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Social consequences and contexts of adverse childhood experiences☆

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ABSTRACT

Adverse childhood experiences' (ACEs) negative consequences on health, education, and life opportunities are often explained through the neurodevelopmental changes in a person's stress reactivity and coping, which contribute to the adoption of health-damaging and antisocial behaviors. However, such focus on the biological dimension eclipses the equally important social dimension of adversity, in particular, how adversities at home can influence association with peers who exhibit and can exacerbate negative behaviors like early and binge drinking, illegal drug use, and gang involvement. More than the consequences for peer formation, this study also investigates the contexts in which ACEs are most predictive. Using a longitudinal study of US youths who were adolescents in 2007 and young adults in 2017, I find that experiencing adversity predicted involvement in peers exhibiting negative behaviors. However, the consequences of ACEs are not similar for everyone and for every outcome: (1) In disadvantaged families where ACEs were most likely, experiencing adversity influenced having peers in gangs but not the other outcomes. (2) In the most advantaged families where ACEs were least likely, having an ACE only predicted adult peers' regular drug use. (3) In families who were in the middle, experiencing adversity predicted early and binge drinking among peers. Taken together, they suggest that complex social processes and environments operate in the negative effects of ACEs, and the present research suggests a method to investigate how ACEs' impact may differ according to one's social context.

Children who experience adversities such as abuse, neglect, and parental alcohol or drug abuse are at an increased risk of developing cardiovascular diseases, having mental health problems, dropping out of high school, and dying prematurely (Brown et al., 2009; Chapman et al., 2004; Metzler et al., 2017; Monnat and Chandler, 2015; Su et al., 2015). The dominant line of inquiry suggests that adverse childhood experiences (ACEs) influence individuals' neurodevelopment, which affects their adoption of antisocial behaviors contributing to negative health, education, and later life outcomes (Hays-Grudo and Morris, 2020; Shonkoff and Garner, 2012). However, this dominance of the biological perspective may constrain a holistic understanding of ACEs, in terms of (1) sidelining social explanations for ACEs' negative impacts, (2) assuming similar biological responses despite dissimilarities in social contexts, and (3) providing interventions that are not attentive to youths' social processes and environments.

The adoption of antisocial behavior is affected not only by biological changes in self-regulation and stress reactivity but also by *social relationships*, such as belonging to peer groups that exhibit, encourage, or exacerbate negative behaviors (Brechwald and Prinstein, 2011). In particular, youths may learn from or select into peers exhibiting early and binge drinking, illegal drug use, and gang involvement, which contribute to negative life outcomes (Costello and Hope, 2016; Ragan, 2020; Ramirez et al., 2012; Rudolph et al., 2018). While studies suggest that parenting and family factors influence involvement with these types of peers (Bahr and Hoffmann, 2010; Fergusson and Horwood, 2003), this present study asks if *ACEs in particular* contribute to the social process of forming peer relationships exhibiting negative behaviors. More importantly, I explore how ACEs impact relationships in *both* adolescence and young adulthood, justified for at least two reasons. First, adolescents more easily associate with, and are influenced by, negative peers (Monahan et al., 2009), and ACE may be a crucial discriminating factor that predicts adolescents' involvement with these peers. Second, young adults display similar peer orientation as adolescents but are also adapting to adult roles and situations (Arnett, 2014; Guassi Moreira et al., 2018), and ACE may be an explanatory factor for the *continued* dominance of negative peer association.

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This relationship between ACEs and negative peers is further shaped by the *social context*—both the context of the family where ACEs happen and the context of the peers who are accessible in one's social environment. Childhood adversities do not happen in a vacuum and the consequences may vary according to different contexts (Fagan and Novak, 2018; Negriff, 2020; Trinidad, 2021; Umberson et al., 2014). Studies often highlight the protective impact of family socioeconomic advantage and the heightened risk for those more socioeconomically disadvantaged (Björkenstam et al., 2013; Luthar et al., 2015; McEwen and McEwen, 2017). However, some studies suggest that those from disadvantaged backgrounds may cope with adversities better (Harvey and Delfabbro, 2004; Hostinar and Miller, 2019) and youths from advantaged families may be unable to address unanticipated adverse experiences (Brand et al., 2019; Luthar and Sexton, 2004). This raises the question of *how* contexts matter for ACEs' negative effects. In particular, the present study investigates the family and peer contexts where ACEs more strongly predicted associating with negative peers.

1. Literature review

1.1. Adversity, peer association, and antisocial behavior

Children who experience adversities such as abuse, neglect, and parental alcohol or drug abuse are more likely in adulthood to develop diseases (Su et al., 2015), have lower self-rated health (Monnat and Chandler, 2015), have depressive disorders (Chapman et al., 2004), and die prematurely (Brown et al., 2009). Many scholars argue that ACEs influence the growing child's neurobiological development, consequently setting into motion a chain of negative influences in terms of social emotional impairments. These changes then affect health-damaging behaviors that ultimately impact individuals' physical and mental health (Hays-Grudo and Morris, 2020; Reading, 2006; Shonkoff and Garner, 2012). In particular, studies emphasize how the chronic experience of adversity in childhood can alter an individual's reactivity to stress, thereby encouraging the development of maladaptive coping mechanisms and the impairment of executive functions like self-regulation (Hughes et al., 2017; Wesarg et al., 2020). These may then have consequences in terms of adopting social behaviors that pose a risk to one's health, such as early alcohol consumption in adolescence (Dube et al., 2006), excessive alcohol use in adulthood (Lee and Chen, 2017), substance abuse and illicit drug use (Dube et al., 2003; Forster et al., 2018), and adolescent gang involvement (Wolff et al., 2020).

A key factor in influencing and exacerbating these health-damaging behaviors are the social relationships individuals have (Umberson et al., 2010). For youths in particular, peers are connected strongly with the adoption of pro- or anti-social behaviors (Costello and Hope, 2016). Such connection between peers and personal behavior can be explained through the reciprocal processes of *selection* into and *socialization* with peers, where a person affiliates with friends who have similar behavioral proclivities, and also learns and adopts behaviors that peers exhibit (Brechwald and Prinstein, 2011; Prinstein and Dodge, 2008). Many researchers focus on the influence of associating with *negative peers*—those who steal, cheat, use illicit drugs, regularly get drunk, and/or exhibit aggressive behavior (Price et al., 2019a)—and how having these types of peers predict negative outcomes such as delinquent behavior (Weerman and Hoeve, 2012), tobacco and alcohol use (Neppl et al., 2016), and violent/property crime (Fergusson et al., 2002; Simons and Burt, 2011). Although individuals select friends who exhibit similar behaviors (making it difficult to ascertain the causal influence of peers), negative peers can nonetheless exacerbate or contribute to individuals' behavioral predispositions (Holt et al., 2012). Thus, negative peers in adolescence and young adulthood remain consequential for one's adoption of social behaviors.

Inasmuch as ACEs influence social behavior through neurodevelopmental changes and insults, adversities may also affect behavior through one's association with negative peers. Social contextual factors such as home environments are important predictors of the peers one makes (Fergusson and Horwood, 2003; Pawlby et al., 1997). For example, children who grow up in adverse home environments may become accustomed to violence and disadvantage that they seek friends exhibiting antisocial behaviors modeled at home, or fail to seek social and emotional supports altogether (Sheikh et al., 2016). Such process of learning at home and transposing it to relationships outside of the home is thus important to understand.

1.2. Social learning process at home and outside of it

Social learning theory posits how misconduct and antisocial behavior arise because of the imitation of others, differential reinforcement (i.e., reward and punishment) for the behavior exhibited, creation of beliefs about the behavior, and exposure to socializers who model, reinforce or influence the individual's beliefs (Akers, 2017; Tittle et al., 2012). For youths in particular, the association with negative peers, exposure to their behaviors, and influence of their attitudes are consequential for the adoption of antisocial behaviors (Price et al., 2019b; Trinidad, 2021). However, social learning with peers is often also predicated and influenced by foundational and formative experiences at home (Cutrín et al., 2017; Fergusson and Horwood, 2003; Keller, 2008). For example, household dysfunction and low parental control are shown to influence youth delinquency through youths' association with negative peers (Deutsch et al., 2012; Ingoldsby et al., 2006). In contrast, more positive experiences at home can buffer the impact of having negative peers on the adoption of delinquent behaviors (DeVore and Ginsburg, 2005; Gao et al., 2013).

Children experiencing adversities—such as abuse, neglect, or parental incarceration, drug, or alcohol problems—may similarly lack parental support and positive adult modeling (Wade et al., 2014). More than a biological insult, an ACE is a potential indicator of the socialization that happens at home (Neppl et al., 2016; Schafer et al., 2011). For example, parental dysfunctions at home, such as illegal drug use and alcoholism, influence children's adoption of similar behaviors that make them select into friend groups accepting of such behaviors (Anda et al., 2002; Dube et al., 2003, 2006; Trucco et al., 2011). In a qualitative study, Baird (2012, p. 179) highlight how children with family problems fail to develop a "moral rejection" of gangs that lead them to ultimately form part of gangs. However, it is not just about the presence of negative models that are consequential since the absence of parental influence is also associated with higher risks of antisocial behavior, such as for children with incarcerated parents (Murray et al., 2012). While these studies highlight various disadvantageous life circumstances that overlap with ACEs, this present research focuses on ACEs in particular, and offers further support to previous findings of how dysfunctions at home can influence peer selection.

Taken together, these highlight the potential for ACEs to affect the reciprocal processes of selecting into and socializing with negative peers, primarily explained by the type of socialization received at home. In a sense, the social learning at home can set into motion developmental trajectories affecting the social learning happening outside of it through peers.

1.3. Social context and ecology of ACEs

The narrative regarding ACEs is also complicated by the *context*: Schools, neighborhoods, other adult socializers, and family resources contribute to the alleviation or exacerbation of the negative impacts of adversity (Moore and Ramirez, 2016; Sciaraffa et al., 2018). In particular, family advantage or disadvantage—such as socioeconomic position, racial-ethnic identification, and neighborhood and school safety—may contribute to interpreting and coping with vulnerabilities, which then influence the individual's developmental trajectories and relationships (Darling, 2007; Spencer, 2007; Velez and Spencer, 2018). Thus, I ask how the child's context can enhance or reduce ACEs'

negative impact.

Family disadvantage is associated with higher exposure to ACEs and greater vulnerability from their negative effects (Umberson et al., 2014). Studies show that ACEs are more prevalent among children in lower income and minority households (Strompolis et al., 2019). More notably, lack of resources may make coping with adversities more difficult, such that ACEs have persistent negative effects for disadvantaged populations (Evans and Kim, 2013; Giovanelli et al., 2016). However, some studies also argue that low-income and minority youths have more experiences in overcoming different forms of adversities, and hence, have a range of flexible coping strategies to rely on (Kitano and Lewis, 2005; Morales, 2010). Thus, despite family disadvantage's greater association with ACEs, the effects of childhood adversities may not be as consequential because an ACE is simply one other adversity a disadvantaged youth has to overcome.

On the other end, family advantage in terms of social, economic, or racial-ethnic capital is often assumed to have a protective impact for children, both because of the lower chances of ACEs happening for these populations (Straatmann et al., 2020; Walsh et al., 2019) and because of family resources that advantaged youths can fall back on when they do experience adversities (Balistreri and Alvira-Hammond, 2016; Goldstein et al., 2020). However, children who experience relative advantage may also be ill-prepared for adverse experiences and thus have worse outcomes. For example, Brand et al. (2019) find that divorce leads to worse academic outcomes for youths in relatively stable and advantaged families, presumably because they were unprepared with such disruption. Somehow, affluence may also be considered costly since more advantaged youths experience excessive pressures, isolation from parents, and inability to cope (Luthar and Latendresse, 2005; Luthar and Sexton, 2004). It thus goes against the simplistic understanding of advantaged youths being "low risk" and disadvantaged ones being "high risk."

This present research extends the literature on ACEs to consider the social consequences and contexts of adversity. Significant gaps in the ACE literature exist in terms of how ACEs in particular affect the formation of peers, *and* how the effect of ACEs differ according to the social context of advantage. In this study, I explore not only how ACEs influence adolescent peers engaged in early drinking and gang involvement, but also the long-term impact of ACEs at home on peers who regularly got drunk and used drugs in young adulthood.

2. Methods

2.1. Data

The data for this study linked variables from three datasets of the Panel Study of Income Dynamics (PSID): the 2007 main study, 2007 Child Development Supplement (CDS), and 2017 Transition into Adulthood Supplement (TAS). The PSID began in 1968 with a probability sample of 4800 households in the United States, and was conducted annually until 1997 and biannually thereafter (Panel Study of Income Dynamics (PSID), 2014). In 1997, the PSID collected information on children aged 0–12 years old through the CDS, and by 2007, many have reached adolescence, which was when they were 10–18 years old (Sawyer et al., 2018). I investigate this developmental period because of its consequences for children's outcomes, such as peer formation, education, and health (Swanson et al., 2010). Similarly, the PSID collected information on these individuals' changes and transition into adulthood, and by 2017, the TAS had data of all young adults in the PSID, aged 18–28 years old. Thus, the 2007 and 2017 datasets corresponded to when the participants were in adolescence and young adulthood. Data were obtained through the University of Michigan - Institute for Social Research's Data Center, where relevant variables were included from the respective datasets. The analytic sample included 1155 individuals in the 2007 and 2017 waves of the PSID. Missing values were imputed, preserving cases with missing values on the independent variables (Janssen et al., 2010). The PSID had approval from the University of Michigan's human subjects review board.

2.2. Measures

Adverse childhood experience is a dichotomous variable that measures whether an individual had experienced at least one form of adversity before 18 years old. It included parental alcohol or drug problem, parental incarceration, childhood physical abuse or neglect (i.e., parent never or not very often care for the child), domestic violence, food insecurity, and housing insecurity.

Four outcome variables were used for the individual's peer association. For adolescent outcomes, (1) *Peers in gangs* is a dichotomous variable coded 1 if at least some of the individual's peers in 2007 were in gangs (at least 3 in a 5-point scale) while (2) *Peers' early drinking* is a variable coded 1 if at least some peers drank alcohol regularly before 18 years old. For outcomes in young adulthood, (3) *Peers' regular drug use* is a dichotomous variable coded 1 if most of the individual's close friends in 2017 regularly used drugs while (4) *Peers' binge drinking* is a variable coded 1 if most of the individual's adult friends regularly drank alcohol. For simplicity, I use "negative peers" as a shorthand when referring to individuals having peers who exhibited any of the behaviors above.

Background factors, used as covariates, included dichotomous variables that indicated whether the individual was part of a racial-ethnic minority (Blacks, Hispanics, Asians, other), male, had a father or had a mother who completed college in 2007, and had parents who were still married in 2007.

Socioeconomic factors were also used as covariates. Parental household income in 2007 was included as a continuous variable. Other covariates included indicators for whether the family lived in a mobile home, owned their home, and had a household head employed or retired in 2007. In order to control for school or neighborhood factors, I created a dichotomous indicator of unsafe school environment coded 1 if any of the following happened when the child was in school: been hit at least once a week, been stolen from at least once a week, or had a gun or knife pulled on the individual.

2.3. Estimating average treatment effects

To estimate the average effect of at least one ACE on the likelihood of having negative peers, I used three different strategies. First, I computed a naïve estimate using logistic regression that did not adjust for the covariates. Second, I computed an adjusted estimate that included the different covariates in the logistic regression model. Third, I used a propensity score method (PSM) to present estimates of the average treatment effect that regresses the likelihood of having negative peers on ACE, while accounting for the individual's likelihood of having an ACE.

Formally, the treatment effect (TE_i) of experiencing adversity or ACE is defined as the difference between the potential outcomes in the treated (i.e., had ACE) and untreated (i.e., did not have ACE) state for individual i ($A_i = 1, 0$):

$$TE_i = Y_i(1) - Y_i(0) \tag{1}$$

This asks whether a child who experienced adversity had different outcomes than what would otherwise had come if the child did not experience adversity. Given the impossibility of observing both treated and untreated outcomes in the same individual, the average treatment effect (*ATE*) is defined as the average difference in the outcomes between children who experienced and did not experience adversity:

$$ATE = E(Y(1) - Y(0)) \tag{2}$$

To address potential bias given the differences in family and background characteristics of those who experienced adversity and those who did not, I estimated the propensity (P) of experiencing adversity in childhood based on the observed vector of covariates, $\boldsymbol{C}$:

$$P = \Pr(A_i = 1|C_i) \quad (3)$$

By including these covariates, the treated and untreated groups have become more balanced and comparable such that the potential bias is reduced. Thus, the *ATE* conditioned on the propensity of the individual experiencing adversity is formally identified as follows:

$$ATE_p = E(Y(1) - Y(0)|P = p) \quad (4)$$

I then estimate a series of logistic regression models for the impact of adversity on the four outcomes for negative peers:

$$\text{logit} \;\; [\Pr(Y_i = 1|P)] = \beta_0 + \beta_1 A_i + \beta_2 P_{i.} \quad (5)$$

where Y_i is whether the individual had negative peers in adolescence or adulthood, A_i is whether the individual experienced adversity in childhood, and P_i is probability that the individual experienced adversity in childhood, given a vector of covariates $\boldsymbol{C}$.

2.4. Estimating heterogeneous treatment effects

I adopted two approaches to estimate heterogeneous treatment effects. First, I used the smoothing-differencing method with these three steps: (*i*) estimate the propensity scores for all units by regressing adversity on a vector of covariates; (*ii*) separately for the treated and untreated groups, fit nonparametric regressions of the dependent variable on the propensity score; and (*iii*) take the difference in the nonparametric regression lines between the treated and untreated groups at different levels of propensity (Xie et al., 2012). Four separate graphs were created for each outcome variable with propensity scores on the x-axis and the treatment effect on the y-axis.

Second, in order to ascertain if the patterns observed from the graphs were significant, I used the stratification-multilevel method (see Xie et al., 2012), where I constructed propensity score strata based on the shape of the nonparametric function obtained from the smoothing-differencing method. I then estimated the stratum-specific conditional average treatment effects:

$$ATE_{s,p} = E(Y(1) - Y(0)|S = s, \; P = p), \quad (6)$$

where $S = \{1, 2, \ldots s\}$ indicates the propensity score stratum. With the objective of investigating a systematic pattern of heterogeneous treatment effect across strata, I created only four strata because of the shape of the smoothing-differencing graphs and because of the ease in interpretation with dividing the sample from the ones least likely (stratum 1) to most likely have an ACE (stratum 4). Each stratum had closely similar number of observations, and cutoff points were determined through this. For every propensity score stratum and for each of the four outcome variables, I estimated logistic regression models as shown in Equation (5). Supplementary files with different model specifications are available upon request.

3. Results

3.1. Adversity, peers, and family background

Youths who experienced at least one form of adversity in childhood were more likely to have peers who exhibited negative behaviors, such as early and binge drinking, drugs use, and gang involvement. Table 1 presents significant differences between those who had at least one ACE and those who did not, with a greater proportion of individuals with ACEs also having negative peers. For example, 14.8 percent of youths who had an ACE had adolescent peers who regularly drank alcohol while only 8 percent of those without ACE had these types of peers. Similar statistically significant differences were present between the two groups, in terms of peers who belonged in gangs, and peers' binge drinking and drug use in young adulthood.

Differences, however, were present not only with the youths' association with peers but also with their family backgrounds. Compared to those who did not have any ACEs, those who experienced at least one form of adversity in childhood were more likely to be from a minority background, have fathers and mothers less likely to have finished college, and whose parents were less likely to be married during their adolescence.

In terms of socioeconomic factors, those who experienced adversity were more likely to be from low-income households given that the average household income for this group is $48,937 compared to $77,249 for those without ACEs. Individuals with ACEs were also in families that were less likely to own their home and have household heads who were less likely to be employed. In addition, these youths were also more likely to be in unsafe school environments than those who have not experienced adversities.

Taken together, these findings emphasize the salient differences

Table 1
Descriptive statistics of outcomes and backgrounds.

	No adversity		At least one adversity		Difference	t-tests
	Mean	SD	Mean	SD		
Adolescent outcomes						
Peers' gang involvement (binary 1/0)	0.080		0.148		−0.068	**
Peers' early drinking (binary 1/0)	0.105		0.152		−0.047	*
Young adulthood outcomes						
Peers' regular drug use (binary 1/0)	0.066		0.165		−0.099	***
Peers' binge drinking (binary 1/0)	0.139		0.201		−0.062	*
Background Factors						
Minority (binary 1/0)	0.499		0.597		−0.098	**
Male (binary 1/0)	0.459		0.525		−0.066	
Father complete college (binary 1/0)	0.281		0.108		0.173	***
Mother complete college (binary 1/0)	0.304		0.196		0.108	***
Parents still married in 2007 (binary 1/0)	0.606		0.486		0.120	***
Socioeconomic Factors						
Parents' household income ($1000)	77.249	(78.124)	49.937	(36.774)	27.312	***
Living in a mobile home (binary 1/0)	0.573		0.458		0.115	
Owns home (binary 1/0)	0.689		0.496		0.193	***
Household head employed (binary 1/0)	0.839		0.753		0.086	**
Household head retired (binary 1/0)	0.032		0.018		0.014	
Unsafe school environment (binary 1/0)	0.130		0.183		−0.053	*
Number	872		283			

Note: The table presents the proportion who belong to the category (or the mean value), comparing those who did not experience any adversity with those who experienced at least one adverse childhood experience. Differences were computed with the corresponding p-values, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.
Source: Panel Study of Income Dynamics (2007 Main Study, 2007 Child Development Supplement & 2017 Transition into Adulthood Supplement)

between those who experienced adversity in childhood and those who did not, highlighting not only differences in the association with peers exhibiting antisocial behaviors but also differences in family backgrounds and socioeconomic factors.

3.2. Estimated effects of ACEs

Models were estimated to measure the effect of having at least one ACE on peer association. In Table 2, unadjusted estimates (first column) suggest that experiencing adversity in childhood was associated with higher probabilities of having adolescent peers who belonged to gangs and regularly drank alcohol, and adult peers who regularly got drunk and used drugs.

When adjusting for covariates in a logistic regression (second column) or accounting for the propensity of having an ACE (third column), experiencing adversity in childhood was still associated with a higher probability of having peers exhibit early and binge drinking, and regular drug use. Using estimates from the propensity score method, those who experienced an ACE had higher odds of having adolescent peers engage in early drinking (OR 1.83, $p < 0.01$), having adult peers who binge drink (OR 1.68, $p < 0.01$), and having adult peers who regularly used illegal drugs (OR 2.73, $p < 0.001$). The association between ACE and gang participation, however, was no longer significant when either covariates or propensity scores were included.

3.3. Estimated heterogeneous effects of ACEs

Although adversities in childhood are suggested to, on average, affect youths' association with negative peers, these effects may vary depending on the propensity for ACEs, or the likelihood of the family being disadvantaged in the first place. Fig. 1 presents smoothing-differencing heterogeneity results, with the x-axis representing the continuous propensity score and the y-axis representing the observed coefficient differences between individuals with ACEs and those without on the four outcome variables: adolescent peers' early drinking and gang involvement, and adult peers' binge drinking and regular drug use.

The figure suggests differences in the effect of adversity on peer association. The top left panel on Fig. 1 shows that the effect of adversity on having peers in gangs is significant for those who are already more likely to experience adversity, i.e., those already disadvantaged to begin with. The top right panel shows an opposite trend with the treatment effect of ACEs on having friends regularly use drugs being significant for youths who are least likely to experience adversity. Interestingly, the bottom panels show an inverted U shape that suggests that those who are moderately likely to experience adversity—i.e., neither in precarious nor affluent conditions—experience most significantly the effects of ACE on forming peers who drink in adolescence or get drunk in adulthood. While the panels in Fig. 1 provide suggestive directions, these need to be confirmed with the stratification-multilevel models.

Table 3 presents heterogeneous effect estimates by propensity score strata. Four propensity score strata were constructed, and the effect of adversity on the different peer outcome variables were estimated for every stratum, comparing those who had ACE from those who did not. Stratum 4 included individuals most likely to experience adversity, indicating greater experience of family disadvantage, while stratum 1 included those least likely to experience adversity, suggesting families who were more socially and economically advantaged.

How do ACEs impact those most likely to experience adversity? The bottom panel on Table 3 shows that for individuals who were most likely to experience adversity in childhood (stratum 4), experiencing adversity predicted having peers in gangs. Among these youths, those with ACEs had four times the odds of having peers in gangs when compared to those who did not have ACEs (OR 4.21, $p < 0.05$). However, having an adverse childhood experience did not predict the other outcome variables related to peers' drinking or using drugs. Similar to results in Fig. 1, these suggest that for those in the most disadvantaged positions, childhood adversity influences associating with peers in gangs but not peers exhibiting other antisocial behaviors.

How do ACEs impact those least likely to experience adversity? For individuals least likely to experience adversity (stratum 1), having an ACE was most predictive only for peers' regular drug use. The top panel of Table 3 suggests that for individuals least likely to experience adversity, those who experienced it had six times the odds of having friends who regularly used drugs than those who did not have ACEs ($p < 0.01$). This finding was confirmed in the smoothing-differencing graph on Fig. 1 suggesting more statistically significant effects for those in the lower propensity group. Qualitatively, this suggests that in the most advantaged households where adversity is least likely, experiencing adversity influences peer selection into those who regularly used drugs.

How do ACEs impact those moderately likely to experience adversity? For individuals who were moderately likely to experience adversity (strata 2 and 3), experiencing adversity did not predict having friends in gangs or regularly using drugs. However, it predicted involvement with peers who regularly drank alcohol in adolescence (OR 2.69, $p < 0.01$) and regularly got drunk in young adulthood (OR 2.10, $p < 0.05$). Fig. 1 suggests similar deductions, given the inverted U shape for both outcomes. These results highlight how experiencing adversity can be consequential as well for those in the middle—i.e., those who have some form of socioeconomic and familial advantage.

4. Discussion and conclusions

Reviews and studies on adverse childhood experiences highlight the impact of ACEs on brain development and health-damaging behaviors—often explained through epigenetic modifications from early life environments, biological changes that affect stress reactivity, and

Table 2
Effects of adverse childhood experience on association with peers in adolescence and young adulthood.

	Unadjusted Logit		Adjusted Logit (individual covariates)		Adjusted Logit (propensity score covariate)	
	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Outcome variables:						
Adolescent peers'						
Gang involvement	1.99**	[1.31–3.05]	1.44	[0.92–2.28]	1.46	[0.93–2.29]
Early drinking	1.52*	[1.02–2.29]	1.86**	[1.21–2.89]	1.83**	[1.19–2.81]
Adult peers'						
Regular drug use	2.81***	[1.85–4.24]	2.59***	[1.67–4.01]	2.73***	[1.74–4.29]
Binge drinking	1.56*	[1.10–2.21]	1.92**	[1.32–2.79]	1.68**	[1.14–2.48]

Notes: Estimates are based on logistic regression models. The first column provides unadjusted logistic regression estimates of ACE on the likelihood of having peers exhibiting negative behaviors. The second column present estimates that adjust for a set of covariates such as gender, minority status, parents' education, family income, school environment, parents' marital status, home ownership, and employment. The third column presents regression estimates from a propensity score-based method that controls for propensity score in the model. All estimates are in odds ratio with the 95% confidence interval (CI) in brackets. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Source: Panel Study of Income Dynamics (2007 Main Study, 2007 Child Development Supplement & 2017 Transition into Adulthood Supplement), $n = 1155$

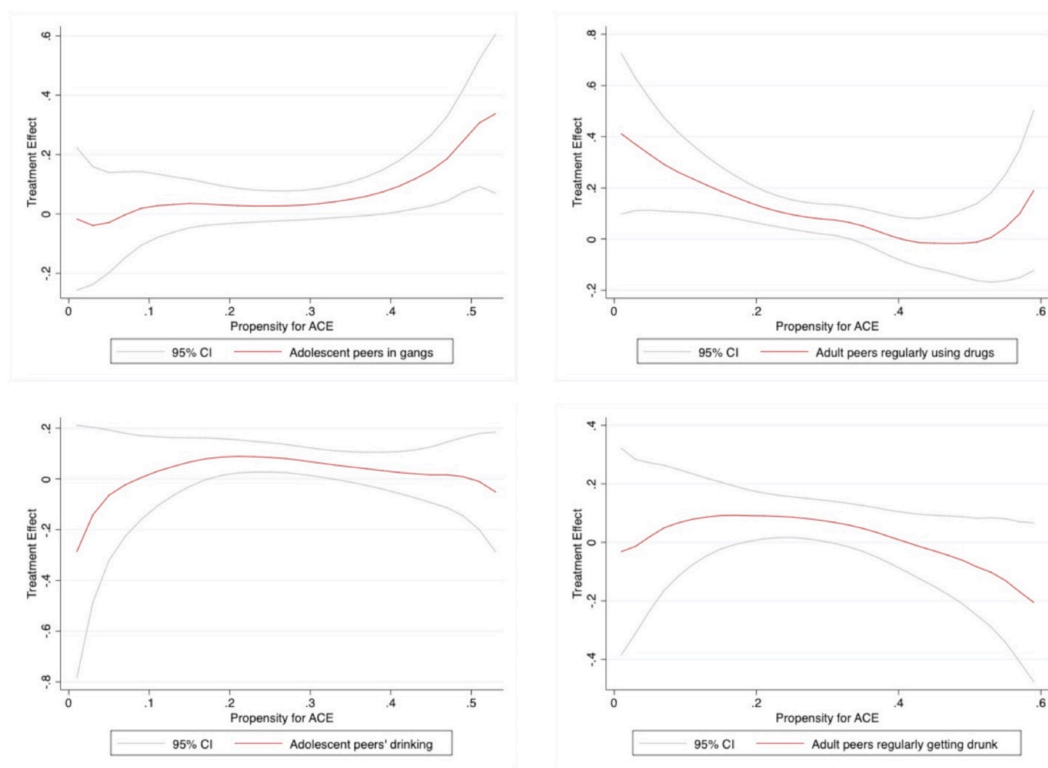

Fig. 1. Smoothing-differencing heterogeneous effects of adverse childhood experience (ACE) on associating with peers in gangs, and peers who regularly drink, use drugs, or get drunk. Note: Propensity scores were estimated by a logit regression model of ACE on a set of background and family disadvantage covariates. The red line presents estimated treatment effect for the propensity score level while grey lines present the 95% confidence interval.

Table 3
Heterogeneous effects of adverse childhood experience on peer association, by propensity score strata (odds ratio).

	Adolescent Peers'				Young Adult Peers'			
	Gang involvement		Early drinking		Regular drug use		Binge drinking	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Stratum 1: ACEs least likely (most advantaged)								
ACE	3.17	[0.60–16.82]	1.25	[0.40–3.95]	6.00**	[1.99–18.05]	1.66	[0.61–4.49]
Stratum 2: ACEs less likely								
ACE	1.60	[0.74–3.43]	2.69**	[1.35–5.35]	2.07	[0.91–4.71]	1.62	[0.84–3.10]
Stratum 3: ACEs more likely								
ACE	0.67	[0.31–1.45]	1.29	[0.58–2.82]	2.70*	[1.25–5.82]	2.10*	[1.06–4.15]
Stratum 4: ACEs most likely (most disadvantaged)								
ACE	4.21*	[1.42–12.49]	2.14	[0.70–6.46]	2.37	[0.86–6.49]	1.23	[1.06–4.15]

Notes: The table provides the odds ratio (OR) with the 95% confidence interval (CI) in brackets for the impact of having at least one adverse childhood experience (ACE) on the likelihood of having adolescent peers who drink alcohol regularly or are in gangs, or young adult peers who regularly get drunk or regularly use drugs, using the stratification-multilevel method for heterogeneous treatment effects. Adjusted models control for the propensity score of having ACEs. Propensity scores were estimated by a logit regression model of ACE on a set of family disadvantage covariates. *$*p < 0.05$, $**p < 0.01$, $***p < 0.001$.*
Source: Panel Study of Income Dynamics (2007 Main Study, 2007 Child Development Supplement & 2017 Transition into Adulthood Supplement), $n = 1155$

changes in brain structure affecting self-regulation and executive function (Hays-Grudo and Morris, 2020; Hughes et al., 2017; Kalmakis and Chandler, 2014; Shonkoff and Garner, 2012). However, I argue that a holistic conceptualization of ACEs must not overlook the social dimension of adversity. On the one hand, ACEs are social experiences that have consequences on the social relationships at home and beyond it. On the other hand, ACEs operate within social contexts that alleviate or exacerbate their negative impacts. More than the simplistic view that disadvantaged contexts are harmful and advantaged ones are protective, the study suggests nuanced differences in the interaction between ACEs and youth contexts.

Experiencing adversity in childhood influences associating with peers who exhibit negative behaviors such as early and binge drinking, regular drug use, and gang involvement. Studies suggest that associating with these types of peers arise because of the lack of parental supervision (Bahr and Hoffmann, 2010; Baird, 2012; Fergusson and Horwood, 2003). From a social perspective, ACEs signify not just discrete adversities but also home environments that "*normalize*" *antisocial behaviors*, suggesting that harsh parenting can influence youths' attitudes regarding supposedly negative behaviors (Neppl et al., 2016). From a neurodevelopmental perspective, youths with ACEs may themselves exhibit a predisposition to these antisocial behaviors (Brumley et al., 2017; Hunt et al., 2017), such that they simply *select into peer groups* accepting of their proclivities. Both perspectives highlight the reciprocal processes of socialization from and selection into peer groups, influenced by ACEs at home.

Another aspect of ACEs that receives little attention is the influence of the social context within which ACEs happen. This present study

suggests that the effect of ACEs on peer association depends on the likelihood of ACEs to happen, i.e., the family context of advantage or disadvantage. Although studies highlight the harms of compounded disadvantage and the protection afforded by family advantage (Evans and Kim, 2013; Giovanelli et al., 2016; Goldstein et al., 2020), this study suggests a more nuanced approach to how context matters for ACEs, particularly as ACEs were predictive of different outcomes depending on the context. For the most disadvantaged youths, ACEs only predicted association with gang members, while for those most advantaged, ACEs actually predicted having peers regularly use drugs. Moreover, the influence of ACEs on peers' early and binge drinking was significant for those in the "middle" strata.

These variations in the impact of ACEs may be partly explained by the context of how and where peers are made, underscoring the role of ecological *systems* rather than just *individual* socializers (Darling, 2007; Spencer, 2007). In disadvantaged contexts, the family situation may mirror community disadvantage. Given the presence and proximity of gangs in these communities, ACEs and lack of parental supervision at home may make these youths more susceptible to gang involvement (Wolff et al., 2020). Similarly, in advantaged contexts, the proximity of peers who engage in drugs may influence those who had ACEs be more open to these negative peers (Luthar & D'Avanzo, 1999). Given the cost of acquiring drugs, affluence may not be as protective as often thought and may actually make it easier for peer groups to engage in behaviors involving substance abuse and illegal drug use (Luthar et al., 2015; Luthar and Sexton, 2004). Easier access to drugs with poorer parental supervision may thus contribute to this outcome. For youths who are neither in precarious nor affluent situations, ACEs still tip the scales for having peers engage in early and binge drinking, potentially indicating the accessibility of these "deviant" behaviors for regular youths (Trucco et al., 2011). Taken together, they suggest the importance of both family context and proximal peer environment in understanding the effects of ACEs.

A further contribution of the present study is the method for understanding how ACEs impact negative outcomes while taking into account the individual's propensity or likelihood of having ACEs in the first place. In this current work, we find that these variables approximate the social contextual conditions, which are associated with higher or lower likelihood of experiencing adversity. The present study is among the first ACEs study to investigate heterogeneous treatment effects through propensity-score and stratification-multilevel methods (Xie et al., 2012). Thus, future studies on ACEs may draw on the methods used for this research to help with the inclusion of social contextual factors in estimating the effect of ACEs.

The present study does not negate the robust literature on ACEs' impact on the child's neurodevelopment; rather it complements this by suggesting the equally valid social dimensions of ACEs. In this attempt, I show how the public health literature on ACEs can be in conversation with social scientific concepts of *social learning* (Akers, 2017; Pratt et al., 2010) and *ecological systems* (Bronfenbrenner, 1979; Spencer, 2007). This research suggests the need to attend to the variations that arise from differing contexts because childhood advantage is not always protective and childhood disadvantage is not always injurious. Issues of race, poverty, and class need to be included in understanding ACEs, and a biological explanation cannot fully account for ACEs' consequences and may even implicitly place the responsibility on the individual rather than structural deficits and systemic injustices. Further studies may thus look into how the impact of ACEs on education, health, and life outcomes differ across these contexts with the present study suggesting a method for doing such analyses. In addition, a practical implication of this study is to attend to the particular contextual factors that can exacerbate ACEs' negative impacts.

Despite the study's contribution to the literature and its practical implication, limitations still need to be acknowledged. First, the use of dichotomous variables for statistical simplicity and intuitive interpretation may be at the expense of more information that comes from ordinal or interval variables. Nonetheless, this study lays the foundation for similar studies that use non-dichotomous variables. Second, the study focuses on the impact of ACEs on peers and not on the individuals' behavior. Future research may look into the mediation or moderation that may happen when ACEs affect either or both peer association and antisocial behavior. Third, certain youths with ACEs do not necessarily form part of any negative peer groups, and so research must also be done to see what social and personal protective factors may be at work in this. Lastly, the study provides theory-based reasons for how ACEs impact peer relationships, and qualitative research needs to complement the present study to uncover this process of peer formation.

Notwithstanding these limitations, this study still contributes to an extension of the theorization of ACEs by emphasizing the social aspects of ACEs. I argue that ACEs influence the likelihood of associating with negative peers in adolescence and young adulthood, and that these effects differ according to the youths' context of family advantage/disadvantage and their context of potential peers. By suggesting the importance of the social consequences and contexts of ACEs, I suggest a step towards a conceptualization of ACEs that acknowledges the social realities of adversity in addition to the biological ones, and that potential impacts on health, education, and life outcomes happen through these social consequences and contexts.

Credit author statement

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