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A trauma-informed approach to understanding firearm decision-making among Black adolescents: Implications for prevention

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ABSTRACT

Firearm violence remains a public health crisis in marginalized, urban communities, with Black adolescents bearing the burden of firearm homicides and injuries. As such, the prevention of firearm violence among adolescents has moved to a high priority of the U.S. public health agenda. The current paper reviews recent literature to highlight the heterogeneity in firearm behavior among Black adolescents and underscore the need for additional research on decision-making and firearm behavior to better understand how adolescents make decisions to acquire, carry, and use firearms. Through a discussion of the disproportionate levels of trauma exposure and trauma symptoms experienced by Black adolescents, the current paper also proposes a trauma-informed approach to understanding decision-making for risky firearm behavior. We discuss the broader impacts of this approach, including the development of a more comprehensive and contextually relevant understanding of the variability in risky firearm behavior and improvements in risk screening capabilities and preventive intervention strategies.

1. Introduction

Firearm violence is one of the most devastating and burdensome public health issues in the United States, with an annual economic toll of $280 billion (Everytown Research & Policy, 2022) and rates that are approximately 25 times higher than rates in other developed nations (Grinshteyn and Hemenway, 2016, 2019). Black youth in the U.S. are over eight times more likely to die from firearm homicide than white youth (Zimmerman et al., 2019), and homicide becomes the leading cause of death for Black boys starting at age 15 (Abt, 2019; Currie, 2020). While demographic (e.g., age), structural (e.g., neighborhood disadvantage), and social (e.g., peer delinquency) risk factors of firearm behavior have been identified (Abt, 2019; DaViera and Roy, 2020; Currie, 2020), there is substantial variability in rates of firearm carrying and usage, even among youth who share similar risk factors and access to guns (e.g., Carter et al., 2020a; Dong et al., 2019; Dong and Wiebe, 2018; Pardini et al., 2021). Our future success at preventing firearm violence, in part, will hinge on our ability to understand individual differences in decision-making processes—why youth who share similar risk factors for firearm behavior make different choices about acquiring, carrying, and using firearms (Comer and Connolly, 2020). Very little research explores decision-making processes for firearm behavior, but given that firearm behavior peaks during adolescence, examining decision-making during this developmental period is paramount. Stress exposure predicts riskier decision-making during adolescence, and the disproportionate levels of traumatic stress and trauma symptoms experienced by Black youth may increase the likelihood of using risky firearm decision-making strategies. As such, we propose using trauma-informed covariates of firearm behavior to better understand individual differences in decision-making for risky firearm behavior among Black adolescents. We also discuss the impact of this approach on the development of more effective prevention strategies.

2. Burden of firearm violence for black, male adolescents

Firearm violence poses a greater threat to public safety in the United States than any other similarly developed nations, and particularly to adolescents (Gunn and Boxer, 2021). Firearm violence is now the leading cause of death for children and adolescents in the United States (Goldstick et al., 2022). Further, urban gun violence in the U.S. has

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historically impacted the Black community more than any other community. Indeed, homicide—for which a firearm is used between 72% and 90% of the time—is the leading cause of death for young Black men (Abt, 2019; Currie, 2020). In fact, more Black men aged 15 to 24 die of homicide than the next 19 causes of death combined (Currie, 2020). Over half of young Black men who survive a violent penetrative injury will return to the hospital for a similar penetrative injury within 5 years and 20% of this population will die within the same time period (Rich, 2009; Richardson et al., 2016).

Compounding the sobering figures on racial disparities in gun homicide rates is the recent national surge in gun violence. The homicide rate in the U.S. increased 25% from 2019 to 2020, the largest single-year increase on record (Barrett, 2020; Mascia, 2022). These unprecedented increases are occurring disproportionately in disinvested, urban communities (Beckett and Clayton, 2021), exacerbated by the COVID-19 pandemic. The COVID-19 pandemic exacerbated the underlying structural conditions contributing to gun violence, including poverty, unemployment, lack of resources, disconnection from support services, stress, hopelessness, and loss, and these increases have systematically impacted Black communities and placed Black adolescents at the epicenter of gun violence and loss. As such, the prevention of gun violence among adolescents has moved to a high priority goal of the U.S. public health agenda (Gunn and Boxer, 2021).

3. Risky firearm behavior during adolescence

The prevention of risky firearm behavior (i.e., gun carrying and gun usage) is a logical starting point for reducing and preventing homicide deaths and firearm injuries among youth (Price and Khubchandani, 2017; Spano, 2012), as youth who carry guns are significantly more likely to be involved in a violent crime situation than youth who do not carry a gun (Emmert et al., 2018; Lizotte et al., 2000; Watts, 2019). Adolescence may be the most important developmental period for addressing firearm violence and risky firearm behavior. In a nationally representative U.S. sample, first-time handgun carrying was most likely to occur during mid-to-late adolescence, peaking around age 15 (Dong and Wiebe, 2018). Black youth are 63% more likely to report gun carrying than White youth (Comer and Connolly, 2020) and guns are involved in 30% of violent incidents involving young Black men, compared to 5% of incidents involving young white men (Felson and Painter-Davis, 2012).

Heterogeneity in Risky Firearm Behavior. A number of demographic (e.g., race/ethnicity), structural (e.g., neighborhood disadvantage), and social (e.g., peer delinquency; gang membership) risk factors of firearm carrying and usage during adolescence have been identified (Abt, 2019; Beardslee et al., 2018; Beardslee et al., 2021; Currie, 2020; Lizotte et al., 2000; Simon et al., 1998). Delinquent behaviors, such as drug selling and early conduct problems, have also been linked to increased firearm behavior (Beardslee et al., 2018; Docherty et al., 2019; Lizotte et al., 2000; Vaughn et al., 2012). However, several studies show that there is substantial heterogeneity in firearm carrying and usage, even among youth who share similar demographic and structural risk factors and access to guns (Carter et al., 2020a; Dong et al., 2019; Dong and Wiebe, 2018; Keil et al., 2020; Oliphant et al., 2019; Pardini et al., 2021; Sokol et al., 2020; Steinman and Zimmerman, 2003; Vaughn et al., 2017). The heterogeneity suggests the decisions to acquire, carry, and use a firearm are not equivalent across youth who share the same risk factors, and general risk factor research does not capture individual differences in firearm behavior. Unfortunately, many preventive interventions for risky firearm behavior are often based on this aggregated data, which is grounded in a perspective that established demographic, structural, social, and behavioral factors carry equivalent risk across youth (Dong et al., 2019; Dong et al., 2019). We are not suggesting that general risk factor research used in prevention efforts has not been useful or effective. Rather, we argue that investigating individual differences in decision processes using a trauma-informed lens can illuminate why preventive interventions show limited effectiveness (Bushman et al., 2016) and guide future improvements.

4. Decision-making and risky firearm behavior

While the identification of structural and demographic risk factors of firearm behavior is important (Carter et al., 2020b), engagement in firearm behavior is determined, in part, by an individual's explicit decision to obtain, carry, and/or use a firearm. Before an adolescent engages in firearm behavior, they start out with a decision to make, but very little research has been conducted to identify the decision factors that adolescents use or how they weigh those decision factors. Some research reveals that the desire for protection fueled by the perceived lack of safety is an important motivator of gun-carrying behavior among adolescents (Hemenway et al., 2011; Mukherjee et al., 2020; Oliphant et al., 2019), particularly in environments with high rates of violent crime (Dong et al., 2019). One qualitative study interviewed justice-involved male adolescents and found that when deciding whether or not to engage in firearm behavior, other decision factors such as availability of a trustworthy supplier, availability of a suitable firearm, price of firearm, fear of being arrested and incarcerated, possibility of hurting oneself or others, and respect for the opinion of others may influence decisions to carry a firearm (Freed et al., 2001). Although participants reported that they weighed the risks of firearm behavior against the perceived benefit of protection offered by a firearm, the study did not examine the dynamic relationship between the risks and benefits that occurs during decision-making (Freed et al., 2001). A better understanding of how youth use decision factors can inform preventive interventions for firearm violence.

5. Trauma and decision-making

Whether youth feel an increased need to protect themselves against victimization or if they are retaliating against prior acts of violence, decisions to acquire, carry, and/or use a firearm are often made under heightened levels of stress and fear (Pierre, 2019). Traditional theories of decision-making assume that individuals evaluate decision-factors based on the probability and desirability of associated consequences, and heightened stress and negative emotions play a limited role in the cognitive evaluations of risk in a given situation (Pierre, 2019). However, more recent decision-making frameworks propose that stress and heightened fear/anxiety play a prominent role in decision-making (Galván and Rahdar, 2013; Loewenstein et al., 2001; Pachur et al., 2012; Pierre, 2019). Notably, individuals under heightened stress, particularly uncontrollable stress, make riskier decisions—i.e., decision-making that lacks full consideration of all decision factors or consideration of decision factors in a hasty, non-systematic manner (e.g., Starcke and Brand, 2012).

Adolescents are particularly susceptible to the effects of stress on their decision-making (Galván and Rahdar, 2013; Kambam and Thompson, 2009). Stress can increase risky decision-making in adolescence by overactivating the socio-emotional network and decreasing controlled cognitive processes in the cognitive control network that are involved in decision-making (Botdorf et al., 2017; Starcke and Brand, 2012). A decrease in controlled cognitive processes limits individuals' ability to overcome automatic responses (Starcke and Brand, 2012), which may be particularly dangerous in both threatening and uncertain or ambiguous situations. Trauma informed approaches recognize and acknowledge the role that traumatic stress may have on adolescents' mental, physical, and emotional health (Ginwright, 2018), specifically that elevated rates of gun-carrying behavior among Black adolescents may be rooted in experiences of trauma. As such, we propose a trauma-informed approach to understanding heterogeneity in decision-making for this population that examines traumatic stress and symptoms as covariates that influence their decision-making processes.

Trauma exposure as a covariate of firearm decision-making. Traumatic

stressors are events that involve a threat, or the actual occurrence, of an untimely death or severe physical injury that could be life threatening or a violation of bodily integrity, and that evoke reactions of extreme fear, helplessness, or horror (American Psychiatric Association, 2013). As noted earlier, lack of safety is an important motivator of gun-carrying behavior (Dong et al., 2019; Hemenway et al., 2011; Mukherjee et al., 2020; Oliphant et al., 2019), but feeling unsafe is linked to prior traumatic victimization—experiencing injury or threats with a weapon and physical assault (Mukherjee et al., 2020). Youth who have been shot or almost been injured by a gun are more likely to carry a gun as a means for protection from repeated aggression or retaliation (Black and Hausman, 2008; Carter et al., 2020b). In addition, witnessing violence within the community, such as seeing someone being shot or shot at, gang violence, frequent physical altercations, or hearing gunshots heightens the likelihood of youth to carry guns around the neighborhood, especially when police bias is high and police support is low (Luster and Oh, 2001; Sokol et al., 2022). These experiences heighten youth's perceptions of levels of feeling unsafe, thus leading to an increased yearning for protection (Molnar et al., 2004).

Unfortunately, exposure to violence systematically impacts Black adolescents in under-resourced urban communities, leading to disproportionate levels of lack of safety. Between 50% to 97% of Black adolescents in disinvested urban communities report community violence exposure during adolescence (Busby et al., 2013; Gaylord-Harden et al., 2011; Gaylord-Harden et al., 2017; Lambert et al., 2012; McDonald et al., 2011; Phan et al., 2020; So et al., 2021). Youth may be exposed to community violence by witnessing violent acts that happen to others or by being directly victimized (Fowler et al., 2009). Compounding these issues, community violence occurs in the context of other ever-present threats in the lives of Black youth, such as police harassment and brutality, and racial discrimination and stereotyping. Further, community violence exposure is not experienced solely at the individual level—it is also an adverse community experience (Opara et al., 2020). Adverse community experiences, such as economic disinvestment, violence, and racial segregation, are destructive factors driven by systemic racism that traumatize entire communities (Kravitz-Wirtz et al., 2022; Pinderhughes, 2017).

At the individual level, trauma exposure, including community violence, has a direct impact on brain structures and functions that are involved in decision-making. Violence exposure is associated with alterations in amygdala circuitry and connectivity to the prefrontal cortex, and the ventral striatum during adolescence (Nooner et al., 2013; Thomason et al., 2015; Tottenham and Galván, 2016). Community violence is also associated with structural atrophy in the hippocampus and impairment in amygdala activity (Carrion and Wong, 2012; Weston, 2014) and alterations in salivary cortisol responses during adolescence (Aiyer et al., 2014; Kliewer, 2016; Peckins et al., 2012; Suglia et al., 2010), above and beyond the effects of violence in other settings. Abnormal levels of cortisol, in tandem with abnormalities in levels of norepinephrine, are associated with chronic hyperarousal in youth exposed to trauma (Kendall-Tackett, 2000). The changes in brain structure and functioning lead to increased fear reactivity, attentional biases towards threat, poor response inhibition and impulse control, emotional reasoning, and difficulty regulating affect (Monahan et al., 2015; Thomason et al., 2015; Tottenham and Galván, 2016).

Trauma symptomatology as a covariate of firearm decision-making. While trauma exposure is an important and understudied determinant of firearm behavior, it is the role of associated trauma symptoms that may mediate the association between violence exposure and decisions about firearm acquisition, carrying, and usage. A number of studies using nationally representative samples (e.g., Andrews et al., 2015; López et al., 2017) and clinic-based samples (e.g., Douglas et al., 2021) find that Black youth have higher prevalence rates of trauma symptoms than other groups (Roberts et al., 2011). The differences in prevalence rates are not due to racial identity, but are due, instead, to systematic differences in rates of exposure to traumatic stressors (Andrews et al., 2015; Douglas et al., 2021; Pole et al., 2008), particularly community violence (e.g., Fowler et al., 2009; Gaylord-Harden et al., 2017; Hunt et al., 2011; McDonald and Richmond, 2008; Post et al., 2014).

Posttraumatic stress symptoms include intrusive symptoms, avoidance, negative alternations in cognition and mood, which includes emotional numbing, and hyperarousal (American Psychiatric Association, 2013). The most frequently experienced trauma symptoms in young Black men and adolescents are physiological arousal symptoms (Phan et al., 2020; Rich and Grey, 2005; Smith and Patton, 2016), often exhibited in direct response to the threat of violence (Fowler et al., 2009; Margolin and Gordis, 2000; Paxton et al., 2004). Hyperarousal symptoms are rooted in the body's neuro-physiological response (hypothalamic–pituitary–adrenal axis), which directs an individual's resources to promote survival in the face of danger. One such symptom, hypervigilance, serves a survival function by enhancing an individual's detection of and reaction to threatening stimuli and increases the likelihood that individuals can avoid dangerous situations (Kimble et al., 2013).

In a sample of Black adolescent boys, 85% reported experiencing symptoms of physiological hyperarousal, with over 1 in 3 of these boys reporting that they experienced the symptoms at least 2–4 times a week (Phan et al., 2020). The greater unpredictability, unfamiliarity, and pervasiveness of community violence leads to a need to be especially vigilant in the community (Post et al., 2014). Hypervigilance can result in an attentional bias to threat, which involves the tendency to prioritize the processing of threats over benign or neutral stimuli (Azriel and Bar-Haim, 2020). Youth in environments with chronic, but often unpredictable, levels of violence may be preoccupied with preparation for possible future exposure (Eagle and Kaminer, 2013). In expectation of future threat, individuals may constantly appraise their surroundings to determine how immediate and serious environmental threats are (Eagle and Kaminer, 2013).

Emotional numbing has traditionally been described as a restricted range of affect and capacity to feel emotions that includes numbing to both positive and negative emotions, but in the DSM-5 numbing is now conceptualized as the restriction of positive emotions only (Li et al., 2020). However, research with children and adolescents suggests that numbing of negative emotions, including fear and anger, also play a prominent role in their posttrauma stress reactions to violence exposure (Allwood et al., 2011; Kerig et al., 2016). Emotional numbing in adolescents is caused by the depletion of cognitive and emotional resources due to chronic hyperarousal (Weems et al., 2003), and it may serve an adaptive role by minimizing emotions related to traumatic memories or reducing emotional distress after trauma exposure (Kerig et al., 2012; Li et al., 2020).

Trauma symptoms can have a profound impact on decision-making in several ways (Aupperle et al., 2012; Miu et al., 2008; Starcke and Brand, 2012). First, trauma symptoms may decrease the availability of cognitive resources that individuals need to make demanding and complex decisions regarding risky behaviors (Orcutt et al., 2002). Real-world decision-making involves integrating previous decisions, is often made under time constraints, and necessitates the use of feedback from a changing environment (Prezenski et al., 2017), all of which require individuals to devote sufficient cognitive resources to the task. Individuals experiencing heightened levels of trauma symptoms allocate a majority of their information processing resources towards threat detection and interpretation (Hayes et al., 2012), as well as to processing and encoding emotional information (Hayes et al., 2012; Steinmetz et al., 2010). While the narrowing of an individual's attentional and emotional focus may be adaptive in contexts with ever present threats, this threat sensitization is at the expense of resources allocated to other higher order cognitive processes that may be helpful for decision-making (Hayes et al., 2012). Further, other posttraumatic stress symptoms, such as intrusive thoughts and flashback memories, may be distracting and deplete resources needed for concentration (Hayes et al., 2012).

Second, trauma symptoms impact information processing, which leads to deficits in accurately recognizing and responding to risk (Kerig

et al., 2010; Orcutt et al., 2002). Hyperarousal symptoms increase one's difficulty to use social and environmental cues appropriately to make measured decisions about threat and, thus, some youth may unintentionally overreact in benign, ambiguous, or mild situations (Kerig et al., 2010; Nagel et al., 2016; Phan et al., 2020). Further, this overreaction may be exacerbated by emotional numbing, as attempts to numb or blunt emotional distress may inadvertently decrease inhibitions that prevent risky behaviors (Allwood et al., 2011; Kerig et al., 2012; Ng-Mak et al., 2002). Selectively attending to threatening stimuli is typically an adaptive response that enables individuals to evade dangerous and distressing situations (Wolters et al., 2012). However, exaggerated attentional bias to threat disrupts subsequent cognitive processing of environmental information (Fani et al., 2012) which leads to impaired decision-making (Allwood and Bell, 2008). Another posttraumatic stress symptom, dissociation, results in difficulty concentrating on one's immediate surroundings and integrating information that may be relevant to decision-making (Kerig et al., 2012; Orcutt et al., 2002; Ross et al., 2020).

Third, for some youth, posttraumatic stress symptoms may impair self-protective behavior by negatively impacting an adolescent's ability to disengage from dangerous situations (Orcutt et al., 2002). For youth in communities with chronic or ongoing levels of violence, trauma exposure is both current and anticipated in the future, as opposed to existing only in the past (Eagle and Kaminer, 2013; Stein et al., 2016). As such, youth experiencing exposure to chronic levels of violence are not only managing cognitive and emotional reactions to past and current trauma exposure, but also preparing for the possibility of future exposure. Hyperarousal symptoms maintain the body's preparation to respond to threat, and hypervigilance becomes a critical coping strategy to employ in anticipation of future victimization or witnessing of community violence (Phan et al., 2020; Smith and Patton, 2016). However, chronic hyperarousal may contribute to the development of an internal alarm system with high sensitivity to possible threat, but low specificity to accurately identify threat, resulting in repeated false alarms (Orcutt et al., 2002). Eventually, the over-reactivity of this alarm system may lead to "alarm fatigue" in which youth begin to ignore or discount internal signals of danger (Orcutt et al., 2002). In other words, repeated false alarms may cause a failure of emotional arousal to cue individuals to engage in self-protective behavior, such as avoiding active threats. As such, youth may inadvertently find themselves in dangerous situations (Kerig et al., 2010; Orcutt et al., 2002) and may be more likely to use force as protection.

Finally, as an adverse community experience, violence that occurs in a community can burden the entire community through the concentration of trauma among individual community members and leave a collective experience of traumatization (Pinderhughes et al., 2015). The effects of this community trauma can manifest in several ways that may restrict the ability of adults to provide instrumental and emotional support to youth (Hoffman and Kruczek, 2011; Weisner, 2020). Collective efficacy, or the ability for community members to collectively support one another and their neighborhood, can be adversely impacted by chronic community violence exposure (Sampson et al., 1997; Pinderhughes et al., 2015), hindering the social connectedness of the community and impacting community members' decisions on whether or not to engage and support their community through community activities.

In sum, we propose that trauma exposure and trauma symptoms are covariates that impact the decision-making process in ways that may increase risky decision making. Rather than conceptualizing decision-making for risky firearm behavior as a static trait that occurs only at a cognitive level (i.e., weighing relevant decision factors), a trauma-informed approach would conceptualize decision-making as a dynamic process that is influenced by an individual's past, current, and anticipated trauma exposure and associated trauma symptoms.

6. Implementation of a trauma-informed approach to study firearm decision making

As such, research questions should focus on how adolescents' existing levels of trauma exposure and trauma symptoms might influence their ability to weigh risks and benefits and to consider all of their options in potentially violent situations. While it is beyond the scope of this paper to go into finer details regarding experimental design, data structures, and quantitative decision-making models appropriate for a trauma-informed approach, we can briefly discuss some of the major factors needed for incorporating trauma covariates into firearm decision-making research and provide some concrete touchpoints.

A major consideration for research studies is the application of suitable decision-making models that are sensitive to measuring the relative contributions of various decision factors. There is a large literature on *discrete choice models* that are suitable for this task and have been widely applied across many choice contexts, including transportation and marketing (see Louviere et al., 2000 for an introduction). These choice models are often used to evaluate how individuals weigh various decision factors when making choices and can be used to identify heterogeneity in preferences and choice strategy (e.g., Coote et al., 2021). These models are typically coupled with data collected from discrete choice experiments, which are comprised of choice trials where research participants indicate choice given a set of choice alternatives (e.g., Louviere et al., 2000). For firearm-related decisions, these choices could be comprised of, for example, whether or not an individual would carry a firearm given a set of contextual decision factors such as risk of arrest, likelihood of injuring oneself, and whether they feel that they are in a dangerous situation.

A promising avenue for modeling firearm decisions in research studies comes from the alcohol and addictions literature. McCarthy et al. (2021) recently developed a decision-making model, based on Bayesian cognitive modeling (Lee and Wagenmakers, 2014), that has been successfully applied to alcohol impaired driving decisions. McCarthy et al. developed a decision task that presented hypothetical drinking scenarios that varied levels of two decision factors: quantity of alcohol consumption (one to six drinks) and the cost of a ride service such as Uber ($5–25). The use of this approach yielded important information regarding how individuals weigh these decision factors. Specifically, there were individuals who *ignored* the cost of a safe ride and based decisions on alcohol consumption, and this group made safer choices (i.e., choosing not to drive while impaired). Conversely, there were individuals who showed a more complex pattern of decision-making—who systematically considered *both* the cost of a safe ride and the number of alcoholic drinks consumed when deciding whether or not to drive while impaired, and this group was more likely to report drunk driving events within the past six months.

Analogous Bayesian decision models could be developed and applied to risky firearm decision making, accounting for various decision factors for firearm behavior (e.g. Freed et al., 2001). Such research would clarify the firearm decision making process by exploring how youth make trade-offs across decision factors. For example, when deciding whether or not to carry a handgun, there may be youth who employ a simple decision factor: they always carry a handgun in their neighborhood as a means of general protection whenever they perceive any level of danger, regardless of other decision factors. Other youth may weigh additional decision factors against protection, such as level of concern about hurting others and likelihood of being caught, thus resulting in a more complex pattern of decision-making. Bayesian decision models would allow researchers to model these relationships across multiple decision factors and choices.

Next, given a method for measuring and detecting individual differences in decision strategy, researchers can examine how particular decision strategies relate to youths' trauma exposure and trauma symptoms. To include trauma-informed covariates, adolescent participants' scores on self-report measures assessing trauma exposure and

posttraumatic stress symptoms would be obtained and utilized in models. Youth self-report measures of trauma exposure can include measures that assess a range of traumatic experiences (e.g., UCLA PTSD Reaction Index; Kaplow et al., 2020) or those specific to one form of trauma (e.g., My Exposure to Violence Scale; Buka et al., 1997). However, it is important to note that variety scores (number of different types of traumatic events to which one has been exposed) have stronger predictive validity than count scores (overall number of events to which one has been exposed) or single item measures (e.g., Grassetti et al., 2018; Rasmussen et al., 2020), although both may be useful (Wilker et al., 2015). In addition, measures that provide more in-depth information regarding proximity to violence and relationship to victims may also be useful (Sargent et al., 2020). When assessing trauma symptoms, measures that utilize a continuum/severity of symptoms approach (e.g., Child PTSD Symptom Scale; Foa et al., 2017), rather than threshold or diagnosis approach are recommended. Although clinical levels of disorders may be more debilitating than subthreshold levels, there is significant impairment associated with subclinical symptoms in youth (Allen et al., 2014; Gutermann et al., 2016). Self-report measures that assess past, current, and anticipated traumatic stress responses, such as the Continuous Traumatic Stress Response Scale (Goral et al., 2021) should be considered.

As noted, trauma exposure may relate to overall fewer decision factors being considered, strongly weighting factors relating to emotional and/or immediate risk or payoffs. More specifically, an adolescent who has a history of witnessing violence that happens to others may sense a pervasiveness of violence (Post et al., 2014), but not a direct threat. As such, the adolescent may be more inclined to acquire a firearm, but not to carry it. In contrast, an adolescent who has been victimized may be more inclined to carry or use for protection or retaliation (Carter et al., 2017). However, at present, these predictions are speculative, as there has been no research that examines how trauma might influence firearm decision-making. By obtaining adolescents' self-reported ratings of trauma exposure and trauma symptoms and instantiating decision strategies within a quantitative model of decision making, researchers can rigorously examine associations between trauma exposure/symptoms and firearm decision making strategy—whether the distribution of decision strategy classifications across participants differs as a function of covariates (trauma exposure and trauma symptoms). This can take the form of correlational analyses and/or machine learning methodologies such as random forest analyses (e.g., Hastie et al., 2009). This approach has the potential to identify mediational relationships between trauma and risky firearm behaviors, providing a clearer picture of the heterogeneity in behaviors among individuals with similar overall risk profiles and backgrounds. This framework allows us to move beyond simply identifying correlates of risky behavior. By identifying *how* individuals use various decision factors to make risky firearm-related decisions, we can tailor intervention efforts to encourage safer decisions. Similarly, with an understanding of how trauma impacts the decision-making process, we can tailor firearm intervention and prevention efforts based on levels of trauma exposure and trauma symptoms.

7. Implications for trauma-informed firearm intervention and prevention

Understanding heterogeneity in decision making as it relates to firearm behavior is beneficial to prevention efforts. We discuss three strategies used in firearm prevention efforts to highlight how a trauma-informed understanding of decision-making can enhance prevention efforts: screening measures, motivational interviews, and decisional balance exercises.

Risk Screening Measures. Risk assessment or risk screening is an essential step for counselors and clinicians, trauma unit staff, educators, probation officers, etc. to determine the likelihood that an adolescent may engage in risky firearm behavior. Violence risk screening has been utilized most frequently in emergency departments with youth who are being treated for violent injuries (Goldstick et al., 2017; Williamson et al., 2014). In fact, identifying adolescents who are at risk for violence is the initial step in most emergency department-based violence prevention programs (Cunningham et al., 2009). Youth who receive emergency department care for assault show elevated rates of subsequent firearm violence, with almost 60% of assault-injured youth reporting violent firearm aggression within 2 years of their visit to the emergency department (Carter et al., 2015). Research finds that Black boys who are treated for violent injuries are at heightened risk for subsequent firearm violence and/or returns to the emergency department for violent injuries, and research identifies risk factors, such as access to firearms, attitudes favoring retaliation, peer delinquency, community violence exposure, and substance use (Carter et al., 2015; Carter et al., 2020b; Cunningham et al., 2009; Goldstick et al., 2019; Hankin et al., 2014). Risk screening measures based on this research focus on questions related to serious fighting behavior, friend weapon carrying, community violence exposure, and being threatened with a firearm (Goldstick et al., 2017).

While helpful for triaging youth into intervention programs, these assessment tools run the risk of being rooted in a deficit perspective that focuses on what is wrong with the adolescent, rather than a trauma-informed approach that focuses on what has happened to the adolescent (Ginwright, 2018). As such, subsequent referring of youth to interventions that focus on social problem-solving skills, cognitive processing skills, or life skills may be prioritized over referring youth to interventions that prioritize treating unresolved trauma. When trauma symptoms go unrecognized and unaddressed, individuals are less likely to engage in treatment, and more likely to terminate treatment prematurely or show future engagement in risky behaviors (Center for Substance Abuse Treatment, 2014). There have been calls to include screening of posttraumatic stress symptoms in violence risk screening (Cunningham et al., 2009), consistent with research findings which identify posttraumatic stress disorder as a risk factor for subsequent firearm behavior (Carter et al., 2015). Through research that identifies how trauma may impact firearm decision-making, appropriate questions regarding trauma exposure and trauma symptoms can be included on screening instruments. The inclusion of trauma in screening instruments may help to maximize the ability of providers to match youth to appropriate interventions and ensure that treatment planning is commensurate with the needs of clients (Center for Substance Abuse Treatment, 2014).

Motivational Interviewing. Motivational interviewing is a client-centered psychological intervention designed to increase motivation by helping youth identify and explore motivations or reasons for change (Miller and Rollnick, 2012). Elements of motivational interviewing have shown effectiveness in reducing violent behavior by helping youth explore and resolve their ambivalence about change, which in turn, increases their individual motivation for changing violent behaviors (Walton et al., 2010). Similar to risk screening, motivational interviewing has been used in Hospital-based Violence Intervention Programs (HVIPs) for youth presenting to emergency departments with violent injuries. For example, one study examined the use of motivational interviewing elements in a collaborative care intervention targeting risk behaviors, including weapon carrying, among adolescents who were hospitalized due to gun violence injuries (Zatzick et al., 2014). Results of the study showed that patients who received motivational interviewing incorporated in the collaborative care intervention experienced a significant reduction in weapon carrying 12-months post-treatment (Zatzick et al., 2014).

Given the traumatic nature of experiencing gun violence (whether as a witness or victim) and its association with gun carriage, it is essential for motivational interviewing to be administered through a trauma framework. The incorporation of trauma into motivational interviewing may be particularly helpful for youth who are at the "contemplation" stage of change (i.e., awareness that a problem exists, but ambivalent

about change). At this stage, motivational interviewing often focuses on developing or amplifying the discrepancy between the adolescent's values or goals and the risk behavior that is being prioritized for change (Noonan and Moyers, 1997). However, for youth with trauma exposure, the discrepancy may be due to lack of safety that is further exacerbated by trauma symptoms. A trauma-focused motivational interview would allow adolescents to acknowledge their underlying motives for carrying or using a gun as a response to their traumatic experiences and work towards identifying alternative responses that elicit feelings of safety to enhance change in behavior. Drawing connections between trauma exposure, trauma symptoms, and goals for change may improve the contextual relevance or real-world relevance of motivational interviewing protocols, which in turn, may encourage more self-exploration from youth. Further, when the role of trauma on their motivation and decision-making has been acknowledged and validated, adolescents may be more receptive to referrals for more intensive treatment for trauma.

Decisional Balance Exercises. Decisional balance exercises are often used in behavioral interventions to discuss reasons for not engaging in risk behaviors (Carter et al., 2016; Walton et al., 2010). Decisional balance exercises give equal weight to positive and negative motivations for both retaining and changing behavior (Miller and Rose, 2015). For example, youth may be given a worksheet and asked to identify the positive and negative consequences of a current behavior, and positive and negative consequences about changing the behavior. In targeting risky firearm behavior, it is necessary to understand the contextual relevance (i.e., real world relevance) of these exercises as they apply to youth's reasons for and against engaging in firearm acquisition, firearm carriage, and firearm usage. As noted above, youth may be more likely to acquire or carry firearms when they perceive less safety in their community. With the acquisition and carriage of a gun, however, youth also fear potential risks associated with gun behavior. Fear of the consequences of possessing a gun, such as getting arrested and possibly incarcerated is most salient (Freed et al., 2001). Especially among youth in communities where community violence is high, more police presence has been seen to dissuade youth from carrying guns around their neighborhoods. Fear of hurting oneself is another risk identified by youth. With an increased exposure to a gun, youth fear the inevitable increased likelihood of the gun going off in various accidental situations. Additionally, hurting others is a risk. Youth who are frequently interacting with friends and family members, especially younger family members, are less likely to possess a gun out of the risk for their siblings, cousins, etc. to engage with the weapon and unintentionally harm themselves.

In working on decisional balance exercises for youth engagement in risky firearm behavior, an understanding must be made on not just the risks of gun carrying or the "delinquent" reasons for risky firearm behavior, but the noted benefits of carrying especially as it concerns prior or potential victimization and youth wanting to feel protected and safe. Using a trauma-informed approach, decisional balance exercises will allow youth to thoroughly explore and weigh the benefits and risks of acquiring and carrying a gun as it applies to their real-world experiences and environments and visualize how balancing the risks against the benefits would manifest in their individual contexts to, thereby, enhance youth engagement and improve intervention effectiveness.

8. Conclusions and future directions

We have identified a need to understand the heterogeneity in firearm decision-making among Black adolescents and called for future research to explore complex associations between trauma exposure, trauma symptoms, and firearm decision-making. The ability to regulate one's emotions during decision-making, remember prior decisions and their consequences, and utilize this information for subsequent decision-making begins to improve during adolescence (Klaczynski et al., 2001), making this developmental period ideal for intervention efforts aimed at reducing risky firearm behaviors. We propose that research that seeks to understand how trauma influences firearm decision-making may be particularly effective for understanding heterogeneity in firearm decision-making and enhancing the effectiveness of strategies to prevent firearm violence during adolescence. Such research can contribute essential new knowledge to the development and refinement of risk screening, motivational intervention, and decisional balance exercises. Given the rising homicide rates, firearm-related violence and injuries, and incarceration in urban communities, there is a need for future research to provide knowledge that helps to ensure healthy outcomes for Black adolescents.

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Credit author statement

NGH, CDS, and HH conceptualized the idea for the manuscript. NGH, CDS, HH, and JA wrote, reviewed, and edited the manuscript. All authors approved the final version for submission.

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Data availability

No data was used for the research described in the article.

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