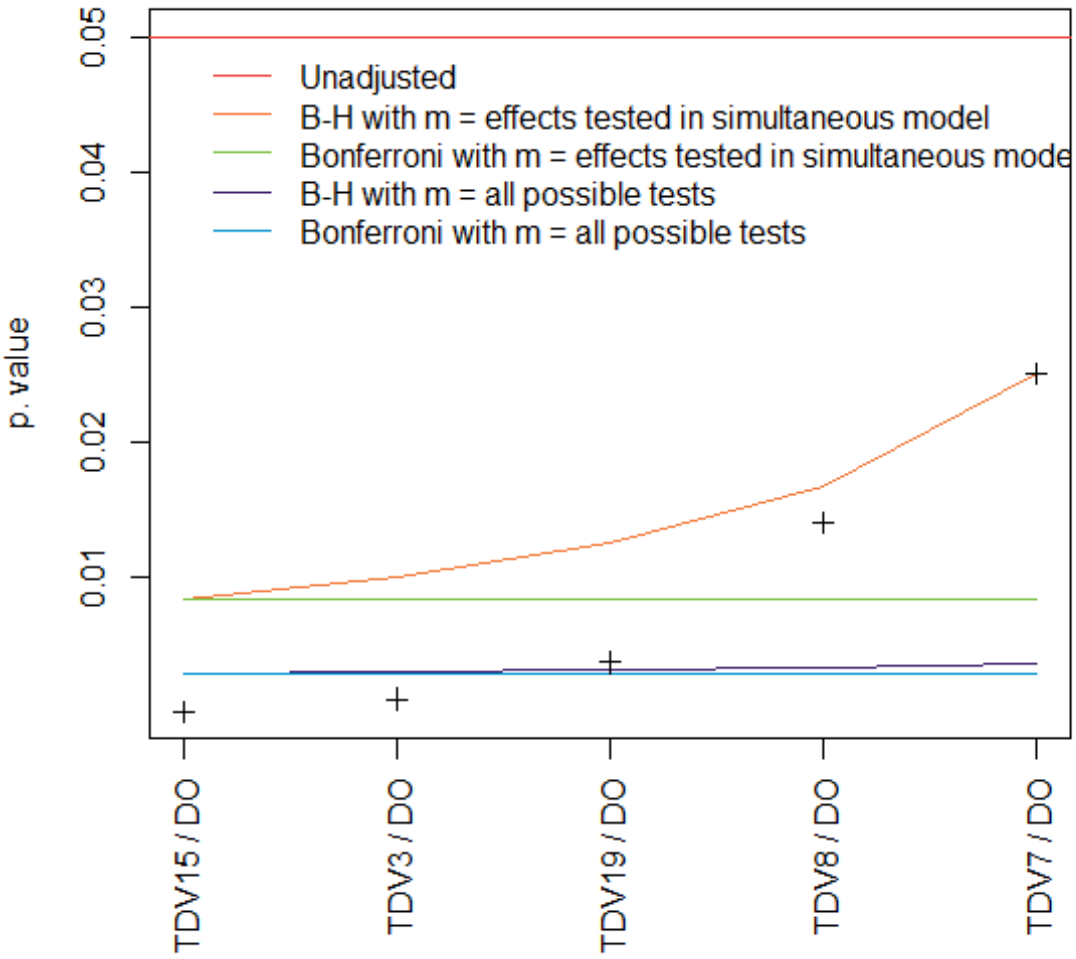


Figure 10

Visualization of Sexual TDV Perpetration Intercept DIF Effects as a Function of Trimming Criteria

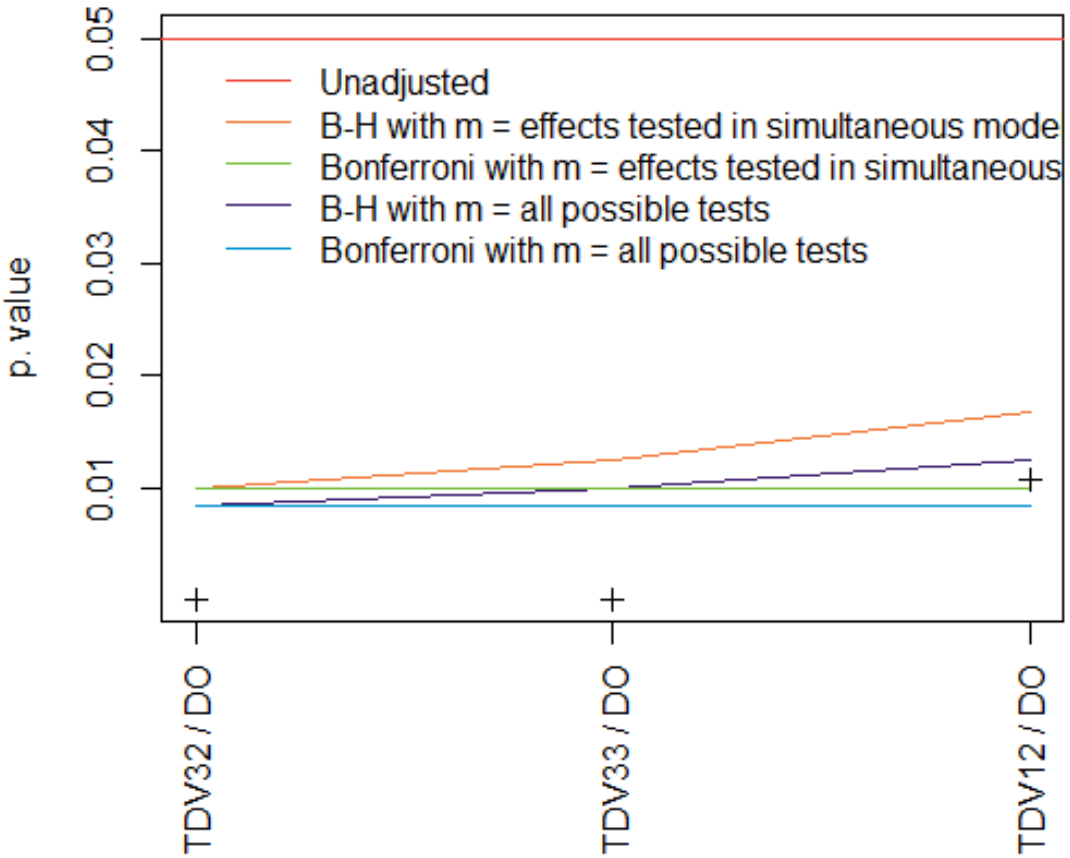
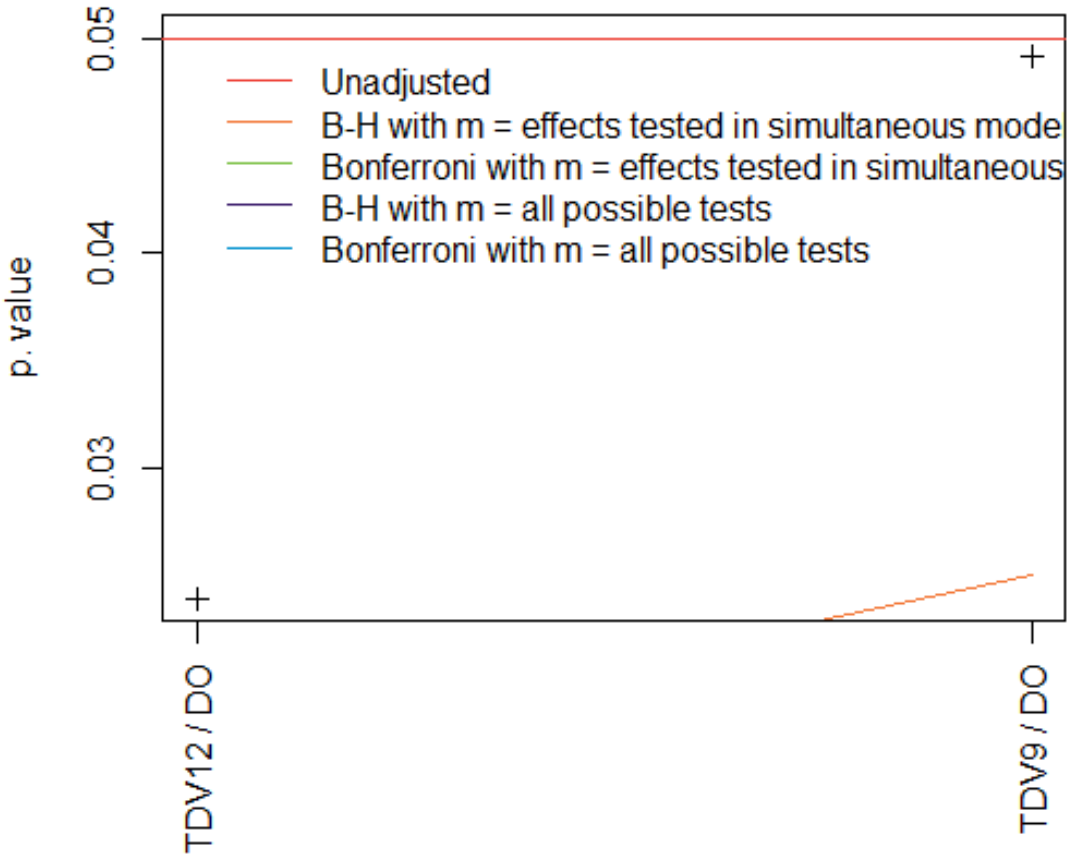


Figure 11

Visualization of Sexual TDV Perpetration Loading DIF Effects as a Function of Trimming Criteria



Appendix E – Visualization of Estimated Factor Scores

Figure 12

Violin Plot for Family Violence Posterior Factor Scores

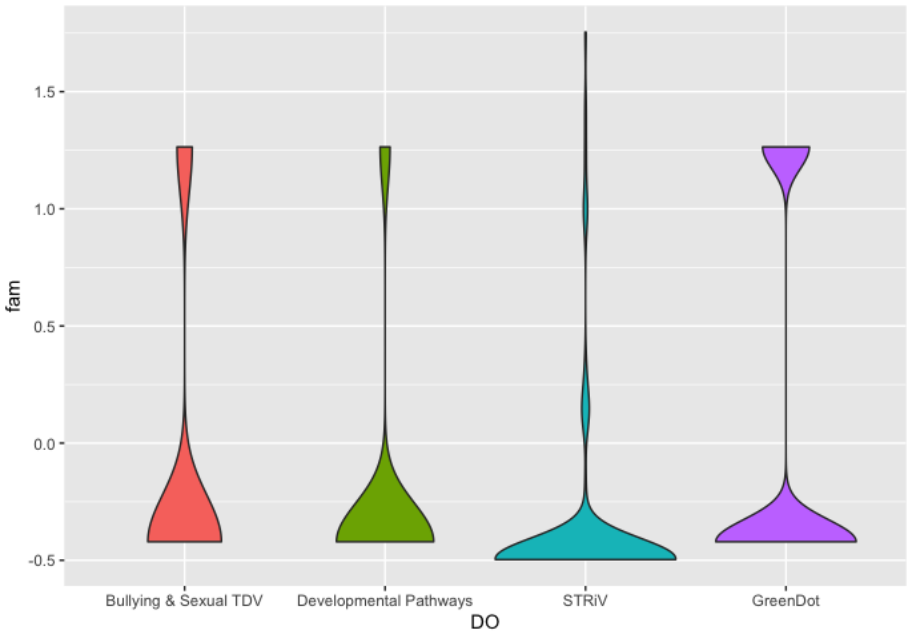


Figure 13

Violin Plot for ADV Posterior Factor Scores

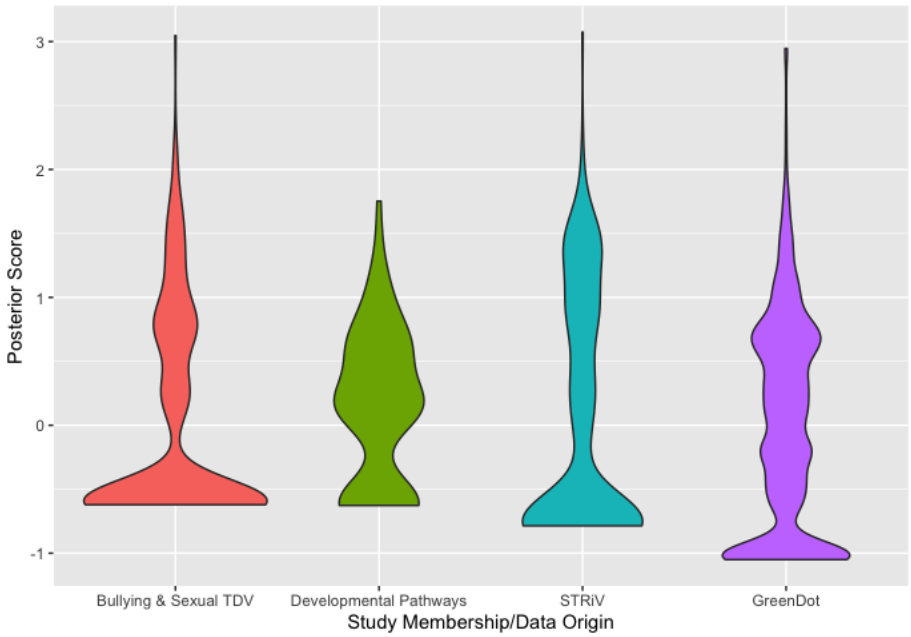


Figure 14

Violin Plot for Physical TDV Perpetration Posterior Factor Scores

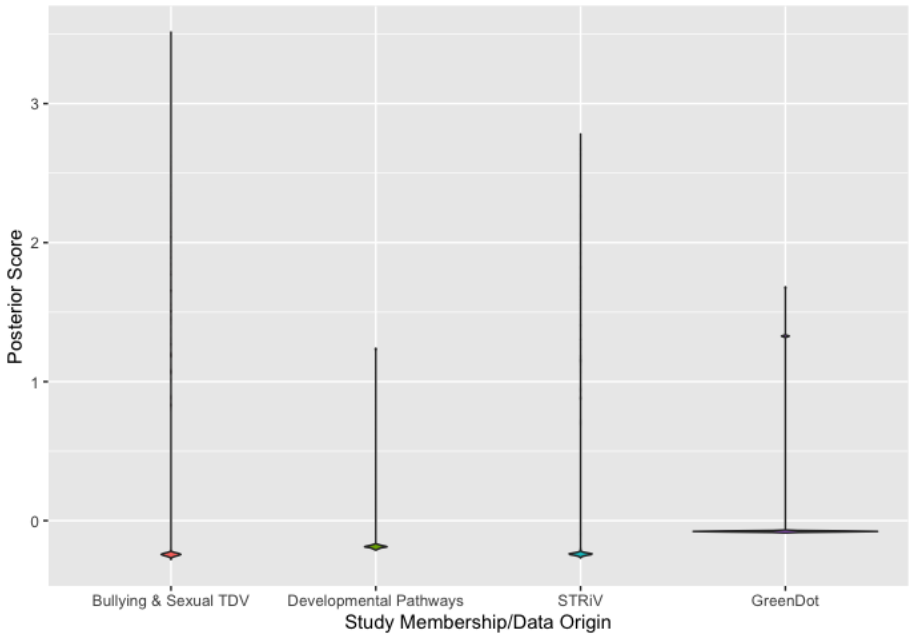


Figure 15

Violin Plot for Sexual TDV Perpetration Posterior Factor Scores

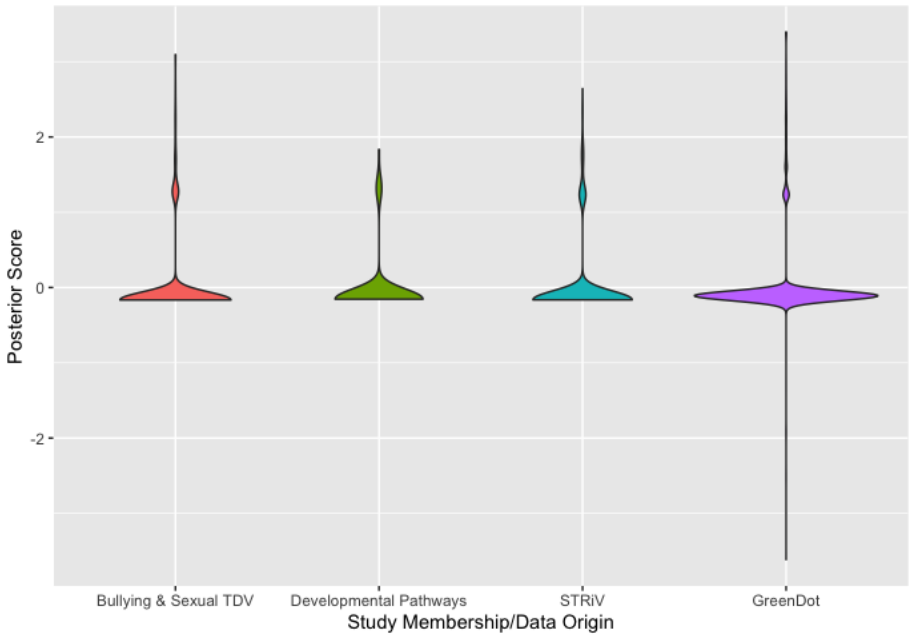
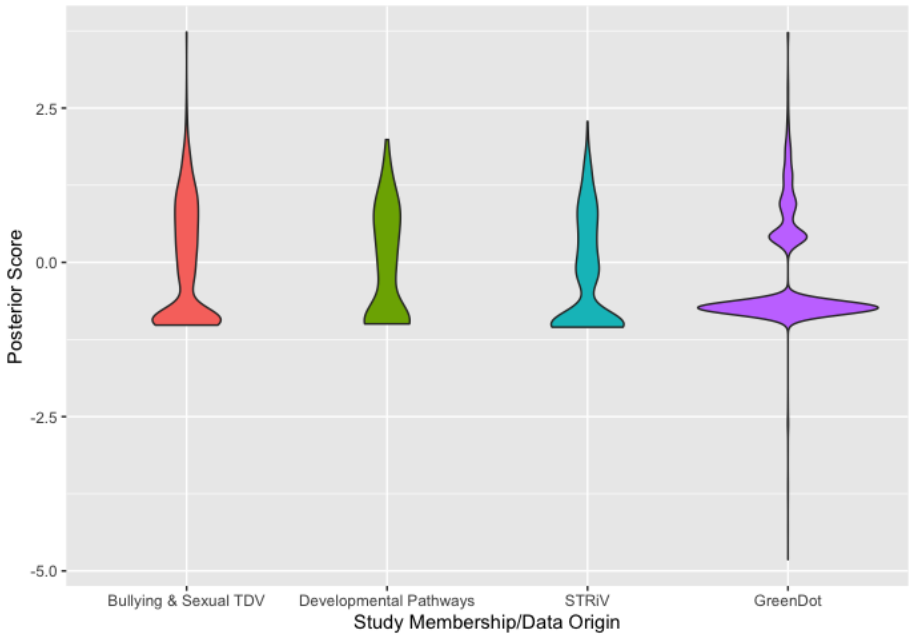


Figure 16

Violin Plot for Psychological TDV Perpetration Posterior Factor Scores



Appendix F – MNLFA MPlus Syntax

The R-Package aMNLFA (Gottfredson & Cole, 2019) was used to generate MPlus input templates to conduct moderated nonlinear factor analysis (MNLFA) following the steps outlined in Curran et al. (2014) & Cole et al. (2023). Below includes annotated syntax used to estimate factor scores for each of the constructs (exposure to family violence, acceptance of dating violence, physical TDV perpetration, psychological TDV perpetration, and sexual TDV perpetration).

Moderated Nonlinear Factor Analysis - Exposure to Family Violence

```
TITLE: Mean Impact Model;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3 DO ; !include study membership/dataset origin
(DO) as moderator
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
ANALYSIS: ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0]; !constrain factor mean to zero to identify model
ETA@1;
ETA BY FAM1*(l1); !new labels are defined in parentheses to be used in later models
ETA BY FAM2*(l2);
ETA BY FAM3*(l3);
ETA ON DO; !include DO as moderator/covariate (linear function) for factor mean
OUTPUT: tech1;

TITLE: Variance Impact Model;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
```

```
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
CONSTRAINT= DO ; !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
ETA ON DO ;
ETA*(veta); !estimate factor variance (set to one to identify model) and define new label
ETA BY FAM1*(l1);
ETA BY FAM2*(l2);
ETA BY FAM3*(l3);
MODEL CONSTRAINT:
new(v1*0); !label parameters of moderators (variance)
veta=1*exp(v1*DO); !allow DO to moderate factor variance and use log linear function
to avoid negative variance
OUTPUT: tech1;

TITLE: Measurement Invariance Model for FAM1;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
CONSTRAINT= DO ; !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0]; !constraint factor mean to zero to identify model
ETA@1;
ETA BY FAM1*(l1);
ETA BY FAM2*(l2);
ETA BY FAM3*(l3);
FAM1 on DO; !moderation of item 1 intercept
MODEL CONSTRAINT:
new(l1_00*1 l1_1*0 );
```

```
l1=l1_00 +l1_1*DO; !label used for moderation of item 1 factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for FAM2;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
CONSTRAINT= DO ; !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY FAM1*(l1);
ETA BY FAM2*(l2);
ETA BY FAM3*(l3);
FAM2 on DO; !moderation of item 3 intercept
MODEL CONSTRAINT:
new(l2_00*1 l2_1*0);
l2=l2_00 +l2_1*DO; !label used for moderation of item 2 factor loading
OUTPUT: tech1;


TITLE: Measurement Invariance Model for FAM3;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
CONSTRAINT= DO ; !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
```

```
[ETA@0];
ETA@1;
ETA BY FAM1*(l1);
ETA BY FAM2*(l2);
ETA BY FAM3*(l3);
FAM3 on DO; !moderation of item 3 intercept
MODEL CONSTRAINT:
new(l3_00*1 l3_1*0);
l3=l3_00 +l3_1*DO; !label used for moderation of item 3 factor loading
OUTPUT: tech1;


TITLE: Simultaneous MNLFA using MLF as estimator - variance impact term retained;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=MLF;
CONDITION=0;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
ETA BY FAM1*(l_1);
ETA BY FAM2*(l_2);
ETA BY FAM3*(l_3);
ETA ON DO;
FAM1 on DO;
FAM2 on DO;
FAM3 on DO;
MODEL CONSTRAINT:
veta=1*exp(v1*DO+0); !only retaining variance impact term
OUTPUT: tech1;

TITLE: Final Model to Get Scoring Parameters
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/FAM/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
```

```
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= FAM1 FAM2 FAM3 ;
CONSTRAINT= ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
ETA BY FAM1*(l_1);
ETA BY FAM2*(l_2);
ETA BY FAM3*(l_3);
MODEL CONSTRAINT:
veta=1*exp(0);
OUTPUT: tech1;


TITLE: Scoring Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/FAM/full.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH FAM1 FAM2 FAM3 DO;
MISSING=.;
USEVARIABLES= FAM1 FAM2 FAM3;
AUXILIARY=SMY;
CATEGORICAL= FAM1 FAM2 FAM3 ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
!parameter values generated from MNLFA final model are used to fix parameter values
in scoring model
ETA BY FAM1 @20356.834;
ETA BY FAM2 @2.816;
ETA BY FAM3 @1.867;
!NA;
[FAM1$1@12975.688];
[FAM2$1@4.44];
[FAM3$1@3.011];
MODEL CONSTRAINT:
```

```
veta=1*exp(0);
OUTPUT: tech1;
SAVEDATA: SAVE=FSCORES; FILE=scores.dat; !save estimated factor scores
```

Moderated Nonlinear Factor Analysis - Acceptance of Dating Violence

```
TITLE: Mean Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO
;  !include study membership/dataset origin (DO) as moderator
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];  !constraint factor mean to zero to identify model
ETA@1;
!new labels are defined in parentheses to be used in later models
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ETA ON DO ;  !include DO as moderator/covariate (linear function) for factor mean
```

```
OUTPUT: tech1;

TITLE: Variance Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO
;  !include study membership/dataset origin (DO) as moderator
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ; !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
ETA ON DO ;
ETA*(veta);
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
MODEL CONSTRAINT:
new(v1*0);!label parameters of moderators (variance)
veta=1*exp(v1*DO); !allow DO to moderate factor variance and use log linear function
to avoid negative variance
OUTPUT: tech1;
```

```
TITLE: Measurement Invariance Model for ADV1A
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV1A on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l1_00*1 l1_1*0);
l1=l1_00 +l1_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;
```

```
TITLE: Measurement Invariance Model for ADV1B
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV1B on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l10_00*1 l10_1*0);
l10=l10_00 +l10_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV2A
```

```
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV2A on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l2_00*1 l2_1*0);
l2=l2_00 +l2_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV2B
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
```

```
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV2B on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l11_00*1 l11_1*0);
l11=l11_00 +l11_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;


TITLE: Measurement Invariance Model for ADV3A
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV3A on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l3_00*1 l3_1*0);
l3=l3_00 +l3_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV3B
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV3B on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l5_00*1 l5_1*0);
l5=l5_00 +l5_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV4A
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV4A on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l4_00*1 l4_1*0);
l10=l4_00 +l4_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV4B
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV4B on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l12_00*1 l12_1*0);
l10=l12_00 +l12_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV5;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV5 on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l6_00*1 l6_1*0);
l10=l6_00 +l6_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV6A;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV6A on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l7_00*1 l7_1*0);
l7=l7_00 +l7_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV6B;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV6B on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l8_00*1 l8_1*0);
l8=l8_00 +l8_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV7A;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV7A on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l9_00*1 l9_1*0);
l9=l9_00 +l9_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV7B;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV7B on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l13_00*1 l13_1*0);
l13=l13_00 +l13_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV8;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV8 on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l14_00*1 l14_1*0);
l14=l14_00 +l9_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV9;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV9 on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l15_00*1 l15_1*0);
l15=l15_00 +l15_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for ADV7A;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY ADV1A*(l1);
ETA BY ADV2A*(l2);
ETA BY ADV3A*(l3);
ETA BY ADV4A*(l4);
ETA BY ADV3B*(l5);
ETA BY ADV5*(l6);
ETA BY ADV6A*(l7);
ETA BY ADV6B*(l8);
ETA BY ADV7A*(l9);
ETA BY ADV1B*(l10);
ETA BY ADV2B*(l11);
ETA BY ADV4B*(l12);
ETA BY ADV7B*(l13);
ETA BY ADV8*(l14);
ETA BY ADV9*(l15);
ETA BY ADV10*(l16);
ADV10 on DO;  !moderation of intercept
MODEL CONSTRAINT:
new(l16_00*1 l16_1*0);
l16=l16_00 +l16_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Simultaneous MNLFA using MLF as estimator -retaining all significant mean,
variance, and DIF effects;
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta); !retaining variance impact
ETA BY ADV1A*(l_1);
ETA BY ADV2A*(l_2);
ETA BY ADV3A*(l_3);
ETA BY ADV4A*(l_4);
ETA BY ADV3B*(l_5);
ETA BY ADV5*(l_6);
ETA BY ADV6A*(l_7);
ETA BY ADV6B*(l_8);
ETA BY ADV7A*(l_9);
ETA BY ADV1B*(l_10);
ETA BY ADV2B*(l_11);
ETA BY ADV4B*(l_12);
ETA BY ADV7B*(l_13);
ETA BY ADV8*(l_14);
ETA BY ADV9*(l_15);
ETA BY ADV10*(l_16);
ETA ON DO;
!include intercept DIF
ADV1A on DO;
ADV2A on DO;
ADV4A on DO;
ADV6A on DO;
ADV6B on DO;
ADV7A on DO;
ADV1B on DO;
ADV2B on DO;
ADV4B on DO;
ADV7B on DO;
```

```
ADV8 on DO;
ADV9 on DO;
ADV10 on DO;
MODEL CONSTRAINT:
new( l1_0*1   l1_1*0
  l2_0*1   l2_1*0
  l4_0*1   l4_1*0
  l7_0*1   l7_1*0
  l8_0*1   l8_1*0);
veta=1*exp(0);
!significant loading DIF terms
  l_1=l1_0 +l1_1*DO;
  l_2=l2_0 +l2_1*DO;
  l_4=l4_0 +l4_1*DO;
  l_7=l7_0 +l7_1*DO;
  l_8=l8_0 +l8_1*DO;
 OUTPUT: tech1;

TITLE: Final Model to Get Scoring Parameters
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA
5.20.23/ADV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta); !variance impact effect
ETA BY ADV1A*(l_1);
ETA BY ADV2A*(l_2);
ETA BY ADV3A*(l_3);
ETA BY ADV4A*(l_4);
ETA BY ADV3B*(l_5);
ETA BY ADV5*(l_6);
```

```
ETA BY ADV6A*(l_7);
ETA BY ADV6B*(l_8);
ETA BY ADV7A*(l_9);
ETA BY ADV1B*(l_10);
ETA BY ADV2B*(l_11);
ETA BY ADV4B*(l_12);
ETA BY ADV7B*(l_13);
ETA BY ADV8*(l_14);
ETA BY ADV9*(l_15);
ETA BY ADV10*(l_16);
!include significant intercept DIF effects
ADV1A on DO;
ADV2A on DO;
ADV4A on DO;
ADV6A on DO;
ADV6B on DO;
ADV7A on DO;
ADV1B on DO;
ADV2B on DO;
ADV4B on DO;
ADV7B on DO;
ADV8 on DO;
ADV9 on DO;
ADV10 on DO;
MODEL CONSTRAINT:
new(
  l1_0*1   l1_1*0
  l2_0*1   l2_1*0
  l4_0*1   l4_1*0
 l7_0*1   l7_1*0 );
  veta=1*exp(0); !variance impact
  l_1=l1_0 +l1_1*DO; !significant loading DIF terms
  l_2=l2_0 +l2_1*DO;
  l_4=l4_0 +l4_1*DO;
  l_7=l7_0 +l7_1*DO;
OUTPUT: tech1;


TITLE: Scoring Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/ADV/full.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH ADV1A ADV2A ADV3A ADV4A ADV3B
ADV5 ADV6A ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9
ADV10 DO;
MISSING=.;
IDVARIABLE IS ID;
```

```
USEVARIABLES= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A
ADV6B ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 DO;
AUXILIARY=SMY;
CATEGORICAL= ADV1A ADV2A ADV3A ADV4A ADV3B ADV5 ADV6A ADV6B
ADV7A ADV1B ADV2B ADV4B ADV7B ADV8 ADV9 ADV10 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
!parameter values generated from MNLFA final model are used to fix parameter values
in scoring model
ETA BY ADV1A*(l_1);
ETA BY ADV2A*(l_2);
ETA BY ADV3A @4.293;
ETA BY ADV4A*(l_4);
ETA BY ADV3B @2.198;
ETA BY ADV5 @4.575;
ETA BY ADV6A*(l_7);
ETA BY ADV6B @1.808;
ETA BY ADV7A @3.106;
ETA BY ADV1B @12.138;
ETA BY ADV2B @13.408;
ETA BY ADV4B @18.807;
ETA BY ADV7B @7.942;
ETA BY ADV8 @0.975;
ETA BY ADV9 @2.586;
ETA BY ADV10 @2.405;
ADV1A ON DO@2.671;
ADV2A ON DO@4.829;
ADV4A ON DO@2.943;
ADV6A ON DO@1.024;
ADV6B ON DO@-0.431;
ADV7A ON DO@-1.069;
ADV1B ON DO@-8.3;
ADV2B ON DO@-8.871;
ADV4B ON DO@-13.042;
ADV7B ON DO@-4.335;
ADV8 ON DO@-0.109;
ADV9 ON DO@-0.517;
ADV10 ON DO@-0.585;
[ADV1A$1@11.386];
```

[ADV1A$2@14.535];
[ADV1A$3@16.511];
[ADV2A$1@17.727];
[ADV2A$2@21.3];
[ADV2A$3@23.395];
[ADV3A$1@5.848];
[ADV3A$2@7.535];
[ADV3A$3@9.965];
[ADV4A$1@11.965];
[ADV4A$2@14.896];
[ADV4A$3@16.547];
[ADV3B$1@2.359];
[ADV3B$2@3.336];
[ADV3B$3@5.53];
[ADV5$1@7.215];
[ADV5$2@8.906];
[ADV5$3@11.391];
[ADV6A$1@3.882];
[ADV6A$2@5.275];
[ADV6A$3@7.111];
[ADV6B$1@0.574];
[ADV6B$2@1.409];
[ADV6B$3@2.447];
[ADV7A$1@-1.289];
[ADV7A$2@1.491];
[ADV7A$3@3.401];
[ADV1B$1@-10.814];
[ADV1B$2@0.691];
[ADV1B$3@5.509];
[ADV2B$1@-11.086];
[ADV2B$2@-0.981];
[ADV2B$3@5.219];
[ADV4B$1@-17.527];
[ADV4B$2@-4.394];
[ADV4B$3@5.219];
[ADV7B$1@-4.262];
[ADV7B$2@0.989];
[ADV7B$3@4.812];
[ADV8$1@0.199];
[ADV8$2@1.234];
[ADV8$3@2.58];
[ADV9$1@-1.73];
[ADV9$2@1.664];
[ADV9$3@4.195];
[ADV10$1@-1.963];
[ADV10$2@1.091];

```
[ADV10$3@4.088];
MODEL CONSTRAINT:
veta=1*exp(0);
l_1=6.931 -1.154*DO;
l_2=10.037 -2.056*DO;
l_4=7.382 -1.427*DO;
l_7=2.924 -0.327*DO;
OUTPUT: tech1;
SAVEDATA:
SAVE=FSCORES;
FILE=scores_ADV.dat;
```

Moderated Nonlinear Factor Analysis - Physical TDV Perpetration

```
TITLE: Mean Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
ETA ON DO ;
OUTPUT: tech1;
```

```
TITLE: Variance Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
ETA ON DO ;
ETA*(veta);
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
MODEL CONSTRAINT:
new(v1*0);
veta=1*exp(v1*DO);
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV17
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO;
AUXILIARY= SMY SEX RACE ETH ;
```

```
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV17 on DO;
MODEL CONSTRAINT:
new(l1_00*1 l1_1*0);
l1=l1_00+l1_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV20
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
```

```
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV20 on DO;
MODEL CONSTRAINT:
new(l2_00*1 l2_1*0);
l2=l2_00+l2_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV24
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
 MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
```

```
TDV24 on DO;
MODEL CONSTRAINT:
new(l3_00*1 l3_1*0);
l3=l3_00 +l3_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV26
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV26 on DO;
MODEL CONSTRAINT:
new(l4_00*1 l4_1*0);
l4=l4_00+l4_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV27
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV27 on DO;
MODEL CONSTRAINT:
new(l5_00*1 l5_1*0);
l5=l5_00 +l5_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV28
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
```

```
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV28 on DO;
MODEL CONSTRAINT:
new(l6_00*1 l6_1*0);
l6=l6_00 +l6_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV29
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
```

```
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV29 on DO;
MODEL CONSTRAINT:
new(l7_00*1 l7_1*0);
l7=l7_00 +l7_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV30
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV30 on DO;
MODEL CONSTRAINT:
new(l8_00*1 l8_1*0);
l8=l8_00+l8_1*DO;
```

```
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV31
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV17*(l1);
ETA BY TDV20*(l2);
ETA BY TDV24*(l3);
ETA BY TDV26*(l4);
ETA BY TDV27*(l5);
ETA BY TDV28*(l6);
ETA BY TDV29*(l7);
ETA BY TDV30*(l8);
ETA BY TDV31*(l9);
TDV31 on DO;
MODEL CONSTRAINT:
new(l9_00*1 l9_1*0);
l9=l9_00 +l9_1*DO;
OUTPUT: tech1;

TITLE: Simultaneous MNLFA -retaining all significant mean, variance, and DIF effects
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
```

```
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
  MODEL:
[ETA@0];
ETA*(veta);
ETA BY TDV17*(l_1);
ETA BY TDV20*(l_2);
ETA BY TDV24*(l_3);
ETA BY TDV26*(l_4);
ETA BY TDV27*(l_5);
ETA BY TDV28*(l_6);
ETA BY TDV29*(l_7);
ETA BY TDV30*(l_8);
ETA BY TDV31*(l_9);
ETA ON DO;
TDV17 on DO;
TDV20 on DO;
MODEL CONSTRAINT:
new( l1_0*1   l1_1*0 );
veta=1*exp(0);
l_1=l1_0 +l1_1*DO;
OUTPUT: tech1;

TITLE: Final Model to Get Scoring Parameters
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
```

```
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
ETA BY TDV17*(l_1);
ETA BY TDV20*(l_2);
ETA BY TDV24*(l_3);
ETA BY TDV26*(l_4);
ETA BY TDV27*(l_5);
ETA BY TDV28*(l_6);
ETA BY TDV29*(l_7);
ETA BY TDV30*(l_8);
ETA BY TDV31*(l_9);
TDV17 on DO;
TDV20 on DO;
MODEL CONSTRAINT:
new(l1_0*1   l1_1*0);
veta=1*exp(0);
l_1=l1_0 +l1_1*DO;
OUTPUT: tech1;

TITLE: Scoring Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Physical
TDV/full.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV17 TDV20 TDV24 TDV26 TDV27 TDV28
TDV29 TDV30 TDV31 DO;
MISSING=.;
IDVARIABLE IS ID;
USEVARIABLES= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 DO;
AUXILIARY=SMY;
CATEGORICAL= TDV17 TDV20 TDV24 TDV26 TDV27 TDV28 TDV29 TDV30
TDV31 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
```

```
ETA BY TDV17*(l_1);
ETA BY TDV20 @5.308;
ETA BY TDV24 @4.081;
ETA BY TDV26 @4.196;
ETA BY TDV27 @3.94;
ETA BY TDV28 @3.616;
ETA BY TDV29 @2.613;
ETA BY TDV30 @1.904;
ETA BY TDV31 @6.163;
TDV17 ON DO@1.333;
TDV20 ON DO@-0.645;
[TDV17$1@9.376];
[TDV17$2@12.193];
[TDV17$3@15.476];
[TDV20$1@7.555];
[TDV20$2@10.77];
[TDV20$3@12.779];
[TDV24$1@6.798];
[TDV24$2@9.187];
[TDV24$3@12.065];
[TDV26$1@9.55];
[TDV26$2@11.152];
[TDV26$3@12.982];
[TDV27$1@8.393];
[TDV27$2@10.42];
[TDV27$3@11.365];
[TDV28$1@7.023];
[TDV28$2@9.044];
[TDV28$3@10.886];
[TDV29$1@4.646];
[TDV29$2@6.216];
[TDV29$3@7.194];
[TDV30$1@5.342];
[TDV30$2@6.34];
[TDV30$3@7.301];
[TDV31$1@16.622];
[TDV31$2@17.692];
MODEL CONSTRAINT:
veta=1*exp(0);
l_1=6.207 -1.108*DO;
OUTPUT: tech1;
SAVEDATA: SAVE=FSCORES; FILE=scores.dat;
```

Moderated Nonlinear Factor Analysis - Psychological TDV

```
TITLE: Mean Impact Model
```

```
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO; !include study membership/dataset origin (DO) as moderator
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];  !constrain factor mean to zero to identify model
ETA@1;
ETA BY TDV2*(l1);!new labels are defined in parentheses to be used in later models
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
ETA ON DO;  !include DO as moderator/covariate (linear function) for factor mean
OUTPUT: tech1;

TITLE: Variance Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19
TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO; !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
ETA ON DO;
ETA*(veta); !estimate factor variance (set to one to identify model) and define new label
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
MODEL CONSTRAINT:
new(v1*0); !label parameters of moderators (variance)
veta=1*exp(v1*DO); !allow DO to moderate factor variance and use log linear function
to avoid negative variance
OUTPUT: tech1;
TITLE: Measurement Invariance Model for TDV2
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO;  !study membership as moderator of factor variance
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV2 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l1_00*1 l1_1*0);
l1=l1_00 +l1_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV3
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV3 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l2_00*1 l2_1*0);
l2=l2_00+l2_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV4
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV4 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l3_00*1 l3_1*0);
l3=l3_00+l3_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV5
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV5 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l4_00*1 l4_1*0);
l4=l4_00+l4_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV7
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV7 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l5_00*1 l5_1*0);
l5=l5_00+l5_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV8
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV8 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l6_00*1 l6_1*0);
l6=l6_00+l6_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV11
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV11 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l7_00*1 l7_1*0);
l7=l7_00+l7_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV13
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV13 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l8_00*1 l8_1*0);
l8=l8_00+l8_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV14
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV14 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l9_00*1 l9_1*0);
l9=l9_00+l9_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV15
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV15 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l10_00*1 l10_1*0);
l10=l10_00+l10_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV16
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV16 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l11_00*1 l11_1*0);
l11=l11_00+l11_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV18
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV18 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l12_00*1 l12_1*0);
l12=l12_00+l12_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV19
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV19 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l13_00*1 l13_1*0);
l13=l13_00+l13_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV21
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV21 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l14_00*1 l14_1*0);
l14=l14_00+l14_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV22
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV22 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l15_00*1 l15_1*0);
l15=l15_00+l15_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV23
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV23 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l16_00*1 l16_1*0);
l16=l16_00+l16_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV25
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV25 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l17_00*1 l17_1*0);
l17=l17_00+l17_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV34
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV2*(l1);
ETA BY TDV3*(l2);
ETA BY TDV4*(l3);
ETA BY TDV5*(l4);
ETA BY TDV7*(l5);
ETA BY TDV8*(l6);
ETA BY TDV11*(l7);
ETA BY TDV13*(l8);
ETA BY TDV14*(l9);
ETA BY TDV15*(l10);
ETA BY TDV16*(l11);
ETA BY TDV18*(l12);
ETA BY TDV19*(l13);
ETA BY TDV21*(l14);
ETA BY TDV22*(l15);
ETA BY TDV23*(l16);
ETA BY TDV25*(l17);
ETA BY TDV34*(l18);
TDV34 on DO; !moderation of intercept
MODEL CONSTRAINT:
new(l18_00*1 l18_1*0);
l18=l18_00+l18_1*DO; !label used for moderation of factor loading
OUTPUT: tech1;

TITLE: Simultaneous MNLFA -retaining all significant mean, variance, and DIF effects
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
```

```
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
ETA BY TDV2*(l_1);
ETA BY TDV3*(l_2);
ETA BY TDV4*(l_3);
ETA BY TDV5*(l_4);
ETA BY TDV7*(l_5);
ETA BY TDV8*(l_6);
ETA BY TDV11*(l_7);
ETA BY TDV13*(l_8);
ETA BY TDV14*(l_9);
ETA BY TDV15*(l_10);
ETA BY TDV16*(l_11);
ETA BY TDV18*(l_12);
ETA BY TDV19*(l_13);
ETA BY TDV21*(l_14);
ETA BY TDV22*(l_15);
ETA BY TDV23*(l_16);
ETA BY TDV25*(l_17);
ETA BY TDV34*(l_18);
ETA ON DO;
!include intercept DIF
TDV2 on DO;
TDV3 on DO;
TDV7 on DO;
TDV8 on DO;
TDV11 on DO;
TDV15 on DO;
TDV18 on DO;
TDV19 on DO;
```

```
TDV21 on DO;
TDV34 on DO;
MODEL CONSTRAINT:
new( v1*0
l2_0*1   l2_1*0
l5_0*1   l5_1*0
l6_0*1   l6_1*0
l10_0*1   l10_1*0
l13_0*1   l13_1*0
l14_0*1   l14_1*0);
veta=1*exp(v1*DO+0);
!significant loading DIF terms
l_2=l2_0 +l2_1*DO;
l_5=l5_0 +l5_1*DO;
l_6=l6_0 +l6_1*DO;
l_10=l10_0 +l10_1*DO;
l_13=l13_0 +l13_1*DO;
l_14=l14_0 +l14_1*DO;
OUTPUT: tech1;

TITLE: Final Model to Get Scoring Parameters
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15
TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO;
MISSING=.;
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
ETA BY TDV2*(l_1);
ETA BY TDV3*(l_2);
ETA BY TDV4*(l_3);
ETA BY TDV5*(l_4);
```

```
ETA BY TDV7*(l_5);
ETA BY TDV8*(l_6);
ETA BY TDV11*(l_7);
ETA BY TDV13*(l_8);
ETA BY TDV14*(l_9);
ETA BY TDV15*(l_10);
ETA BY TDV16*(l_11);
ETA BY TDV18*(l_12);
ETA BY TDV19*(l_13);
ETA BY TDV21*(l_14);
ETA BY TDV22*(l_15);
ETA BY TDV23*(l_16);
ETA BY TDV25*(l_17);
ETA BY TDV34*(l_18);
ETA ON DO;
!include intercept DIF
TDV3 on DO;
TDV8 on DO;
TDV11 on DO;
TDV15 on DO;
TDV18 on DO;
TDV19 on DO;
TDV34 on DO;
MODEL CONSTRAINT:
new(V1*0
l2_0*1   l2_1*0
l6_0*1   l6_1*0
l10_0*1   l10_1*0
l13_0*1   l13_1*0);
veta=1*exp(v1*DO+0);
!significant loading DIF terms
l_2=l2_0 +l2_1*DO;
l_6=l6_0 +l6_1*DO;
l_10=l10_0 +l10_1*DO;
l_13=l13_0 +l13_1*DO;
OUTPUT: tech1;

TITLE: Scoring Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Psych
TDV/full.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11
TDV13 TDV14 TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25
TDV34 DO;
MISSING=.;
IDVARIABLE IS ID;
```

```
USEVARIABLES= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 DO;
AUXILIARY=SMY;
CATEGORICAL= TDV2 TDV3 TDV4 TDV5 TDV7 TDV8 TDV11 TDV13 TDV14
TDV15 TDV16 TDV18 TDV19 TDV21 TDV22 TDV23 TDV25 TDV34 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
!parameter values generated from MNLFA final model are used to fix parameter values
in scoring model
ETA BY TDV2 @2.692;
ETA BY TDV3*(l_2);
ETA BY TDV4 @2.039;
ETA BY TDV5 @2.729;
ETA BY TDV7 @2.939;
ETA BY TDV8*(l_6);
ETA BY TDV11 @3.18;
ETA BY TDV13 @2.762;
ETA BY TDV14 @2.167;
ETA BY TDV15*(l_10);
ETA BY TDV16 @2.663;
ETA BY TDV18 @2.451;
ETA BY TDV19*(l_13);
ETA BY TDV21 @2.381;
ETA BY TDV22 @2.482;
ETA BY TDV23 @2.402;
ETA BY TDV25 @2.679;
ETA BY TDV34 @2.208;
ETA ON DO@-0.047;
TDV3 ON DO@-0.183;
TDV8 ON DO@0.451;
TDV11 ON DO@0.816;
TDV15 ON DO@-0.513;
TDV18 ON DO@-0.407;
TDV19 ON DO@0.724;
TDV34 ON DO@-0.44;
[TDV2$1@5.461];
[TDV2$2@7.145];
[TDV2$3@9.384];
[TDV3$1@1.372];
```

[TDV3$2@3.653];
[TDV3$3@6.423];
[TDV4$1@-10.081];
[TDV4$2@4.528];
[TDV4$3@6.248];
[TDV4$4@7.097];
[TDV4$5@7.864];
[TDV5$1@2.042];
[TDV5$2@4.273];
[TDV5$3@6.354];
[TDV7$1@2.578];
[TDV7$2@4.855];
[TDV7$3@7.274];
[TDV8$1@3.567];
[TDV8$2@5.623];
[TDV8$3@7.787];
[TDV11$1@6.209];
[TDV11$2@8.544];
[TDV11$3@10.42];
[TDV13$1@6.152];
[TDV13$2@7.744];
[TDV13$3@8.956];
[TDV14$1@3.984];
[TDV14$2@5.989];
[TDV14$3@7.007];
[TDV15$1@-10.458];
[TDV15$2@0.451];
[TDV15$3@2.067];
[TDV15$4@3.029];
[TDV15$5@3.828];
[TDV16$1@1.967];
[TDV16$2@4.12];
[TDV16$3@6.24];
[TDV18$1@0.996];
[TDV18$2@2.977];
[TDV18$3@4.885];
[TDV19$1@5.415];
[TDV19$2@7.106];
[TDV19$3@9.052];
[TDV21$1@-10.884];
[TDV21$2@4.739];
[TDV21$3@6.301];
[TDV21$4@7.177];
[TDV21$5@7.914];
[TDV22$1@2.38];
[TDV22$2@4.371];

```
[TDV22$3@6.23];
[TDV23$1@4.795];
[TDV23$2@6.177];
[TDV23$3@8.088];
[TDV25$1@5.847];
[TDV25$2@7.582];
[TDV25$3@9.139];
[TDV34$1@-10.495];
[TDV34$2@-0.396];
[TDV34$3@1.66];
[TDV34$4@2.821];
[TDV34$5@3.482];
MODEL CONSTRAINT:
veta=1*exp(0.089*DO+0);
l_2=2.887 -0.326*DO;
l_6=3.407 -0.299*DO;
l_10=1.252 +0.139*DO;
l_13=2.888 -0.454*DO;
OUTPUT: tech1;
SAVEDATA: !save factor scores
SAVE=FSCORES;
FILE=scores.dat;
```

Moderated Nonlinear Factor Analysis - Sexual TDV Perpetration

```
TITLE: Mean Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
```

```
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
ETA ON DO ;
OUTPUT: tech1;

TITLE: Variance Impact Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML
;ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
ETA ON DO ;
ETA*(veta);
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
MODEL CONSTRAINT:
new(v1*0);
veta=1*exp( v1*DO);
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV1
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
```

```
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
TDV1 on DO;
MODEL CONSTRAINT:
new(l1_00*1 l1_1*0);
l1=l1_00 +l1_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV9
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
```

```
TDV9 on DO;
MODEL CONSTRAINT:
new(l2_00*1 l2_1*0);
l2=l2_00 +l2_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV10
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
TDV10 on DO;
MODEL CONSTRAINT:
new(l3_00*1 l3_1*0);
l3=l3_00 +l3_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV12
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
```

```
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
TDV12 on DO;
MODEL CONSTRAINT:
new(l4_00*1 l4_1*0);
l4=l4_00 +l4_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV32
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
```

```
ETA BY TDV33*(l6);
TDV32 on DO;
MODEL CONSTRAINT:
new(l5_00*1 l5_1*0);
l5=l5_00 +l5_1*DO;
OUTPUT: tech1;

TITLE: Measurement Invariance Model for TDV33
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO ;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA@1;
ETA BY TDV1*(l1);
ETA BY TDV9*(l2);
ETA BY TDV10*(l3);
ETA BY TDV12*(l4);
ETA BY TDV32*(l5);
ETA BY TDV33*(l6);
TDV33 on DO;
MODEL CONSTRAINT:
new(l6_00*1 l6_1*0);
l6=l6_00 +l6_1*DO;
OUTPUT: tech1;

TITLE: Round 2 Calibration Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO;
```

```
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= DO ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL: !include all mean and variance impact terms with p less than .05
[ETA@0];
ETA*(veta);
ETA BY TDV1*(l_1);
ETA BY TDV9*(l_2);
ETA BY TDV10*(l_3);
ETA BY TDV12*(l_4);
ETA BY TDV32*(l_5);
ETA BY TDV33*(l_6);
TDV9 on DO;
TDV10 on DO;
TDV12 on DO;
TDV32 on DO;
TDV33 on DO;
MODEL CONSTRAINT:
new(l2_0*1   l2_1*0 l3_0*1   l3_1*0 l4_0*1   l4_1*0);
veta=1*exp(0);
l_2=l2_0 +l2_1*DO;
l_3=l3_0 +l3_1*DO;
l_4=l4_0 +l4_1*DO;
OUTPUT: tech1;

TITLE: Final Model to Get Scoring Parameters w BH correction and m choice
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/calibration.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO;
AUXILIARY= SMY SEX RACE ETH ;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
CONSTRAINT= ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
```

```
MODEL:
[ETA@0];
ETA*(veta);
ETA BY TDV1*(l_1);
ETA BY TDV9*(l_2);
ETA BY TDV10*(l_3);
ETA BY TDV12*(l_4);
ETA BY TDV32*(l_5);
ETA BY TDV33*(l_6);
TDV12 on DO;
TDV32 on DO;
TDV33 on DO;
MODEL CONSTRAINT:
new( );
veta=1*exp(0);
OUTPUT: tech1;

TITLE: Scoring Model
DATA: FILE = "D:/Data/M3 IDA/Merged Datasets/AMNLFA 5.20.23/Sexual
TDV/full.dat";
VARIABLE:
NAMES = ID SMY SEX RACE ETH TDV1 TDV9 TDV10 TDV12 TDV32 TDV33
DO;
MISSING=.;
IDVARIABLE IS ID;
USEVARIABLES= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 DO;
AUXILIARY=SMY;
CATEGORICAL= TDV1 TDV9 TDV10 TDV12 TDV32 TDV33 ;
ANALYSIS:
ESTIMATOR=ML;
ALGORITHM=INTEGRATION;
INTEGRATION=MONTECARLO;
PROCESSORS=4;
MODEL:
[ETA@0];
ETA*(veta);
!parameter values generated from MNLFA final model are used to fix parameter values
in scoring model
ETA BY TDV1 @2.97;
ETA BY TDV9 @4.602;
ETA BY TDV10 @6.978;
ETA BY TDV12 @3.01;
ETA BY TDV32 @3.794;
ETA BY TDV33 @2.361;
!NA;
TDV12 ON DO@0.079;
```

```
TDV32 ON DO@-1.595;
TDV33 ON DO@-0.696;
[TDV1$1@5.747];
[TDV1$2@7.99];
[TDV1$3@9.373];
[TDV9$1@-15.098];
[TDV9$2@10.594];
[TDV9$3@11.89];
[TDV9$4@12.929];
[TDV9$5@14.124];
[TDV10$1@15.461];
[TDV10$2@17.987];
[TDV10$3@19.874];
[TDV12$1@5.427];
[TDV12$2@7.534];
[TDV12$3@8.814];
[TDV32$1@-18.798];
[TDV32$2@1.612];
[TDV32$3@3.2];
[TDV32$4@4.22];
[TDV32$5@5.288];
[TDV33$1@-11.499];
[TDV33$2@2.049];
[TDV33$3@3.471];
[TDV33$4@4.248];
[TDV33$5@4.934];
MODEL CONSTRAINT:
veta=1*exp(0);
OUTPUT: tech1;
SAVEDATA: SAVE=FSCORES; FILE=scores.dat;
```