Pathways Between Early Socioeconomic Deprivation and Alcohol-Related Problems in Emerging Adulthood: Examination of Environmental and Psychosocial Determinants

Kevin William Campbell

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PATHWAYS BETWEEN EARLY SOCIOECONOMIC DEPRIVATION AND ALCOHOL-RELATED PROBLEMS IN EMERGING ADULTHOOD: EXAMINATION OF ENVIRONMENTAL AND PSYCHOSOCIAL DETERMINANTS

by

Kevin William Campbell

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Major: Clinical Psychology

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Abstract

The alcohol harm paradox (AHP) has been proposed to account for findings that socioeconomically deprived individuals experience disproportionate rates of alcohol-related harm, despite consuming similar or lower amounts of alcohol relative to more advantaged groups. However, the underlying mechanisms responsible are not well understood. Hogarth proposed the existence of three etiological pathways underpinning the AHP. Emerging adults (EAs) ages 21.5 to 25 (N = 466; M_{age} = 22.6, 57.5% female, 49.4% White, 38.6% Black, 31.1% non-college EAs), who reported consuming 3/4+ alcoholic drinks (for women/men) at least twice in the past month provided information on childhood family poverty, adverse childhood experiences (ACEs), internalizing symptoms, drinking motives, environmental reward, alcohol demand, alcohol-involved and alcohol-free reinforcement, and alcohol problems at baseline, 8, 16, and 24 months. Neighborhood disadvantage data from the American Community Survey and density of on-premise alcohol outlets were linked according to participants’ census tract at baseline. Structural equation modeling was used to validate the proposed conceptual model by simultaneously assessing the three etiological pathways. Results indicated that childhood family poverty was indirectly associated with increases in alcohol-related problems in emerging adulthood via: (1) greater exposure to ACEs, greater levels of internalizing symptoms, increases in drinking to cope motives, and increases in alcohol demand (stress-distress-coping pathway), and via (2) greater neighborhood disadvantage in emerging adulthood, chronic environmental reward deprivation, and increases in relative-reinforcement value (RRV) of alcohol-involved activities (alternative reward pathway). However, results did not support an indirect effect via neighborhood disadvantage, on-premise alcohol outlet density, and increases in alcohol demand (cue exposure/availability pathway) in the current sample. Results highlight the need to address
distal, community, neighborhood, and broader policy-level factors that indirectly effect proximal, individual-level determinants that give rise to the AHP.
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Pathways Between Early Socioeconomic Deprivation and Alcohol-Related Problems in Emerging Adulthood: Examination of Environmental and Psychosocial Determinants

Excessive alcohol use represents a leading cause of preventable death and disability and imposes a significant health and economic burden on the United States. Indeed, between 2011 to 2015, there was approximately 95,000 alcohol-related deaths and 2.8 million years of potential life lost (YPLL) annually (Esser et al., 2020). Estimates from the most recent analysis suggest that excessive alcohol use contributed to nearly $249 billion in economic costs in 2010 (Centers for Disease Control and Prevention [CDC], 2016). Emerging adulthood, typically defined as ages 18 to 25, is conceptualized as the developmental period characterized by increased independence, identity exploration, and transitions to adult roles and responsibilities (Arnett, 2007). Among all age groups, the prevalence of heavy drinking (Schulenberg et al., 2017) and past year alcohol use disorder (AUD; Center for Behavioral Health Statistics and Quality, 2015) is greatest among emerging adults (EAs). As a result, individuals in this age group demonstrate increased risk-taking, drinking and driving, risky sexual activity, and occupational/academic consequences that have the potential to interfere with the achievement of developmental milestones and the acquisition of adult roles and obligations, such as educational completion, employment, or parenthood (Dawson et al., 2008). Thus, emerging adulthood is a critical developmental period that sets the foundation for outcomes across the lifespan and understanding pathways of risk for alcohol misuse among EAs is critical for prevention and intervention efforts.

Alcohol Harm Paradox

Extant literature has suggested a complex relationship between socioeconomic status (SES) and alcohol use. Despite consuming similar or lower average amounts of alcohol relative to their more advantaged counterparts (Probst et al., 2020), individuals characterized by
economic and social disadvantage (i.e., lower educational attainment, lower household income, racial/ethnic minorities, and greater neighborhood disadvantage) experience higher rates of alcohol dependence (Karriker-Jaffe et al., 2012), alcohol-related morbidity (Jones et al., 2015), and alcohol-related mortality (Probst et al., 2020), even after adjusting for drinking level. This phenomenon has been termed the *alcohol harm paradox* (AHP), whereby disadvantaged SES populations experience disproportionate rates of alcohol-related harm that cannot be explained by drinking level alone. Understanding the mechanisms that contribute to disproportionately greater alcohol-related harm in socioeconomically deprived individuals is a significant public health concern.

While a recent review identified 41 distinct theoretical explanations proposed in the extant literature to explain why socioeconomically deprived individuals are at greater risk of experiencing alcohol-related harm (Boyd et al., 2022), the existing body of research has predominantly focused on individual determinants to explain the AHP, specifically pattern of drinking (Lewer et al., 2016), and other health-risk behaviors (e.g., poor diet, smoking; Bellis et al., 2016), giving less attention to the potential influence of contextual and structural determinants associated with SES conditions. Two record linkage studies found that socioeconomically deprived individuals experienced greater rates of alcohol-related harm, even after accounting for pattern of drinking and other health-risk behaviors (Gartner et al., 2019; Katikireddi et al., 2017). Additional support for these findings were provided by a meta-analysis conducted by Probst and colleagues (2020) demonstrating that SES differences in drinking quantity and pattern could only account for up to 25% of SES disparities in alcohol-related morbidity and mortality. These findings suggest that the AHP can only be partially explained by individual-level health behaviors. In order to improve our understanding of the mechanisms
underpinning the AHP, a shift in focus from individual-level factors to broader community and social determinants of health including environmental and psychosocial factors (e.g., neighborhood context, material resources, exposure to social stressors) is necessary to address alcohol-related health disparities.

**Behavioral Economics**

Behavioral economics combines principles of microeconomics and behavioral psychology to understand molar patterns of choice behavior. From this perspective, individuals are inherently motivated to seek out experiences that are reinforcing (e.g., eating, sexual activity, social activity, status or achievement-related goal pursuit, using substances) and when given the choice between different reinforcement options, individual decision making is typically biased in selecting the option with the greatest overall reinforcement value. Due to the direct pharmacological effects (e.g., intoxication, tension-reduction), substance use may be characterized as an immediate and highly potent reinforcing behavior with delayed costs. However, decisions to engage in substance use must compete with alternative reinforcing activities in the environment, which often have salutary, delayed benefits and require sustained patterns of behavior (e.g., exercising, academic pursuits, playing a musical instrument). Thus, the reinforcing value ascribed to a substance varies as a function of environmental contextual factors related to the availability and price of a substance as well as constraints on the quality and accessibility of substance-free alternatives (Bickel et al., 2014; Tucker et al., 2023). Given that individual decision making is contingent on the options available within the environment, behavioral economics provides a useful framework to broaden our investigation of substance misuse beyond individual-level determinants to include other levels of the built environment,
such as community- or societal-level factors or other social determinants of health (CDC, 2021; Institute of Medicine [IOM], 2003).

**Conceptual Model**

Behavioral economic theories of substance use propose that the central mechanism underpinning addiction is a distortion in valuation processes characterized by excessive valuation and preference for immediate, potent reinforcers such as alcohol, relative to competing substance-free alternative reinforcers (Bickel et al., 2014; Hogarth & Field, 2020) and arises from molar patterns of interactions between individual and environmental/contextual determinants. Research that integrates multi-level determinants within the social environment has highlighted the role of several environmental and psychosocial factors associated with SES deprivation, including fewer constraints on alcohol use, exposure to adverse experiences, and decreased access to non-substance reinforcers, that significantly increase the reinforcing value of alcohol relative to alternative reinforcers, implicating these factors as potential mechanisms contributing to the AHP. As a logical extension of behavioral economic accounts, Hogarth (2022) proposed a conceptual model (Figure 1) in which early exposure to SES deprivation may explain the development of alcohol misuse through three sequential risk pathways. The model proposes that socioeconomically deprived individuals are more likely to reside in environments characterized by deprivation contributing to (1) increased frequency of exposure to alcohol-related cues and alcohol availability; (2) increased frequency of exposure to environmental stressors, which subsequently, result in greater internalizing symptoms and substance coping motives; and (3) decreased access to environmental reward that may compete with alcohol use. All three risk pathways are theorized to converge on greater relative reinforcement value of
alcohol compared to competing alternative reinforcers and other commodities, conferring risk for hazardous alcohol use.

**The Cue Exposure/Availability Pathway**

Prior research applying geographic mapping has consistently shown greater concentration and proximity to alcohol outlets within disadvantaged neighborhoods (Furr-Holden et al., 2019; Lee et al., 2020; Macdonald et al., 2018; Romley et al., 2007; Trangenstein et al., 2020a). In addition, alcohol outlet density (i.e., number of alcohol retailers and accessibility within a designated space) is positively associated with EA alcohol use (Foster et al., 2017; Tanumihardjo et al., 2015) and associated harm (e.g., violent crime, domestic violence, traffic injury), above and beyond SES and other known risk factors (Campbell et al., 2009; Popova et al., 2009; Sherk et al., 2018), signifying the relationship between SES and alcohol misuse may potentially be mediated by density of alcohol retail outlets. Greater outlet density within disadvantaged contexts contributes to greater physical accessibility to alcohol, decreased prices due to competition, and greater exposure to alcohol advertisements (Foster et al., 2017; Xuan et al., 2015). Research has suggested that individuals characterized by lower SES (income, educational attainment, occupational status) may be more sensitive to changes in alcohol pricing. For example, alcohol-related hospitalizations and mortality in Finland significantly increased following alcohol price reductions, and these effects were more pronounced among lower SES populations (Herttua et al., 2015; Mäkelä et al., 2015). Experimental studies using the alcohol purchase task (APT; Murphy & MacKillop, 2006) to measure the relative reinforcing value of alcohol (also termed demand), have shown that cue exposure manipulations are associated with small-to-medium effect size increases in demand, and theoretically, the magnitude of motivation to consume alcohol (Acuff et al., 2020). The APT is a hypothetical commodity purchase task in
which participants are instructed to estimate their consumption of alcohol across a set of prices that gradually increase (Murphy & MacKillop, 2006; Owens et al., 2015) and indices of demand derived from the APT demonstrate robust associations with alcohol use (Lemley et al., 2016; Murphy & MacKillop, 2006), alcohol-related problems (Acuff et al., 2018), and AUD (Bertholet et al., 2015). MacKillop and colleagues (2010) found significant increases in alcohol demand (intensity, breakpoint, \( O_{\text{max}} \)) among heavy drinkers following exposure to personalized alcohol cues (looking at and smelling a cup of beer) relative to a neutral cue condition (looking at and smelling a cup of water). Thus, fewer constraints on access to alcohol and disproportionate exposure to alcohol cues in deprived environments may elicit an expectation of alcohol availability, contributing to greater motivation (demand) for alcohol use, representing a pathway of risk for alcohol misuse among individuals occupying disadvantaged neighborhoods.

**The Stress-Distress-Coping Pathway**

The stress-distress-coping pathway posits that SES deprivation is related to increased frequency of exposure to adverse experiences (e.g., abuse, neglect, family conflict; Turner & Avison, 2003), which, in turn, contributes to greater risk of psychopathology (e.g., anxiety, depression; Reiss et al., 2019; Ribeiro et al., 2017), contributing to the development of maladaptive coping strategies such as using alcohol to mitigate negative affect (Heim et al., 2021; Karriker-Jaffe et al., 2016), which, in turn, increases vulnerability for persistent alcohol misuse. According to the family stress model (FSM), parents in families with greater SES disadvantage experience greater economic pressures and lower levels of available support and resources, which, contribute to a stressful life context within the family environment (Conger et al., 2010). Adverse childhood experiences (ACEs) are theorized to represent a set of chronic stressors, signifying family-level environments characterized by a constellation of negative
events that include child maltreatment (e.g., physical, sexual, and emotional abuse, as well as physical and emotional neglect) and household dysfunction (e.g., parental separation, substance use, mental illness, domestic violence, and incarceration) that occur during childhood and negatively impact socioemotional and behavioral health outcomes across the life course (Felitti et al., 1998; Hughes et al., 2017). In accordance with the FSM, research has shown greater prevalence of ACEs among children in lower income and minority households (Strompolis et al., 2019) and family poverty is associated with greater negative effects resulting from ACEs (Umberson et al., 2014). Additionally, greater cumulative exposure to ACEs is robustly associated with greater alcohol use (Marks et al., 2021; Rogers et al., 2022), alcohol-related problems (Brett et al., 2018; Espeleta et al., 2018; Goldstein et al., 2010; Marks et al., 2021; Shin et al., 2015, 2018), and AUD (Moss et al., 2020; Quinn et al., 2019) in EAs.

ACEs are theorized to negatively impact an individual’s neurodevelopment, most notably stress reactivity and impaired emotion regulation, contributing to increased vulnerability for the adoption of maladaptive coping strategies (i.e., consuming alcohol to mitigate distress; Hughes et al., 2017; Wesarg et al., 2020), thus, conferring risk for alcohol-related problems and AUD (Cicchetti & Handley, 2019). An internalizing pathway has been proposed to explain this relationship between exposure to ACEs and alcohol-related problems in adulthood. The pathway is characterized by high rates of internalizing pathology across childhood that continue into adolescence and emerging adulthood (Hussong et al., 2011). Indeed, exposure to ACEs contribute to enduring risk for developing various negative mental health outcomes, including posttraumatic stress symptoms (Messman-Moore & Bhuptani, 2017), depression (Culpin et al., 2015; Dunn et al., 2013), and anxiety (Culpin et al., 2015; Scott et al., 2010) in EAs. Further, results from a meta-analysis suggested that exposure to four or more ACEs significantly
increased the likelihood of depression in adulthood (Hughes et al., 2017). The internalizing pathway is also hypothesized to involve positive expectancies related to the tension-reduction qualities associated with alcohol use and endorsement of substance use coping motives to diminish or regulate negative affect (Hussong et al., 2011), both of which are robustly associated with heavy drinking and alcohol-related problems in cross-sectional (Bravo et al., 2016; Bravo & Pearson, 2017) and longitudinal (Merril et al., 2014; Mezquita et al., 2014; Vernig & Orsillo, 2015) studies of EAs (Cooper et al., 2016; Kassel et al., 2000; Kuntsche et al., 2005).

Several prominent theories conceptualizing alcohol use as a negatively reinforced behavior, posit that alcohol is a powerful reinforcer when utilized as a means to cope with or reduce negative affect. Thus, if drinking to cope with negative affect is negatively reinforced, it’s predicted that an individual should ascribe greater reinforcing value to alcohol (i.e., motivation to consume alcohol or allocate resources to obtain alcohol) in response to experiencing negative affect. Support for this assumption comes from experimental studies using the APT (Murphy & MacKillop, 2006) to measure alcohol’s reinforcing value (also termed demand). Importantly, significant increases in demand have been observed following exposure to negative mood inductions in both within-subjects (Amlung & MacKillop, 2014; Owens et al., 2015) and between-subjects (Rousseau et al., 2011) experimental designs. Additionally, the strength of these effects is stronger among individual who report substance use coping motives (Hogarth & Field, 2020).

Several studies have examined segments of the proposed conceptual pathway including research that has consistently shown that exposure to childhood maltreatment is related to greater alcohol-related problems in EAs via drinking to cope with negative affect (Goldstein et al., 2010; Grayson & Nolen-Hoeksema, 2005; Shin et al., 2020a). Goldstein et al. (2010) found that
drinking to cope with depression mediated the relationship between childhood maltreatment and alcohol-related problems in a sample of female college students. Grayson and Nolen-Hoeksema (2005) found that exposure to childhood sexual abuse predicted greater alcohol-related problems indirectly via drinking to cope with negative emotions in a community sample of adult women. Finally, Shin et al. (2020a) found that exposure to childhood maltreatment predicted greater alcohol-related problems via coping motives using a community sample of EAs. Further, the association between ACEs and alcohol use and problems has been shown to be partially mediated by internalizing symptoms including depression and anxiety in EAs (Shin et al., 2015, 2020b). Studies have also shown that the effects of internalizing psychopathology (e.g., depression, anxiety) on alcohol-related problems is mediated via substance use coping motives (Chinneck et al., 2018; Collins et al., 2018; Gonzalez et al., 2011) in EAs. Finally, Mezquita et al. (2014) found that exposure to childhood emotional abuse predicted negative emotionality, which, in turn, longitudinally predicted alcohol-related problems via coping with depression motives in EAs. The research above highlights substance use coping motives as a proximal determinant contributing to alcohol misuse in at-risk populations and the combination of experimental and naturalistic evidence indicates that disproportionate exposure to adverse experiences within disadvantaged contexts increases motivation for alcohol, particularly among individuals with substance use coping motives, representing a risk pathway to alcohol misuse.

The Alternative Reward Pathway

SES deprivation is characterized by diminished availability of resources (Moore et al., 2008), and socioeconomically deprived individuals are more likely to live in more disadvantaged contexts that provide limited resources and opportunities for alternative reinforcement that might otherwise compete with alcohol use (e.g., community centers, access to musical instruments,
green spaces; Estabrooks et al., 2003; Moore et al., 2008; Rigolon, 2016). In addition, even if alternative reinforcers are available within one’s environment, individuals with greater SES deprivation may be less able to afford them as a result of limited financial resources (Mahoney et al., 2009) or to otherwise access them due to lack of current or historic resources (e.g., education, family support, transportation, childcare). Research has shown that diminished availability of substance-free reinforcers (e.g., social or recreational activities) is related to greater alcohol and drug use while increased availability and participation in alternative substance-free activities is related to lower rates of alcohol and drug use (Bickel et al., 2012; Higgins et al., 2004; Vuchinich & Tucker, 1988). While reward deprivation is a potent risk factor for depression (Carvalho et al., 2011), studies with EAs have shown that reward deficits distinctly predict drug use, alcohol-related problems, and AUD severity even after adjusting for the effects of psychopathology (Joyner et al., 2016; Meshesha et al., 2015; Morris et al., 2017) and lower baseline levels of participation in substance-free compared to substance-involved activities is related to smaller reductions in drinking following exposure to a brief intervention for alcohol use (Murphy et al., 2005, 2019).

Research with adolescents suggests that deficits in reward are associated with drug use (Khoddam et al., 2018) and initiation and escalation of smoking over time (Audrain-McGovern et al., 2011). Further, cross-sectional and longitudinal research has shown that lower parental education, used as a proxy for SES, indirectly predicted greater adolescent substance use via diminished alternative substance-free reinforcers (Andrabi et al., 2017; Lee et al., 2018; Leventhal et al., 2015), suggesting that reduced access to alternative substance-free reinforcement may constitute a mechanism explaining SES disparities in substance-related harm.
The community-based Icelandic Prevention Model represents an important extension of this research at the population level. The nationwide initiative sought to enrich social environments at the neighborhood level by increasing afterschool and evening alternatives in order to decrease the probability that adolescents will initiate and sustain substance use. Population data collected between 1998 and 2020 demonstrate the effectiveness of this approach as evidenced by significant reductions in the frequency of drunkenness, daily smoking, and cannabis use among adolescents (Kristjansson et al., 2020). The combination of laboratory and naturalistic research has contributed to the recognition of substance-free reinforcement as a core treatment target (McKay, 2017) and several efficacious reinforcement-based interventions focus on shifting behavioral allocation towards substance-free reinforcers and away from substance use. These include evidence-based treatments such as contingency management (Petry et al., 2017) and behavioral activation (Daughters et al., 2018). In addition, brief interventions such as the Substance-Free Activity Session (SFAS; Murphy et al., 2012) that aim to increase participation in substance-free activities have shown to reduce alcohol consumption and alcohol-related problems via their effects on the relative-reinforcement value (RRV) of substance-involved activities (Murphy et al., 2019).

In addition to SES disparities in access to environmental reward, persistent substance misuse is associated with diminished reward sensitivity to substance-free stimuli (e.g., food, exercise; Koob & Le Moal, 2008; Lubman et al., 2009). The combined influence of blunted sensitivity to the reinforcing effects of substance-free rewards and disparities in access to alternative reinforcers may result in significant increases in the expected relative reinforcing value ascribed to alcohol among socioeconomically deprived individuals, conferring a risk pathway to alcohol misuse.
Current Study

While evidence to corroborate the multistage conceptual model described by Hogarth (2022) underpinning the AHP comes from the fragmented published research described above, there has been no research to date that has empirically tested the entirety of the model. Shuai et al. (2022) examined the role of the stress-distress-coping pathway using a cross-sectional sample of hazardous EA drinkers and found significant effects of early subjective relative family poverty on alcohol consequences via increased risk of adverse experience, internalizing symptoms, and drinking to cope, providing additional support for the existence of one of the hypothesized pathways.

Using a diverse sample of heavy drinking EAs combined with data at the census tract level, the current study aimed to validate the causal structure proposed by Hogarth (2022) involving the impact of early SES deprivation on alcohol-related problems by simultaneously assessing three separate etiological risk pathways by means of a prospective study. In accordance with existing research (Hogarth, 2022; Shuai et al., 2022), we hypothesized that early exposure to family poverty would prospectively predict increases in alcohol-related problems (controlling for heavy drinking and baseline levels of alcohol-related problems) in emerging adulthood via: (1) greater neighborhood disadvantage, greater access to on-premise alcohol outlets, and increases in alcohol demand (cue exposure/availability pathway); (2) exposure to adverse experiences in childhood, greater levels of internalizing symptoms in emerging adulthood, increases in drinking to cope, and increases in alcohol demand (stress-distress-coping pathway); and (3) greater neighborhood disadvantage, chronic deficits in environmental reward, and increases in relative-reinforcement value (RRV) of alcohol-involved activities (alternative
reward pathway). We hypothesized that all three pathways would converge to predict increases in alcohol-related problems.

In line with critiques related to the oversimplification of reward functioning in the extant literature (e.g., Joyner et al., 2016), the current study incorporates several facets of reward-related processes within a single model. These include the availability and barriers to accessing reward in one’s environment (environmental reward), the relative amount of money allocated to alcohol (demand), and a composite of activity participation and enjoyment associated with alcohol use relative to alcohol-free activities (relative-reinforcement value). While these constructs are conceptually related, they reflect distinct aspects of the multi-faceted construct of reward functioning.

Method

Participants

Participants consisted of non-treatment seeking EAs recruited from a three-year longitudinal study assessing trajectories of heavy drinking among EAs as they transition into adulthood (R01AA024930; Minhas et al., 2020)\(^1\). Inclusion criteria required that participants were between the ages of 21.5 and 24.9 and endorsed consuming at least 3/4 alcoholic drinks (for women/men) on at least two occasions during the prior month. In order to obtain a time lag appropriate to examine potential changes and sufficient variability within hypothesized mediators and their effects on alcohol-related problems, the current study used data collected from surveys at baseline (W1), 8 months (W3), 16 months (W5), and 24 months (W7). Participants that passed quality control checks, had complete data associated with measures of

\(^1\) See Minhas et al. (2020) for baseline descriptive data associated with the larger study sample.
parental education,\textsuperscript{2} household receipt of public benefits during childhood, and Adverse Childhood Experiences (ACEs), and who had adequate data for at least three waves were included in the final analytic sample. The resulting sample consisted of 466 EAs. The average age of the current sample at W1 was 22.6 years ($SD = 1.1$); approximately 49.4% of the participants identified as White, 38.6% identified as Black, 3.2% identified as Asian, 5.6% identified as multiracial, 1.7% identified as “other,” and 5.6% identified as Hispanic/Latinx. Approximately 57.5% of the sample identified as female and 68.9% reported current enrollment or completion of a four-year college degree.

\textbf{Procedures}

Participants were recruited within a midsize city in the southern United States via online advertisements and flyers posted in the community, campus-wide emails and surveys to students enrolled in psychology courses at a large public university, and via in-person recruitment at different events (e.g., concerts, sporting events). Participants were excluded if they reported a history of psychotic episodes or treatment for substance use disorder. Eligible participants attended a two-hour session in a university research laboratory, where they completed various measures relating to demographics, substance use behaviors, and psychosocial variables associated with risk for substance use. Follow-up surveys were completed at 4-month intervals and alternated between in-person appointments and partial assessments completed remotely.\textsuperscript{3} Participants were compensated $40 for in-person surveys which took approximately 90 minutes.

\textsuperscript{2} Participants who provided educational attainment data for at least one parent were considered to have complete data for the measure of parental education.

\textsuperscript{3} All surveys were conducted remotely after March 2020, following the initiation of local COVID-19 lockdown procedures.
to complete, and $20 for remote surveys which took approximately 30 minutes to complete. All study procedures were approved by the university Institutional Review Board.

**Measures**

**Demographics and Background Characteristics**

Participants reported their age, sex at birth (*male*, *female*), and race (*White*, *Black*, *Asian*, *multiracial*, *other*). Participants also reported their college status with college being operationalized as current enrollment or completion of a four-year college degree or higher, and non-college being operationalized as having completed an associate degree or less and no current four-year college enrollment.

**Childhood Family Poverty**

A composite index for family poverty was constructed from three indicators assessing parental education and household receipt of public benefits during childhood. Participants indicated the highest level of schooling completed by each of their parents (1 = *no formal schooling*, 2 = *less than a high school diploma*, 3 = *a high school diploma or GED*, 4 = *technical certificate or degree*, 5 = *some college or a 2-year degree*, 6 = *4-year college degree*, 7 = *some postgraduate work*, 8 = *post-graduate or advanced professional degree*). Participant responses were collapsed in order to form a dichotomous measure of parental education for each parent (0 = *4-year college degree or higher*, 1 = *less than a 4-year college degree*; Cho & Kogan, 2016). Highest education level achieved by either parent served as the indicator for parental education. Participants answered two additional questions in which they indicated if any member of their household, including themselves, were ever a recipient of free or reduced price school lunch, or Food Stamps (SNAP) at any time during their childhood (0 = *did not receive public benefits*, 1 = *public benefits recipient*). Given the dichotomous nature of the indicators, polychoric principal
component analysis was used to estimate a composite z-score measure for childhood family poverty, with larger values reflecting greater childhood family poverty. Internal consistency in the current sample was $\alpha = 0.90$.

**Current Neighborhood Disadvantage**

The Social Deprivation Index (SDI; Butler et al., 2013) is a composite measure of neighborhood disadvantage based on seven demographic and household variables computed at the census tract level using 5-year estimates obtained from the U.S. Census Bureau’s American Community Survey (ACS) spanning from 2015 to 2019 (U.S. Census Bureau, 2019). The following census tract indicators were used to calculate the weighted composite measure representing neighborhood disadvantage: percent of population living in poverty; percent of population 25 years or older with less than 12 years of education; percent of single-parent households with dependents < 18 years of age; percent of households living in renter-occupied housing units; percent of households living in overcrowded housing units; percent of households without a vehicle; and percent of non-employed adults for the population 16-64 years of age. There was considerable variability across census tracts, as indicated by the large range of many of the indicators. SDI scores range from 0 to 100 and represent decile relative rankings with greater values reflecting neighborhoods characterized by greater disadvantage. Participants’ reported street address or ZIP Code centroid reported at W1 was geocoded to the census tract in which they were located. Street addresses that did not match automatically were matched using Google Maps. Neighborhood disadvantage scores were then matched to each participant according to their geocoded census tract and thus, these estimates correspond to level of neighborhood disadvantage at W1. Models accounted for precision of geocoding depending on whether geocoding was assigned based on street address or ZIP Code.
**On-Premise Alcohol Outlet Density**

Density of alcohol outlets at the census tract level were based on 2019 business address data obtained from Dun & Bradstreet (www.dnb.com). Our search was based on the North American Industry Classification System (NAICS) code 7224 Drinking Places (Alcoholic Beverages) to specify on-premise alcohol outlets which included bars, breweries, cocktail lounges, drinking places, night clubs, restaurants, cafes, hotels, and recreation clubs. Our search identified 629 on-premise alcohol outlets. The current study verified that all identified on-premise alcohol outlets were open for business at the time of data collection. All business addresses were geocoded using ArcGIS 10.2 with a 99% success rate.

**Adverse Childhood Experiences**

The Adverse Childhood Experiences Questionnaire (ACEs; Felitti et al., 1998) contains ten items that assess exposure to different forms of childhood trauma prior to the age of 18 using a dichotomous response scale (yes/no). Of the ten items, five items assess for different forms of childhood maltreatment (e.g., physical abuse, sexual abuse, emotional abuse, emotional neglect, and physical neglect) while the other five items assess for exposure to different forms of household dysfunction (e.g., parental separation, domestic violence, parental substance use, mental illness, and incarceration). A cumulative ACEs score was computed by summing all ten items ($\alpha = 0.74$) with greater values indicating greater exposure to childhood adversities. Data obtained from retrospective self-reports of adverse childhood experiences have been shown to demonstrate strong correlations with prospective reports (Newbury et al., 2018).

**Internalizing Symptoms**

The Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS) was used to assess internalizing symptoms. The PHQ-ADS is composed of the Patient Health Questionnaire
Depression Scale (PHQ-9; Kroenke & Spitzer, 2002) and the Generalized Anxiety Disorder Questionnaire (GAD-7; Löwe et al., 2008). The PHQ-9 is composed of nine items (e.g., “feeling down, depressed, or hopeless”) while the GAD-7 is composed of seven items (e.g., “worrying too much about different things”). Across both scales, participants report the frequency of experiencing each symptom over the prior month using a scale ranging from zero (not at all) to three (nearly every day). Thus, the PHQ-ADS contains 16 total items that are summed to create a composite score of internalizing symptoms ranging from 0 to 48. Scores of 10, 20, and 30 serve as thresholds representing the boundary between mild, moderate, and severe levels of depression-anxiety symptom severity. The PHQ-ADS has demonstrated adequate reliability in addition to strong construct and factorial validity in prior research (Chilcot et al., 2018; Kroenke et al., 2016). Internal consistency in the current sample was $\alpha = 0.89$ at W1.

**Drinking to Cope Motives**

Drinking motives were assessed using the Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). The DMQ-R consists of 20 items that consider motivations for drinking within four areas: coping, conformity, social, and enhancement. However, given the aims of the current study, only the coping subscale was used within the present analysis. The coping subscale is composed of five items reflecting drinking to cope with negative affect. Participants indicated how frequently their own drinking is motivated by each of five different reasons (e.g., “To forget about your problems”) on a scale ranging from one (almost never/never) to five (almost always/always). The DMQ-R has previously shown evidence of high internal consistency, test-retest reliability, and predictive validity for alcohol consumption and alcohol-related problems in college students (Grant et al., 2007). Internal consistency in the current sample was $\alpha = 0.88$ at W1 and $\alpha = 0.87$ at W3.
Environmental Reward

Environmental access to reward was assessed using the 9-item Environmental Suppressors subscale of the Reward Probability Index (RPI; Carvalho et al., 2011). The Environmental Suppressors subscale assesses resource availability and barriers to accessing or engaging in reinforcing activities within one’s environment (e.g., “I have few financial resources, which limits what I can do,” “I wish I could find a place to live that brought more satisfaction to my life”). Participants respond using a four-point Likert scale that ranges from one (strongly disagree) to four (strongly agree). All nine items are reverse coded and then summed to estimate a total score (range 9-36) with greater values reflecting fewer barriers and therefore, greater availability of environmental reward. The RPI may measure more historical and persistent deficits in environmental reward compared to reinforcement survey approaches including the Activity Level Questionnaire (ALQ; Meshesha et al., 2020) described next. The RPI has shown strong convergent and discriminant validity (Carvalho et al., 2011; Voss et al., 2021). The internal consistency for the subscale was $\alpha = 0.86$ at W1 and 0.87 at W3 in the current sample. For the purpose of creating a higher-order latent variable reflecting chronic reward deprivation, individual items from the Environmental Suppressors subscale collected at W1 and W3 were not reverse coded, as is customary, prior to being specified as indicators within confirmatory factory analyses, thus, resulting first-order and second-order latent variables reflect increased environmental constraints on engaging in rewarding activities that are likely to promote risk for drinking.

Relative-Reinforcement Value (RRV)

The Activity Level Questionnaire (ALQ; based on Meshesha et al., 2020) was used to assess past month time spent participating in and subjective enjoyment across 36 substance-
involved and substance-free activities. The exact wording used within the ALQ defined substance-involved and substance-free activities as those activities in which the participant was or was not drinking alcohol and using other drugs. Given the aims of the current study, we will refer to these as alcohol-involved and alcohol-free activities, respectively. Participants reported their frequency of engaging in each activity on a Likert scale from zero (zero times in the past month) to six (several times per day) and enjoyment ratings on a Likert scale from zero (unpleasant or neutral) to four (extremely pleasant). Frequency and enjoyment ratings associated with each alcohol-involved and alcohol-free activity were multiplied to estimate cross-product scores. Resulting cross-products were then averaged across all activities to estimate a total alcohol-involved (α = 0.93) and alcohol-free (α = 0.88) reinforcement score for each participant. A measure of relative-reinforcement value (RRV) for alcohol-involved activities was estimated to index alcohol-involved reinforcement relative to total reinforcement (alcohol-involved reinforcement / [alcohol-involved + alcohol-free reinforcement]), with greater values on the resulting relative-reinforcement value (range 0-1) reflecting greater relative reinforcement from alcohol-involved activities. The internal consistency for relative-reinforcement value (RRV) for alcohol-involved activities was α = 0.90 at W1 and 0.93 at W5 in the current sample. Reinforcement survey measures have demonstrated strong reliability and validity as well as robust associations with alcohol-related problems within samples of EA drinkers (Acuff et al., 2019; Magidson et al., 2017).

**Alcohol Demand**

The Alcohol Purchase Task (APT; Murphy & MacKillop, 2006) was used to measure alcohol demand. Participants indicated the amount of standard alcoholic drinks they would consume across 30 escalating price points ranging from $0 to $40 per drink. Participants are told
that they would not have the opportunity to consume alcohol before or after the hypothetical task and that they are not able to stockpile drinks for later consumption. Different indices of demand reflecting different aspects associated with motivation to consume alcohol, can be obtained from the creation of demand curves, which plot reported consumption at each price. Nonsystematic data were detected based on the 3-criterion Stein macro (Stein et al., 2015) which included the following detection limits for trend (Q < 0.025), bounce (B = 0.10), and reversals from zero (2 or greater). The current study utilized two observed indices that represent alcohol reinforcing efficacy: demand intensity (unconstrained consumption, or when drinks are free) and $O_{\text{max}}$ (maximum expenditure across all price points). Demand intensity and $O_{\text{max}}$ demonstrate robust associations with alcohol outcomes (Martínez-Loredo et al., 2021) and can be combined to form an alcohol demand amplitude latent factor reflecting volumetric consumption (Bidwell et al., 2012; MacKillop et al., 2009). Data obtained from hypothetical alcohol purchase tasks are associated with actual consumption (Amlung & MacKillop, 2015), and demand indices have demonstrated good test-retest reliability (Acuff & Murphy, 2017).

**Heavy Drinking**

The Daily Drinking Questionnaire (DDQ; Collins et al., 1985) was used to assess the number of standard alcoholic beverages consumed during a typical week in the past 30 days. A measure of heavy drinking was created by summing the number of times a participant reported consuming 4/5+ alcoholic beverages (for women/men) in a typical week to approximate frequency of heavy drinking days. The DDQ has been frequently used and is well validated among EAs (MacKillop & Murphy, 2007) and has shown to correlate with actual drinking behavior (Kivlahan et al., 1990). The present study used frequency of heavy drinking to control for alcohol consumption in the structural model.
**Alcohol-Related Problems**

The 24-item Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2005) was used to assess alcohol-related problems. Participants indicated whether or not they had experienced 24 potential problems resulting from alcohol consumption within the past four months using a dichotomous response scale. Responses are summed to create a total score reflecting the total number of negative problems experienced within the four-month period. The B-YAACQ has been widely used in EA samples and has demonstrated strong internal consistency, test-retest reliability (Kahler et al., 2008), and invariance across college status, race, and SES (Campbell et al., 2022). Internal consistency in the current sample was $\alpha = 0.86$ at W1 and $\alpha = 0.89$ at W7.

**Data Analysis**

**Distance Metrics**

Followings recommendations put forth by the CDC (2017) for assessing density of alcohol outlets, three population-weighted distance (PWD) metrics were calculated to measure access to on-premise alcohol outlets at the census tract level. The seven closet on-premise alcohol outlets were determined for each census tract using ArcGIS 10.2 Network Analyst (Esri, Redlands, CA). Using the geometric centroid of each census tract as the origin, driving distance through a street network, driving time though a street network with speed limits, and Euclidian (flight) distance were calculated to the seven nearest on-premise alcohol outlets and then averaged using SAS GEODIST (SAS, Cary, North Carolina). To estimate the population-weighted distance (PWD) metrics, the current study used the 2019 census population count to weigh the data. This method adjusts for varying population distributions and accounts for the uneven probability of accessing specific outlets. Census tract-based spatial access metrics were
then linked to geocoded individual data based on participants’ home address or ZIP Code reported at W1.

**Principal Component Analysis**

Based on previous research examining the latent factor structure of behavioral economic purchase tasks (MacKillop et al., 2009; Bidwell et al., 2012), principal component analysis (PCA) with oblimin rotation was used to estimate an alcohol demand amplitude latent factor, representing maximal level of use, at both W1 and W5 using intensity and $O_{\text{max}}$ as indicators.

**Measurement Model**

Confirmatory factor analysis (CFA) was used to validate the existing factor structure associated with the Environmental Suppressors subscale of the RPI, the coping subscale of the DMQ-R, and the total B-YAACQ as well as to assess for measurement invariance across waves. CFA offers a sophisticated analysis of construct validity and resulting estimates are adjusted for measurement error. Based on prior literature examining the factor structure of each measure (Voss et al., 2021; Cooper et al., 1994; Kahler et al., 2005), items from each subscale or total scale were specified as indicators for six separate single factor CFAs reflecting the unidimensional latent constructs of environmental reward at W1 and W3, drinking to cope at W1 and W3, and alcohol-related problems at W1 and W7. To standardize the metric of the estimated models, the unit variance identification (UVI) method was used in which the variance of each of the estimated latent factors was fixed to 1.0, thus allowing all factor loadings to be freely estimated. Models were specified in Mplus Version 8.3 (Muthén & Muthén, 1998 – 2021) using mean and variance adjusted weighted least squares (WLSMV) estimation and the delta parameterization which addresses non-normality of categorical indicators (Brown, 2015) for analyses with categorical items and robust maximum likelihood (MLR) estimation for analyses
with continuous items. Model fit was evaluated using criteria suggested by Hu and Bentler (1999) including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). CFI and TLI values ≥ 0.90 suggest acceptable fit, while values ≥ 0.95 suggest excellent fit (Hu & Bentler, 1999). RMSEA values ≤ .08 indicate acceptable fit, while values ≤ .05 suggest excellent fit (Browne & Cudeck, 1992).

**Factorial Invariance**

Upon obtaining evidence to ensure adequate model fit and confirmation of the established factor structure for each construct, tests of longitudinal measurement invariance were conducted to assess whether items from each subscale or total scale measure the same latent construct across waves. The individual models estimated at specific waves were incorporated within three distinct construct-specific configural models to examine whether the factor structure associated with each latent construct is equivalent across time (i.e., items load on latent factors in a similar pattern). Configural models were specified using the previously mentioned unit variance identification (UVI) method in which the variance of each latent factor was fixed to 1.0 across waves and no other equality constraints were imposed, thus all factor loadings and item thresholds/intercepts were freely estimated across waves. Correlations between indicator-specific residuals for the same indicators measured repeatedly across waves were specified for the latent constructs of environmental reward and drinking to cope. The configural model for each latent construct then served as the baseline model against which all other competing models with additional parameter constraints were compared. Next, metric invariance was assessed through the estimation of a model in which factor loadings of the same indicator were constrained to equality across waves. Finally, scalar invariance was assessed through the estimation of a model in which both factor loadings and item thresholds/intercepts were constrained to equality across
waves. Establishment of scalar invariance suggests that any observed change in the mean of the latent constructs is not attributable to variability in the item intercepts/thresholds over time. Thus, evidence for scalar invariance allows us to assume that any observed change in the latent factor means over time is reflective of true change in the construct (Brown, 2015). The current study used the model comparison criteria of ΔCFI/ΔTFI ≥ .01 (Cheung & Rensvold, 2002) and ΔRMSEA ≥ .015 (Chen, 2007) to indicate a significant worsening of model fit and violation of invariance when comparing increasingly constrained models. Due to its sensitivity to sample size (Kline, 2016), the current study placed little weight on the chi-square difference (Δχ²) test when examining factorial invariance, however, it is reported for completeness.

**Structural Model**

The proposed structural equation model (see Figure 2) was estimated in Mplus Version 8.3 (Muthén & Muthén, 1998 – 2021), using a probit link and mean and variance adjusted weighted least squares (WLSMV) estimation. As shown in Figure 2, we estimated a longitudinal structural model in which early exposure to family poverty was examined as a predictor of exposure to ACEs prior to the age of 18, internalizing symptoms and neighborhood disadvantage at W1, and alcohol-related problems at W7. Further, ACEs were modeled as a predictor of alcohol-related problems at W7 and internalizing symptoms at W1, which, in turn, was modeled as a predictor of drinking to cope at W3 and alcohol-related problems at W7. Neighborhood disadvantage was examined as a predictor of alcohol-outlet density at W1, chronic reward deprivation, and alcohol-related problems at W7. Alcohol-outlet density and drinking to cope at W3 were examined as predictors of alcohol demand amplitude at W5 and alcohol-related problems at W7, while chronic reward deprivation was examined as a predictor of relative-reinforcement value (RRV) of alcohol-involved activities at W5 and alcohol-related problems at
W7. Alcohol demand amplitude and relative-reinforcement value (RRV) of alcohol-involved activities at W5 were then modeled as predictors of alcohol-related problems at W7. Age, sex, race, and college status were included as covariates for all endogenous variables. Based on recommendations from the American Statistical Association (Nuzzo, 2014; Wasserstein & Lazar, 2016), covariates that did not demonstrate marginal associations ($p < .10$) with endogenous variables were deleted to prevent statistical overcontrolling. W1 measures of drinking to cope, alcohol demand amplitude, relative-reinforcement value (RRV), and alcohol-related problems were included as covariates for their associated subsequent values (the autoregressive effects) to appropriately assess prospective effects. Heavy drinking at W7 was also included as a covariate for W7 alcohol-related problems. Covariances were estimated among all variables measured at W1 and the covariance of the residuals of measures at concurrent time points were also specified.

Overall model fit was assessed using the same criteria previously described. Magnitude, direction, and significance of path estimates were also considered to assess the reliability and explanatory power of the model. Adjusted standard errors associated with SEM parameters were computed using the TYPE = COMPLEX option in Mplus to account for the clustering of individual data within census tracts. Direct and indirect effects were assessed using bias-corrected bootstrapped estimates (Tibshirani & Efron, 1993) based on 10,000 replications. This technique produces a robust test of mediation that is able to account for small deviations from normality (Fritz & MacKinnon, 2007). Statistical significance of indirect effects was evaluated using 95% bias-corrected bootstrapped confidence intervals not containing zero. Full-information maximum likelihood estimation (FIML) was used to account for missing data (0%-17.6% missing; Little et al., 2014).
Results

Descriptive Statistics

At W1, the current analytic sample reported 1.59 ($SD = 1.54$) heavy drinking days per typical week over the prior month, and 6.37 ($SD = 4.44$) alcohol-related problems. The 466 EAs within the current sample resided within 200 unique census tracts. Within the current sample, 52.8% of participants indicated that their biological mother had a 4-year college degree or higher, 60.3% indicated that their biological father had a 4-year college degree or higher, 43.3% indicated receiving free or reduced price school lunch, and 33.7% indicated receiving Food Stamps (SNAP) during childhood. Table 1 presents descriptive statistics for the individual census tract indicators used to form the composite measure of neighborhood disadvantage and the three estimated population-weighted access measures. Across all census tracts, the median Inter-quintile range (IQR) neighborhood disadvantage score was 51 (23-87), and the average neighborhood disadvantage score was 55.77 ($SD = 29.40$). The average population-weighted driving distance to the closest seven on-premise alcohol outlets was 1.98 ($SD = 1.95$) miles, the average population-weighted driving time was 4.52 ($SD = 4.04$) minutes, and the average population-weighted Euclidian distance was 1.33 ($SD = 1.39$) miles. The population-weighted access measures demonstrated strong bivariate associations with each other ($r$’s ranging from 0.97 to 0.99). However, PWD driving distance demonstrated stronger associations with alcohol-related problems than either PWD driving time or PWD Euclidian distance and thus, was used within the analysis to represent alcohol outlet density. Retention rates within the current analytic sample were high, with 90.3% of the W1 sample retained at W3, 86.3% at W5, and 82.4% at W7. Missing data analysis revealed no significant differences between participants retained in
the final analytic sample and those that were excluded for any measure at W1, thus providing evidence for the assumption of missing at random (MAR).

Preliminary Analysis

Descriptive statistics and bivariate correlations for all variables used within the present analysis are presented in Table 2. With few exceptions, childhood family poverty was significantly ($p < .001$) moderately correlated with ACEs, neighborhood disadvantage in emerging adulthood, W1 internalizing symptoms, drinking to cope at W1 and W3, chronic reward deprivation, and W1 relative-reinforcement value (RRV) for alcohol-involved activities. Neighborhood disadvantage in emerging adulthood was positively correlated with ACEs, on-premise alcohol outlet density (across all three PWD metrics), chronic reward deprivation, W1 relative-reinforcement value (RRV), and W7 heavy drinking. Population-weighted driving distance, population-weighted driving time, and population-weighted Euclidian distance were all significantly negatively correlated with W7 heavy drinking, albeit modestly. ACEs were moderately correlated with W1 internalizing symptoms, drinking to cope at W1 and W3, chronic reward deprivation, and heavy drinking and alcohol-related problems at W1 and W7. Internalizing symptoms at W1 was positively correlated with drinking to cope at W1 and W3, chronic reward deprivation, and alcohol-related problems at W1 and W7. Greater endorsement of drinking to cope at W3 was moderately correlated with alcohol demand amplitude at W1 and W5, and heavy drinking and alcohol-related problems at W1 and W7. Chronic reward deprivation was moderately correlated with relative-reinforcement value (RRV) at W1 and W5, and heavy drinking and alcohol-related problems at W1 and W7. Finally, relative-reinforcement value (RRV) for alcohol-involved activities and alcohol demand amplitude at W5 were positively correlated with heavy drinking and alcohol-related problems at W1 and W7. With the
exception of the nonsignificant correlation between on-premise alcohol outlet density (across all three PWD metrics) and alcohol demand amplitude, the pattern of bivariate correlations provided preliminary evidence to justify the proposed mediation analysis.

**Principal Component Analysis**

Consistent with prior research, examination of scree plots (Goldberg & Velicer, 2006), parallel analysis (Horn, 1965), and the minimum average partial (MAP) test (Velicer, 1976) from the PCA using intensity and $O_{max}$, provided support for a single-component solution representing alcohol demand amplitude that accounted for 69.5% of the total variance at W1 and 70.4% of the total variance at W5. Factor scores were extracted via standardized regression coefficients and used within the structural model.

**Measurement Model**

**Environmental Reward**

Single factor CFAs were first estimated separately at W1 and W3 to validate the existing factor structure associated with the Environmental Suppressors subscale. Items from the Environmental Suppressors subscale at W1 and W3 were reverse recoded to facilitate greater interpretation of results, thus, higher scores reflect greater levels of reward deprivation. Model fit statistics indicated acceptable fit to the data at both waves, $W1: \chi^2 (26, N = 466) = 77.923, p < .001, \text{CFI/TLI} = .958/.942, \text{RMSEA} = .059 (90\% \text{CI [.045, .075]});$ $W3: \chi^2 (26, N = 421) = 72.558, p < .001, \text{CFI/TLI} = .969/.955, \text{RMSEA} = .052 (90\% \text{CI [.034, .070]}).$ Factor loadings are available upon request from the author. To establish longitudinal measurement invariance for the latent construct across waves, a sequence of incremental invariance testing was applied. Individual models were incorporated into an analysis to test for configural invariance. Table 3 presents fit indices and model comparisons between estimated nested models (i.e., configural,
metric, and scalar). Results suggested that the configural model provided acceptable fit to the data, $\chi^2 (125, N = 466) = 305.968, p < .001$, CFI/TLI = .942/.929, RMSEA = .050 (90% CI [.043, .057]), suggesting that the factor structure (i.e., equivalent pattern of items contributing to the same latent factor) associated with the construct of environmental reward is consistent across time. Next, metric invariance was examined through the estimation of models in which factor loadings of the same indicator were constrained to equality across waves. Model fit statistics suggested that the metric invariance model provided acceptable fit to the data, $\chi^2 (133, N = 466) = 313.025, p < .001$, CFI/TLI = .942/.934, RMSEA = .048 (90% CI [.041, .055]), indicating invariance of the indicator factor loadings across time. In comparing the configural and metric models, the change in chi-square was nonsignificant ($\Delta \chi^2_{diff} [8] = 7.057, p > 0.1$), the CFI remained constant, and change in TLI and RMSEA indicated an improvement in model fit at the metric level. Finally, a scalar invariance model was estimated in which both loadings and measurement intercepts were constrained to equality across waves. Results suggested that the scalar invariance model provided acceptable fit to the data, $\chi^2 (141, N = 466) = 320.059, p < .001$, CFI/TLI = .943/.938, RMSEA = .047 (90% CI [.040, .053]). In comparing the metric and scalar models, the change in chi-square was nonsignificant ($\Delta \chi^2_{diff} [8] = 7.034, p > 0.1$), and the change in CFI, TLI, and RMSEA indicated an improvement in model fit at the scalar level providing evidence that the Environmental Suppressors subscale measures the same latent construct across time.

**Drinking to Cope**

Model fit statistics indicated excellent fit to the data at both waves, $W1$: $\chi^2 (5, N = 466) = 15.203, p < .001$, CFI/TLI = .991/.981, RMSEA = .048 (90% CI [.026, .064]); $W3$: $\chi^2 (5, N = 421) = 9.174, p < .001$, CFI/TLI = .994/.989, RMSEA = .042 (90% CI [.025, .055]). The coping
subscale demonstrated excellent model fit at the configural level, \( \chi^2 (29, N = 466) = 64.234, p < .001, \text{CFI/TLI} = .991/.986, \text{RMSEA} = .046 (90\% \text{CI} [.031, .061]) \). A subsequent test of metric invariance also indicated excellent model fit, \( \chi^2 (33, N = 466) = 66.224, p < .001, \text{CFI/TLI} = .991/.988, \text{RMSEA} = .041 (90\% \text{CI} [.027, .056]) \), suggesting that the magnitude of the association between the indicators and the latent construct is equivalent across waves. In comparing the configural and metric models, the change in chi-square was nonsignificant (\( \Delta \chi^2 \text{diff} [4] = 1.990, p > 0.1 \)), the CFI remained constant, and change in TLI and RMSEA indicated an improvement in model fit at the metric level. A subsequent test of scalar invariance also demonstrated excellent model fit, \( \chi^2 (37, N = 466) = 77.510, p < .001, \text{CFI/TLI} = .990/.987, \text{RMSEA} = .043 (90\% \text{CI} [.030, .057]) \). In comparing the metric and scalar models, a significant change in chi-square was found (\( \Delta \chi^2 \text{diff} [4] = 11.286, p < .001 \)). However, negligible changes in CFI/TLI (< .01) and RMSEA (< .015) indicated no significant decrements in model fit from metric to scalar.

**Alcohol-Related Problems**

Model fit statistics indicated acceptable fit to the data at both waves, \( W1: \chi^2 (1080, N = 466) = 1479.549, p < .001, \text{CFI/TLI} = .932/.926, \text{RMSEA} = .045 (90\% \text{CI} [.023, .056]); W7: \chi^2 (1080, N = 384) = 1546.590, p < .001, \text{CFI/TLI} = .963/.961, \text{RMSEA} = .032 (90\% \text{CI} [.028, .035]) \). The B-YAACQ demonstrated acceptable model fit at the configural level, \( \chi^2 (1079, N = 466) = 1525.395, p < .001, \text{CFI/TLI} = .947/.945, \text{RMSEA} = .027 (90\% \text{CI} [.023, .030]) \). A subsequent test of scalar invariance\(^4\) demonstrated excellent model fit, \( \chi^2 (1125, N = 466) = 1535.428, p < .001, \text{CFI/TLI} = .951/.951, \text{RMSEA} = .025 (90\% \text{CI} [.022, .028]) \), indicating

\(^4\) Given the categorical nature of the indicators, tests of metric invariance are not possible within the incremental testing approach as factor loadings and thresholds are constrained and tested simultaneously.
invariance of the indicator factor loadings and thresholds across waves. In comparing the configural and scalar models, the change in chi-square was nonsignificant ($\Delta \chi^2_{\text{diff}} [46] = 10.033, p > 0.1$), and the change in CFI, TLI, and RMSEA indicated an improvement in model fit at the scalar level suggesting that the B-YAACQ measures the same latent construct across time.

**Chronic Reward Deprivation Higher-Order Factor Structure**

Given the relative stability associated with the Environmental Suppressors subscale over time (e.g., high correlations among environmental reward latent factors across waves; Murphy et al., 2021), a second-order factor structure was estimated using the environmental reward latent factors estimated at W1 and W3 to assess whether the construct is best captured as a latent variable reflecting chronic reward deprivation in emerging adulthood. The first-order environmental reward latent factors estimated at W1 and W3 were specified as indicators of a higher-order latent factor representing chronic reward deprivation. Thus, the second-order latent factor represents the shared variance of environmental reward measured at W1 and W3, with higher scores signifying higher levels of reward deprivation across time. The higher-order model demonstrated good fit to the data, $\chi^2 (120, N = 466) = 205.193, p < .001$, CFI/TLI = .973/.965, RMSEA = .035 (90% CI [.027, .043]). Factor scores were extracted from the higher-order measurement model representing chronic reward deprivation and used within the structural model to reduce complexity.

**Structural Model**

The hypothesized model (M0) provided acceptable fit within the current sample (see Table 4). In the interest of parsimony, five nonsignificant path coefficients were subsequently deleted (the direct effects of family poverty, ACEs, drinking to cope at W3, neighborhood disadvantage in emerging adulthood, and on-premise alcohol outlet density on alcohol-related
problems at W7). While the direct effect of on-premise alcohol outlet density on alcohol demand amplitude at W5 was nonsignificant, it was retained in the model given the aim of the current analysis was to validate the comprehensive model and the relevance of this path in the proposed cue exposure/availability pathway (see Table 4, M1). As a final step, all paths specified in which endogenous variables were regressed on covariates were examined and those which did not demonstrate marginal effects ($p < .10$) were trimmed to prevent statistical overcontrolling, resulting in the deletion of 11 additional paths (the effects of age on ACEs, W1 internalizing symptoms, W3 drinking to cope, neighborhood disadvantage, and chronic reward deprivation; the effects of sex on neighborhood disadvantage and alcohol outlet density; the effects of race on ACEs, W1 internalizing symptoms, and alcohol outlet density; and the effect of college status on alcohol outlet density). The final model provided an excellent fit to the data, $\chi^2 (2615, N = 466) = 3409.923, p < .001$, CFI/TLI = .954/.951, RMSEA = .025 (90% CI [.023, .028]) (see Table 4, M2). Standardized coefficients for each direct effect in the final model are depicted in Figure 3. Table 5 presents the total indirect and specific indirect effects along with their associated standardized 95% CIs. Given that the latent variable of drinking to cope at W3, relative-reinforcement value (RRV) at W5, alcohol demand amplitude at W5, and the latent variable of alcohol-related problems at W7 were estimated controlling for their associated values at W1 (autoregressive effects), effect sizes for standardized coefficients associated with paths predicting these variables are interpreted using recommendations provided by Orth et al. (2022), such that 0.03 indicates a small effect, 0.07 indicates a medium effect, and 0.12 or greater indicates a large effect.
Direct Effects

Early exposure to family poverty was positively associated with greater exposure to childhood adversity ($\beta = 0.39$, 95% CI [0.29, 0.48], $p < .001$), internalizing symptoms in emerging adulthood ($\beta = 0.19$, 95% CI [0.05, 0.32], $p = .024$), and neighborhood disadvantage at W1 ($\beta = 0.33$, 95% CI [0.21, 0.46], $p < .001$). Greater exposure to ACEs was positively associated with internalizing symptoms in emerging adulthood ($\beta = 0.19$, 95% CI [0.05, 0.32], $p = .024$), and neighborhood disadvantage at W1 ($\beta = 0.33$, 95% CI [0.21, 0.46], $p < .001$). Furthermore, neighborhood disadvantage was associated with greater access to on-premise alcohol outlets ($\beta = -0.43$, 95% CI [-0.53, -0.33], $p < .001$), and greater levels of chronic reward deprivation ($\beta = 0.28$, 95% CI [0.20, 0.37], $p < .001$). Contrary to hypotheses, greater access to on-premise alcohol outlets was not associated with increases in alcohol demand amplitude at W5.5 Drinking to cope at W3 was associated with increases in alcohol demand amplitude at W5 ($\beta = 0.13$, 95% CI [0.05, 0.21], $p < .001$). Chronic reward deprivation was associated with increases in relative-reinforcement value (RRV) for alcohol-involved activities at W5 ($\beta = 0.15$, 95% CI [0.09, 0.22], $p < .001$) and increases in alcohol-related problems at W7 ($\beta = 0.20$, 95% CI [0.14, 0.29], $p < .001$). Finally, alcohol demand amplitude and relative-reinforcement value (RRV) at W5 were associated with increases in alcohol-related problems at W7 ($\beta = 0.22$, 95% CI [0.12, 0.32], $p < .001$; $\beta = 0.22$, 95% CI [0.12, 0.33], $p < .001$, respectively). All associations were in the hypothesized direction and the path

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5 Two additional models were estimated using PWD driving time and PWD Euclidian distance, respectively, to represent alcohol outlet density. Results were largely consistent in terms of model fit, $R^2$ values, and path coefficients across models for each of the three PWD access metrics. However, models that were specified using PWD driving time and PWD Euclidian distance demonstrated associations that were slightly weaker than those reported in the text.
coefficient from W1 internalizing symptoms exhibited the greatest magnitude in predicting increases in alcohol-related problems at W7.

The model explained approximately 14% of the variability in ACEs, 19% of the variability in W1 internalizing symptoms, 13% of the variability in W1 neighborhood disadvantage, 19% of the variability in on-premise alcohol outlet density, 46% of the variability in W3 drinking to cope, 17% of the variability in chronic reward deprivation, 36% of the variability in W5 alcohol demand amplitude, 20% of the variability in W5 relative-reinforcement value (RRV) for alcohol-involved activities, and 71% of the variability in W7 alcohol-related problems. The model explained a substantial proportion of the variance in alcohol-related problems at W7 ($R^2 = .71$). This suggests that the structural model demonstrates good fit to the data, has significant explanatory power, and can reliability predict changes in alcohol-related problems.

**Indirect Effects**

*Childhood Family Poverty as a predictor of W7 Alcohol-Related Problems*

The total indirect effect of childhood family poverty on W7 alcohol-related problems was positive and statistically significant ($\beta = 0.104, 95\% \text{ CI} [0.058, 0.147]$). The stress-distress-coping pathway consisted of four specific indirect effects: (1) indirect effect via internalizing symptoms at W1 ($\beta = 0.044, 95\% \text{ CI} [0.006, 0.079]$); (2) a significant serial-mediation effect via ACEs and internalizing symptoms at W1 ($\beta = 0.034, 95\% \text{ CI} [0.015, 0.045]$); (3) a significant serial-mediation effect via internalizing symptoms at W1, changes in drinking to cope at W3, and changes in alcohol demand amplitude at W5 ($\beta = 0.002, 95\% \text{ CI} [0.001, 0.004]$); and (4) a significant serial-mediation effect via ACEs, internalizing symptoms at W1, changes in drinking to cope at W3, and changes in alcohol demand amplitude at W5 ($\beta = 0.002, 95\% \text{ CI} [0.001, 0.004]$).
The alternative reward pathway consisted of two specific indirect effects: (1) a significant serial-mediation effect via neighborhood disadvantage in emerging adulthood and chronic reward deprivation ($\beta = 0.018, 95\% \text{ CI} [0.010, 0.027]$); and (2) a significant serial-mediation effect via neighborhood disadvantage in emerging adulthood, chronic reward deprivation, and changes in relative-reinforcement value (RRV) of alcohol-involved activities at W5 ($\beta = 0.003, 95\% \text{ CI} [0.001, 0.006]$). Results did not provide support for the cue exposure/availability pathway as the hypothesized indirect effect via neighborhood disadvantage in emerging adulthood, alcohol outlet density, and changes in alcohol demand amplitude at W5 was nonsignificant. This finding was not surprising given that alcohol outlet density did not demonstrate a significant association with changes in alcohol demand amplitude at W5.

**Discussion**

The alcohol-harm paradox (AHP) is the phenomenon in which individuals who experience socioeconomic deprivation also experience greater rates of alcohol-related harm relative to their more advantaged counterparts, despite consumption of equivalent or lower volumes of alcohol. However, our understanding of the mechanisms underpinning the AHP remain unclear. This may be due in part to a persistent emphasis in the field on individual-level determinants, including trait and state level psychological factors (e.g., cognitions, affect, craving, personality, and genetic risk factors), while the role of the broader socioecological context and multiple influences at the neighborhood, community, and policy-level have remained underexplored. Behavioral economic theory posits that the etiology and maintenance of addictive behaviors results from temporally extended patterns of choice behavior and resource allocation that are influenced by social and structural determinants within a consistently changing broader context (Acuff et al., 2023; Tucker & Witkiewitz, 2022). Thus, behavioral economics provides a
useful theoretical framework to expand our conceptual perspective and serves as an organizational structure for the various levels of influence beyond individual-level determinants that impact and maintain temporally extended patterns of addictive behavior.

Behavioral economics suggests that addiction arises from patterns of behavioral allocation over extended intervals resulting in a persistent preference for and engagement in substance use relative to other available substance-free activities and commodities. Based on the fragmented evidence described above, Hogarth (2022) proposed a conceptual model suggesting that individual, community, and broader environmental and policy-level factors that co-vary with socioeconomic deprivation contribute to patterns of choice behavior and resource allocation that result in an overvaluation of alcohol relative to alcohol-free rewards, resulting in the persistent choice to drink despite negative consequences. The current study tested three potential etiological pathways through which socioeconomic deprivation may contribute to a persistent pattern of alcohol misuse and the disproportionate harm experienced within lower SES populations within a sample of EAs reporting some level of alcohol misuse at W1. The present study empirically tested a comprehensive model to assess whether determinants of health related to socioeconomic deprivation indirectly predict an overvaluation of alcohol relative to alcohol-free alternatives and other commodities, which, in turn, result in greater alcohol-related problems in emerging adulthood. Results provide partial support for the model, as evidenced by findings that support the existence of both the stress-distress-coping pathway and the alternative reward pathway.

The Cue Exposure/Availability Pathway

The present study provided partial support for the cue exposure/availability pathway, in that childhood family poverty was associated with greater neighborhood disadvantage in
emerging adulthood, which was associated with greater access to on-premise alcohol outlets. Results support and extend the hypothesis put forth by Hogarth (2022), in which individuals characterized by lower SES are likely to reside in disadvantaged neighborhoods by demonstrating the stability of this association into emerging adulthood. Results are also consistent with several published studies utilizing geographic mapping that have reported greater density of alcohol outlets within neighborhoods characterized by greater disadvantage (Furr-Holden et al., 2019; Lee et al., 2020; Macdonald et al., 2018; Romley et al., 2007; Trangenstein et al., 2020a). Contrary to our hypotheses, greater access to on-premise alcohol outlets was not longitudinally associated with increases in alcohol demand amplitude. Hogarth (2022) proposed that residing within environments with greater deprivation contributes to increased exposure to alcohol-related cues and greater access to alcohol. The current study did not incorporate a measure to quantify the number of alcohol-related cues within the environment, which is hypothesized to contribute to greater alcohol demand and consumption by means of increasing expectancies related to the availability of alcohol. Future research incorporating existing sources of data such as Google Street View or other methods to quantify alcohol-related cues (e.g., advertising) within the environment can contribute to a more nuanced understanding of the association between spatial distributions of alcohol marketing and motivation to drink.

Contrary to past research suggesting that alcohol outlet density is positively associated with EA alcohol consumption (Foster et al., 2017; Tanumihardjo et al., 2015) and alcohol-related harm (Campbell et al., 2009; Popova et al., 2009; Sherk et al., 2018), greater access to on-premise alcohol outlets was not prospectively associated with changes in heavy drinking or alcohol-related problems. While research has generally shown stronger associations between density of off-premise alcohol outlets with alcohol misuse and alcohol-related problems
(Scribner et al., 1999), the current study chose to focus exclusively on on-premise alcohol outlets given that the majority of participants reported residing in a census tract within a control state, which is defined by the National Alcohol Beverage Control Association as a state in which the sale of distilled spirits is controlled or regulated at the wholesale level by government agencies that regulate the number of off-premise alcohol outlets within a given area. Off-premise alcohol outlets are distinct from on-premise outlets such as restaurants and bars, given that they are able to offer alcohol for purchase in large amounts. Alcohol purchased from off-premise outlets can then be consumed in uncontrolled settings (e.g., within the home, parking lots, outside the outlet). Furthermore, within on-premise alcohol outlets, servers can place constraints on access by denying service to patrons who are intoxicated. Thus, the feasibility of purchasing large amounts of alcohol combined with consumption in uncontrolled settings may contribute to greater levels of alcohol misuse and related harm. Given research suggesting that off-premise alcohol outlets may demonstrate unique risk for alcohol-related harm, future research that includes off-premise alcohol outlets is necessary to gain a greater understanding of the impact of access to both on- and off-premise alcohol outlets. It is also feasible that within the current sample of EAs, alcohol may be more accessible via sources distinct from on-premise outlets, including peers or within the home. In addition, the advent of services that deliver alcohol resulting from the COVID-19 pandemic and the fact that most participants within the current sample reported residing within a city that has an 88.7% rate of vehicle ownership, an average of 1.53 cars per household (Moody et al., 2021), and historically poor public transportation, may have reduced the relative impact of distance to alcohol outlets.

It is worth noting that bivariate correlations revealed significant, albeit modest associations between heavy drinking at W7 and on-premise alcohol outlet density ($r_s = -.10$ for
each PWD access metric). Interestingly, W1 and W7 alcohol-related problems were not significantly correlated with any of the three measures of alcohol outlet density. Thus, it may be the case that greater density of on-premise alcohol outlets is better characterized as a predictor of static levels of heavy drinking but does not predict escalations in consumption. The lack of significant correlation with static levels of alcohol-related problems in addition to the nonsignificant direct effect predicting increases in alcohol-related problems at W7, may indicate that on-premise alcohol outlet density does not contribute unique risk for alcohol-related problems, independent of heavy drinking levels. Witkiewitz and Tucker (2024) recently published an article that highlights how the individual, neighborhood, and community-level factors that support and maintain continued harmful substance use, are not invariably the lack of or inverse of individual, neighborhood, and community-level factors that encourage recovery. For example, research using a large sample of problem drinkers recruited from substance use treatment settings showed that living within more disadvantaged neighborhoods with greater density of on-premise alcohol outlets differentiated between those individuals who relapsed and those who maintained stable recovery (Karriker-Jaffe et al., 2020). Thus, greater access to on-premise alcohol outlets may not represent a mechanism giving rise to the AHP but may be better characterized as an environmental-level factor that maintains harmful alcohol use.

**The Stress-Distress-Coping Pathway**

Consistent with previous research, childhood family poverty was associated with greater exposure to ACEs (Strompolis et al., 2019; Turner & Avison, 2003), and greater levels of internalizing symptoms reported in emerging adulthood (Reiss et al., 2019; Ribeiro et al., 2017). Greater exposure to ACEs was longitudinally associated with greater levels of internalizing symptoms in emerging adulthood, further highlighting the enduring risk conferred by exposure
to ACEs across the life course (Culpin et al., 2015; Dunn et al., 2013; Scott et al., 2010; Hughes et al., 2017). Internalizing symptoms in emerging adulthood (baseline assessment) demonstrated an effect of large magnitude on increases in drinking to cope at W3 (8-month follow-up; $\beta = 0.36$). These results are consistent with research that suggests that exposure to ACEs increases risk for substance misuse in adulthood through neuroadaptations that exacerbate stress reactivity and that give rise to maladaptive coping strategies used to mitigate negative affect (Bucci et al., 2016; Hussong et al., 2011). Endorsement of coping motives also demonstrated a large effect on increases in alcohol demand amplitude at W5 (16-month follow-up; $\beta = 0.13$), which supports negative reinforcement theories of addiction that propose that alcohol is a potent reinforcer when used to manage emotional distress. Our results are consistent with laboratory studies that have shown how the experience of negative affect resulting from manipulations of negative mood induction, gives rise to greater levels of alcohol demand reported by participants (Amlung & MacKillop et al., 2014; Owens et al., 2015; Rousseau et al., 2011).

Several significant indirect effects from childhood family poverty to changes in alcohol-related problems in emerging adulthood were observed within the stress-distress-coping pathway. One set of pathways originating from childhood family poverty flowed through internalizing symptoms in emerging adulthood (directly and indirectly via greater exposure to ACEs) and onward through increases in drinking to cope motives and increases in alcohol demand amplitude. Several arguments can be made to explain this result. Individuals characterized by greater levels of socioeconomic deprivation experience increased exposure to chronic stressors that over time, diminish mental health (Mulia et al., 2008; Myers, 2009) while simultaneously limiting access to adaptive means of coping. Research has demonstrated that cumulative exposure to early life stress is associated with structural alterations to the anterior
cingulate cortex, as well as the orbitofrontal, dorsolateral, and subgenual prefrontal cortex (PFC; De Brito et al., 2013; Tomoda et al., 2009), and neuroadaptations of stress-response systems, that include cortisol reactivity (Carpenter et al., 2009; Sinha, 2008). The affected brain regions and stress-response systems may contribute to emotional dysregulation and neurocognitive impairments associated with cognitive functioning. Thus, individuals who experience chronic and prolonged stress due to limited access to and influence over fundamental material and social resources or through exposure to ACEs, are susceptible to neuroadaptations that give rise to impairments in emotion regulation that confer risk for negative emotionality (Cicchetti & Handley, 2019).

One’s ability to adaptively regulate negative emotional experiences has been shown to be influenced by relationships with primary caregivers in childhood. Individuals with primary caregivers that exemplify warmth and support, who demonstrate adaptive emotional regulation strategies, and who illustrate the ability to label emotions and validate others’ emotional experiences are more likely to develop high levels of emotional regulation (Dvir et al., 2014; Gruhn & Compas, 2020). Caregivers within families characterized by greater levels of socioeconomic deprivation are less likely to demonstrate these beneficial behaviors and instead, show elevated rates of emotional unresponsiveness and modeling of maladaptive coping strategies (Cicchetti & Handley, 2019; Weissman et al., 2019). Thus, children who are reared within socioeconomically deprived family contexts show greater emotional reactivity to stress, reduced ability to identify and comprehend emotions, and exhibit impaired capacity for effectively regulating distressing emotions (Dvir et al., 2014; Gruhn & Compas, 2020; Weissman et al., 2019). Impairments in emotional regulation are likely to persist across the life course.
(Warmingham et al., 2023), increasing risk for the adoption of alcohol use to regulate or reduce negative affect states in adulthood (Shin et al., 2015).

Socioeconomic deprivation has been shown to contribute to disproportionate levels of emotional distress in which alcohol may be used to reduce negative affect (Heim et al., 2021; Karriker-Jaffe et al., 2016). Furthermore, socioeconomic deprivation is associated with reduced access to material and social resources that may permit the use of other substitute strategies for emotion regulation that are less harmful. Limited economic resources may also limit one’s ability to alter their environment or relocate to a different environment that may have less impact on exacerbating emotional distress. Disproportionate internalizing symptomology resulting from socioeconomic deprivation in combination with disparities in material and social resources that would allow substitute options for coping with emotional distress may contribute to a reliance on using alcohol to regulate negative affect thus, increasing the reinforcing value ascribed to alcohol, given its relevance to mitigate these factors.

Contrary to prior research that has shown direct effects of coping motives on alcohol-related problems in EAs (Cooper et al., 2016; Kuntsche et al., 2005), results from the current analysis suggest that the effect of coping motives on alcohol-related problems is better characterized as indirect through its impact on the reinforcing value ascribed to alcohol (alcohol demand). Thus, results provide preliminary support to suggest that alcohol demand is a critical mechanism through which coping motives give rise to increases in alcohol-related problems, yet prior studies have not included this variable. Specifically, and in support of negative reinforcement theories, results suggest that greater levels of internalizing symptoms resulting from cumulative life stress predict increases in drinking to cope motives that collectively increase the reinforcing value of alcohol, leading to increases in alcohol-related problems. Prior
research using a cross-sectional sample of college students found that individuals with greater levels of alcohol demand, demonstrated greater enhancement and coping motives, which, in turn, predicted greater alcohol-related problems (Yurasek et al., 2011). The findings of the current analysis provide an important extension to the previous study by investigating directionality of the association between these two constructs in the proposed pathway, suggesting that drinking to cope motives prospectively predicts later increases in alcohol demand over time.

Findings also revealed a significant indirect effect between early exposure to family poverty and increases in alcohol-related problems in emerging adulthood that flowed through internalizing symptoms (directly and indirectly via ACEs) as evidenced by the significant residual effect of internalizing symptoms on alcohol-related problems ($\beta = 0.23$). Greater levels of internalizing symptomology may be indicative of psychological problems that represent a robust individual-level risk factor for substance misuse due to the increased potential for psychological problems to limit one’s ability to access resources to effectively cope with or mitigate stress and negative affect, thus contributing to greater reliance on the effects of alcohol to manage emotional distress.

**The Alternative Reward Pathway**

Mediation analysis revealed that greater levels of childhood family poverty was associated with greater neighborhood disadvantage in emerging adulthood, which was indirectly associated with increases in alcohol-related problems through greater levels of chronic reward deprivation. Additionally, as described above, neighborhood disadvantage demonstrated an indirect effect on increases in alcohol-related problems through chronic reward deprivation and increases in relative-reinforcement value (RRV) for alcohol-involved activities. This is consistent with prior literature suggesting that the influence of neighborhood disadvantage in
contributing to substance misuse is likely transmitted indirectly (Zimmerman & Farrell, 2017; Karriker-Jaffe, 2011), emphasizing that distal community and environmental-level factors exert effects via multiple links in a chain. The coefficients from chronic reward deprivation to increases in W5 relative-reinforcement value (RRV; $\beta = 0.15$) and increases in W7 alcohol-related problems ($\beta = 0.20$) were positive, statistically significant and of large magnitude suggesting the importance of limited access to reward within ones’ environment as a robust risk factor involved in persistent addiction.

These results are in line with prior research demonstrating higher rates of substance misuse and AUD severity in environments characterized by limited availability of substance-free activities that might otherwise compete with alcohol use (Murphy et al., 2021; Joyner et al., 2016; Morris et al., 2017). Individuals residing in environments that are punishing or that are characterized by limited reinforcing opportunities are at heightened risk of engaging in harmful substance use as a substitute for engaging in few pleasurable or rewarding activities (Joyner et al., 2016). Murphy and colleagues (2021) applied growth mixture modeling to a secondary analysis of intervention data using heavy drinking college students and identified two trajectories of environmental reward: a high-stable reward availability trajectory and a low-increasing reward availability trajectory. Individuals in the low-increasing reward availability trajectory reported substantially greater levels of alcohol severity across the entire 16-month follow-up compared to the high-stable reward availability trajectory, emphasizing the persistent pattern between contexts devoid of reward and heightened risk for AUD (Joyner et al., 2016).

These results reflect an overvaluation of alcohol that is consistent with the behavioral economic theory of reinforcer pathology. The theory suggests that the reinforcing value of alcohol can increase as a result of deficits in alternative reinforcers (e.g., limited leisure
activities, or occupational/academic goals), contributing to a persistent preference for alcohol compared to alternatives. Frequent alcohol use can result in diminished reinforcement from substance-free alternatives (e.g., adversely affect fitness, social, or occupational functioning), which may contribute to additional increases in the relative value of alcohol leading to a pattern of reinforcer pathology defined by an escalating desire for alcohol relative to salient alternative reinforcers (Bickel et al., 2014). Research supports this notion as individuals meeting criteria for AUD show greater allocation of time and obtain more reinforcement from drinking relative to alcohol-free activities (Acuff et al., 2019). Over time, this persistent pattern of alcohol use results in a reduced behavioral repertoire, in which alcohol consumption is the principal source of reinforcement.

Studies examining addiction recovery through a behavioral economic framework have demonstrated the importance of changes in patterns over time that favor greater behavioral and resource allocation geared toward salutary substance-free reinforcers while concurrently reducing those associated with substance use as an important mechanism contributing to beneficial reductions in substance use behaviors (Acuff et al., 2019; Tucker et al., 2021, 2023; Vuchinich et al., 2023). Taken together, results provide support for the hypothesis that living within socioeconomically deprived environments that lack access to substance-free reinforcing activities and increase risk for exposure to adverse childhood experiences contributes to increased valuation for and time spent engaging in alcohol-involved activities relative to alternative alcohol-free rewards and commodities, increasing the propensity for alcohol-related problems over time.
Prevention and Clinical Implications

Understanding the mechanisms by which inequalities in environmental exposure contribute to alcohol use and misuse in emerging adults can inform the development of prevention and intervention strategies and policy approaches aimed at reducing disparities in alcohol-related harm. Given that the current research was not an intervention or clinical trial, implications must be interpreted with caution.

Results highlight several modifiable individual-level determinants involved within the stress-distress-coping pathway that include elevated internalizing symptoms, drinking to cope motives, and alcohol demand, that may serve as appropriate treatment targets at the individual-level. Extant literature focusing on modifiable individual-level factors has demonstrated that reducing negative affect (Sliedrecht et al., 2019), broadening behavioral repertoires of coping behavior (Roos & Witkiewitz, 2016), decreasing reward delay discounting (Athamneh et al., 2022; Craft et al., 2022), and enhancing future orientation (Snider et al., 2016) are associated with positive behavior change and reductions in substance use. Individual-level interventions that seek to broaden one’s adaptive coping repertoire have shown to result in beneficial reductions in alcohol-related problems among individuals with AUD (Witkiewitz et al., 2018). Thus, individuals with greater socioeconomic deprivation and/or those exposed to childhood adversity may benefit from programs that target maladaptive coping motives by increasing the use of substitute coping strategies that are more adaptive, such as cognitive reframing or problem-focused strategies that include bolstering social support (Wadsworth, 2015). Additionally, interventions that teach distress tolerance skills may be especially effective among this at-risk population due to impaired emotion regulation.
While exposure to ACEs represents an enduring individual-level determinant associated with increased risk for alcohol misuse, it is generally unmodifiable (Borgert et al., 2023). Thus, emphasis on the prevention of ACEs via better family supports and policy-level initiatives to reduce poverty and increase access to quality education, healthcare, and community resources is crucial. In particular, interventions that seek to bolster family-level systems may result in reduced rates of ACEs. For example, teaching techniques to caregivers to better respond to their own individual stressors and providing resources and supports to decrease rates of abuse and neglect among socioeconomically disadvantaged families may contribute to decreased intrafamily discord and mitigate the negative impact of psychopathology. Programs that intervene at the community and neighborhood-level that function to reduce environmental stress via improving housing (Jason et al., 2006) and working conditions (Stansfeld & Candy, 2006) may result in beneficial reductions in the perceived value of alcohol. Finally, research has demonstrated that greater access to greenspace is associated with decreases in internalizing symptomology (Astell-Burt & Feng, 2019; Engemann et al., 2019), lower levels of alcohol craving (Martin et al., 2019), and greater substance use treatment engagement (Berry et al., 2021).

Derailment of the alternative reward pathway can be accomplished through reinforcement-based interventions at the individual-level that enhance access to and increase engagement with substance-free activities. Examples include intensive evidence-based treatments such as contingency management (Bolivar et al., 2021; Petry et al., 2017; Fazzino et al., 2019), behavioral activation (Daughters et al., 2018), social prescribing services that include patient navigators (Pescheny et al., 2020), employment interventions (Walton & Hall, 2016), and community reinforcement. In addition, brief motivational interventions (BMIs) that target
reductions in the relative-reinforcement value of substances via goal setting and increasing engagement in future-oriented positive alternatives that are incongruent with substance use, have been shown to reduce heavy drinking and alcohol-related problems in EAs (Correia et al., 2005; Murphy et al., 2012, 2019).

Interventions focusing on alternatives to addictive behavior that aim to change the environment through enrichment by providing increased opportunities to access alcohol-free activities and commodities that may compete with drinking reflect opportunities to intervene at broader environmental, community, and neighborhood-levels. Research applying behavioral economic frameworks to choice behavior has provided robust evidence demonstrating reductions in preference for alcohol and other substances through the fostering of enriched environments that offer alternative reinforcement (Acuff et al., 2023; Murphy et al., 2021; Tucker et al., 2023; Vuchinich et al., 2023). The previously mentioned Icelandic Prevention Model (Kristjansson et al., 2020) represents an example of intervening at the broader community and policy-level to reduce substance use among adolescents. Elements of the model included increasing parental monitoring, strengthening interpersonal relationships, increasing access to enjoyable leisure and social activities such as community programs and extracurricular activities, as well as policy-level initiatives that increased the costs associated with substance use through enforcement of a national ban on alcohol and tobacco marketing, and national media campaigns to deter smoking. The program demonstrated a substantial reduction in rates of adolescent substance use in addition to significant increases in engagement in organized social activities across the 20-year span of the intervention (Kristjansson et al., 2021).

Interruption of the cue exposure/availability pathway could be achieved by intervening at the policy-level through zoning and licensing initiatives that regulate the number, density, and
distance between alcohol outlets within a specified area. Evidence supports regulation of alcohol outlet density as an efficacious procedure for precluding harmful alcohol use and associated problems, resulting in safer communities (Glasser & Roberts, 2021). Policy-level laws and licensing restrictions that oversee and govern the spatial distribution and operation of alcohol outlets represent a cost-effective strategy to decrease levels of heavy drinking via increased constraints on the physical availability of alcohol (Sherk et al., 2018; Campbell et al., 2009; Trangenstein et al., 2020b). Other interventions that target broader environmental-level influences include instatement of policies related to the regulation of advertising for alcohol products (Babor et al., 2017) and the introduction of plain packaging policies which may reduce the probability that substance-related cues will evoke expectancies of substance availability that result in the decision to use (Hogarth et al., 2015).

Limitations and Future Directions

The current study has several limitations. First, the identification of on-premise alcohol outlets was determined using a commercial dataset. While each outlet was verified to be open for business at the time of data collection, we are not able to determine the frequency in which this data is updated and thus, it is possible that newly opened businesses may have been excluded from the current analysis, potentially resulting in an underestimation of access within some census tracts. Following procedures described by Miller (1956) and Saaty and Ozdemir (2003), we used seven on-premise alcohol outlets to define our spatial choice set in estimating measures of spatial access. However, current literature lacks recommendations for best practices in determination of a spatial choice set (i.e., number of alcohol outlets) and would benefit from additional research that evaluates differences based on number of outlets selected. The current study only assessed participants’ home address at baseline, which may have impacted
longitudinal results given that the majority of the sample was comprised of college students who are likely to live near college campuses while in school and relocate to different neighborhoods upon graduating. Future research that seeks to incorporate repeated assessment of address data may result in increased understanding of how neighborhood contexts relate to alcohol misuse over time. Next, the indicators used to derive the measure of neighborhood disadvantage utilize data obtained at the census tract level which may not coincide with EAs’ perceptions of neighborhood boundaries. While the purchase of alcohol from off-premise (e.g., liquor stores) alcohol outlets to consume at home is common, the current study chose to focus exclusively on on-premise alcohol outlets given that the majority of EAs within the current sample reported residing in a census tract within a state that regulates the number of off-premise alcohol outlets within a given area. Thus, results from the current study may not be generalizable to EAs in other states with differing policies related to regulating alcohol outlet density. Research that applies similar methods across multiple states may help elucidate how alcohol environments contribute to disparate outcomes as a function of policy differences associated with the sale of alcohol, potentially influencing policymakers that aim to construct contexts associated with healthier environments. The current study used a retrospective assessment of ACEs, which may potentially be impacted by recall or biases in reporting. However, retrospective reports of core, well-defined ACEs have shown to possess acceptable psychometric properties (Reuben et al., 2016) and have been shown to demonstrate strong associations with prospective reports (Newbury et al., 2018). While summing of individuals ACEs to form a composite is widely accepted (Bellis et al., 2014; Reuben et al., 2016), it fails to accommodate potentially different associations arising from distinct combinations of ACEs. Also, the measure used to assess for ACEs does not consider duration of exposure or differences in age at time of exposure.
Additionally, childhood family poverty and ACEs were assessed contemporaneously. Given that associations between contemporaneous variables are correlational in nature, we are unable to define the causal order between these constructs and it possible that causality may be bi-directional. However, the current analyses specified casual order between these variables based on theory associated with the conceptual model. The model proposed by Hogarth (2022) acknowledges the presence of a positive feedback loop in which persistent alcohol use negatively impacts future SES via psychological (e.g., cognitive impairment) and structural (e.g., legal issues) influences. Over time, persistent patterns of alcohol misuse may exacerbate socioeconomic deprivation by negatively impacting occupational and educational performance (Berg et al., 2013), and contribute to increased allocation of financial resources toward the purchase of alcohol as well as the costs incurred from alcohol-related problems. Thus, additional research that incorporates data collected into later adulthood would allow for the examination of potential reciprocal effects of persistent alcohol use on prospective SES. Lastly, the role of race in the proposed etiological pathways warrants additional attention. While race was specified as a covariate to statistically control for this variable within the current analysis, Black EAs in the US are overrepresented in socioeconomically deprived populations and are more likely to reside within disadvantaged neighborhoods lacking alternative reinforcers (Cellini et al., 2008; Crosnoe, 2005), on account of racialized economic segregation (Osypuk & Acevedo-Garcia, 2010) and structural racism. This has negative implications given that Black EAs demonstrate low levels of upward SES mobility (Chetty et al., 2020) and experience disproportionate alcohol-related harms at the same level of consumption compared to White EAs (Campbell et al., 2022; Collins, 2016). Thus, additional research applying multigroup analysis to larger samples is
needed to examine whether the proposed pathways vary as a function of race as well as the intersectionality between race, college status, and sex.

Despite these limitations, the current study has a number of important strengths. First, the study used a large community sample of EAs from a longitudinal study spanning two years and covered a life period associated with important transitions in adult roles and health behaviors. This permitted the use of detailed mediation analyses to validate the hypothesized risk pathways. Additionally, the simultaneous estimation of the three theorized pathways allowed for modeling of the covariance between reward deprivation and internalizing symptoms while also specifying direct effects of both of these constructs on alcohol-related problems. Thus, resulting estimates from the alternative reward pathway are interpreted while controlling for the effect of internalizing symptoms, providing greater confidence that the construct of environmental reward deprivation is associated with increases in alcohol-related problems. The sample also oversampled non-college and non-White EAs resulting in greater representativeness and applicability to the hypothesized model specifying environmental and psychosocial determinants associated with conditions of SES deprivation. Next, childhood family poverty was defined using variables that represent different components of SES deprivation, thus, providing a more nuanced definition. Parental educational obtainment characterizes parental knowledge, while receipt of public benefits characterizes financial and material resources. The study demonstrates a robust approach to calculate alcohol outlet density by using spatial accessibility measures to quantify the physical alcohol environment. The method used, adjusts for unequal population distributions, incorporates street-level data contributing to more accurate estimates of access (Larsen et al., 2015), and measures of spatial access have demonstrated greater sensitivity (Grubesic et al., 2016), superior model fit, and reduced error compared to commonly used count
and proximity-based methods of alcohol outlet density measurement (Trangenstein et al., 2018). This study also uses a small geographic unit of analysis (census tract), which have shown to produce parameter estimates that are better suited to detect variations at the local level. Smaller geographic units of analysis represent relatively homogeneous populations which are less vulnerable to biases resulting from aggregation such as the loss of small area effects that result from averaging across large, heterogenous populations and inflated standard errors (Gruenewald et al., 1996; Scribner et al., 1999). Finally, participants’ home address at W1 was geocoded which allowed us to combine objective measures of neighborhood disadvantage and population-weighted accessibility metrics at the census tract level with individual data to examine multiple levels of influence that might potentially contribute to the AHP.

Conclusion

Due to an overemphasis on individual-level determinants within the field combined with insufficient consideration of broader levels of influence, the casual mechanisms contributing to the AHP are not well understood. Using data from a longitudinal study of EAs supplemented with data on the neighborhood environment, the current study provides partial support for the conceptual model proposed by Hogarth (2022) in which the relationship between socioeconomic deprivation and alcohol misuse can be partially explained by three etiological risk pathways arising from disproportionate exposure to environmental influences that covary with socioeconomic deprivation. Findings support two risk pathways linking early exposure to family poverty with increases in alcohol-related problems in emerging adulthood via: 1) increased likelihood of adverse experiences which give rise to greater internalizing symptomology and using alcohol to cope, and 2) residing within disadvantaged neighborhood contexts that are devoid of environmental reward which otherwise might compete with alcohol use. Pathways
converged to powerfully augment the reinforcing value of alcohol relative to non-alcohol activities and commodities, contributing to a pattern of increasing behavioral allocation to drinking that intensifies over a temporally extended pattern of use. Results highlight neighborhood, community, and broader environmental-level factors that contribute to disproportionate alcohol-related harm in individuals with greater socioeconomic deprivation, providing support to expand upon policy agendas that only consider individual-level determinants.
References


Macdonald, L., Olsen, J. R., Shortt, N. K., & Ellaway, A. (2018). Do ‘environmental bads’ such as alcohol, fast food, tobacco, and gambling outlets cluster and co-locate in more deprived areas in Glasgow City, Scotland? *Health & Place, 51*, 224-231.


Table 1
Descriptive Statistics for Social Deprivation Indicators and Population-Weighted Distance Metrics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (M)</th>
<th>Standard Deviation (SD)</th>
<th>Minimum (Min)</th>
<th>Maximum (Max)</th>
<th>P20</th>
<th>P40</th>
<th>P50</th>
<th>P60</th>
<th>P80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Deprivation Index</td>
<td>55.77</td>
<td>29.40</td>
<td>1</td>
<td>100</td>
<td>23</td>
<td>45</td>
<td>51</td>
<td>69</td>
<td>87</td>
</tr>
<tr>
<td>Social Deprivation Indicators (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living in poverty</td>
<td>59.24</td>
<td>30.22</td>
<td>1</td>
<td>100</td>
<td>28</td>
<td>49</td>
<td>67</td>
<td>74</td>
<td>89</td>
</tr>
<tr>
<td>Less than high school graduate</td>
<td>44.10</td>
<td>29.14</td>
<td>1</td>
<td>96</td>
<td>12</td>
<td>31</td>
<td>43</td>
<td>55</td>
<td>75</td>
</tr>
<tr>
<td>Single-parent households</td>
<td>58.46</td>
<td>32.82</td>
<td>1</td>
<td>100</td>
<td>20</td>
<td>49</td>
<td>63</td>
<td>79</td>
<td>93</td>
</tr>
<tr>
<td>Renter-occupied</td>
<td>63.60</td>
<td>28.38</td>
<td>1</td>
<td>100</td>
<td>33</td>
<td>65</td>
<td>70</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Residential overcrowding</td>
<td>36.32</td>
<td>28.46</td>
<td>1</td>
<td>96</td>
<td>10</td>
<td>26</td>
<td>40</td>
<td>47</td>
<td>64</td>
</tr>
<tr>
<td>No motor vehicle</td>
<td>51.55</td>
<td>29.78</td>
<td>1</td>
<td>98</td>
<td>23</td>
<td>38</td>
<td>47</td>
<td>62</td>
<td>86</td>
</tr>
<tr>
<td>Non-employed</td>
<td>47.96</td>
<td>28.22</td>
<td>1</td>
<td>100</td>
<td>21</td>
<td>43</td>
<td>69</td>
<td>87</td>
<td>96</td>
</tr>
<tr>
<td>Less than high school graduate</td>
<td>51.55</td>
<td>28.22</td>
<td>1</td>
<td>100</td>
<td>21</td>
<td>43</td>
<td>69</td>
<td>87</td>
<td>96</td>
</tr>
<tr>
<td>Living in poverty</td>
<td>51.55</td>
<td>28.22</td>
<td>1</td>
<td>100</td>
<td>21</td>
<td>43</td>
<td>69</td>
<td>87</td>
<td>96</td>
</tr>
<tr>
<td>Alcohol Outlet Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Census tracts are the unit of analysis (n = 200). Data are weighted by census tract population. All measures are converted to centile rankings.

M = mean; SD = standard deviation; PWD = population-weighted distance; P20, P40, P50, P60, P80 = 20th, 40th, 50th, 60th, 80th centile rankings, respectively.

Miles is the unit of analysis.

Minutes is the unit of analysis.

PWD Distance

PWD Time

PWD Euclidian

Non-employed

No motor vehicle

Residential overcrowding

Renter-occupied

Single-parent households

Less than high school graduate

Living in poverty

Social Deprivation Index (%)
### Correlation, Means, Proportions, and Standard Deviations among Study Variables

**Table 2**
Note. W1 = Baseline assessment; W3 = 8 months after W1; W5 = 16 months after W1; W7 = 24 months after W1; M = mean; SD = standard deviation; SDI = Social Deprivation Index; PWD = population-weighted distance; ACE = Adverse Childhood Experiences; HDD = heavy drinking days; RRV = relative-reinforcement value for alcohol-involved activities.
Table 3

Facetual Invariance Analysis for the Latent Constructs of Environmental Reward, Drinking to Cope, and Alcohol-Related Problems

<table>
<thead>
<tr>
<th></th>
<th>Alcohol-Related Problems (n = 466)</th>
<th>Drinking to Cope (n = 466)</th>
<th>Environmental Reward (n = 466)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Configural Invariance</td>
<td>Scalar Invariance</td>
<td>Configural Invariance</td>
</tr>
<tr>
<td>df</td>
<td>207</td>
<td>19</td>
<td>1079</td>
</tr>
<tr>
<td>χ²</td>
<td>1525.395*</td>
<td>775.10*</td>
<td>1535.428*</td>
</tr>
<tr>
<td>RMSEA (90% CI)</td>
<td>0.027 (0.023, 0.030)</td>
<td>9.04 (0.013, 0.057)</td>
<td>0.030 (0.024, 0.035)</td>
</tr>
<tr>
<td>CFI</td>
<td>0.947</td>
<td>0.954</td>
<td>0.951</td>
</tr>
<tr>
<td>TLI</td>
<td>0.945</td>
<td>0.951</td>
<td>0.946</td>
</tr>
</tbody>
</table>

Note. CFI = comparative fit index; CI = confidence interval; RMSEA = root mean square error of approximation; TLI = Tucker-Lewis

ACFI/AVLL = 10 (decrease indicates deterioration in model fit; Cheung & Rensvold, 2002) and RMSEA ≥ 0.015 (increase indicates deterioration in model fit; Chen, 2007). Tests of factorial invariance were assessed using the model comparison standard of ACI/AVLL ≥ 10 (decrease indicates deterioration in model fit; Cheung & Rensvold, 2002) and RMSEA ≥ 0.015 (increase indicates deterioration in model fit; Chen, 2007). Models for the latent constructs of environmental reward and drinking to cope were estimated specifying autocorrelated errors among the same indicators across waves.
Table 4. Model Fit of Structural Model Evaluating Etiological Pathways from Early Socioeconomic Disadvantage to Alcohol-Related Problems in Emerging Adulthood

<table>
<thead>
<tr>
<th>Model</th>
<th>Comparison File Indices</th>
<th>Overall File Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0 Hypothesized Model</td>
<td>ARMS ε, ACFI, VTLI</td>
<td>RMSEA (90% CI)</td>
</tr>
<tr>
<td>M1 Modified Model</td>
<td>0.002, 0.003</td>
<td>3.997, 9.32</td>
</tr>
<tr>
<td>M2 Final Model</td>
<td>0.003, 0.003</td>
<td>2.604, 7.699</td>
</tr>
</tbody>
</table>

Note. RMSEA = root mean square error of approximation; CI = confidence interval; d = p < .001. Estimated models were compared using model comparison standard of change in Chi-square: ΔΔRMSEA ≥ .015 (increase indicates deterioration); ΔΔCFI/ΔΔTLI ≥ .01 (decrease indicates deterioration in model fit; Cheung & Rensvold, 2002) and ARMS ε > .015 (increase indicates deterioration in model fit; Cheung & Rensvold, 2002).
Table 5

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Predictor: Childhood Poverty</th>
<th>95% CI</th>
<th>Predictor: Childhood Poverty</th>
<th>95% CI</th>
<th>Predictor: Childhood Poverty</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol-Related Problems at W7</td>
<td>0.104</td>
<td>0.058, 0.147</td>
<td>Neighbordood Disadvantage</td>
<td>0.001</td>
<td>-0.001, 0.002</td>
<td>Neighborhood Disadvantage</td>
</tr>
<tr>
<td></td>
<td>0.044</td>
<td>0.006, 0.079</td>
<td>ACEs</td>
<td>0.034</td>
<td>0.015, 0.045</td>
<td>ACEs</td>
</tr>
<tr>
<td></td>
<td>0.001</td>
<td>-0.010, 0.027</td>
<td>Chroniclessness</td>
<td>0.018</td>
<td>0.010, 0.027</td>
<td>Chroniclessness</td>
</tr>
<tr>
<td></td>
<td>0.003</td>
<td>0.001, 0.006</td>
<td>Relative Reinforcement Value for Alcohol-Related Activities</td>
<td>0.002</td>
<td>0.001, 0.004</td>
<td>Relative Reinforcement Value for Alcohol-Related Activities</td>
</tr>
</tbody>
</table>

Note. W1 = Baseline assessment; W3 = 8 months after W1; W5 = 16 months after W1; W7 = 24 months after W1; ACE = Adverse Childhood Experiences; RRV = relative reinforcement value for alcohol-involved activities; Significant associations are in bold typeface and were determined using a 95% bias-corrected bootstrapped confidence interval based on 10,000 replications. Significant associations that do not contain zero correspond to the effect associated with the on-premise alcohol outlet density metric of PWD distance.

The Cue Exposure/Availability Pathway

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Predictor: Childhood Poverty</th>
<th>95% CI</th>
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<th>95% CI</th>
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<th>95% CI</th>
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<td>0.034</td>
<td>0.015, 0.045</td>
<td>ACEs</td>
</tr>
<tr>
<td></td>
<td>0.001</td>
<td>-0.010, 0.027</td>
<td>Chroniclessness</td>
<td>0.018</td>
<td>0.010, 0.027</td>
<td>Chroniclessness</td>
</tr>
<tr>
<td></td>
<td>0.003</td>
<td>0.001, 0.006</td>
<td>Relative Reinforcement Value for Alcohol-Related Activities</td>
<td>0.002</td>
<td>0.001, 0.004</td>
<td>Relative Reinforcement Value for Alcohol-Related Activities</td>
</tr>
</tbody>
</table>

Note. W1 = Baseline assessment; W3 = 8 months after W1; W5 = 16 months after W1; W7 = 24 months after W1; ACE = Adverse Childhood Experiences; RRV = relative reinforcement value for alcohol-involved activities; Significant associations are in bold typeface and were determined using a 95% bias-corrected bootstrapped confidence interval based on 10,000 replications. Significant associations that do not contain zero correspond to the effect associated with the on-premise alcohol outlet density metric of PWD distance.
Risk for Addiction

Figure 1: Conceptual Model Proposed by Hogarth (2022) Highlighting the Role of Socioeconomic Deprivation-Related Factors in Conferring Risk for Addiction. From "The Persistence of Addiction is Better Explained by Socioeconomic Deprivation-Related Factors Powerfully Motivating Goal-Directed Drug Choice than By Automaticity, Habit or Compulsion Theories Favored by the Brain Disease Model," by L. Hogarth, 2022, in Evaluating the Brain Disease Model of Addiction (pp 216-236). Routledge.
Figure 2

Proposed Model Evaluating Etiological Pathways from Early Socioeconomic Disadvantage to Alcohol-Related Problems in Emerging Adulthood

- Note: W1 = Baseline assessment; W3 = 8 months after W1; W5 = 16 months after W1; W7 = 24 months after W1; ACE = Adverse Childhood Experiences; RRV = Relative Reinforcement Value for Alcohol-involved Activities; Correlations between exogenous variables, the paths between covariates and all the endogenous variables, the latent variables W1 drinking to cope and W1 alcohol-related problems and the observed variables W1 RRV, W1 alcohol demand amplitude, and W1 heavy drinking days and the paths to their associated values at W3, W5, and W7 (autoregressive effects) and the covariances between residuals within the same wave are not depicted in the figure in the interest of parsimony. All endogenous variables are estimated at mean levels of age, sex, race, and college status. The ovals indicate latent variables while the squares indicate observed variables. Model uses factor scores from higher-order CFA reflecting chronic reward deprivation to reduce model complexity.
Figure 3

Standardized Path Coefficients for Final Model Evaluating Etiological Pathways from Early Socioeconomic Disadvantage to Alcohol-Related Problems in Emerging Adulthood (N = 466)

Note: W1 = Baseline assessment; W3 = 8 months after W1; W5 = 16 months after W1; W7 = 24 months after W1; ACE = Adverse Childhood Experiences; RRV = relative-reinforcement value for alcohol-involved activities; Correlations between exogenous variables, the paths between covariates and all the endogenous variables, the latent variables W1 drinking to cope and W1 alcohol-related problems, the relative-reinforcement value for alcohol-involved activities, the latent variables W1 drinking to cope and W1 alcohol-related problems and the observed variables W1 RRV, W1 alcohol demand amplitude, and W1 heavy drinking days and the paths to family poverty, internalizing symptoms, alcohol-related problems, and neighborhood disadvantage.
Their associated values at W3, W5, and W7 (autoregressive effects), and the covariances between residuals within the same wave are not depicted in the figure in the interest of parsimony. All endogenous variables are estimated at mean levels of age, sex, race, and college status minus the paths of age on ACEs, W3 internalizing symptoms, and alcohol outlet density; the path of sex on neighborhood disadvantage and alcohol outlet density; the paths of race on ACEs, W3 internalizing symptoms, and alcohol outlet density; the path of college status on alcohol outlet density; the paths of sex on neighborhood disadvantage and alcohol outlet density; and the path of age on ACEs, W3 internalizing symptoms, and alcohol outlet density. The model uses factor scores from higher-order CFA reflecting chronic reward deprivation while the squares indicate observed variables. Model uses factor scores from higher-order CFA reflecting chronic reward deprivation while the squares indicate observed variables. Model uses factor scores from higher-order CFA reflecting chronic reward deprivation while the squares indicate observed variables. Model uses factor scores from higher-order CFA reflecting chronic reward deprivation while the squares indicate observed variables.