DISSERTATION

STRUCTURAL EQUATION MODELING OF RURAL ADOLESCENT

INHALANT ABUSE ACROSS ETHNIC GROUPS

Submitted by

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In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Fall 2011

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ABSTRACT

STRUCTURAL EQUATION MODELING OF RURAL ADOLESCENT

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This project aimed to increase understanding of inhalant abuse among ethnically diverse rural adolescents, an under-researched population when it comes to substance abuse (Pruitt, 2009). The present project used general findings about substance use from previous research reported in the literature, as well as findings specifically addressing inhalants, to test structural equation models of inhalant abuse for three major ethnic groups: African Americans, Mexican Americans and Whites. The sample consisted of survey responses from a total of approximately 17,000 rural adolescents, primarily from the Western and Southeastern United States, and was a subset of data collected under a nation-wide study of substance use by rural youth. The size and diversity of this sample allowed for the testing of Peer Cluster Theory and its ability to predict inhalant abuse across three ethnicities. The study utilized Structural Equation Modeling and included the following constructs: family caring, family sanctions, religious identification, school adjustment, peer drug associations, and inhalant abuse. According to Peer Cluster Theory, the effects of all the above factors on inhalant abuse are mediated through peer drug associations.

The first hypothesis of this study was that Peer Cluster Theory would be successful as a predictive model for inhalant abuse, as it has been for other types of drug

abuse (Breitmayer et al., 1993; Oetting, Donnermeyer, & Deffenbacher, 1998; Oetting, Donnermeyer, Trimble, & Beauvais, 1998). The second hypothesis, more exploratory in nature, was based on prior qualitative work (Wood et al., under review) and stated that there would be differences in model fit and/or specific regression coefficient paths across ethnic groups. The third hypothesis, based on findings reported in the literature by Mackesy-Amiti and Fendrich (2000), was that African Americans would have a lower regression coefficient for the path from school adjustment to peer drug associations than would Mexican Americans or Whites.

Findings indicated that Peer Cluster Theory was validated as a predictive model of inhalant abuse for all three ethnicities. Measurement variance made ethnic comparisons tenuous, but a substantive difference was found in the regression coefficients for the path from family sanctions to peer drug associations comparing ethnicities, with higher values for African Americans than for Whites. The hypothesis that the path from school adjustment to peer drug associations would be weaker for African Americans was not supported. Implications of the findings, limitations of the study, and directions for future research are discussed.

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CHAPTER I: INTRODUCTION

Inhalant abuse is by no means a new problem. It can be traced as far back as ancient Greece, when people seeking oracular visions would inhale vapors emanating from the ground (Hernandez-Avila & Pierucci-Lagha, 2005). In the United States, inhalant abuse emerged as a large-scale phenomenon around the time of World War II, coinciding with an expansion of industrial jobs and consequent exposure to chemicals that could be inhaled to get high (Hernandez-Avila & Pierucci-Lagha, 2005). Around the 1950s and 1960s, there were also several widely publicized cases of "glue sniffing" in the U.S. (Kolecki & Shih, 2008).

For the purposes of this research, inhalants are defined as volatile chemical products that can be inhaled through the nose or mouth as a drug. The use of these volatile chemicals as drugs will also be considered abuse. This is because there is no safe or socially accepted way of using as drugs chemicals designed for other purposes, and because these products are extremely dangerous--sometimes causing death in a single dosage (Beauvais, 2000; Fullwood & Ginther, 2000; Bowen, 2011). These products have a long history of abuse in the United States, but have only recently started to garner significant research attention. The problem of inhalant abuse is a significant one, with approximately 14.5% of 8th graders having abused these substances (Johnston, O'Malley, Bachman, & Schulenberg, 2010). This also means that inhalants are the third most commonly abused drug by 8th graders, behind only alcohol and marijuana (Johnston et

al., 2010). Among some populations in the US, rates of inhalant abuse are even higher. For example, rates approaching 30% have been found among alternative high school students in the United States (Fleschler, Tortolero, Baumler, Vernon, & Weller, 2002). Internationally, inhalant abuse seems to be just as troublesome a problem, and has been documented in young people from Mexico, Brazil, Columbia, Paraguay, Egypt, Israel, Japan, India, Australia, Canada, and other countries (Cairney, Maruff, Burns, & Currie, 2002; Coleman, Charles, & Collins, 2001; Duggal, Sinha, & Nizamie, 2000; Elkoussi & Bakheet, 2011; Gomibuchi, Gomibuchi, & Kurata, 2001; Hynes-Dowell, Mateu-Gelabert, Taunhauser Barros, & Delva, 2011; Kikuchi & Wada, 2003; Lopez-Quintero & Neumark, 2011; MacLean & D'Abbs, 2002; Neumark & Bar-Hamburger, 2011; Sharma & Lal, 2011; Villatoro, Cruz, Ortiz, & Medina-Mora, 2011; Waraich, Chavan, & Rah, 2003).

A study reviewing patterns of inhalant abuse in high schools across South America found that inhalants were either the first or second most frequently abused substance by participants. Lifetime usage rates ranged from a high of 16.55% in Brazil to a low of 2.67% in Paraguay. Many international studies in the past have highlighted the abuse of inhalants among street children, but this study shows that inhalant abuse does exist internationally even in the context of educational systems (Hynes-Dowell, Mateu-Gelabert, Taunhauser Barros, & Delva, 2011).

Among street children in Egypt, nearly 91% reported abusing inhalants at some point. Reasons given included because they were inexpensive, legal, and easy to acquire. Approximately one-third of the children studied (34.2%) reported using a product known as "Kolla," which is an industrial glue (Elkoussi & Bakheet, 2011).

In Israel, research an adolescent inhalant abuse found a past-month abuse rate of 7.5%. Past-month abuse of inhalants was also associated with other risky behaviors, including illicit drug use, smoking, binge drinking, and truancy (Neumark & Bar-Hamburger, 2011).

A long-term study of inhalant abuse in Mexico identified several consistent trends. Specifically, inhalant abuse generally begins at 12–14 years. Prevalence is approximately 1% in the general population, but 7% among high school students, and higher for street children. Toluene is the main active ingredient of the inhalants abused, but preferences vary within population groups. And marijuana and inhalants are now the two most commonly abused drugs among Mexican female high school students (Villatoro, Cruz, Ortiz, & Medina-Mora, 2011).

In Australia in particular, gasoline (or "petrol" in the Australian dialect) abuse among the country's Aboriginal adolescents, as well as attempts to treat its abuse, have received increasing attention in recent years (Cairney & Maruff, 2007; D'Abbs, 2006; Dingwall, Lewis, Maruff, & Cairney, 2010; Preuss & Brown, 2006; Senior, Chenhall, & Daniels, 2006).

In Canada, some practitioners have begun to utilize culturally-specific treatment models for inhalant abuse. For example, the Youth Solvent Addiction Program (YSAP) was established in 1996 in response to inhalant abuse among First Nations and Inuit youth in Canada. The YSAP integrates both Western approaches to treatment and elements in order to maximize effectiveness and appropriateness (Dell & Hopkins, 2011).

These are just some of the myriad research studies on inhalant abuse outside of the US. As can be seen by the content and scope of these studies, inhalant abuse is truly a

problem of international scale, occurring in countries ranging across 6 continents and having highly varying cultures.

The present research focused on a rural sample of American youth. Although some research suggests youth in rural areas may have higher usage rates of drugs than their urban counterparts, rural research tends to be lacking (Pruitt, 2009). However, some research on drug abuse has focused specifically on rural areas (Edwards et al, 2007; Leukefeld & Edwards, 1999; Peters, Oetting, & Edwards, 1992; Stanley, Comello, Edwards, & Marquart, 2008). In contrast to research finding higher rates of drug abuse in rural areas, some research has found lower or comparable rates of drug abuse among rural populations, as compared with urban populations (Peters, Oetting, & Edwards, 1992; Stanley, Comello, Edwards, & Marquart, 2008). Overall, research focusing specifically on inhalants and rurality (Edwards et al, 2007) found mixed results depending on ethnic group, gender, and rurality, with some populations showing higher levels of inhalant abuse in rural areas and others showing more abuse in metro areas. This project aimed to add to the understanding of the issue of inhalant abuse in rural communities, a population that makes up approximately one-fifth of Americans (Pruitt, 2009).

Effects of Inhalants

Along with being relatively common among our nation's youth and youth of other countries, inhalant abuse is also extremely harmful. For example, repeated abuse of inhalants can lead to extensive damage of vital bodily systems such as the heart, lungs, kidneys, and brain (Cairney, Maruff, Burns, & Currie, 2002; Kurtzman, Otsuka, & Wahl, 2001). Inhalant abuse can lead to severe medical repercussions, yet they are often

overlooked by scientists and medical professionals (Bowen, 2011). Two particularly egregious health consequences of inhalant abuse are sudden sniffing death syndrome and fetal solvent syndrome. Sudden sniffing death syndrome entails a sudden heart failure by someone under the influence of inhalants, usually if they are startled suddenly. Fetal solvent syndrome can be caused by in utero exposure to inhalants and is characterized by brain atrophy as well as behavioral, cognitive, and emotional abnormalities (Pascual et al., 2010). There has been research which found that exposure to toluene and n-hexane in rats during critical neural development periods retarded normal development of key neurological structures (Pascual et al., 2010). Similar patterns of exposure may lead to fetal solvent syndrome in humans. Rats exposed to toluene and n-hexane shortly after birth showed comparatively impaired dendrite growth and substantially lower brain weight, substantiating the deleterious effects on mammalian neural development of these common inhalant ingredients. However, this syndrome is not well understood, and medical professionals are just starting to become aware of the phenomenon in humans (Pascual et al., 2010).

Inhalant abuse is associated particularly with significant cognitive and neurological harm, as has been shown in multiple studies with both humans and animals (Takagi, Lubman, & Yücel, 2011). Long-term inhalant abuse is also associated with significant cognitive deficits and psychiatric disorders (Brouette & Anton, 2001; Cairney et al., 2002; Kurtzman et al., 2001). As with other drugs of abuse, chronic inhalant abusers have been found in some cases to suffer from withdrawal symptoms (Howard, Cotler, Compton, & Ben-Abdallah, 2001; Keriotis & Upadhyaya, 2000). Finally, perhaps the most dangerous aspect of inhalant abuse is that death can result even from a single

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dosing, usually by cardiac arrest, with a phenomenon known as "sudden sniffing death syndrome" (Beauvais, 2000; Bowen, 2011; Fullwood & Ginther, 2000). However, death is also possible from the cumulative damaging effects of chronic inhalant abuse (Maxwell, 2001).

Recent research has also found that inhalant abusers seem to suffer more brain damage and cognitive deficits than abusers of other drugs. For example, a study conducted with Indigenous Australians found that those who had a history of abusing petrol (gasoline) had poorer performance on psychomotor tasks, visual attention, memory, learning, spatial awareness and executive function. These effects were found even when factors such as age, education, gender, familiarity with computers, and regular long term cannabis use were controlled for (Dingwall, Lewis, Maruff, & Cairney, 2010). Another recent study found that a history of inhalant abuse was associated with leukoencephalopathy and myelin deterioration, whereas a history of alcohol and other drug abuse was not, and brain damage related to inhalant abuse can also begin within a few years (Al-Hajri, & Del Bigio, 2010). In a study comparing inhalant abusers, abusers of other drugs not including inhalants, and a control group, all drug users performed worse than the control group on cognitive tasks. However, inhalant abusers performed even worse than the non-inhalant abusing drug abusers on certain cognitive tasks (Takagi et al, 2011). And a research study examining the impact inhalant abuse may have on white matter in adolescents found that abnormalities existed in the white matter of inhalant abusers. These abnormalities, though also present in a group of cannabis users studied, were more exaggerated among inhalant abusers, particularly among those who began their inhalant abuse earlier. The authors conclude that abnormalities in white

matter may be the morphological underpinning for the cognitive and behavioral deficits commonly observed among long-term inhalant abusers (Yücel et al., 2010).

Although few studies have tested the degree to which these neural deficits may be permanent, one study found that some neurological functioning may be recovered, dependent upon the length and severity of inhalant abuse, as well as time abstinent. However, certain kinds of neurological damage, particularly those associated with lead entering the body through leaded gasoline exposure, may be permanent (Dingwall & Cairney, 2011).

Additionally, inhalant abuse--particularly high levels of inhalant abuse--is associated with several other risky behaviors. Researchers have found that college students who have a history of early inhalant abuse have elevated levels of behaviors such as binge drinking, smoking, and use of illicit drugs (Bennett, Walters, Miller, & Woodall, 2000). High-risk behaviors such as engaging in unprotected sex or acts of physical violence have also been found to be more likely among high frequency inhalant abusers (Garland & Howard, 2011). Suicidal ideation is significantly more common among inhalant abusers than non-abusers. Suicidal ideation is even more common among those who abuse inhalants at high levels, as compared to those who abuse inhalants at lower levels (Howard et al, 2010). And a study examining the relationship between inhalant abuse and other variables found that inhalant abuse is associated with higher rates of hepatitis C. Specifically, the rate of hepatitis C infection was 81% in inhalant abusers, compared to 55% in those abusing other drugs but reporting no inhalant abuse. This elevated high hepatitis C prevalence persisted even after controlling for risky

injection practices, suggesting that inhalant abusers may form networks of higher risk even within an already high-risk population (Shaw, Deering, Jolly, & Wylie, 2010).

Little research has been conducted on the effects of inhalants from the abuser's perspective and why people choose to inhale these chemicals, but there are some preliminary findings. Some evidence suggests that inhalants are used by some to regulate negative affective states (Garland, & Howard, 2011). Differences in the experience of high-frequency versus low-frequency inhalant abusers have also been noted. Specifically, Garland and Howard (2010) found that low-frequency inhalant abusers experienced primarily pleasant effects, whereas high-frequency inhalant abusers tended to experience a combination of pleasant and aversive effects, including chest pain, depressed mood, and suicidal ideation. Some research has also explored the preferences inhalant abusers show toward specific products. One study found that among paint abusing adolescents, some preferred inhaling chromatic paints because they were thought to be associated with more hallucinations than non-chromatic paints (Takagi, Yücel, & Lubman, 2010).

Toluene

Many studies have examined a common active ingredient in several inhalant products known as toluene. This compound is a solvent and is found primarily in products such as paint thinners and adhesives (Del Re & Woodward, 2005). In tests of addictiveness on rats, toluene was found to be highly addictive. Rats showed a strong tendency to self-administer toluene after 6 exposures, and an even stronger preference for administering toluene after 14 exposures (Lee, Gerasimov, Schiffer, & Gifford, 2006). Research has also found that toluene activates dopamine pathways in the brain, similar to other drugs such as heroin, cocaine, or amphetamines (Riegel, Zapata, Shippenberg, &

French, 2007). It has also been found that mice taught to discriminate between amphetamine and saline will respond to toluene as if it were amphetamine a significant amount of the time (Bowen, 2006). And among a group of toluene-based inhalant abusing adolescents in Mexico, hallucinations--including changes in color perception, visual, somatic, auditory, and tactile hallucinations--were common (Cruz & Domínguez, 2011). Interestingly, adolescent rats also behave differently than adult rats when exposed to toluene. Specifically, the adolescent rats generally are more active when exposed to toluene, as compared with adult rats (Batis, Hannigan, & Bowen, 2010).

Other nonhuman animal research also suggests that continued exposure to toluene may be neurotoxic, although the extent of damage and how similar the effects would be in humans are unclear (Yucel, Takagi, Walterfang, & Lubman, 2008). However, some research on chronic human abusers of toluene has been conducted, finding that in correspondence with severe cognitive deficits, these abusers tended to have damage to portions of white matter (as opposed to gray matter) in their brains (Yucel et al. 2008).

Treatments

Several experts have argued that more research is needed to inform the development of treatment paradigms specifically targeting inhalant abusers (Dell, Gust, & MacLean, 2011; Ives, 2011). Inhalants are one of the most toxic psychoactive substances, and inhalant abusers are an extremely high risk group, yet inhalant abuse remains a poorly understood phenomenon and even many treatment professionals remain unaware of how inhalant abusers tend to differ from abusers of other drugs (Garland & Howard, 2010, 2011; Ives, 2011). A recent study examined what treatment professionals perceive as needed to further the treatment of inhalant abuse. Many participants

expressed a lack of knowledge when it came to inhalant abuse and were uncertain what unique considerations might be needed in treating inhalant abusers. Recommendations for increased treatment effectiveness included the development of evidence-based inhalant abuse treatment, local need assessment, and the formal evaluation of treatment approaches currently being applied to inhalant abuse (Ives, 2011). However, one study did find a reduced rate of relapse for inhalant abusers whose treatment included Cognitive Behavioral Therapy (CBT). In a randomized trial study of CBT conducted in Turkey, inhalant abusers who received CBT were 20 percent less likely to relapse a year after treatment, when compared to a control group of inhalant abusers who had not received CBT (Ögel & Coskun, 2011).

Gender and Ethnicity Effects

In a review of inhalants, Mata (2002) found that as children get older, inhalant abuse is more prevalent among boys, and a study conducted in Texas found that over 90% of inhalant-related deaths involved male abusers (Maxwell, 2001), suggesting that males may be more prone to more long-term or extreme inhalant abuse. However, a 1992 study found that at younger ages, males and females tended to abuse inhalants at similar rates, and among certain age and ethnic groups the female abuse rate surpassed that of males (Beauvais, 1992). Several more recent studies have also examined the issue of inhalant abuse and possible gender differences, with widely varying results, some confirming earlier research, some not (Edwards et al., 2007; Freedenthal, Vaughn, Jenson, & Howard, 2007; Wu & Howard, 2007). The present study, however, focuses on possible differences across ethnic groups.

Some unique differences in inhalant abuse have also been found across various ethnic groups. For example, Mackesy-Amiti and Fendrich (2000) found that good grades were associated with lower inhalant abuse only for Whites. Conversely, they found that getting bad grades was associated with more inhalant abuse for all ethnic groups included except African Americans. Other studies have similarly found differences in factors related to inhalant abuse along ethnic lines.

A study by Edwards et al. (2007) found consistently different rates of inhalant abuse for adolescents of different ethnicities. They found that the highest lifetime usage rates of inhalants were among American Indian (22%) and Hispanic (23%) participants, Whites had an intermediate rate of abuse at approximately 15%, and Asian (10%) and African American (8%) adolescents had significantly lower inhalant abuse rates than adolescents of other ethnicities. Further, in a qualitative focus group study with adults conducted by Wood, Edwards, and Bell (under review) it was found that several factors related to inhalant abuse varied systematically across ethnicity. Specifically, among African Americans (who consistently tend to have the lowest inhalant abuse rates) there were two strong trends: a trend toward community involvement in the nurturing and discipline of children, and a trend toward rejection of inhalants as a drug of choice. The trend toward community involvement in child rearing, labeled "community parenting" in the qualitative study, was only found to occur consistently among the African American participants and represented, in the participants' opinion, a significant protective factor for their children, or a feature of their community that prevented inhalant abuse. The trend toward a rejection of inhalants as a preferred drug was also expressed in terms of a protective factor; in this case it was mentioned in the context of a cultural factor that

helped African American adolescents stay away from inhalants. This trend only occurred among African American participants, but appeared quite consistently in this group. Among Asian Americans interviewed, there was a strong trend toward extremely pro-active, involved parenting. Asian participants mentioned that they structured much of their children's time and provided them with ample extra-curricular activities, often with the deliberate intention of keeping them away from drugs, including inhalants.

Theoretical Background

Despite being an extremely harmful and prevalent drug, many experts have noted that, compared to research efforts on other comparable drugs of abuse, research on inhalants is relatively lacking (Dell, Gust, & MacLean, 2011; Perron et al, 2011; Ridenour, 2005). Particularly relevant for the current work is that, despite findings that inhalant abuse is more common among some ethnic groups (Edwards et al., 2007), little research has been reported on inhalant abuse among ethnic minorities. Theory can help drive needed research, and it may be useful to incorporate a theory that has been used in overall substance abuse to examine predictors of adolescent inhalant abuse across ethnic groups.

Peer Cluster Theory describes factors related to drug abuse (including inhalant abuse) among adolescents. This theory is useful to the present research endeavor both because it represents several of the factors found to be most highly associated with drug abuse overall and because it provides a model that details how these factors relate among each other and how that process is associated with actual drug abuse rates. Research on drug abuse in general has consistently found that among all the factors predictive of drug abuse for adolescents, the strongest correlations have come from peer associations with

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drugs. Peer Cluster Theory (Oetting & Beauvais, 1986, 1987, 1988) describes the phenomenon of adolescent drug abuse by proposing a model of factors related to drug abuse in which all major factors, such as family caring, family sanctions, school adjustment, and religious identification, affect drug use through the mediated pathway of peer drug associations (see Figure 1).

Family caring is defined as how much concern the family shows toward youths and their activities. Family sanctions are how much youths perceive that the family would try to stop them from engaging in various harmful activities. Religious identification is a general measure of how devoted youths are to religion. School adjustment indicates how well youths like school and teachers. Peer drug associations are the degree to which youths' peers use various drugs, and drug use is simply a measure of how often and whether or not youths use drugs (which, for this study, referred only to inhalants). This theory provides the major background that was utilized to develop structural equation models of factors related to inhalant abuse for testing.

In addition to Peer Cluster Theory, Primary Socialization Theory also informed the current research of the processes that typically are the basis for transmitting cultural values. Briefly, Primary Socialization Theory describes the three primary forces that transmit values, these being family, school, and peer clusters (Breitmayer et al., 1993; Oetting, Donnermeyer, & Deffenbacher, 1998; Oetting, Donnermeyer, Trimble, & Beauvais, 1998). Family is defined as the group of people who raise a child, imparting values and norms of behavior in the process. School is the cultural and social environment of the educational institutions that youths attend. And finally, peer clusters
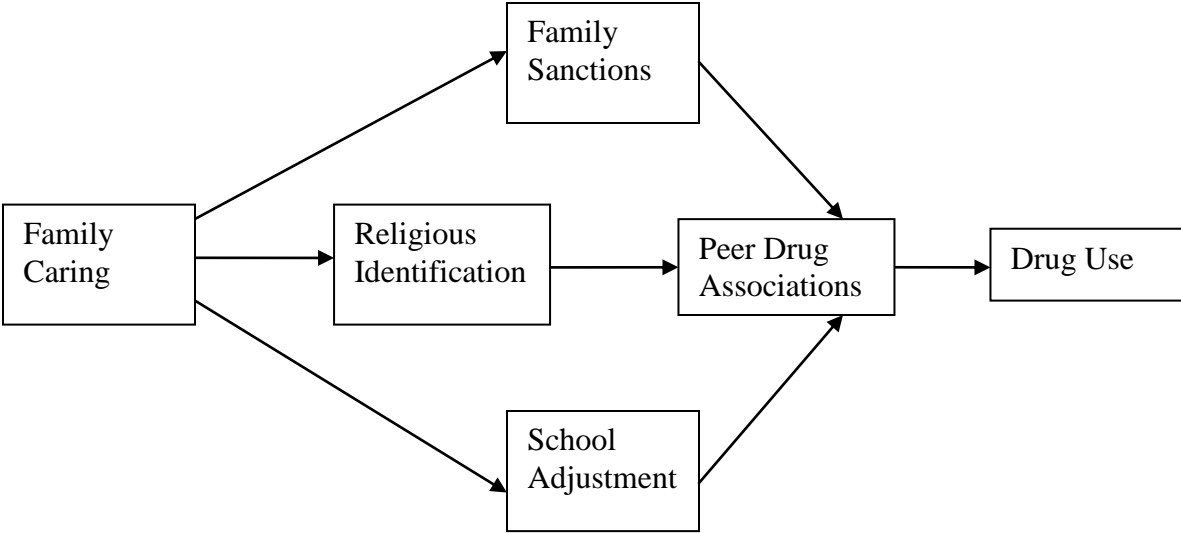
Figure 1. Peer Cluster Theory.

are the groups of friends with whom a specific youth associates and with whom he or she develops norms. Primary Socialization Theory states that in the process of normal development all other forces impacting the socialization of a child are mediated by these three primary socialization sources (see Figure 2). These other factors consist of peers, media, association groups, neighborhood/community, extended family, and religious institutions. Briefly, the theory defines peers as individuals with whom the youth spends time and who are approximately the same age (in contrast to peer clusters, which are norm forming groups of peers). Media is defined as television, radio, internet, newspapers, magazines, and any other sources of passive cultural information that the youth may encounter. Association groups are groups that the youth may participate in such as Scouts and sports teams. Neighborhood and community are the people living around the youth. Extended family refers to the array of aunts, uncles, grandparents, cousins, and other relatives with whom the youth has contact. All of these forces can influence the youth, but according to Primary Socialization Theory, only if they correspond to and are reinforced by more primary forces such as family, school, and peers. One caveat should be mentioned, however. Primary Socialization Theory acknowledges that in the absence of adequate primary socialization (for example, a neglectful family life), factors that would not normally serve as primary socialization forces (such as media or extended family) can become primary socializing forces.

 Primary Socialization Theory is highly compatible with Peer Cluster Theory. The main difference is that Primary Socialization Theory describes socialization across a wide range of ages, whereas Peer Cluster Theory focuses on adolescence, when peers are

peers

media

Peer
Clusters

religious
institutions

associational
groups

Youth

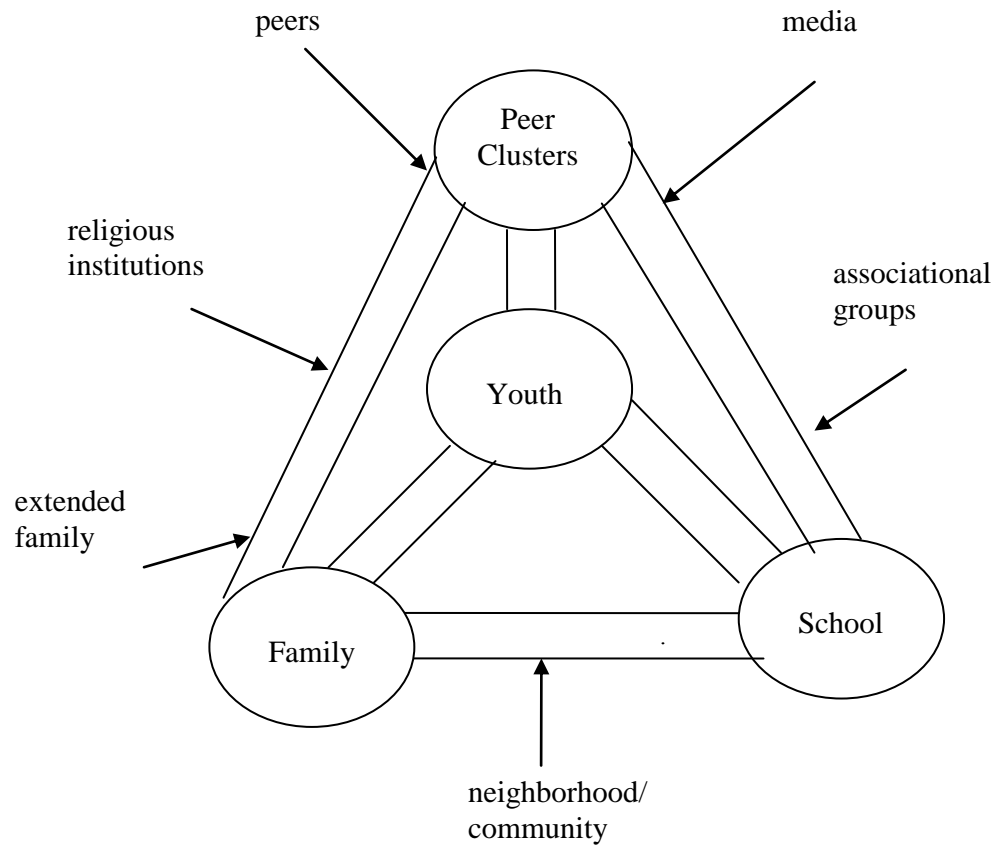extended
family

Family

School

neighborhood/
community

Figure 2. Primary Socialization Theory.

generally the most important socializing force. Because of its utility in describing processes of cultural value transmission (Oetting, Donnermeyer, Trimble et al., 1998) and the way in which community norms might impact drug use (Oetting, Donnermeyer, & Deffenbacher, 1998), Primary Socialization Theory also provides a meaningful theoretical context for the present research.

Current Research Goals

The ultimate goal of the present project was to build upon the above mentioned research to develop a more comprehensive understanding of inhalant abuse, as well as how factors related to inhalant abuse vary across ethnicity. It was hoped that in gaining this understanding, information relevant for culturally appropriate prevention strategies could be available to inform government and private agencies interested in undertaking such efforts.

In order to accomplish these goals, the current study was designed to be a direct continuation of the Peer Cluster Theory literature, as well as the Wood et al. (under review) qualitative study, utilizing the quantitative methodology known as Structural Equation Modeling (SEM; Byrne, 1994). SEM is a statistical procedure that allows for the creation of models representing factors related to the outcome of interest, in this case inhalant abuse. It also has the feature of allowing for the testing of different models for different population subsets. For this research study, these features make it ideal because the goal is to use Peer Cluster Theory, along with the patterns found in the Wood et al. (under review) qualitative study, to develop models that can then be tested quantitatively. Further, the SEM feature of being able to test whether models differ across different groups should allow the author to determine whether the factors shown to differ across

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ethnicity in the Wood et al. (under review) adult focus group study would also differ in the same ways when subjected to quantitative analysis of adolescent self-reported behavior.

Hypotheses

Hypothesis I posited that Peer Cluster Theory would work as a predictive model for inhalant abuse, as it has for other types of drug abuse (Breitmayer et al., 1993; Oetting, Donnermeyer, & Deffenbacher, 1998; Oetting, Donnermeyer, Trimble, & Beauvais, 1998). Peer Cluster Theory argues that the factors of family relations, school adjustment, and religious involvement are all associated with drug use. However, it further argues that all of these factors are mediated through a pathway of peer drug associations (Oetting & Beauvais, 1986, 1987, 1988). The Peer Cluster Theory mediation model was tested in the present study, and although it has been tested before, this time it was examined in the context of three different ethnic groups (African American, Mexican American, and White) to determine whether it would function in the same way for all three groups. It was also tested specifically with inhalant abuse to see if it would work as a predictive model with this unique drug. Inhalant abuse differs from other types of drug abuse in several meaningful ways such as availability, affordability, and lack of awareness of harmful consequences of use. Wood et al. (under review) in fact found that many adults in rural communities lacked awareness that chemicals such as gasoline and spray paint could even be inhaled as drugs. However, many of these same adults expressed awareness of drugs such as marijuana and meth, highlighting the unique nature of inhalants as a drug.

Hypothesis II, more exploratory in nature, was based on prior qualitative work (Wood et al., under review) and stated that there could be differences in model fit or specific regression coefficient paths across ethnic groups. Although this hypothesis was exploratory in nature, it was assumed that there would be more similarities in model fit and coefficient values across the two ethnic groups with similar inhalant abuse rates (Mexican American and White) and that there could be some differences in the group with consistently lower inhalant abuse rates (African American). Therefore, a main focus of the comparison of ethnic groups was to examine how factors predicting inhalant abuse for African Americans (the group with the lowest inhalant abuse rate) differed from Mexican Americans and Whites (groups with consistently higher rates of inhalant abuse).

As noted earlier, Mackesy-Amiti and Fendrich (2000) found that grades were mostly unrelated to inhalant abuse among African American youths. Therefore, Hypothesis III stated that African Americans would have a lower regression coefficient for the path from school adjustment (a proxy for grades) to peer drug associations (see Figure 3).
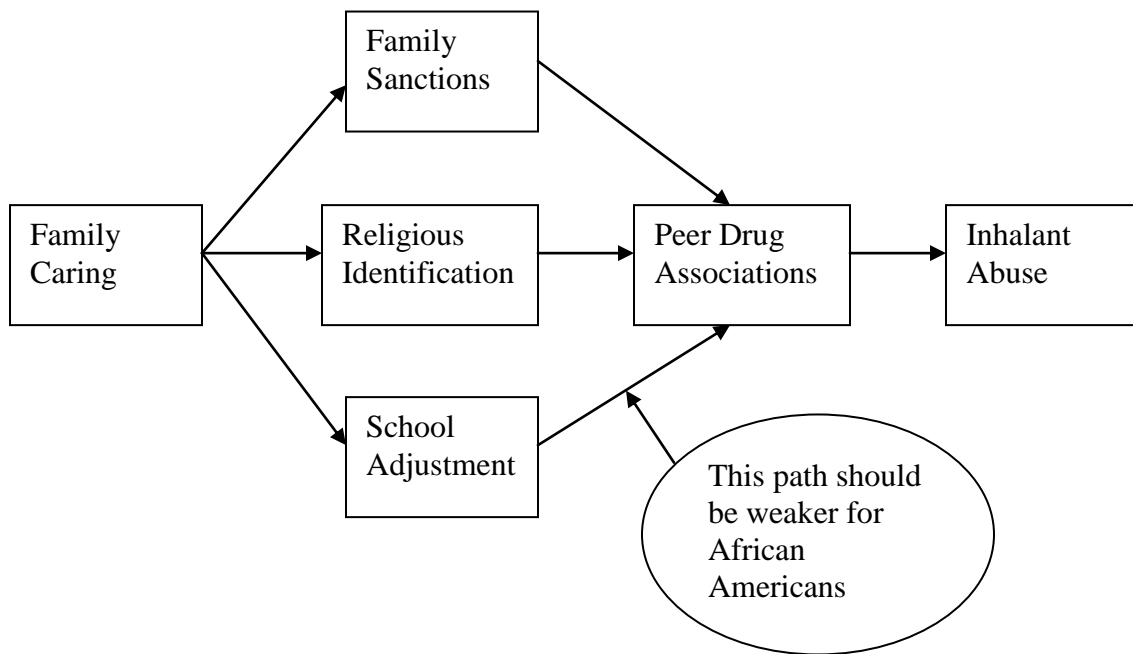
Figure 3. Peer Cluster Theory Indicating Differential Pathway Strength for African Americans.

CHAPTER II: METHOD

Participants

This study utilized a data set collected by the Colorado State University Tri-Ethnic Center for Prevention Research under a research project titled "Adolescent Drug Use in Rural America." This project was funded by the National Institute on Drug Abuse (R01 DA98349; PI: Ruth W. Edwards). Survey data were collected using a stratified random sample of students in middle and high schools across the US between 1996 and 2000, with oversampling in rural ethnic minority communities (specifically Mexican American and African American). The sample was stratified based on rurality and region of the country. Ethnic minority communities were defined as communities that included 40% or more of the targeted ethnic minority individuals attending schools in the community. The pool of minority communities from which the sample was drawn was based on statistics available in the National Center for Educational Statistics (NCES) database. Using a random sampling methodology, communities were selected from the list of eligible communities for each stratum. The high school (or most ethnically representative high school if there were more than one in the community) was contacted and invited to participate in the study. If the high school consented to participate, then the feeder middle school(s) to that high school was/were contacted and asked to participate. If the researchers were unable to recruit a selected community, another community was selected from the pool of eligible communities and the process was repeated.

The subset of data utilized in this study included 17,146 seventh through ninth grade students in the oversampled Mexican American and African American communities as well as communities which were predominantly White matched with the targeted minority communities based on level of rurality and region of the country. The mean age of participants was 13.45 with a standard deviation of 1.08. The gender split was approximately equal, with 49.9% indicating they were male and 49.6% female. Of the total number of participants, 13,266 indicated they were White, 2,215 African American, and 1,665 Mexican American. Other ethnic groups present in the original data set (primarily American Indian and Asian) were excluded from this analysis because they were represented in numbers too small for SEM analysis after narrowing the dataset to the oversampled ethnic minority communities and the White communities matched to them. This was done in order to ensure a consistent level of rurality and exclude data taken from non-rural communities, such that rurality would not be a confounding variable in the analysis.

The designation of the subsample as "Mexican-American" rather than the more generally used designation of "Hispanic" is intentional and correctly identifies the sample. Those students indicating that they were Puerto Rican, Cuban American, Spanish American or other Hispanic were not included in the sample because they were represented in insufficient numbers. Similarly, the designation of the subsample as "White" is because that is the term used on the survey and those individuals checking it did not additionally check any other designation.

Procedure

Schools that chose to participate were mailed the Community Drug and Alcohol Survey (CDAS-described below) to administer to all registered students in their school. Data were collected anonymously and according to human research standards. After the surveys were collected, they were mailed back to the Tri-Ethnic Center for data processing.

Materials

All students in the targeted grades at the targeted schools present on the day of the surveying were asked to complete the Community Drug and Alcohol Survey (CDAS), a 99-item optical mark form that asks students about a variety of topics, including inhalant abuse, use of other drugs, relationships with peers, school adjustment, experiences with crime and violence, relationships with family members, and ethnic group identification. The questions from the CDAS included in this study are listed in Appendix A as well as below. These include the indicators for the constructs that are elements of Peer Cluster Theory (see Figure 4) and four questions (numbers 1, 2, 3, and 40) needed for demographic information. The survey is at approximately a sixth grade reading level and, on average, students take approximately 20 minutes to complete it.

Constructs and Indicators

The latent constructs for the structural equation model were each comprised of several observed variables or indicators (survey questions; see Appendix A) that were regressed upon them. Specifically, family caring was comprised of 2 survey questions both with four possible responses (scored as 1, 2, 3, and 4, respectively), numbers 83a and 83b on the CDAS survey. Question 83 read "Does your family… a. Care about you?

A lot, Some, Not much, Not at all b. Care what you do? A lot, Some, Not much, Not at all." Family sanctions had 4 parts of survey question number 82, all with four possible responses (scored as 1, 2, 3, and 4, respectively). Question 82 read "How much would your family try to stop you from…." The four parts of this question used in the present study were: "b. Getting drunk, c. Using inhalants like glue, gas, etc., d. Using marijuana, and e. Using other drugs." The response options for all of these sub-questions were: "A lot, Some, Not much, Not at all." Religious identification had three questions, numbers 51, 52, and 53, again each with 4 possible responses (scored as 1, 2, 3, and 4, respectively). Question 51 read "Are you religious? A lot, Some, Not much, No." Question number 52 read "Do you practice a religion? A lot, Some, Not much, No." And question 53 read "How important is religion on your life? A lot, Some, Not much, Not at all." School adjustment had four parts of question number 66, each with four responses (scored as 1, 2, 3, and 4, respectively). Question 66 read "How much do you agree with each of the following?" The four parts of the question were: "a. I like school, b. My teachers like me, c. I like my teachers, and d. School is fun." The four possible responses to all of these questions were "A lot, Some, Not much, Not at all." Peer drug associations had the most indicators with 3 questions each containing 5 sub-questions, for a total of 15. All of these questions had 4 response options (scored as 1, 2, 3, and 4, respectively). The first question (34) read: "How much would your friends try to stop you from…." The sub-questions were: "a. Using marijuana?, b. Using cocaine?, c. "Sniffing" or "huffing" something like glue, gas, etc. (inhalants)?, d. Using uppers?, and e. Using downers?" The responses for all of these were "A lot, Some, Not much, Not at all." Question 35 read "How many of your friends do each of the following…." The sub-questions were the

same as number 34, but the response options were: "None, A few, Most of them, All of them." Question 36 read "How often have your friends asked you to use…." The sub-questions were the same as 34 and 35, but the response options were: "Very often, Some, Not very often, Not at all." Because the large number of indicators for the peer drug associations construct created statistical anomalies in the analysis, it was broken down into 3 subscales: inhalants, marijuana, and other drugs. The three subscales were then the components of the construct.

The final construct, inhalant abuse, had two indicators, questions number 26d and 28c. Question 26d had 5 responses (scored as 1, 2, 3, 4 and 5, respectively) and 28c had 6 responses (scored as 1, 2, 3, 4, 5 and 6, respectively). Question number 26 read "Have you used any of these drugs to get high during the last month?" Sub-question d read: "d. Inhalants ("Sniff" or "huff" something like glue, gas, paint, etc.)," and the responses were as follows: "No, 1-2 times, 3-9 times, 10-19 times, 20 or more times." And finally question 28 read: "28. In using each of the following, are you a…." Part c read "c. Inhalants ("Sniff" or "huff" something like glue, gas, paint, etc.)," and the response options were: "Non-user, Very light user, Light user, Moderate user, Heavy user, Very heavy user."

Lifetime use estimates were based on question 22d. Question number 22 read "Have you ever tried any of the following drugs? *If you don't know what they are, mark "no".*" Sub-section d read "d. Inhalants ("Sniff" or "huff" something like glue, gas, paint, etc.)" and the response options were "yes" or "no."

Analyses

Structural Equation Modeling (SEM) was used to test the hypotheses of this study. SEM has several strengths as a statistical method that makes it ideal for this inquiry (Byrne, 1994). First, it is designed to allow for testing complex models, including interaction effects such as mediation and moderation. This is important because Peer Cluster Theory hypothesizes a mediation effect, for which the current study planned to test in three ethnic groups. It is also important because a prior, qualitative study conducted by the author suggests that among the group with the lowest inhalant abuse rates (African Americans), factors related to inhalant abuse may operate differently than for other ethnic groups. SEM is well suited for testing both of these possibilities. Further, SEM allows for the statistical comparison of different models for different population subsets, and reveals whether the observed differences are statistically significant or more likely just due to chance. This is a key feature for the present study because different models were compared for the different ethnic groups to determine whether factors related to inhalant abuse operate differentially across these groups. Figure 4 shows the full latent model tested using SEM. The boxes indicate questions (indicators) that load onto certain factors (constructs). This factor loading was measured in the preliminary (measurement) analysis. The circles represent factors that were hypothesized to be related in specific ways, signified by the arrows. These relations were tested in a second stage of analysis, the structural analysis.

The current analysis utilized a subset of questions included on the CDAS. Demographic characteristics, gender, and ethnicity were single-item responses and were included for demographic information and to allow for cross-ethnic comparisons.
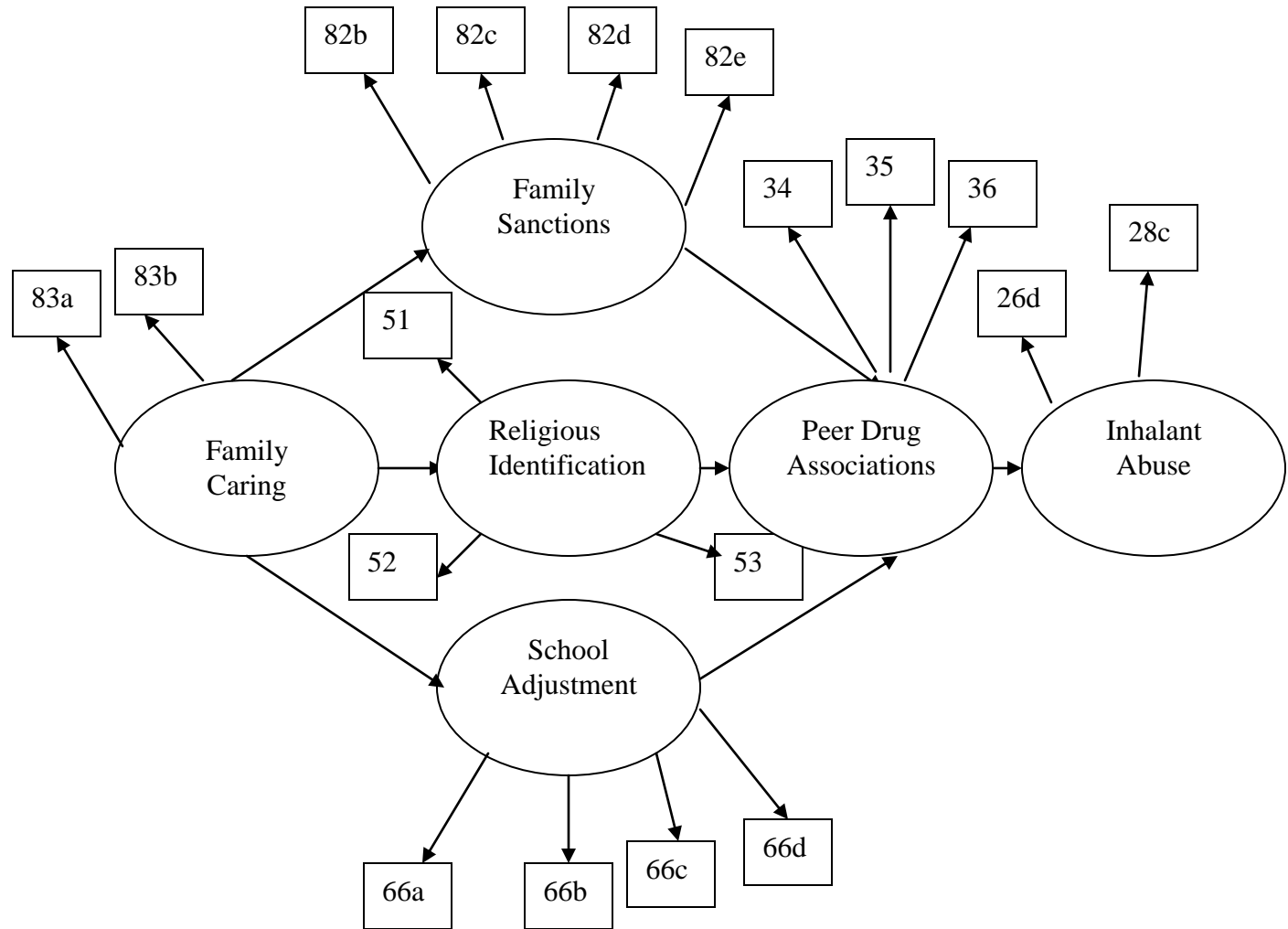
Figure 4. Latent variable model of factors predicting inhalant abuse. Numbers indicate the item number from the survey in Appendix A.

Questions on peer drug associations, religious identification, family caring, family sanctions, school adjustment, and inhalant abuse were utilized both to test the fit of Peer Cluster Theory when predicting solely inhalant abuse (the dependent variable), and to test differences in the way Peer Cluster Theory may operate across ethnicities. See Appendix A (or the description above) for all CDAS questions included in this study.

CHAPTER III: RESULTS

Reliability Analysis

A reliability analysis was conducted on all of the survey questions to be used in the SEM analyses in order to ensure sufficient reliability of the survey instrument before proceeding with analyses. Cronbach's alpha values were calculated for all of the survey scales to be used in the present research. This procedure tests the degree to which the survey questions are associated with each other. Survey items loading onto the same construct should have a high Cronbach's alpha, and a .8 or higher Cronbach's alpha indicates sufficient reliability. The correlation for family caring among Whites, as well as the Cronbach's alpha for peer drug associations among Whites and the correlation for inhalant abuse among African Americans showed values closer to .7 than .8, indicating less than ideal reliability. Table 1 shows the specific Cronbach's alphas for each scale, both overall and across the three ethnic groups.

Descriptive Statistics

Lifetime inhalant abuse rates by ethnicity (derived from question 22) were calculated for the present sample and were found to be consistent with prior research. Specifically, African Americans showed the lowest percentage of lifetime abuse at 8.4%. Mexican Americans had a lifetime prevalence of 13% and Whites had a lifetime prevalence of 13.2%. Johnston et al. (2010) found a higher lifetime inhalant abuse prevalence among 8th graders overall than found in any of these ethnic groups, but this

Table 1

Cronbach's Alpha Values for All Scales

	Cronbach's alpha			
Scale	Overall	African American	Mexican American	White
Family caring	.75*	.84*	.91*	.69*
Family sanctions	.97	.99	.98	.96
Religious identification	.90	.89	.88	.91
School adjustment	.87	.88	.90	.88
Peer drug associations	.79	.77	.79	.74
Inhalant abuse	.77*	.67*	.80*	.87*

*Because family caring and inhalant abuse are composed of only two questions, these are correlations rather than Cronbach's alpha.

could be for several reasons. First, 8th graders tend to have the highest reported lifetime inhalant abuse rate of any grade (Johnston et al., 2010). Second, Johnston et al.'s data were from 2010 and rates of inhalant abuse tend to fluctuate somewhat from year to year (Johnston et al., 2010). Their data were also not rural, so the inclusion of participants from more densely populated areas may have had an impact.

Figures 5 and 6 show the reported inhalant use levels, omitting those who reported no use and those with missing data on the use items. Monthly frequency of inhalant use is presented in Figure 5, and degree of abuse is shown in Figure 6. Both figures indicate that over half the users fall into the lightest use category and that less than 10% of users fall into the heaviest abuse category. Moreover, the patterns appear similar across the three ethnicities. All of the following analyses refer to the entire sample, including the nonusers and users, with imputed missing data for the SEM analysis.

As can be inferred from the lifetime abuse rate numbers, inhalant abuse was highly skewed toward non-users, representing approximately 85-90% of the sample, depending on ethnic group. Given the highly skewed nature of the dependent variable in these analyses, the robust estimation method of SEM, which compensates for non-normal data, was used. Means and standard deviations for all of the scales used in the present study are presented in Table 2. Means of factors across ethnic group are presented in Table 3. Results from an ANOVA for each factor showed that all variables appeared to differ significantly across ethnicity. However, given the large sample for the present study, some of these differences, while statistically significant, might not be very
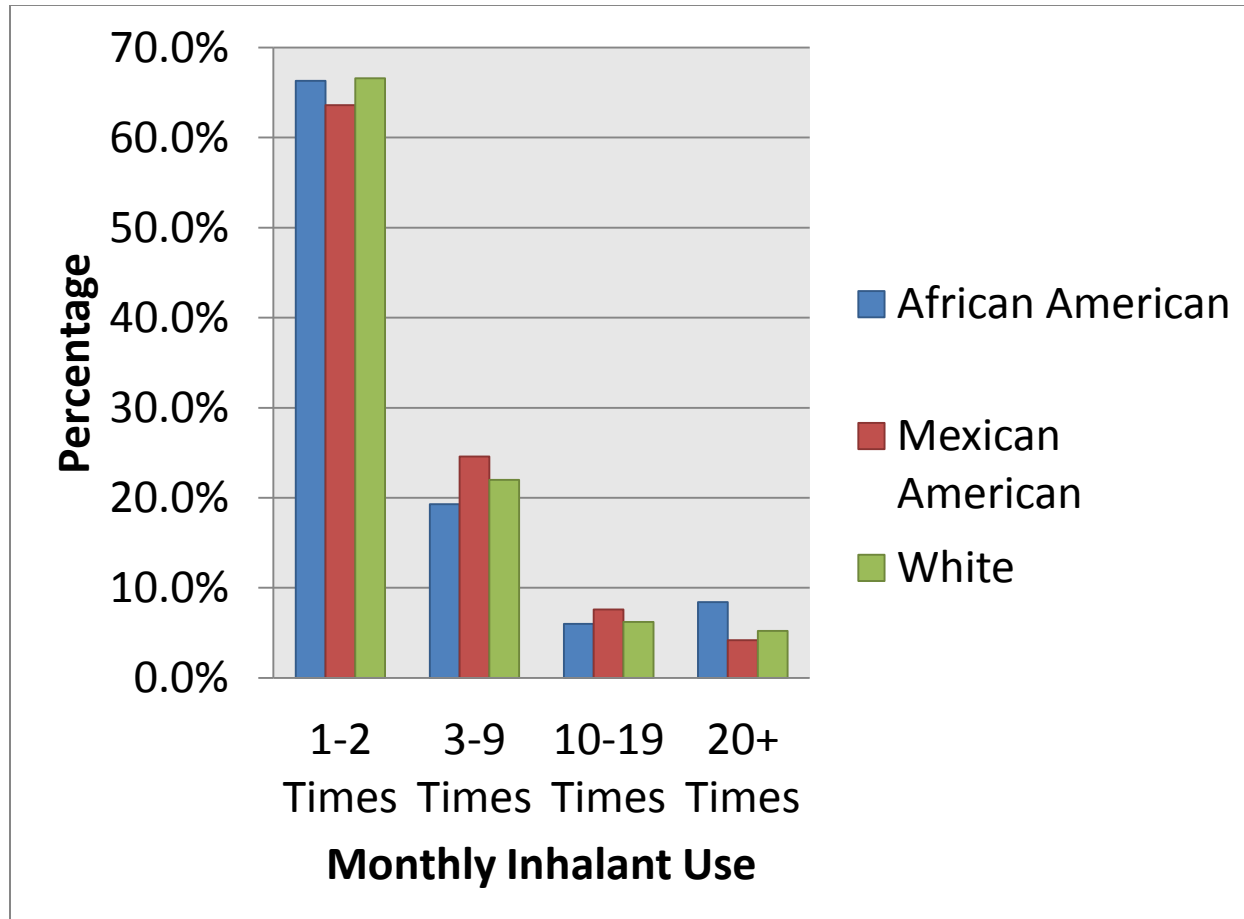
Figure 5: Graph of reported monthly inhalant use by ethnicity, omitting nonusers. Percentages refer only to percentage of users (less than 14% of the entire sample).
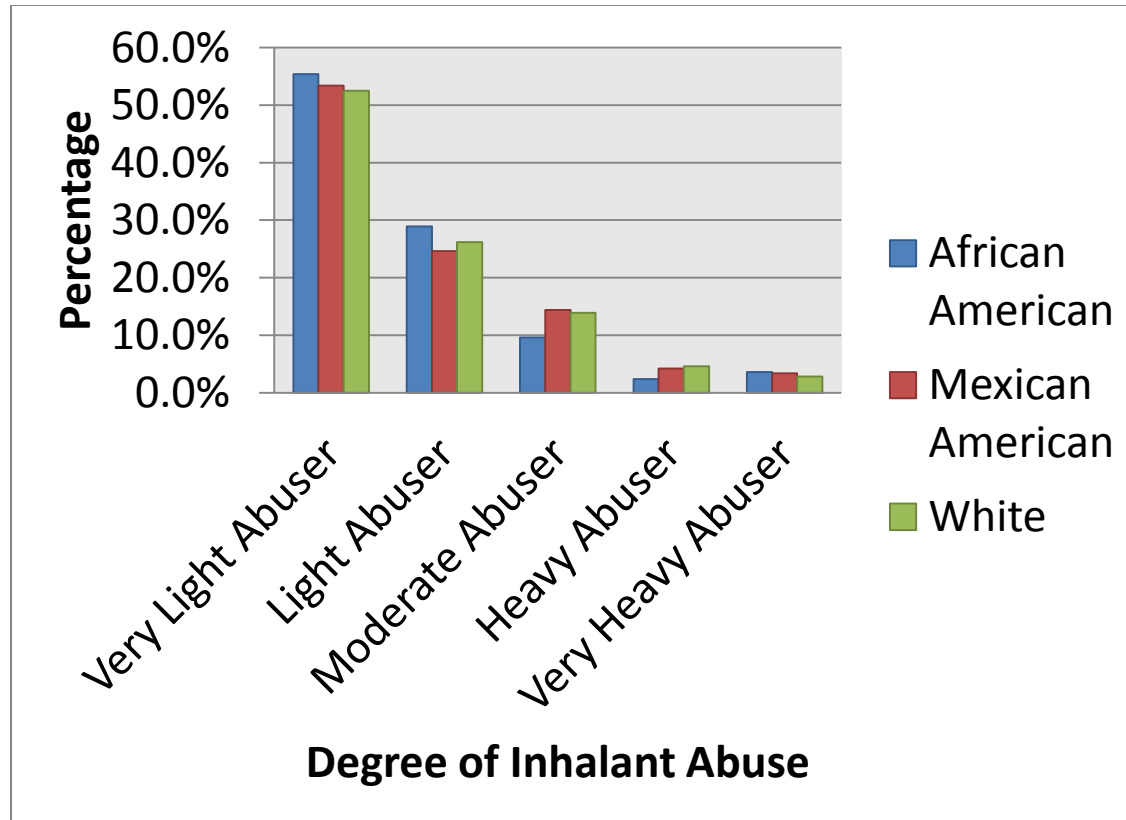
Figure 6: Graph of reported degree of inhalant abuse by ethnicity, omitting nonusers. Percentages refer only to percentage of users

(less than 14% of the entire sample).

Table 2

Means and Standard Deviations for All Scales

Variable	M	sd
Family caring	7.60	.93
Family sanctions	14.81	2.71
Religious identification	8.80	2.62
School adjustment	11.61	2.80
Peer drug associations	28.75	5.53
Inhalant abuse	2.26	.93

Table 3

Means of All Factors and ANOVA Results Across the Three Ethnic Groups

Factor	African American	Mexican American	White	F	df	p	eta^2
Family caring	7.54a	7.35b	7.65c	15.24	2, 17140	<.001	.01
Family sanctions	14.02a	14.00a	15.05b	43.59	2, 17140	<.001	.03
Religious identification	8.70a	8.26b	8.88c	5.40	2, 17140	<.001	.01
School adjustment	11.77a	11.70ab	11.57b	223.80	2, 17140	<.01	.00
Peer drug associations	27.22a	28.24b	29.07c	83.80	2, 17140	<.001	.01
Inhalant abuse	2.17a	2.29b	2.27b	11.34	2, 17140	<.001	.01

Within each factor means that do not share a common letter are significantly different by a Tukey test at p< .05

meaningful. As can be seen from Table 3, most of the values do differ to a statistically significant extent across ethnic groups. However, the vast majority of these differences amount to very low eta^2 values, bringing their practical significance into question. The highest eta^2 was .03 for family sanctions. Correlations among the factors are shown in Table 4 for the overall data and in Tables 5, 6, and 7 for ethnicity-specific data. Most of the factors were correlated to a modestly positive degree, except for inhalant abuse. Inhalant abuse shows primarily negative correlations with the other factors. This trend is consistent across ethnic groups.

Measurement Model and Missing Data Imputation

Missing data were imputed using the multiple imputation function of EQS, the statistical program utilized in the analyses. Initially, the measurement model was analyzed and found to have an overall Cronbach's alpha of .81 but only a .59 comparative fit index. This is rather low, making it unlikely that the model would reach sufficient fit in the structural analysis. However, upon further examination it was found that the high number of indicators for the peer drug associations factor was responsible for this low fit, so they were combined into three scales (one for inhalants, one for marijuana, and one for other drugs). The measurement model was run again and it reached an adequate fit of .96. In order to compensate for non-normal data distributions, a robust analysis was also run and this found a fit index of .94. Table 8 lists the factor loadings and residuals for all of the survey questions used.

Structural Model

A structural analysis was conducted and the comparative fit index for the model depicted in Figure 7 was found to be .95, while the robust fit index was .93. This

Table 4

Overall Correlation Matrix

Factor	Family caring	Family sanc.	Religious id.	School adj.	Peer drug	Inhalant abuse
Family caring	--	.47*	.27*	.36*	.08*	-.18*
Family sanctions	.47*	--	.21*	.20*	.20*	-.13*
Religious identification	.27*	.21*	--	.31*	.07*	-.11*
School adjustment	.36*	.20*	.20*	--	.06*	-.22*
Peer drug associations	.08*	.20*	.07*	.06*	--	.13*
Inhalant abuse	-.18*	-.13*	-.11*	-.22*	.13*	--

Note: value marked with an asterisk are significant at *p*<.01

Table 5

Correlation Matrix for African Americans

Factor	Family caring	Family sanc.	Religious id.	School adj.	Peer drug	Inhalant abuse
Family caring	--	.47*	.29*	.37*	.19*	-.09*
Family sanctions	.47*	--	.23*	.19*	.37*	-.04*
Religious identification	.29*	.23*	--	.34*	.10*	-.05*
School adjustment	.37*	.19*	.34*	--	.10*	-.13*
Peer drug associations	.19*	.37*	.10*	.10*	--	.09*
Inhalant abuse	-.09*	-.04*	-.05*	-.13*	.09*	--

Note: value marked with an asterisk are significant at *p*<.01

Table 6

Correlation Matrix for Mexican Americans

Factor	Family caring	Family sanc.	Religious id.	School adj.	Peer drug	Inhalant abuse
Family caring	--	.64*	.36*	.38*	.05*	-.13*
Family sanctions	.64*	--	.30*	.24*	.22*	-.09*
Religious identification	.36*	.30*	--	.27*	.06*	-.04*
School adjustment	.38*	.24*	.27*	--	.08*	-.16*
Peer drug associations	.05*	.22*	.06*	.08*	--	.17*
Inhalant abuse	-.13*	-.09*	-.04*	-.16*	.17*	--

Note: value marked with an asterisk are significant at *p*<.01

Table 7

Correlation Matrix for Whites

Factor	Family caring	Family sanc.	Religious id.	School adj.	Peer drug	Inhalant abuse
Family caring	--	.41*	.25*	.37*	.04*	-.21*
Family sanctions	.41*	--	.18*	.21*	.12*	-.16*
Religious identification	.25*	.18*	--	.31*	.06*	-.13*
School adjustment	.37*	.21*	.31*	--	.05*	-.24*
Peer drug associations	.04*	.12*	.06*	.05*	--	.13*
Inhalant abuse	-.21*	-.16*	-.13*	-.24*	.13*	--

Note: value marked with an asterisk are significant at *p*<.01

Table 8

Factor Loadings and Residuals

| Question	Factor Loading	Residual
Inhalant abuse 26	.85	.54
Inhalant abuse 28	.90	.43
Peer drug associations 34A	-.83	.55
Peer drug associations 34B	-.93	.38
Peer drug associations 34C	-.88	.48
Peer drug associations 34D	-.99	.13
Peer drug associations 34E	-.99	.13
Peer drug associations 34F	-.71	.70
Peer drug associations 34G	-.83	.57
Peer drug associations 35A	.27	.96
Peer drug associations 35B	.25	.97
Peer drug associations 35C	.25	.97
Peer drug associations 35D	.27	.96
Peer drug associations 35E	.27	.96
Peer drug associations 35F	.22	.98
Peer drug associations 35G	.21	.98
Peer drug associations 35H	.19	.98
Peer drug associations 36A	.22	.98
Peer drug associations 36B	.17	.99
Peer drug associations 36C	.17	.99
Peer drug associations 36D	.18	.98
Peer drug associations 36E	.17	.99
Peer drug associations 36F	.18	.98
Peer drug associations 36G	.14	.99
Religious Identification 52	.88	.47
Religious Identification 53	.88	.48
Religious Identification 54	.85	.53
School adjustment 67A	.82	.57
School adjustment 67B	.76	.65
School adjustment 67C	.83	.56
School adjustment 67D	.81	.59
Family sanctions 83B	.87	.50
Family sanctions 83C	.94	.35
Family sanctions 83D	.97	.26
Family sanctions 83E	.98	.20
Family caring 84A	.86	.51
Family caring 84B	.89	.46
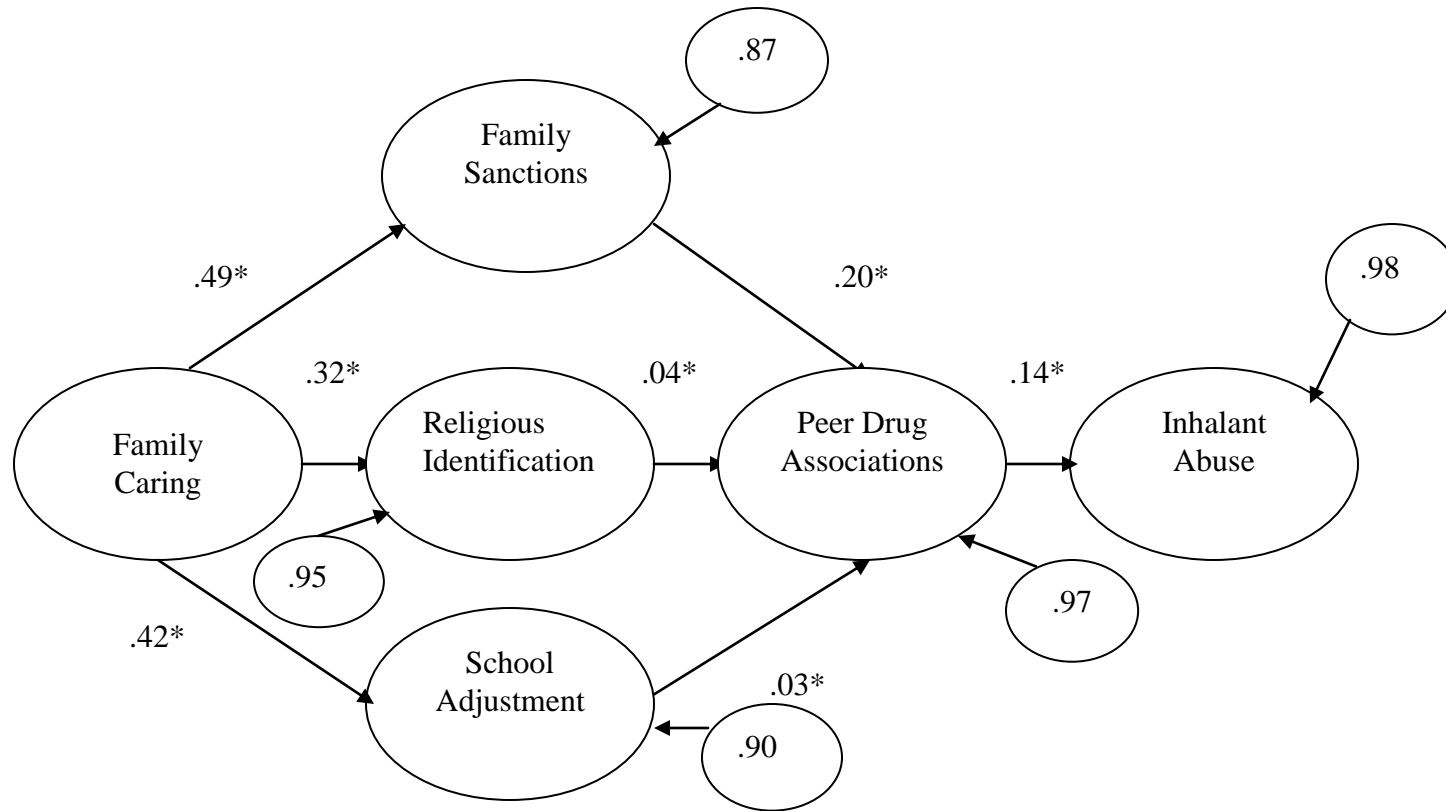
Figure 7: Structural model with regression coefficients and disturbance terms.

represents a high degree of fit, the general threshold for sufficient model fit being approximately .90. A standard Chi-square value of 242,170.64 with 153 degrees of freedom was also found, as well as a robust Chi-square of 95,362.06 with 153 degrees of freedom. These are both statistically significant at $p<.001$, indicating further support for the fit of the model. Therefore, it can be concluded that Peer Cluster Theory appears to be a good fit for predicting inhalant abuse, at least in this data set. Hypothesis I, that Peer Cluster Theory would function adequately in predicting inhalant abuse was supported. Listed in Figure 7 are the regression coefficients for all of the structural model pathways. All of these pathways were found to be statistically significant at $p<.05$ (marked with an asterisk), but some (particularly religious identification to peer drug associations and school adjustment to peer drug associations) are of a low enough magnitude that they may not be considered practically significant. Disturbance terms, which indicate the degree of error in measuring each latent construct, are also presented in Figure 7.

Ethnicity Comparisons

The measurement model was tested on the three different ethnicities using the "groups" command in EQS. This procedure was conducted to test for measurement invariance (essentially to make sure that the survey questions loaded onto factors in the same way for all three groups). Two measurement models were run, one with equality constraints and one without, and then the Chi-square values of the two were compared. The difference in Chi-squares was found to be 404.37 with 18 degrees of freedom, which is significant at $p<.001$. This indicates a lack of measurement invariance, essentially that the same questions are measuring somewhat different factors across the ethnic groups. At this point a Legrange Multiplier test was conducted in order to identify how many factors

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were contributing to the lack of invariance. If there are only one or two, they can be estimated freely, allowing a group analysis to still be conducted. However, 16 of 19 constraints were found to be significant, indicating there were multiple sources for the lack of invariance. Therefore, a single analysis comparing the structural model across ethnic groups would not be valid. However, it was still possible to analyze each group separately and make some very basic comparisons, so three separate measurement and structural models were run, one for each ethnic group. It was found that the measurement model had a high degree of fit for all three groups across both standard and robust fit indices. Specifically, the standard fits were .96 for African American, .97 for Mexican American, and .96 for White. The robust fits were .96 for African American, .97 for Mexican American, and .93 for White. All three structural analyses also reached a good fit across both the standard and robust fit indices. The standard fit indices were .96 for African American, .96 for Mexican American, and .94 for White. The robust fit indices were .96 for African American, .97 for Mexican American, and .92 for White. The Chi-square values were also significant for all three groups at $p<.001$, indicating that Peer Cluster Theory functions adequately as a predictive model for all three groups, as well as overall. Table 9 shows the measurement and structural model fits overall and for all three ethnicities, as well as the Chi-square values for the structural model. As can be seen, the degree of fit for Peer Cluster Theory is highly similar across the three ethnic groups. Regression coefficients and disturbance terms for the three ethnicity-specific models are shown in Figures 8, 9, and 10.

However, there were some differences in regression coefficients across ethnic groups. A difference of .2 or higher is considered meaningful in this kind of analysis, and

Table 9

Fit Statistics for the Structural Model across Ethnicity

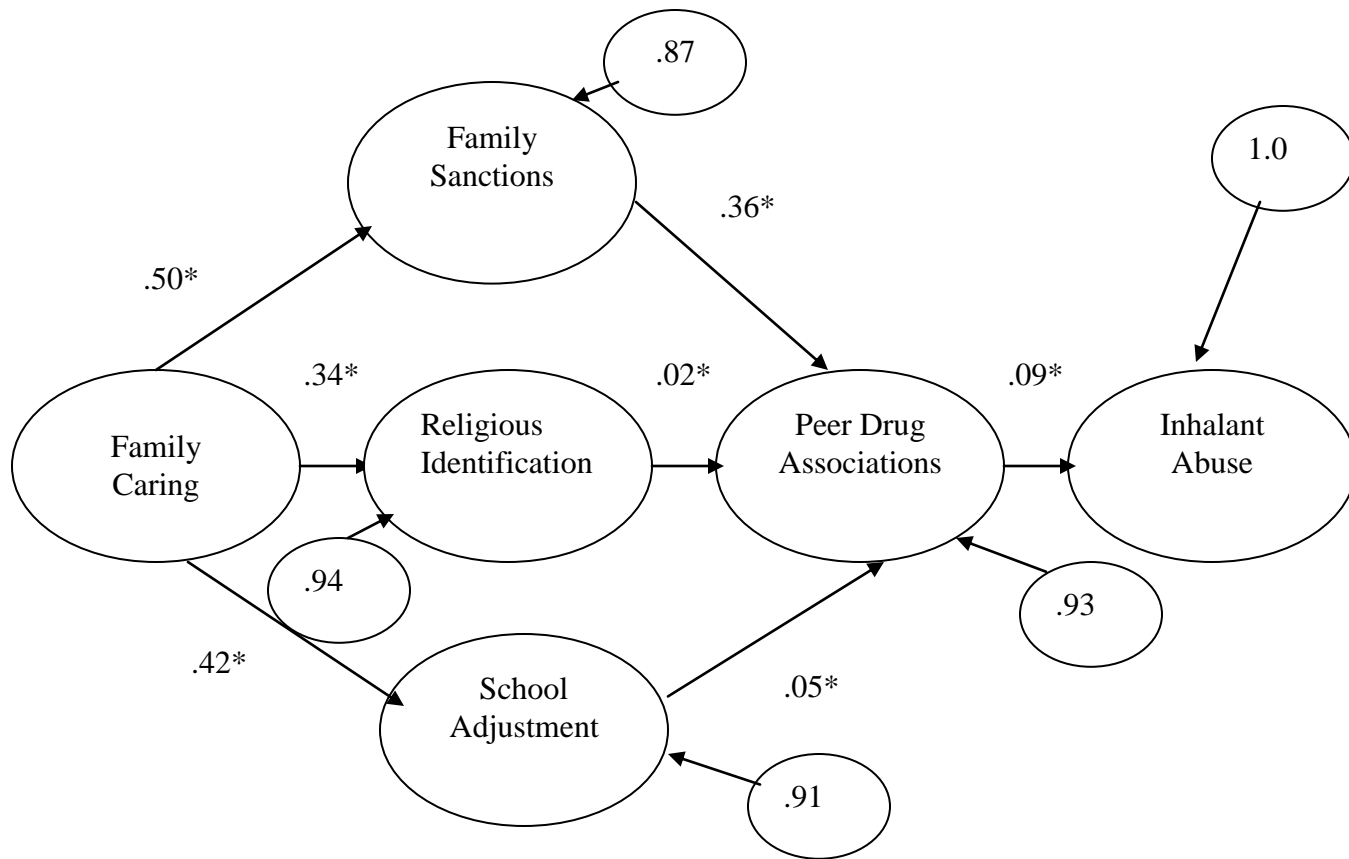| Sample	Measurement CFI	Structural CFI	Robust Measurement CFI	Robust Structural CFI	Robust χ^2	df	p
Overall	.96	.95	.94	.93	95,362.06	153	<.001
African-Americans	.96	.96	.96	.96	17,019.20	153	<.001
Mexican-Americans	.97	.96	.97	.97	13,408.74	153	<.001
White	.96	.94	.93	.92	65,248.66	153	<.001

Figure 8: African American structural model with regression coefficients and disturbance terms.
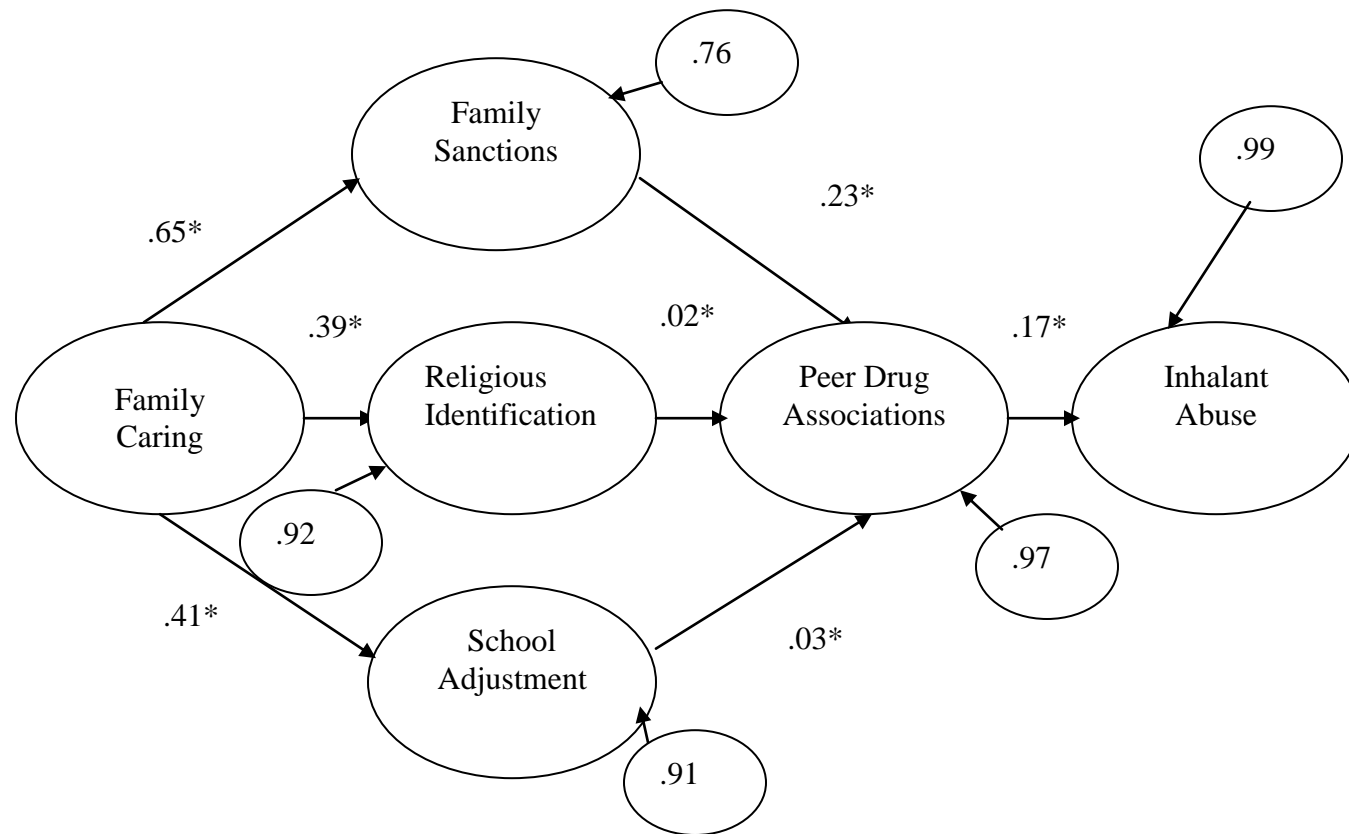
Figure 9: Mexican American structural model with regression coefficients and disturbance terms.
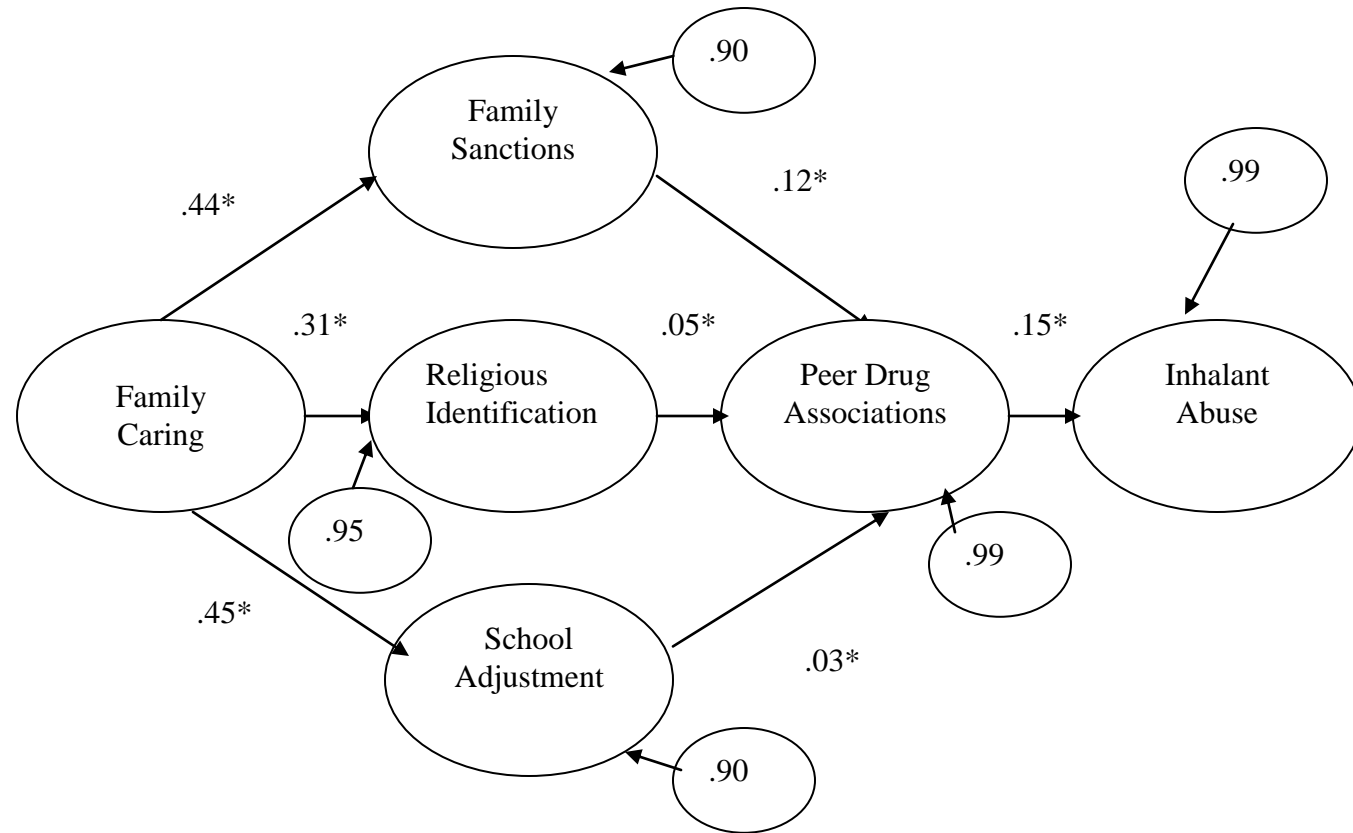
Figure 10: White structural model with regression coefficients and disturbance terms.

as can be seen, most coefficients did not differ across groups to that extent. Notable exceptions are the path from family caring to family sanctions, which was stronger for Mexican Americans (.65) and weaker for Whites (.44), and the path from family sanctions to peer drug associations, which was higher for African Americans (.36) and lower for Whites (.12). Hypothesis II, that the model fit and individual regression coefficients might differ by ethnicity, was somewhat confirmed (see Discussion for more details). Hypothesis III, that the specific pathway of school adjustment to peer drug associations would be weaker for African Americans because of prior research findings that grades were not correlated with inhalant abuse for this group (Mackesy-Amiti & Fendrich 2000) was not confirmed. All of the regression coefficients were also statistically significant (marked with an asterisk). However, some were very low and their practical significance should be questioned.

Overall, Peer Cluster Theory appears to function adequately as a predictive model for inhalant abuse, even when broken down by ethnicity for African Americans, Mexican Americans, and Whites. However, there was a lack of measurement invariance (which means measurement variance was present) across ethnic groups, making meaningful cross-ethnic comparisons difficult. And although all of the regression coefficients of the structural model were statistically significant, some were of such a small magnitude that they may be of little practical significance. Of particular concern in this regard is the regression coefficient from peer drug associations to inhalant abuse. Predicting the variable of interest based on peer behavior is perhaps the most important hypothesis in Peer Cluster Theory, and this key coefficient is rather low (.14) in the overall model and all ethnicity-specific models (.09, .17, & .15, respectively). It is also somewhat lower

than coefficients found when predicting other drug abuse from prior Peer Cluster Theory research (Breitmayer et al., 1993; Oetting, Donnermeyer, & Deffenbacher, 1998; Oetting, Donnermeyer, Trimble, & Beauvais, 1998). Further discussion of possible reasons for this follows in Chapter IV, and further research should certainly examine what characteristics of inhalant abuse may make Peer Cluster Theory somewhat less predictive of this specific drug abuse behavior.

CHAPTER IV: DISCUSSION

In this study, Structural Equation Modeling was utilized to test whether Peer Cluster Theory works as a predictive model for inhalant abuse and to examine ethnic differences in overall model fit and how the factors in the model are related. Specifically, the present study examined the hypothesis that Peer Cluster Theory functions adequately as a predictive model for inhalant abuse. It also examined the hypothesis that Peer Cluster Theory's fit as a predictive model may vary across ethnic groups, and that the regression coefficients of specific paths within the model might differ across ethnicity. It was found that Peer Cluster Theory does have an adequate fit as a predictive model for inhalant abuse and that this adequate fit is consistent across all three ethnic groups studied (African American, Mexican American, and White). However, there were some interesting differences across the ethnic groups with respect to specific variables, though these should be interpreted tentatively since a test for measurement invariance indicated that the measurement of the factors varied across the targeted ethnicities.

Although Hypothesis I was supported with Peer Cluster Theory having a high fit value and Chi-square value as a predictor of inhalant abuse, in examining the regression coefficients for specific pathways, it should be noted that while several are of a magnitude that is practically significant, some are not. It should also be noted that all of the pathways reached statistical significance, but because the way this is tested for each individual pathway is equivalent to a null hypothesis significance test, it is therefore

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fueled by sample size, and the number of participants (more than 17,000) was enough to cause even regression coefficients of less than .1 to be significant.

Interpreting the regression coefficients, the paths between all of the major protective factors (family caring, family sanctions, religious identification, and school adjustment) have moderate associations (see Figure 7). This is not surprising since they are all factors that generally cluster together and are predictive of positive developmental outcomes. Next, the path from family sanctions to peer drug associations is $r=.22$. This is not as high as any of the paths from family caring, but is the highest of the three paths that lead to peer drug associations. This seems to make practical sense, as families with more sanctions would likely take measures to limit their children's involvement with deviant peers. The next two pathways (religious identification to peer drug associations and school adjustment to peer drug associations) are the two lowest of the entire model and are similar ($r=.03$ for religious identification to peer drug associations and $r=.02$ for school adjustment to peer drug associations). These values are so low that in the opinion of the author, they should be considered practically insignificant even though they are statistically significant. Finally, the pathway from peer drug associations to inhalant abuse was $r=.14$. This value is low enough that one could question its practical significance, but gives enough predictive power that it may be considered meaningful. These findings are generally consistent with prior literature using Peer Cluster Theory, although the paths from religious identification and school adjustment to peer drug associations are rather low.

Hypothesis II, that the model fit and individual regression coefficients might differ by ethnicity, was somewhat supported. It is important to recall that in the data used

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in the analyses for this study, measurement variance was found, indicating that the survey questions measured slightly different factors across ethnic groups. Because of this, the cross-ethnic comparisons must be interpreted with caution and any major findings should be confirmed with further testing. It should also be noted that although some of the regression coefficients for the three ethnicity-specific SEM analyses differed by more than .2 from each other, none differed by more than .2 from the overall model.

The two regression coefficient pathways that differed by .2 or more across ethnic group were the path from family caring to family sanctions and the path from family sanctions to peer drug associations. For the pathway of family caring to family sanctions, the value was identical to the overall model for African Americans (.50), higher for Mexican Americans (.65) and lower for Whites (.44; see Figures 7, 8, 9, and 10). Apparently, the relationship between family caring and family sanctions is stronger for Mexican Americans and weaker for Whites, as these two do differ by more than .2. This may be because of a greater emphasis on family in Mexican culture. However, this relationship should certainly be explored with further testing, keeping in mind the caveats previously stated.

The path from family sanctions to peer drug associations differed highly, representing perhaps the most interesting ethnic difference found in the present study, particularly because it is attached to a factor predictive of so much overall delinquency (peer drug associations). Although the value for the path from family sanctions to peer drug associations is .20 for the overall model, the individual ethnicity-specific values run the gamut. The value for Mexican Americans is right in the middle of the range and is almost identical to the overall value (.23 for Mexican Americans versus .20 overall).

However, the value of this path for African Americans is .36 and the value of this path for Whites is only .12 (see Figures 8 and 10). This represents a difference of .24 in this path between Whites and African Americans, and may have implications for prevention efforts targeting specific ethnic groups. Why these specific correlation coefficients may have differed and what implications this has, particularly for delinquency prevention efforts, is discussed below, in the implications section.

Hypothesis III, that the specific pathway of school adjustment to peer drug associations would be weaker for African Americans based on the finding of Mackesy-Amiti and Fendrich (2000) that grades were not correlated with inhalant abuse for this group, was not supported. The value for the path from school adjustment to peer drug associations was consistently low for all three ethnic groups. Interestingly, this seems somewhat contradictory to findings from Mackesy-Amiti and Fendrich (2000). They found that good grades were associated with lower inhalant abuse only for Whites. Conversely, they found that getting bad grades was associated with more inhalant abuse for all ethnic groups included except for African Americans. As it relates to the present study, while school adjustment is not the same as grade performance, they are conceptually similar. This path also does not lead directly into inhalant abuse in the present model, but through peer drug associations. Still, given Mackesy-Amiti and Fendrich's (2000) findings, one would expect the path from school adjustment to peer drug associations to be somewhat stronger for Whites and weaker for African Americans, but instead they were essentially equivalent (and quite low in both cases).

Given these results, it seems possible that the trend of community support being more prevalent in African American communities that has been suggested by this

author's prior qualitative work may still be true, but perhaps a lower school adjustment to peer drug associations path was not the best way to operationalize it. Perhaps further examination of the elevated path of family sanctions to peer drug associations would lead to more information on this trend, particularly if community members in African American communities are (or are perceived to be) extended family. In any case, further investigation should be conducted on this topic.

The additional ANOVA analysis also resulted in primarily inconclusive data. It was found that all of the factors included in the present study (family caring, family sanctions, religious identification, school adjustment, peer drug associations, and inhalant abuse) differed to a statistically significant extent across ethnic groups (see Table 3). However, when the actual magnitude of the mean differences was examined, although most were still statistically significant (see Table 3), the magnitude of most of those differences was so small that it is likely not meaningful. This pattern of statistical significance of very small differences in this last examination is most likely fueled by the large sample size. The one possible exception to this pattern may be family sanctions, which had an eta^2 of .3, compared to .1 or less for all the other factors. This may not be a meaningful difference, but it is suggestive. It may also be related to the regression coefficient from family caring to family sanctions being somewhat higher for Mexican Americans and lower for Whites in the cross-ethnicity SEM analysis. Overall, these findings are suggestive, but further research must be conducted to elucidate any differences and how important they may be.

Patterns of both monthly and light/heavy inhalant abuse appear to indicate a trend of fewer participants being involved as extremeness of abuse increases. There are several

possible reasons for this pattern. For example, inhalants may be abused by many adolescents as an experimental or "starter" drug. Readily available and often not known to be harmful, these drugs are prime candidates for youthful curiosity and may be tried in limited doses by youths who would avoid "real" drugs. The harmful effects of inhalants may also lead some abusers to scale back abuse or make it more likely that symptoms of inhalant abuse are detected and they are referred to treatment. Finally, there is also an aging out phenomenon with inhalant abuse: as youths grow older, fewer report abusing inhalants. This may be due to youths who abuse inhalants when younger graduating to different drugs as they age, rather than becoming more extreme inhalant abusers. Overall, explanations for this trend are speculative, but may warrant further research. Finally, it should also be noted that this trend of decreasing numbers of inhalant abusers at extreme levels appears highly consistent across the three ethnic groups included (African American, Mexican American, and White).

Implications

The main finding of the present research was that Peer Cluster Theory is an adequate predictive model for inhalant abuse. Peer Cluster Theory has in the past been successfully applied to overall drug abuse (Oetting & Beauvais, 1986, 1987, 1988). However, some features of inhalant abuse suggest significant differences that may have reduced the fit of this model. For example, some evidence suggests that abuse of inhalants is particularly toxic to the brain (Yucel et al., 2008; Takagi, Lubman, & Yücel, 2011). Given this neurotoxicity, it is not surprising that individuals who continue to abuse inhalants appear to show greater deficits then individuals who abuse other drugs (Al-Hajri, & Del Bigio, 2010; Dingwall, Lewis, Maruff, & Cairney, 2010; Takagi et al, 2011;

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Yücel et al, 2010). It may be the case that, as damage accumulates, inhalant abusers are less capable than abusers of other drugs in maintaining social networks. There is also the fundamental difference of most inhalants being legal for other purposes and correspondingly being very cheap. This availability and affordability may have a significant impact on inhalants being abused most by young people and tapering off with age (as more money and other drugs become available). And finally, as found in Wood et al. (under review), inhalants are often not seen as drugs and many people appear to be completely unaware that these products can be abused to get high, leading to a lack of awareness of inhalant abuse that is starkly in contrast with most other drugs of abuse.

Despite these differences, this study lends support to the validity of using Peer Cluster Theory to predict inhalant abuse, as well as to guide the design of prevention and intervention campaigns intended to reduce inhalant abuse, indicating a robustness of the theory in predicting widely varying drug abuse behaviors. Prior research has established that Peer Cluster Theory functions as a predictive model for overall drug abuse, but it had not been tested specifically with inhalant abuse. The present study confirms that Peer Cluster Theory also functions as a predictive model for inhalant abuse, increasing the degree to which the model can be generally applicable to specific deviant behaviors.

Peer Cluster Theory could also be used to help design anti-drug interventions specifically targeting constructs found to be associated with drug abuse. Specifically, positive factors such as family caring and sanctions, as well as school adjustment and religious identification could be developed in targeted interventions designed to reduce association with deviant peers and resultant concomitant deviant behavior. In addition, interventions could focus on discouraging youth from developing deviant peer networks

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in order to reduce the likelihood of them engaging in deviant behaviors such as inhalant or other drug abuse. Efforts could even help youths who have developed such networks to branch out and form positive associations as well as teaching them more prosocial interaction styles and highlighting that deviant norms are not universal. Further research would be needed to accomplish such an endeavor, but the body of studies supporting Peer Cluster Theory lend credibility to its usefulness as a basis for anti-drug interventions.

In terms of specific regression pathways found in the present study, most were found to be of a high enough value to provide meaningful predictive power for the factor following them in the model. However, the pathways for religious identification to peer drug associations and school adjustment to peer drug associations were low in the overall model and the ethnicity specific models. The path from peer drug associations to inhalant abuse was also relatively low overall and across ethnic groups (never exceeding .2), indicating that the practical significance of this pathway may also be questioned.

There was also a pattern of decreasing percentages of inhalant abusers being represented at the higher monthly usage rates and heavy versus light abuse levels. The vast majority of inhalant abusers consume inhalants at the lower monthly levels and consider themselves light or very light users. Percentages drop off sharply as rates of monthly inhalant consumptions increases and likewise for heavier inhalant abuse categories. This pattern was consistent across ethnicities. Given research findings that higher levels of inhalant abuse are associated with more significant and more permanent brain damage (Dingwall & Cairney, 2011) and significantly more suicidal ideation (Howard et al., 2010), it is worth noting that there were far fewer high level inhalant abusers than low or occasional inhalant abusers found in the present study.

In terms of ethnicity-specific results, the core findings are the difference in path coefficients from family caring to family sanctions and from family sanctions to peer drug associations. The family caring to family sanctions pathway is higher for Mexican Americans (.65) and lower for Whites (.44), with African Americans in between (.50). This is likely rooted in a stronger emphasis being placed on family and familial relationships among Mexican Americans. Possible implications include a potential greater emphasis on extended family members as role models for Mexican Americans, whereas Whites may be more likely to have non-relatives as role models. However, further research is required to confirm and explore this trend.

The pathway from family sanctions to peer drug associations is higher for African Americans (.36) and lower for Whites (.12), while Mexican Americans have approximately the same path value as the overall model. This may be connected to suggestive evidence of a more community-oriented parenting style among African Americans. If this trend holds in future research, it almost certainly would have implications for ethnicity-specific prevention strategies. For example, in-school or after-school based programs might be more effective for Whites, while home- or community-based programs aimed at strengthening monitoring and sanctions might be more effective for African Americans.

Limitations

One major limitation for the present study was the lack of representation of two ethnic groups, Asian American and American Indian, that were originally intended to be included, because of insufficient representation in the rural areas sampled and thus in the

dataset available for analysis. Future research is needed to examine this issue for these two additional ethnic groups.

Second, some limitations in the data used for the present study were that the data may be somewhat out of date and that the reliability of the dependent variable (inhalant abuse) was rather low, particularly for African Americans. The data were collected between 1996 and 2000, so the data set is now over ten years old. Newer data might show different patterns and could be investigated in the future. The reliability of the inhalant abuse variable was also rather low, with a two-item correlation of .77 overall and .67 for African Americans. Given this lack of reliability in the measurement of the inhalant abuse construct, conclusions regarding this variable should be interpreted as tentative and should be confirmed with additional research. The variable only having two indicators is also a major limitation and is not ideal for Structural Equation Modeling.

Another limitation of any SEM analysis that should be mentioned is that the results are essentially correlational. Factors can be found to be related and mediation can be found, but it is not accurate to say that one factor is causing another, since there is no experimental control or randomization present. Rather, the factors are associated with one another, and in some cases one can be used to predict the value of another, but the language of causality should be avoided.

The survey was also based on self-report, which can be a limitation, particularly when dealing with emotionally sensitive or illegal behaviors, such as drug abuse. Participants may exaggerate drug abuse to look "cool" or under-report drug abuse for fear of getting in trouble. This may be particularly relevant for inhalant abuse, since older students tend to report lower lifetime inhalant abuse rates than younger students, and one

possible explanation for this is that older youths consider inhalants to be a little kid's drug and are reluctant to admit abusing them.

Another limitation is that for the cross-ethnic portion of the present research, measurement variance was found, indicating that the survey questions on some factors may have somewhat different meaning to students across the three ethnic groups and cannot be considered equivalent. Although Structural Equation Modeling analysis was still conducted on the three ethnic groups separately, any interpretation of those results is tentative because of the lack of measurement invariance. It should also be noted that, although differences in lifetime rates of inhalant abuse differing across ethnicities have been consistently found, other ethnic differences have not been so well established, so this field of inquiry is still in an exploratory phase. All of this means that any differences found in the present analysis may not be true differences in the population, making it particularly important that any cross-ethnic findings be confirmed in other research before being treated as reliable.

And a final limitation is that gender was not included in the present study. This is a variable of interest to many researchers (Edwards et al., 2007; Freedenthal, Vaughn, Jenson, & Howard, 2007; Wu & Howard, 2007) and there may have been differences in the SEM analysis across gender, as there were across ethnicity. There is also the possibility that the inclusion of gender in the test for measurement invariance would have changed it in some way by interacting with the ethnicity variable, possibly even eliminating the measurement variance found across ethnicities. This is particularly likely because in most cultural groups norms of behavior vary across gender, making it quite possible that males of one cultural group and females of that same group might interpret

questions differently from one another, leading to an interaction effect between gender and ethnicity. Future research should include gender as a variable in analyses.

Future Research

The present research leads to several potential ideas for future projects. Future studies could further examine the extent to which Peer Cluster Theory works as a predictive model for inhalant abuse with different samples and more varied ethnic group representation. In particular, it may be interesting to examine how results might differ in an urban, as opposed to rural, sample. Further cross-ethnic comparisons should also be conducted, particularly if measurement invariance can be found in a different data set.

Further qualitative analyses may also help to explicate the interesting apparent difference between White and African American participants with regard to the path from family sanctions to peer drug associations. This could be informative as a cultural consideration for prevention programming. Also, because African Americans have some of the lowest rates of inhalant abuse among ethnic groups, if their elevated regression coefficient for this path is tied to lower use, it would be quite useful to find out exactly how and why this is the case, perhaps leading to insights that could inform future inhalant abuse prevention efforts for both African Americans and other ethnic groups.

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Questions from the Community Drug and Alcohol Survey used in the present study

1. What grade are you in?
> 5
> 6
> 7
> 8
> 9
> 10
> 11
> 12

2. How old are you?
> 10
> 11
> 12
> 13
> 14
> 15
> 16
> 17
> 18
> 19
> 20
> 21 or older

3. Sex
> male
> female

22. Have you ever tried any of the following drugs? *If you don't know what they are, mark "no".*
> d. Inhalants ("Sniff" or "huff" something like glue, gas, paint, etc.)
>> yes
>> no

26. Have you used any of these drugs to get high during the last <u>month</u>?
> d. Inhalants ("Sniff" or "huff" something like glue, gas, paint, etc.)
>> No
>> 1-2 times
>> 3-9 times
>> 10-19 times
>> 20 or more times

28. In using each of the following, are you a…
    c. Inhalants ("Sniff" or "huff" something like glue, gas, paint, etc.)
        Non-user
        Very light user
        Light user
        Moderate user
        Heavy user
        Very heavy user

34. How much would your friends try to stop you from…
    a. Using marijuana?
        A lot
        Some
        Not much
        Not at all
    b. Using cocaine?
        A lot
        Some
        Not much
        Not at all
    c. "Sniffing" or "huffing" something like glue, gas, etc. (inhalants)?
        A lot
        Some
        Not much
        Not at all
    d. Using uppers?
        A lot
        Some
        Not much
        Not at all
    e. Using downers?
        A lot
        Some
        Not much
        Not at all

35. How many of your friends do each of the following…
    a. Use marijuana?
        None
        A few
        Most of them
        All of them
    b. Use cocaine?
        None
        A few
        Most of them

All of them
  c. "Sniff" or "huff" glue, gas, etc. (inhalants)?
    None
    A few
    Most of them
    All of them
  d. Use uppers?
    None
    A few
    Most of them
    All of them
  e. Use downers?
    None
    A few
    Most of them
    All of them

36. How often have your friends asked you to use…
  a. Marijuana?
    Very often
    Some
    Not very often
    Not at all
  b. Cocaine?
    Very often
    Some
    Not very often
    Not at all
  c. Inhalants ("Sniff" or "huff" something like glue, gas, etc.)?
    Very often
    Some
    Not very often
    Not at all
  d. Uppers?
    Very often
    Some
    Not very often
    Not at all
  e. Downers?
    Very often
    Some
    Not very often
    Not at all

40. Are you…
    White

Black or African American
American Indian
Alaska Native
Asian American
Mexican American
Spanish American
Puerto Rican American
Other

51. Are you religious?
A lot
Some
Not much
No

52. Do you practice a religion?
A lot
Some
Not much
No

53. How important is religion on your life?
A lot
Some
Not much
Not at all

66. How much do you agree with each of the following?
a. I like school
A lot
Some
Not much
Not at all
b. My teachers like me
A lot
Some
Not much
Not at all
c. I like my teachers
A lot
Some
Not much
Not at all
d. School is fun
A lot
Some

Not much

Not at all

82. How much would your family try to stop you from…
   b. Getting drunk
      A lot
      Some
      Not much
      Not at all
   c. Using inhalants like glue, gas, etc.?
      A lot
      Some
      Not much
      Not at all
   d. Using marijuana
      A lot
      Some
      Not much
      Not at all
   e. Using other drugs
      A lot
      Some
      Not much
      Not at all

83. Does your family…
   a. Care about you?
      A lot
      Some
      Not much
      Not at all
   b. Care what you do?
      A lot
      Some
      Not much
      Not at all