ADOLESCENT CHARACTERISTICS, NEIGHBOURHOOD SOCIAL PROCESSES AND SOCIOECONOMIC FACTORS AND ADOLESCENT INJURY RISK

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ABSTRACT

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Adolescent participants (N=170) completed questionnaires assessing individual characteristics (gender, age, Sensation Seeking, Aggression/Oppositionality, Impulsivity) and characteristics of the neighbourhoods in which they live (Neighbourhood social cohesion/informal social control of youth). Postal codes as reported by the youth were linked to 2006 Canadian census data in order to determine area-level Socioeconomic Status (SES) for each adolescent. Data regarding adolescents' individual traits and characteristics of the neighbourhoods in which they live were examined both as main effects and in individual by neighbourhood interactions as predictors of adolescents' risk of injury. Individual traits predicted injury risk, however, neighbourhood social processes and SES did not predict adolescent injury risk when examined as main effects, whether included alone or together with individual characteristics. Neighbourhood social processes and Neighbourhood SES each moderated the relation between certain individual traits and injury risk. The value of examining individual-context interactions in injury risk research is discussed.

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The effects of adolescent characteristics, neighbourhood social processes, and neighbourhood socioeconomic factors on adolescent injury risk

Unintentional injury is one of the most serious health threats to children throughout the more economically developed world. In Canada, unintentional injury is the leading cause of death for children over the age of 1 year (Statistics Canada, 2007) and accounts for more than one quarter of all visits to pediatric emergency departments (Macarthur & Pless, 1999; Shanon, Bashaw, Lewis, & Feldman, 1992).

Researchers in fields such as psychology, public health, medicine, and epidemiology, have worked individually and in collaboration for several decades to address this urgent health concern (Alwash & McCarthy, 1987; Cubbin, LeClere, & Smith, 2007; Dougherty, Pless, & Wilkins, 1990; Edwards, Roberts, Green, & Lutchmun, 2006; Laflamme & Diderichsen, 2000; Macpherson, Roberts, & Pless, 1998; Manheimer & Mellinger, 1967; Morrongiello, 2005; Peterson, Farmer, & Mori, 1987; Rivara & Barber, 1985; Schwebel & Barton, 2005). Results of such research have reinforced the view that unintentional childhood injuries are not random events, but are predicted by a wide range of factors. A number of individual characteristics (e.g., male gender, high-intensity behaviour; Morrongiello, Corbett, McCourt, & Johnston, 2006; Rivara, Bergman, LoGerfo, & Weiss, 1982) as well as characteristics of the environment (e.g., disadvantaged neighbourhood, hazardous product design; Reading, Langford, Haynes, & Lovett, 1999; Rodgers & Leland, 2008) have been associated with elevated risk of unintentional childhood injury. Identification of these risk factors is a valuable endeavour, because, if injury events are predictable, it follows that they are, theoretically, preventable. Unfortunately, even given a generally good understanding of many discrete

predictors of injury, preventable hospitalizations and deaths of Canadian children and adolescents continue to occur each year at unacceptably high rates. Many researchers of unintentional childhood injury are calling for new questions and innovative study designs that would move the field beyond the analysis of separate risk factors and towards knowledge of how risk factors might interact with one another (Caughy, Nettles, & O'Campo, 2008; Morrongiello & Schwebel, 2008; Schwebel & Barton, 2005). In particular, they are advocating for research to promote our understanding of how a child's individual traits interact with contextual processes (i.e., individual x environment interaction effects) so that more tailored and effective injury prevention programs can be developed. The present study aims to address this gap in the literature by assessing how interactions between individual behavioral traits and macro contextual (neighbourhood) characteristics predict risk taking and the recent history of injuries of grade 10/11 youth.

Background Literature

A growing body of evidence suggests that interactions between individual-level and social-environmental context variables hold important clues to understanding processes that may be missed when examining main effects alone. In several studies focused on childhood behavioural concerns, individual-level predictors of outcomes, such as aggressive and risky, antisocial behaviour, were found to be more or less important, depending on the context in which a child was developing (Caspi, Lynam, Moffitt, & Silva, 1993; Dupéré, Lacourse, Willms, Leventhal, & Tremblay, 2008; Huijbregts, Séguin, Zoccolillo, Boivin, & Tremblay, 2008; Lindstrom, 1996; Lynam et al., 2000; Meier, Slutske, Arndt, & Cadoret, 2008; Monuteaux, Blacker, Biederman, Fitzmaurice, &

Buka, 2006). For example, traits such as impulsivity and callousness, generally associated with antisocial behaviour, were better predictors of delinquency among adolescents within more socioeconomically disadvantaged or less socially cohesive neighbourhoods (Lynam et al., 2000; Meier et al., 2008; however see Vazsonyi, Cleveland, & Wiebe, 2006 and Vazsonyi & Klanjsek, 2008 for conflicting results). Similarly, prenatal exposure to mothers' smoking was a more powerful predictor of children's later antisocial behaviour within low socioeconomic families (Huijbregts et al., 2008; Monuteaux et al., 2006).[1] Finally, Caughy and colleagues (2008) found that collective processes can also interact with socioeconomic context to predict developmental outcomes. Specifically, communities that were more highly involved with children had children with fewer behavioural concerns, but this relation only held within socioeconomically disadvantaged areas.

Along analogous lines to the study of person by environment interactions, which tend to be concerned with phenotype (e.g., behaviour/temperament), research involving gene by environment interactions has also revealed differences in how genes are expressed (e.g., study of epigenetic mechanisms), or in how strongly genes are associated with outcomes, depending on social processes and socioeconomic milieux (e.g., heredity studies; Brody et al., 2009a; Brody, Beach, Philibert, Chen, & Murry, 2009b; Caspi et al., 2003; Legrand, Keyes, McGue, Iacono, & Krueger, 2008; Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003; Tuvblad, Grann, & Lichtenstein, 2006; Weaver et al., 2004). Scores on IQ tests, for example, are more highly heritable within more

[1] Evidence from the adult antisocial behaviour literature also suggests the presence of an individual-context interaction; for example, testosterone levels were more strongly associated with antisocial behaviour for men of lower SES (Dabbs & Morris, 1990).

advantaged socioeconomic environments, whereas shared environment accounts for more variance in IQ in low socioeconomic status (SES) contexts (Turkheimer et al., 2003). Similarly, genetic influences on antisocial behaviour among adolescents have been found to be stronger within high SES versus low SES families (Tuvblad et al., 2006). These findings might be considered examples of what Rutter and his colleagues (Rutter, Moffitt, & Caspi, 2006) term a "basic feature of heritability," namely that "the population variance attributable to genetic factors may be expected to be lower in any subsection of the population exposed to a major adverse environmental influence known to impact on the trait being investigated" (p.235). The authors present several fascinating examples of both such "heredity by environment" interactions (i.e., in which heritability of a particular trait varies with context) and "gene by environment" interactions (i.e., in which the expression of genes varies by environment, or the effects of genes vary by social context). One particularly interesting hypothesis for which there is some empirical support is that societal constraints can act as moderators of heritability (Rutter et al., 2006). It has been suggested that when there are widespread social norms disapproving of a given behaviour, heritability will be low for the behaviour (e.g., alcoholism among North American women in the early to mid 1900s). When such social constraints are lifted, heritability rises. Similarly, opportunities to express a trait can increase due to changes in society, and then heritability increases (e.g., educational attainment in a country with a newly introduced public education system). Thus, a variety of findings support the basic notion that how people's individual traits are expressed can be powerfully affected by social context, although there is little agreement about the social-contextual factors that are implicated.

Evidence supporting this heredity by environment and gene by environment interaction research leads to some interesting questions when one considers unintentional childhood injury. Given that injury risk and the adverse environmental context of socioeconomic disadvantage are related, might the extent to which genetic factors relate to injury-risk behaviours vary with the extent of socioeconomic advantage? If social constraints surrounding injury-risk behaviour are lower in certain contexts, will inherent individual traits become better predictors of such behaviour in those contexts?

Although unintentional childhood injury researchers have not yet focussed on gene by environment interactions, it is clear from evidence in other fields (e.g., medicine) that context is a critical factor when trying to understand individual propensity to be at risk for (or protected from) negative outcomes.

Returning to the field of behaviour by context interaction, in contrast to a more substantial body of research related to general child and adolescent behaviour concerns (e.g., externalizing symptoms), few studies in the area of unintentional childhood injury have examined such potential interactive effects. What little evidence does exist, however, suggests that examining how individual traits might interact with context could be important to better understand unintentional injury risk for children and adolescents (Morrongiello, Klemencic, & Corbett, 2008; Schwebel & Bounds, 2003; Schwebel, Brezausek, Ramey, & Ramey, 2004). In a study by Schwebel and Bounds (2003), for example, children who were more impulsive and lacking in self-control made more accurate (potentially less risky) judgments about their physical abilities when their parents were watching them, as compared to when their parents were hidden behind a

one-way mirror. Similarly, Schwebel and colleagues (2004) observed interactions between child behaviour and parenting such that positive parenting practices lowered more temperamentally "difficult" children's risk of injury. Morrongiello and colleagues (2008) also conducted an investigation of child and parent behaviours, finding that particular temperamental traits of young children were predictive of their injury risk under conditions of lower levels of maternal supervision, but not under high supervision levels. Overall, preliminary, limited evidence suggests that child temperamental traits do not predict injury risk in the same way across contexts (i.e., environmental processes moderate the temperament-injury relation).

A key difficulty that arises when attempting to examine person by context interactions is that of adequately defining and assessing the "context" or "environment" in which an individual is developing. Early theorists attempting to address the role of context in child development, such as Bronfenbrenner (1979), discussed the importance of considering not only a child's immediate surroundings (e.g., family and those directly interacting with child), but also the wider social circles of community and society, which have at least indirect (if not direct) influence on child development, as well. Others have emphasized the inextricable nature of 'individual' and 'environment,' pointing to subtle and complex interactions that occur between the two from the moment a child is born (and, in fact, during prenatal development; see evidence from experimental research with primates, e.g., Kraemer, Moore, Newman, Barr, & Schneider, 2008); people have individual propensities that lead them to "create" their environments (e.g., Scarr, 1996), while environments "create" people (e.g., through differential expression of genetic potential across social contexts, e.g., Brody et al., 2009a). In more recent years, studies

of ‘neighbourhood’ or ‘community’ effects have attempted to link social and physical aspects of children’s environments, beyond the immediate family, to child development outcomes, including unintentional injury risk (e.g., Haynes, Reading, & Gale, 2003; Laflamme & Reimers, 2006; O’Campo, Rao, Gielen, Royalty, & Wilson, 2000; Reading et al., 1999). Such research has been plagued with problems related to separating “individual-level,” “family-level,” and “community-level” effects. Indeed, meaningful separation of individual-level from neighbourhood-level effects on a statistical level has been argued by some to be impossible (e.g., Oakes, 2004; see Diez Roux, 2004 for opposing view). Insofar as people have choice with respect to where they live and with whom they socialize, individual traits and family characteristics will tend to be associated with broader community-wide variables (e.g., latent individual level variables associated with area-level SES, Aaronson, 1998). Insofar as context affects human development and behaviour (e.g., through social and behavioural norms, modelling of behaviours; Ellen & Turner, 1997), individual traits and family characteristics will also likely be associated with community characteristics. Admittedly, such entanglement of levels of variables can make the study of person by environment interactions a daunting task.

An aspect of “context” that is particularly difficult to define and assess is SES. Researchers often equate “environment” with SES level in their studies (e.g., McCaffery et al., 2008; Tuvblad et al., 2006), suggesting that level of social/economic disadvantage or advantage indexes a specific, *homogenous* context that is experienced in comparable ways by all within. Although there do likely exist some common experiences among families and children living in poverty within a given society, evidence also suggests that understanding the effect that low SES has on child development cannot be derived by

simply measuring a family's social and economic resources (e.g., education level, income, wealth, occupation). Indeed, it is also important to consider social processes that may vary with SES (e.g., social cohesion of community, subjective feelings of safety and well-being in neighbourhood), and that may have different meaning for child development outcomes, depending on the child's SES. For example, in an earlier cited study by Caughy and colleagues (2008), a variable gauging a social process ("Community Involvement with Children") was predictive of fewer behaviour problems among children only within a low SES community. The relative importance of various social processes for child outcomes may be moderated by the social and economic resources families have at their disposal. Such social processes should not, however, be theoretically equated with SES status. Impoverished children, for example, may have a wide variety of experiences as a function of exposure to important social processes and it is, therefore, inappropriate to assume that low SES is associated with a similar environment for all.

In fact, it may be more fruitful for researchers to investigate context in terms of social processes potentially related to SES, rather than relying solely on global measures of SES when studying unintentional injury. Although it has become clear that SES is the best predictor of a wide range of health-related outcomes in Canada (Health Disparities Task Group, 2004), including certain classes of unintentional injury (e.g., Dougherty et al., 1990), it is rarely argued that inherent characteristics of those living in economically disadvantaged or advantaged situations directly explain health outcomes. Natural experiments involving associations between large-scale changes in population SES (e.g., during times of economic recession or improvement) and changes in population health

(e.g., Costello, Compton, Keeler, & Angold, 2003), as well as comparisons of health outcomes across countries with varying levels of wealth (Wagstaff, 2002) provide strong support for the idea that the SES gradient in health outcomes is not due to putative individual differences across SES. As such, it is of interest to investigate those correlates of low SES that relate directly to negative health outcomes (e.g., lack of access to child safety gear or means to alter hazardous features of housing, fewer resources for adequately monitoring children; Olsen, Bottorff, Raina, & Frankish, 2008) rather than focusing on the indirect health-predictor of SES itself. Researchers have begun to discuss the importance of understanding underlying processes (Adler et al., 1994, Roosa, Jones, Tein, & Cree, 2003) and to "unpack" the effects of both individual and area level SES on physical and mental health in their studies (O'Campo, Salmon, & Burke, 2009), however more such work is needed to understand why SES is the best predictor of unintentional injury in childhood. An important first step in this direction is the inclusion of SES-related social process variables within investigations of unintentional childhood injury.

Present Study

The present study concentrates on adolescents (i.e., grade 10 and 11 students) and aims to address the following question: Does context moderate the extent to which temperament/individual traits predict youth injury risk? An illustration of the model of context moderating the established link between individual traits and individual injury risk can be seen in Figure 1.

As discussed previously, the "context" in which individuals interact is difficult to define and can be conceptualized in many ways. For the purposes of the present study,

context is considered both in terms of the more direct social process variable of perceived neighbourhood social cohesion as well as in terms of the more frequently examined SES of a given area. The following section outlines the rationale for the choice of specific variables included in the current study. As the investigation involves teens, efforts were made to focus on evidence relating to adolescent unintentional injury risk, in particular. However, where no research including adolescent populations yet exists, findings from studies of younger children or adults were extended to inform the choices made in the present investigation.

Individual Traits that Influence Injury Risk

Age and Gender

Age is an important factor to consider with respect to injury risk, as the types of injuries children experience vary by developmental stage. For example, preschoolers are most likely to be injured in the home by household hazards (e.g., poisoning, burns, falls), while school-age children are more at risk for injuries outside of the home (Shanon et al., 1992). Many variables underlie age differences in injury risk (e.g., differential exposure to home vs. outside environments; cognitive processing; e.g., Hillier & Morrongiello, 1998) and different risk factors must be considered as a function of the age of the population of study. In the current study, the age of participants (high school students) influenced the choice of potential predictors of injury-related risk-taking; both temperament and neighbourhood social processes are of importance, as temperament tends to be increasingly stable by adolescence (Caspi, Roberts, & Shiner, 2005) and neighbourhoods have theoretically more direct bearing on teens who participate more

independently in social activities outside the home than do younger children (Dallago et al., 2009).

In addition, adolescence is a time of increased risk-taking in several domains (e.g., risky sexual practices, illegal use of drugs and alcohol, delinquent/aggressive acts; Leather, 2009) and of higher rates of certain classes of unintentional injury (e.g., serious motor vehicle related injury, Lalloo, Sheiham, & Nazroo, 2003; cycling injuries, Ontario Injury Prevention Resource Centre, 2009). There is also evidence to suggest that sensation seeking tendencies increase in early adolescence (Steinberg et al., 2008; see below for discussion of sensation seeking and unintentional injury risk), as does the tendency toward emotional volatility and rash action in the face of intense emotion (Cyders & Smith, 2008). Such findings provide support for the proposition that adolescence is also a time of increased injury-related risk-taking (i.e., behaviour that is directly related to increased risk of unintentional injury, e.g., failing to wear seatbelt or bike helmet).

With respect to gender, boys are more likely to experience unintentional injury than girls at all ages (e.g., Lalloo et al., 2003; Rivara et al., 1982; Rowe, Maughan, & Goodman, 2004). It is unclear why these gender differences exist, but they are thought to be related to boys' greater likelihood than girls of being identified as active, impulsive, higher in sensation seeking, and less compliant with rules (e.g., Morrongiello & Dawber, 1998). Cognitive mechanisms may also play a role in this differential risk of injury; for example, school-age boys have been found to rate situations as less risky and to view themselves as less vulnerable to injury than girls (Hillier & Morrongiello, 1998;

Morrongiello & Rennie, 1998). Furthermore, evidence suggests that parents treat their sons and daughters differently when it comes to encouragement of risk taking and warning of danger (Morrongiello & Dawber, 1999, 2000). Although there is debate as to whether boys and girls elicit different parenting strategies or whether parents' different socialization strategies lead to different behaviour patterns between genders, it is evident that boys are at greater risk for unintentional injury than girls.

Temperament and behaviour

Several temperamental and behavioural traits have been associated with increased risk of injury (e.g., sensation seeking, impulsivity, oppositionality, aggression, lack of inhibitory control; Bijur, Golding, Haslum, & Kurzon, 1988; Davidson, 1987; Manheimer & Mellinger, 1967; Morrongiello & Lasenby-Lessard, 2007; Plumert & Schwebel, 1997; Schwebel, 2004; Schwebel & Plumert, 1999). While it is not entirely understood how such traits put children at greater risk of injury, certain findings suggest that children differ not only in behaviour that could pose a direct risk (e.g., interacting more frequently with hazards; Schwebel, Tavares, Lucas, Bowling, & Hodgens, 2007) but also in associated cognitive processing styles, which could pose an indirect risk (e.g., overestimating physical abilities; misjudging risky situations as being safe; Morrongiello & Matheis, 2004; Plumert & Schwebel, 1997; Schwebel & Plumert, 1999).

The following temperament traits have been associated with unintentional injury risk and are of particular interest in the current study.

Sensation Seeking. Sensation seeking has been defined as a behavioural tendency to seek out varied, novel, complex, stimulating experiences, and is associated with willingness to take risks in pursuit of such experience (Zuckerman, 2007). It would seem intuitively obvious that seeking out thrilling situations, regardless of dangers they might present, is behaviour that would place someone at greater risk of injury. Indeed, several studies have uncovered links between higher levels of sensation seeking (and/or facets of sensation seeking) and unintentional childhood injuries (e.g., Field & O'Keefe, 2003) as well as higher levels of sensation seeking and greater risk-taking (e.g., Morrongiello & Sedore, 2005; Morrongiello, Lasenby-Lessard, & Corbett, 2009; Schwebel, Stavrinos, & Kongable, 2009). Certain research examining links between sensation seeking and injury or injury-risk behaviours in adolescence and adulthood (e.g., drinking and driving) also points to an association between elevated sensation seeking and greater injury risk (e.g., Zakletskaia, Mundt, Balousek, Wilson, & Fleming, 2009). Other studies, however, indicate that adulthood sensation seeking is a poor predictor of injury risk (e.g., visits to the emergency department; drinking and driving) when relevant covariates (e.g., alcohol consumption) are controlled for in analyses (Bazargan-Hejazi, Gaines, Duan, & Cherpitel, 2007; Field & O'Keefe, 2003).

Overall, there is good evidence that sensation seeking is a trait associated with injury risk in childhood, adolescence, and even adulthood (Bazargan-Hejazi et al., 2007; Field & O'Keefe, 2003; Morrongiello et al., 2009). What is less clear is whether sensation seeking predicts injury risk independently of related risky behaviour (e.g., heavy drinking) and/or how sensation seeking might interact with other risk factors to lead to injury.

Aggression/Oppositionality. Children who demonstrate what might be considered a more "difficult" temperament, including displaying more oppositionality (e.g., being argumentative; defying authority) and aggression (e.g., being physically violent towards others and/or property), are at greater risk for experiencing unintentional injury (Bijur et al., 1988; Bijur, Stewart-Brown, & Butler, 1986; Brehaut, Miller, Raina, & McGrail, 2003; Rowe et al., 2004; Schwebel et al., 2007). This appears to be a fairly consistent finding in the injury literature examining childhood temperamental traits as risk factors (Davidson, 1987; Schwebel, Speltz, Jones, & Bardina, 2002; Schwebel et al., 2007; however see Garzon, Huang, & Todd, 2008 for a null finding relating to preschoolers' visits to the emergency department due to unintentional injury). Evidence suggests that antisocial, conduct-disordered behaviour in older adolescents and even adults continues to relate to unintentional injury risk (e.g., Goldstein et al., 2008).

Although it might seem obvious why those prone to aggression and defiance of authority would be at risk for physical injury (e.g., injuries sustained as a result of increased engagement in violent encounters with others), it is less clear why such people would be at greater risk for *unintentional* injury. One suggestion includes the idea that children acting against their caregivers' (or other adults') wishes are more likely to place themselves in harm's way (e.g., defying safety rules outlined by adults; Schwebel et al., 2007).

In addition, some researchers have examined the possibility that oppositionality and aggression are part of a more general constellation of externalizing behaviours that include Attention Deficit/Hyperactivity Disorder (ADHD)–like symptoms, such as

hyperactivity and impulsivity, and that it is this aggregation of behaviours that puts children at greater risk of injury. Evidence suggests, however, that this is not likely the case; rather, oppositional and aggressive behaviours seem to be related to unintentional injury risk independently of hyperactivity and impulsivity (Schwebel et al., 2002; see Rowe et al., 2004 for results indicating ADHD diagnosis linked with certain injury classes independently of Oppositional Defiant Disorder (ODD), however). An early literature review by Davidson (1987) found good evidence for an association between oppositional/aggressive symptoms and unintentional injury in childhood, but concluded that there was no clear support for a similar association between hyperactivity and unintentional injury. More recently, Schwebel and his colleagues (2002) found that preschool boys with ODD alone had similar injury rates to those with a dual diagnosis of ODD and ADHD, suggesting that it was not ADHD symptomatology, per se, that augmented the children's unintentional injury risk (Schwebel et al., 2002). Although such results do not rule out the possibility that hyperactive and impulsive behaviours relate in some way to unintentional childhood injury (see below for discussion of inhibition/disinhibition and injury risk), they do indicate that oppositional and aggressive behaviours can be considered to be significant predictors of unintentional injury, independent of other externalizing difficulties.

Inhibition/Disinhibition and Impulsivity. Temperament and personality traits associated with the ability versus inability to inhibit one's impulses and regulate one's behaviour (e.g., inhibitory control, impulsivity, lack of planning, difficulty foreseeing consequences, tendency to act rashly) have been of particular interest to injury researchers (Bazargan-Hejazi et al., 2007; Field & O'Keefe, 2004; Schwebel, 2004;

Schwebel & Bounds, 2003; van Aken, Junger, Verhoeven, van Aken, & Dekovic, 2007). There appear to be solid theoretical grounds for suggesting that individuals who are more inhibited, more readily able to control their impulses, and more easily able to regulate their behaviour would be protected from unintentional injury, while those displaying behaviour at the opposite end of the continuum (i.e., disinhibited, acting rashly/on impulse, unable to easily regulate behaviours), would be at greater risk. Children who have more self-control, for example, would theoretically be better able to refrain from interacting with attractive hazards (e.g., lighters; sharp objects), while those with weaker "control" systems (typical of deficits within executive function systems seen in those with difficulties such as ADHD or Fetal Alcohol Syndrome) would not be able to avoid such activity, even supposing they were aware of prohibitions against the behaviour and the nature of the risk they were taking.

Indeed, certain evidence seems to support this theory; for example, studies have found associations between stronger 'attentional control' (facet of conscientiousness) and more cautious street-crossing decisions among college students (Schwebel et al., 2009), as well as between ADHD diagnosis and increased injury (e.g., Rowe et al., 2004), methylphenidate prescription and increased injury (Brehaut et al., 2003), impulsivity and increased injury (Field & O'Keefe, 2004) and elevated hyperactivity symptoms and increased injury (Horwitz, Morgensten, DiPietro, & Morrison, 1988; Lalloo et al., 2003). Such findings seem to provide evidence for the posited disinhibited–elevated injury risk and inhibited–decreased injury risk links.

It would be inaccurate, however, to imply that all findings are consistent with this hypothesized relation. Certain studies have failed to demonstrate any association between impulsivity and injury risk (Morrongiello et al., 2006), inhibitory control and minor injuries (van Aken et al., 2007), or ADHD diagnosis and injury risk (e.g., ADHD symptoms and serious injury; Byrne, Bawden, Beattie, & DeWolfe, 2003), for example. One explanation for these seemingly contradictory findings could relate to the fact that researchers conceptualize and study the broad concepts of "inhibition" and "disinhibition" in different ways. Researchers use varied measurement strategies and definitions for concepts such as "impulsivity" (e.g., Bazargan-Hejazi et al., 2007, conflating "impulsivity" with "risk-taking"; Schwebel, 2004, using both questionnaire and behavioural observation measures of impulsivity).

The current study measures "Lack of Premeditation" as a key facet of inhibition/disinhibition. Lacking premeditation involves lacking the tendency to think things over before acting and tending to approach new situations without caution (Cyders & Smith, 2008; Whiteside & Lynam, 2001). Lack of Premeditation may reflect only one aspect of what is recognized by researchers in the field as a multi-faceted concept of "impulsivity" or "disinhibition" (Cyders & Smith, 2008; Whiteside & Lynam, 2001) and may differ slightly from traditional ideas of impulsive behaviour, in that it involves cognitive processes, such as attentional control and deliberate reflection, which theoretically allow for higher-order regulation of impulses powered by neuropsychological mechanisms (e.g., approach tendencies; Schwebel, 2004). However, for the sake of simplicity, the construct will be referred to as "impulsivity" throughout the description of the current study methods and analyses. The construct is of theoretical

interest in adolescent populations insofar as adolescents spend more time independently with friends, away from adult supervision, and begin to take on more adult-like roles of monitoring and inhibiting their own impulses with fewer external controls on their behaviour.

Context/Environment Characteristics that Influence Injury Risk

Neighbourhood[2] processes – Collective efficacy and informal social control of youth

Neighbourhood-wide social processes have been linked theoretically and empirically to adolescent development, in particular to issues of antisocial and delinquent behaviour, for several decades (e.g., Maccoby, Johnson, & Church, 1958; Sampson, 1997). Evidence suggests that neighbourhood social processes such as social disorganization, informal social control, and collective efficacy are associated with outcomes such as youth crime (e.g., Sampson, 1997), adolescent behaviour at school (e.g., social functioning, academic achievement; Bowen, Bowen & Ware, 2002), and youth prosocial behaviour (e.g., Cantillon, 2006).

Although few studies have linked community or neighbourhood social processes directly with unintentional childhood injury risk (see Soubhi, 2004 and Soubhi, Raina, & Kohen, 2004 for exceptions), there appears to be a solid theoretical basis for doing so. Researchers interested in collective socialization of youth and delinquency have suggested that communities exerting informal social control over children and adolescents are able to effectively deter antisocial, criminal behaviour through processes such as 'collective efficacy' (i.e., social cohesion, including shared values among

[2] "Neighbourhood" within the present study refers to residential area.

neighbours, in combination with a general willingness to intervene on behalf of the common good; Sampson, Raudenbush, & Earls, 1997). For example, neighbours who feel connected to one another, share a sense of common values with respect to raising children, and feel a sense of efficacy in working together towards common goals, will be more likely to monitor neighbourhood children and intervene when they are misbehaving or need protection. To extend this concept to the area of unintentional injury risk, neighbourhoods in which children are monitored by a close-knit community of neighbours, all of whom share similar values and norms for safe behaviour, will likely be less tolerant of risky behaviour and, therefore, will be safer places for children.

Importantly, the effects of strong social networks within a neighbourhood do not always appear to be positive, in the sense of supporting prosocial values and well-being of residents (Caughy, O'Campo, & Muntaner, 2003; Kubrin & Weitzer, 2003). Certain studies have demonstrated that cohesive social networks can undermine a neighbourhood's ability to fight crime (e.g,., when law-abiding and non-law-abiding citizens share close social connections, Pattillo, 1998), while others have shown that cohesion matters only within particular contexts (e.g., when SES is low, cohesion and neighbours' willingness to engage in collective socialization of children predicts fewer child behaviour problems, Caughy et al., 2008). In a study by Caughy and colleagues (2003), children's mental health difficulties were predicted by how many neighbours their parents reported knowing, however this relation varied across levels of neighbourhood SES. Within the wealthiest neighbourhoods in the study, children had more internalizing problems if their mothers reported knowing fewer people (i.e., one component of low "social capital," which is a construct similar to that of social cohesion

and collective efficacy, tapping into mutual trust and concern for one's fellow community members). In contrast, within the most impoverished neighborhoods in the study, children whose mothers knew fewer people had fewer behavioural problems. This kind of finding suggests that social processes promoting integration with and connection to neighbours are not consistently associated with better health for residents, independent of other contextual factors. It may be that the quality of the social processes such as cohesion (i.e., the kinds of norms, values, and activities neighbours share or do not share) are of more importance than the strength of the cohesion, or that the quality or strength of the social processes operating within a neighbourhood influence health-related outcomes differently based on other environmental factors (e.g., SES of the neighbourhood).

With respect to unintentional childhood injury outcomes, it is possible that children will be at greater risk in highly cohesive neighbourhoods sharing norms and values that preclude safe environments for children (e.g., tolerance for domestic violence). Lower cohesion might also prove to be important, given potentially related social processes that could influence child injury risk (e.g., adults working longer hours outside of neighbourhood and leaving children unsupervised more often).

Economic Environment

As alluded to earlier, SES is the most consistent predictor of unintentional childhood injury (Roberts & Pless, 1995). Children who are socioeconomically disadvantaged are more likely to suffer injury-related morbidity and injury-related deaths than their more advantaged counterparts (Durkin, Davidson, Kuhn, O'Connor, & Barlow, 1994; Hippisley-Cox et al., 2002; Lalloo et al., 2003). Studies from the United Kingdom

suggest that, within a system of five "social classes" based on parents' employment status, children of the lowest two classes are five times more likely to suffer an injury-related death than children of the highest two classes (Roberts & Power, 1996). Similar findings from the United States and Canada reveal that injury rates, and particularly injury-related death rates, for children of low SES remain above those associated with children of mid- to high-SES (Durkin et al., 1994; Potter et al., 2005). Although overall unintentional injury rates for the pediatric population within economically developed nations have declined since the 1970s, evidence from researchers in the UK suggests that the sharpest declines in injuries have been observed for the most economically advantaged children, while the most deprived children have experienced less impressive improvements in their injury rates (Roberts & Power, 1996; see however Birken, Parkin, To, & Macarthur, 2006 for evidence that comparable decreases in injury rates have been seen across SES levels in Canada).

SES can be measured at different levels (e.g., individual, family, community), which are all potentially relevant to unintentional injury risk. The currently proposed study will focus on neighbourhood-level SES, as recent study of neighbourhood effects on injury risk suggests that it may be a promising avenue (e.g., Haynes et al., 2003). Indeed, indicators of neighbourhood socioeconomic disadvantage are associated with elevated unintentional childhood injury risk (Haynes et al., 2003; Laflamme & Diderichsen, 2000; Rivara & Barber, 1985). Neighbourhood disadvantage appears to exert an independent effect, in addition to well-established individual-level SES associations with unintentional injury risk (Haynes et al., 2003).

Indices of Injury Risk

Outcomes of interest in the proposed study will include not only adolescents' recent history of medically-attended and minor injuries, but will also incorporate adolescents' current injury-related risk-taking behaviour. The rationale behind using risk-taking behaviour as a proxy for actual unintentional injury events involves low base-rates of serious unintentional injury (Peterson, Brown, Bartelstone, & Kern, 1996), as well as there being good evidence for an association between elevated injury-related risk-taking and actually being injured more frequently (e.g., children higher in sensation seeking engage in more physical risk-taking, as well as being more likely to be injured; Morrongiello & Sedore, 2005).

Although risk-taking is often more broadly considered in the adolescent literature, in that adolescence is typically considered a time of increased risk-taking in several domains (e.g., experimentation with drugs and alcohol; risky sexual practices; delinquency; Leather, 2009), the current study will limit its consideration of risk-taking to behaviour that is legal and poses direct risk for physical injury. Adolescents will self-report on their risk-taking behaviour in the present study, as evidence suggests that they provide valid reports on measures of risky behaviour (e.g., Flisher, Evans, Muller, & Lombard, 2004; Vrouva, Fonagy, Fearon, & Roussow, 2010; see however Williams & Nowatzki, 2005 for evidence that adolescents' reports of substance use are not always accurate when verified through urinalysis).

Method

Participants

Participants were a convenience sample of 170[1] adolescents between the ages of 14 and 18 years old (M =15.5, SD = 0.77) whose high schools planned to implement an injury-risk-awareness program called SMARTRISK "No Regrets" in the future (see Procedure section for more detail with respect to the program). Approximately equal numbers of males (N = 81) and females (N = 87) participated (see Table 1 for a further breakdown of sample by gender and age). The measures for this study were given as part of a pre-intervention baseline evaluation, hence, youth who participated were not to have any awareness of the fact that the SMARTRISK program was going to be implemented at their school in subsequent weeks. Classrooms of students in 7 schools that chose to implement the "No Regrets" program in Newfoundland and New Brunswick were recruited for this study by SMARTRISK staff.

Measures

Individual Characteristics Measures

The full questionnaire was comprised of the measures listed below, presented in random order, with the exception of the demographic and postal code questions, which were always presented first. The questionnaire was initially pilot tested using a group of 6 male and female early adolescents (ages 13-15) recruited via telephone from a database of families that had indicated interest in participating in studies relating to child and adolescent development. The researcher visited the adolescents in their homes and asked

them to complete the questionnaires of interest and to highlight any items that were unclear and/or seemed developmentally inappropriate. Based on this feedback, some minor edits to wording were made, resulting in the questionnaire presented in Appendix A, which is referred to below[2]. See Tables 2 and 3 for questionnaire means or breakdown of sample by category, where applicable.

Demographics. Participants were asked to report on their age, grade in school, and gender.

Sensation Seeking. Sensation Seeking was assessed by the Brief Sensation Seeking Scale (BSSS; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002), which has demonstrated adequate internal consistency (α ranging from .68 to .79 across different ethnic groups, Zuckerman, 2007) and validity (i.e., positive correlations between BSSS and positive attitudes towards and usage of drugs and alcohol; Zuckerman, 2007) in previous research. Internal consistency for this measure was adequate for the present sample (α = .79).

Aggression/Oppositionality. Aggressive and oppositional tendencies were assessed by a brief, 7-item scale developed by Meier and colleagues (2008) to measure delinquent behaviour among adolescents. Internal consistency of items was satisfactory for the present sample (α = .75) and identical to that for the sample recruited by Meier and colleagues (α = .75; Meier et al., 2008).

Impulsivity. Impulsivity was assessed by the (Negative) Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation Seeking and Positive Urgency Scale

(UPPS-P), a version of the UPPS (Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation Seeking) Impulsive Behavior scale by Whiteside and Lynam (2001) revised by Cyders and Smith (2007) to include a subscale assessing Positive Urgency, in addition to the previous authors' subscale assessing Negative Urgency (previously identified simply as "Urgency"). One subscale of the UPPS-P, *(lack of) Premeditation*, was used in the present study. The scale addresses only one aspect of impulsivity (i.e., tendency not to think things over carefully before behaving; not to approach new situations with caution) and several other facets of impulsivity are thought to exist (Cyders & Smith, 2007) that may be of interest to injury-risk researchers (Schwebel, 2004). However, for purposes of simplification, *(lack of) Premeditation* will be referred to as *Impulsivity* in the present discussion of analysis procedures and results. Internal consistency of this subscale was good for this sample ($\alpha = .88$).

Social Process Moderator Measures

Neighbourhood social cohesion/informal social control of youth. Neighbourhood social processes of social cohesion and informal social control of youth were assessed by combining items from (a) a measure used by Browning and colleagues (Browning, Burrington, Leventhal, & Brooks-Gunn, 2008) to tap constructs of social cohesion and intergenerational links between adults and adolescents in the community and (b) a measure used by Meier and colleagues (Meier et al., 2008) to tap "neighbourhood risk." Scale items used by Browning and colleagues (2008) were subjected to reliability analyses in a three-level model and scale reliability was found to be satisfactory. The scale created by Meier and colleagues (2008) was likewise found to have adequate

internal reliability (α =.80). When combining the two studies' scales, items that were essentially identical were left out (see Appendix A for list of items and their sources). Internal reliability for the overall scale within the present sample was good (α =.88).

As a follow-up to pilot-testing of the entire survey package used in the current study, eight adolescents (seven 16 year-olds and one 18-year-old; 5 males and 3 females) were interviewed specifically about the *Neighbourhood social cohesion/Informal social control of youth* measure, as a way of better understanding how youth might be interpreting these questions. It was of particular concern to know whether adolescents understood and held opinions with respect to social processes in their neighbourhoods. Six of the youth, living in the City of Guelph, were recruited via telephone from a database of families that had indicated interest in participating in studies relating to child and adolescent development, while two of the youth, living in a rural area in the Bay of Quinte Region, were known to the researcher. The researcher visited the adolescents in their homes and asked them to discuss their understanding of the questionnaire items. The researcher used such open-ended prompts as "What goes through your mind as you read this question?" and asked for specific examples that would demonstrate a given phenomenon in a neighbourhood (e.g., "How could you tell if neighbours shared values?"; see de Leeuw, Borgers, & Smits, 2004 for discussion of how 'think aloud' cognitive interviewing technique can be effective with children and adolescents, but that youth tend to need more prompting than adults). All adolescents interviewed considered the items to be clearly worded and appeared to have opinions about where their own neighbourhood stood on various dimensions on the questionnaire (e.g., to what extent neighbourhood is "close-knit," to what extent parents in the neighbourhood know each

other). One possible exception to this related to Question 5 (How much do you agree with the following: "People in my neighbourhood do not share the same values"). Two of the adolescents interviewed indicated that they weren't sure about what this meant, however each was able to generate guesses ("Getting along well, sharing similar ideas" "having the same interests") that touched on the essence of its significance. See Appendix B for further details with respect to youths' reflections on the questionnaire items.

Overall, the *Neighbourhood social cohesion/Informal social control of youth* measure is both internally reliable and produces valid scores, in the sense that adolescents understand items well and hold opinions about social processes in their neighbourhoods. The variable assessed by this questionnaire will be referred to as *Neighbourhood social cohesion* throughout the remaining discussion.

Neighbourhood Socioeconomic Indicators

Postal code. Participants were asked to report on their postal codes, which were then linked to 2006 Statistics Canada Census Data that include information with respect to recent SES characteristics of Forward Sortation Areas (FSAs; i.e., areas associated with the first three characters of a postal code) across Canada. See the Data Reduction section for more detail with respect to how census data linked to FSAs in the current study were used in analyses.

Dependent Variables

Recent injury history. Participants were asked to report on the number of injury-related doctor or dentist appointments they had experienced over the past year, as well as

the number of minor injuries (i.e., injuries that were treated at home) they had experienced within the past 3 months. In addition, participants were asked whether they had ever been hospitalized as a result of an injury and whether they had ever been injured as a result of alcohol use (see Appendix A for questions relating to injury history: Questions under "Injuries," 1a through 5). Scores for questions 1a and 1b, respectively, yielded separate indices for *Injury-related Medical Appointments* and *Minor Injuries*. Scores for Questions 5 and 2, respectively, yielded separate categorical outcome variables of *Injury-related Hospitalization* and *Alcohol-related Injury*.

Risk-Taking. Injury-related risk-taking was assessed by a number of questions relating to behaviour in specific situations (i.e., at home vs. when engaged in particular leisure activities). Items were designed for the proposed study to measure adolescents' tendency to engage in behaviour that poses a direct risk for experiencing an unintentional injury, across a number of injury classes (e.g., burn, fall, cut/laceration, motor vehicle accident); these items were developed based on a consideration of common teen activities, common injuries to teens, and a review of past research on risk taking during adolescence. In order to compute *risk taking* scores, responses to each item were first coded (e.g., "How often do you do the following... 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = very often) and then averaged separately to form two subscales: (1) *Risk Taking at Home* (average of Questions 6 to 13) and (2) *Risk Taking during Leisure* (average of Questions 49 to 54). Higher scores on either of these two indices indicate more reported injury-related risk-taking behaviour. The decision to create two separate indices of injury-related risk-taking behaviour was made based on the differences in activities highlighted within each subscale; *Risk Taking at Home* includes risky

behaviours and/or implements that would be readily available in the neighbourhoods of most Canadian teens (e.g., play-fighting with friend; climbing roof/balcony; lighting matches), whereas *Risk Taking during Leisure* includes sports and leisure activities that may be more exclusive to specific areas, cultures, and/or socioeconomic classes (e.g., "extreme" sports; driving dirt bikes/ATVs; snowmobiling). As evidence suggests that the types of injuries most likely to be sustained by people varies by SES (e.g., poorer children are more likely to suffer pedestrian injuries, Edwards et al., 2006, while wealthier adolescents are more likely to suffer sports/recreation injuries, Simpson, Janssen, Craig, & Pickett, 2005), it was of theoretical interest to examine these two distinct subscales separately. Each scale exhibited good internal reliability (α =.85 for *Risk Taking at Home* and α =.83 for *Risk Taking during Leisure*).

Procedure

High school students in selected classrooms in seven schools that were to implement the SMARTRISK "No Regrets" program in the fall of 2009 were recruited to complete the measures for the current study. SMARTRISK is a national, non-profit organization with teen-directed injury prevention as its goal (SMARTRISK, n.d.). The "No Regrets" program is offered to high schools interested in presenting their students with facts about unintentional injury and injury prevention messages, such as "Buckle up," "Look first," "Wear the gear," "Get trained," and "Drive sober." Students participating in the study filled out a questionnaire package, in which the current study measures were embedded, as part of a broader study, including gathering baseline data as a first step of an evaluation of the "No Regrets" program. School staff involved in the

"No Regrets" program administered these paper and pencil surveys (including current study measures) to high school students who subsequently participated in the "No Regrets" program over the course of the 2009-2010 school year.

Results

Data Reduction

Alcohol-related injury. The response options for the question "Have you ever been injured as a result of alcohol use (your own use of alcohol or someone else's)?" were originally divided into 3 points: (1) No, (2) Yes, but not within the past 3 months, and (3) Yes, within the past 3 months. The "Yes" response categories were combined, as it was not of theoretical interest whether or not such an injury had occurred recently, and there was only a small proportion of participants endorsing each "Yes" category (i.e., 10.5% = "yes, w/n past 3 months," 12.4% = "yes, but not w/n past 3 months").

SES. An indicator of Forward Sortation Area Socioeconomic Status (SES) was developed through a procedure used in previous research relating to neighbourhood socioeconomic deprivation (e.g., Matheson, Moineddin, & Glazier, 2008; Messer et al., 2006). The method involves: (a) identifying relevant SES variables based on theoretical grounds; (b) using a data reduction procedure (Principal Components Analysis; PCA) to analyse total variance explained by the chosen variables; and (c) creating a weighted index which combines variables based on their component loadings (Messer et al., 2006; Pampalon & Raymond, 2000).

Potential SES variables were chosen based on theoretical relevance, as well as their availability within 2006 Canadian Census data. SES composites previously created by researchers in the field of area-level social and economic disadvantage were

considered in order to determine which variables to include in the PCA (Matheson et al., 2008; Messer et al., 2006; Pampalon & Raymond, 2000). Ten variables were chosen that were theoretically linked to area SES deprivation and that were accessible within the census dataset: (1) % residents without high school education; (2) % residents in Professional, Scientific, and Technical Services[3] occupations; (3) unemployment rate; (4) average after-tax income; (5) % low income families after tax in 2005; (6) % households spending ≥ 30% of income on rent; (7) % lone female-headed families; (8) % rented housing; (9) average value of dwelling; (10) % houses needing major repairs. These variables characterize key facets of SES, such as education, occupation, income, and material wealth (e.g., home ownership; Shapiro, 2006).

Given that there were too few FSAs in the present study (N = 18) to run valid data reduction analyses, data from all available FSAs in the Provinces of Newfoundland, New Brunswick, and Prince Edward Island (N = 151) were used to conduct a PCA with the 10 chosen variables. These three Maritime Provinces were chosen because the data were collected from high schools in these areas.[4] Results of the PCA, using Varimax rotation (Langlois & Kitchen, 2001; Pampalon & Raymond, 2000) indicated that there were 3 components, with only one variable (% residents without high school education) that did not clearly load heavily on only one of these 3 (i.e., correlation >|.67| with one component and <|.39| with others). As the ultimate goal of the data reduction analysis was to generate a single SES composite, only those 5 variables loading on the first principal component, accounting for 35.54% of the total variance, were retained: (1) average after-tax income; (2) % residents in Professional, Scientific, and Technical Services occupations; (3) average value of dwelling; (4) % houses needing major repairs;

and (5) unemployment rate. Variable loadings of these 5 indicators on the first principal component ranged from |.16| to |.26|.

In order to obtain final variable loadings for use in calculating the SES composite, a PCA was run with only those 5 variables identified as comprising the first principal component. An SES composite indicator was then created by adding the standardized variables, weighted by their component loadings. The resulting SES indicator displayed variability across the 18 FSAs included in the current study (*M*=.16, *SD*=0.77), with a range from -1.14 to 1.68. In addition, the distribution of the SES variable was approximately normal across the 18 FSAs (skewness : standard error of skewness <1.0 and kurtosis : standard error of kurtosis < 1.0).

Predicting Injury-Related Risk-Taking and Injury History

Before testing more complex models of interest in predicting injury-related risk-taking and injury history (i.e., interactions between individual and contextual variables predicting injury risk), more straightforward relations among variables were first assessed through examination of: (1) bivariate correlations and (2) main effects models.

Bivariate correlations. Seven individual and contextual predictor variables (age; gender; aggression/oppositionality; sensation seeking; impulsivity; neighbourhood social cohesion; and SES) were correlated with six injury-risk variables (Risk Taking at Home; Risk Taking during Leisure; Injury-related medical appointments (past year) [5]; Minor injuries (past 3 months) [5]; Injury-related Hospitalization; Alcohol-related Injury). Bivariate correlations and corresponding two-tailed tests of significance are presented in Table 4. Age correlated significantly with having experienced an alcohol-related injury,

such that older adolescents were more likely to report having had such an injury. Other individual predictors (gender, aggression/oppositionality, sensation seeking, and impulsivity) were each significantly correlated with Risk Taking at Home and Risk Taking during Leisure (correlations ranging from .15 to .56) such that boys reported taking more risks and those characterizing themselves as being more aggressive/oppositional, being greater sensation seekers, or acting more impulsively also reported taking more risks. Higher levels of impulsivity correlated with having experienced greater numbers of minor injuries within the past 3 months. Boys and those describing themselves as being more aggressive/oppositional were each more likely to report having been hospitalized due to injury. In addition to older adolescents being more likely to report having experienced an alcohol-related injury, adolescents who characterized themselves as being more aggressive/oppositional, being greater sensation seekers, or acting more impulsively were also more likely to report having experienced an alcohol-related injury (correlations ranging from .23 to .33). Contextual predictors (i.e., Neighbourhood social cohesion and SES) did not correlate significantly with any of the six injury-risk outcome variables.

Correlations among predictor variables were also examined and are presented in Table 5. Higher levels of aggression/oppositionality, sensation seeking, and impulsivity were all positively correlated with one another as expected. Also, not surprisingly, older adolescents and males reported higher levels of aggression/oppositionality. Unexpectedly, however, significant correlations existed between age and contextual variables such that older adolescents were more likely to report less Neighbourhood social cohesion and older adolescents were more likely to live in a FSA of higher SES.

Neighbourhood cohesion and FSA-level SES were significantly negatively correlated, r(*154)* = -.30, p <.001.

Finally, bivariate correlations among injury-risk outcome variables are presented in Table 6. As expected, Risk Taking at Home was significantly correlated with Risk Taking during Leisure, and number of Injury-related Medical appointments was correlated with number of Minor injuries. Having been hospitalized for an injury correlated positively with Risk Taking during Leisure and with number of Injury-related Medical appointments. Having experienced an alcohol-related injury correlated positively with Risk Taking both at Home and during Leisure.

Main effects models.[6] Three sets of regression models were built examining six injury-risk outcome variables of interest: (1) Risk Taking at Home and Risk Taking during Leisure (continuous variables); (2) Number of Injury-related Medical appointments and Number of Minor Injuries; and (3) Injury-related Hospitalization and Alcohol-Related Injury (dichotomous variables, categorized as "yes" or "no"). For each of the three sets of models, the following procedure was observed. As data were considered to be nested (i.e., individual adolescents within FSAs), corrections were necessary to take into account possible correlations of error terms within postal code areas.[7] Analyses were conducted using a correction procedure that acknowledges "nesting" or "clustering" (i.e., statistical consideration of the fact that individuals within a group, such as geographical area, are not necessarily independent of one another, but may be more similar than those within other groups).[8] Outcome variables were first regressed on individual predictors of interest (Age, Gender, Aggression/Oppositionality, Sensation Seeking, and Impulsivity) using general linear models for continuous and transformed

count dependent variables and logistic regression for dichotomous dependent variables. Next, contextual variables of interest (i.e., Neighbourhood cohesion and SES) were added to the model to determine whether these group-level predictors explained further variance in the criterion variable[9].

First, models were built examining the two outcome variables that were continuous, with approximately normal distributions: (a) Risk Taking at Home and (b) Risk Taking during Leisure (see Table 7).

(a) Risk taking at home. In the first model, including only individual-level variables, 39% of the overall variance in Risk Taking at Home was explained. Conduct problems, sensation seeking, and impulsivity were each significant predictors in the model ($p < .01$), with an increase in the level of any of these three traits being associated with an increase in Risk Taking at Home. These traits remained significant predictors in the second model, which also included the two contextual variables, Neighbourhood Cohesion and SES. Neither Neighbourhood Cohesion nor SES was a significant predictor in the model with individual predictors and there was no significant change in the amount of variance explained by the overall model when these contextual variables were added ($R^2 = .39$ for each of the two models; $\Delta R^2 \sim 0$).

(b) Risk taking during leisure. The first model with only individual-level variables, accounted for 13% of the variance in Risk Taking during Leisure. Gender and Sensation Seeking were significant predictors in the model ($p < .01$ and $p < .05$, respectively), with male gender being associated with an increase in Risk Taking during Leisure, as well as an increase in Sensation Seeking being associated with an increase in such risk-taking. Neighbourhood Cohesion and SES did not explain further variance in

Risk Taking during Leisure when added to the model with individual variables (R^2 = .13 for Model 1; R^2 = .14 for Model 2).

Second, general linear models predicting log transformed dependent variables were built to examine the two outcomes that were count variables[10] (c) Number of Injury-related Medical appointments and (d) Number of Minor Injuries (see Table 8):

(c) Number of Injury-related Medical appointments. Two main effects models were built to predict Injury-related Medical appointments. As with the earlier described models built with normally distributed continuous outcome variables, first only individual-level variables were included, then both individual and contextual-level variables were examined together. No individual traits or contextual traits were identified as significant predictors in either the first or second models (see Table 8). Adding Neighbourhood Cohesion and SES did not change the amount of variance explained by the model (R^2 = .04 for Models 1 and 2).

(d) Number of Minor Injuries. In the first model, including only individual level variables, 11% of the overall variance was explained. Gender and impulsivity were significant predictors ($p<.05$), with female gender and higher levels of impulsivity predicting more minor injuries. These predictors remained statistically significant when contextual variables were added to the model, with no change in overall variance accounted for (R^2 = .11 for both models).

Third, models were built to examine the two outcome variables that were dichotomous: (e) Injury-related hospitalization and (f) Alcohol-related injury (see Table 9).

(e) Injury-related hospitalization. Logistic regression models were built to predict the dichotomous outcome variable Injury-related Hospitalization (i.e., "*Have you ever been hospitalized due to injury? Yes or No*"). No individual traits or contextual traits were identified as significant predictors in either model. There was very little change across models in the pseudo-R^2 statistics (e.g., Cox & Snell = .06 in Model 1 and .09 in Model 2).

(f) Alcohol-related injury. Logistic regression estimates in the model predicting Alcohol-related Injury (i.e., *"Have you ever been injured as a result of alcohol use (your own use of alcohol or someone else's)? Yes or No*") revealed 3 significant individual-level predictors of this outcome: Age, Gender and Sensation Seeking (see Table 9). In both Model 1, including only individual-level predictors and Model 2, which added contextual-level variables, being older, being female, and having higher levels of Sensation Seeking each significantly increased the likelihood of experiencing an injury. There was no significant difference in the R^2 analogues between Models 1 and 2 (Cox & Snell = .20 for Model 1 and .21 for Model 2).

Interaction models.[6] Interaction models were built examining the same six injury-risk outcome variables outlined under the previous section, *Main Effects Models*, in order to test the hypothesis that neighbourhood social processes and/or SES moderate the relation between personal attributes and injury risk among adolescents. In a method suggested by Aiken & West (1991) for testing interaction effects between continuous variables using multiple regression, mean-centered predictors of interest are entered into a regression analysis, both individually and in an interaction term. If the interaction term is a statistically significant predictor of the outcome of interest when controlling for the

individual components of the interaction, then follow-up analyses are conducted to further examine the interaction effect.

In two sets of analyses, each of the 5 individual variables interacted with either (g) perceived Neighbourhood Social Cohesion or (h) SES.

(g) Individual characteristics x neighbourhood social cohesion. Each of five individual characteristics was combined in an interaction term with Neighbourhood Social Cohesion in order to predict each of six injury-risk variables, for a total of 30 regression models predicting six outcomes. Significant interactions between individual characteristics and perceived Neighbourhood Social Cohesion were identified in models predicting Risk-Taking at Home (Age x Neighbourhood), Risk-Taking during Leisure (Gender x Neighbourhood; Sensation Seeking x Neighbourhood), Injury-related Medical Appointments (Sensation Seeking x Neighbourhood), Injury-related Hospitalization (Gender x Neighbourhood), and Alcohol-related Injury (Gender x Neighbourhood). No interaction terms were significant predictors of Minor Injuries (see Tables 10 through 12 for interaction term statistics).

Follow-up analyses were conducted to further examine the six significant interactions identified: (1) Age x Neighbourhood Social Cohesion predicting Risk-Taking at Home; (2) Gender x Neighbourhood Social Cohesion predicting Risk-Taking during Leisure; (3) Sensation Seeking x Neighbourhood Social Cohesion predicting Risk-Taking during Leisure; (4) Sensation Seeking x Neighbourhood Social Cohesion predicting Injury-related Medical Appointments; (5) Gender x Neighbourhood Social Cohesion predicting Injury-related Hospitalization; and (6) Gender x Neighbourhood Social Cohesion predicting Alcohol-related Injury. Again in following the method suggested by

Aiken & West (1991), interaction terms were created between the centered individual characteristic variable and the Neighbourhood Social Cohesion variable at one Standard Deviation (SD) above and one SD below its mean. Regression models were built to include the centered individual characteristic variable, the low or high level moderating variable (in this case, Neighbourhood Social Cohesion), as well as the interaction term between the characteristic and high or low moderator. In this way, it was possible to test the effect of the individual characteristic variable on the outcome variable while holding the moderating variable constant at either a low level, a mid level (i.e., at the mean), or high level.

The following summaries describe the findings of the interaction follow-up analyses. See Tables 13 through 18 and Figures 2 to 7 for related statistics.

(1) Age was found to positively predict Risk-Taking at Home only at low levels of Neighbourhood Social Cohesion. In other words, older adolescents engaged in more injury-related risk-taking at home only when Neighbourhood Social Cohesion was low (see Figure 2).

(2) Gender was found to predict Risk-Taking during Leisure at both mid and high levels of Neighbourhood Social Cohesion. Specifically, when Neighbourhood Social Cohesion was mid to high, boys were more likely to engage in such risk-taking than girls (see Figure 3).

(3) Sensation Seeking positively predicted Risk-Taking during Leisure when Neighbourhood Social Cohesion was at low and mid levels. This means that for those who reported lower levels of social cohesion in their neighbourhoods, sensation seeking levels were significant predictors of risk-taking, such that higher sensation seekers were

greater risk-takers, as well. This relation did not hold for those reporting high Social Cohesion in their neighbourhoods (see Figure 4).

(4) Sensation Seeking positively predicted number of Injury-related Medical Appointments when Neighbourhood Social Cohesion was at high levels. Those reporting higher levels of Sensation Seeking also had experienced more injury-related medical appointments over the past 12 months, but this relation only held in neighbourhoods with higher Social Cohesion (see Figure 5).

(5) Gender was a significant predictor of Injury-related Hospitalization, such that males were more likely than females to have been hospitalized, but only when Neighbourhood Social Cohesion was reported to be at mid or high levels (see Figure 6).

(6) Being female significantly raised the likelihood of having experienced an Alcohol-related Injury, but only when Neighbourhood Social Cohesion was low (see Figure 7).

(h) Individual characteristics x SES. Each of five individual characteristics was next combined in an interaction term with SES in order to predict each of six injury-risk variables, for a total of 30 regression models predicting six outcomes. Three significant interactions were identified predicting (1) number of Injury-related Medical Appointments (Impulsivity x SES); (2) Minor Injuries (Gender x SES); and (3) Alcohol-related injury (Impulsivity x SES; see Tables 19 to 21 for interaction term statistics).

Follow-up analyses were conducted to further examine the significant interactions identified: (1) Impulsivity x SES predicting Injury-related Medical Appointments; (2) Gender x SES predicting Minor Injuries; and (3) Impulsivity x SES predicting Alcohol-related Injury. See Tables 22 to 24 and Figures 8 to 10 for related statistics.

(1) Higher impulsivity predicted more Injury-related Medical Appointments, but only when SES was at low or mid levels (see Figure 8).

(2) Females had a greater number of recent minor injuries than males, but only when SES was at mid to high levels (see Figure 9).

(2) Higher impulsivity elevated the risk of having experienced an Alcohol-related Injury, but only when SES was at low or mid levels (see Figure 10).

Discussion

Results of the current analyses reveal several meaningful patterns of relations among individual characteristics, area-level characteristics, and unintentional injury risk in the adolescent population. The following discussion will elaborate on key results, relating these to established literature and commenting on those results that are unexpected given past research findings.

Patterns of correlations in the current sample were generally in line with past results with respect to how individual characteristics relate to injury-related outcomes including injury-related risk-taking, having been hospitalized due to injury in the past, and having experienced an injury as a result of alcohol use. Not surprisingly, males and those who are more aggressive/oppositional, greater sensation seekers and more impulsive are more likely to have experienced the aforementioned injury-related outcomes. Unexpected, however, was the fact that individual characteristics were unrelated to numbers of recently experienced injury-related medical appointments. Two individual characteristics (gender and impulsivity) correlated with number of recent minor injuries, such that females and those reporting higher impulsivity levels also

reported more minor injuries. It is unclear why so few correlations were seen with number of injuries, given that past research has found such relations (e.g., Morrongiello et al., 2006).

Somewhat puzzling correlations were obtained among age and the contextual variables of Neighbourhood Social Cohesion and FSA-level SES. To explain why older adolescents perceived their neighbours as less cohesive or supportive of youth, it may be that interactions among adults and neighbourhood children become less friendly as youth age. Research into American adults' perceptions of young people suggests that adults hold negative stereotypes about teens (e.g., describing teenagers as irresponsible and rude), and these attitudes may lead to more negative treatment of adolescents by unrelated adults (Scales et al., 2004). Scales and colleagues (2004) found that adults in their study considered engagement with younger children to be more important than engagement with teens, which also supports the hypothesis that adolescents are sensing true differences in how much their neighbours support them as they age. The authors suggest that adults should "smile and wave to teenagers they see in the neighborhood" (Scales et al., 2004, p. 755), implying that even small gestures of friendliness towards adolescents may be missing from typical interactions. On the other hand, as adolescents get older they may be more likely to become engaged in certain adolescent-limited antisocial activities (e.g., drinking underage, using illicit drugs; Moffitt, 1993), and may face more disapproval and/or sanction from neighbours based on such behaviours (e.g., calling police to break up rowdy party). As a result, teens may feel that neighbours do not share their values and perceive their "monitoring" as unwanted and intrusive, rather than seeing it as a well-intentioned attempt to keep adolescents in the community safe.

Next, two unexpected correlations were obtained with FSA-level SES: (1) older adolescents lived in neighbourhoods of higher SES and (2) adolescents reporting higher levels of Neighbourhood Social Cohesion lived in areas of lower SES. It may be that students completing the survey in schools based in more advantaged areas happened to be in more senior years (i.e., Grade 11, 12) by chance. Some patterns in the data point to this, in that the three schools with the lowest mean FSA-level SES reported by their students returned surveys completed by mainly Grade 10 students (90% of data), whereas in the school with the highest mean SES, all surveys were completed by Grade 11 and 12 students. Also possible is that families with older adolescents are slightly more likely to be financially secure and living in a wealthier area. For example, families may build wealth and move to more affluent areas as adults are in the workforce for longer periods and are better able to support their offspring financially. As children in the family age they may also begin contributing to the family's income through paid employment. Similarly, wealthier areas may truly be less cohesive within this sample. Some evidence, for example, suggests that those of higher SES are more mobile in terms of moving between areas and in terms of having social relations outside of their neighbourhoods (Lewicka, 2010), which may influence how well people come to know each other in the area where they live. Partial correlations between age, Neighbourhood Social Cohesion, and FSA-level SES were also examined and suggest that the relations between SES and age, as well as SES and Neighbourhood Social Cohesion remain when controlling for Neighbourhood Social Cohesion and age, respectively (r =.35, df = 151, p< .001 and r = -.25, df = 151, p = .002). However, when controlling for SES, the correlation between Neighbourhood Social Cohesion and age became non significant. Correlations including

SES should therefore likely be interpreted with caution, especially given that they involve associations between a variable based on area-level indicators and variables based on individual-level indicators (or individual perceptions of area-level social process) without statistical correction for potential nesting.

Models examining main effects of predictor variables on injury-related outcomes generally fit with previous findings, in that individual characteristics such as being male, having more aggressive/oppositional tendencies, and being more highly sensation seeking and/or impulsive predicted greater injury risk. Interestingly, in none of the models did the contextual variables (i.e., Neighbourhood Social Cohesion and SES) explain variance in injury risk above and beyond that explained by individual characteristics. In fact, neither contextual variable examined was a significant predictor when entered together in models without individual characteristics, with the exception that SES of area significantly predicted hospitalization, with higher SES being associated with higher likelihood of having been hospitalized due to injury (see Table 23). This overall lack of predictive power of SES, in particular, is surprising in the sense that social factors are often strong and consistent predictors of health outcomes (e.g., children in low income families and/or low income neighbourhoods are at greater risk of unintentional injury and other adverse health outcomes; Edwards et al., 2006; Hasselberg, Laflamme, & Weitoft, 2001; Hippisley-Cox et al., 2002; Laing & Logan, 1999; Lalloo et al., 2003; Nersesian, Petit, Shaper, Lemieux, & Naor, 1985; Petrou, Kupek, Hockley, & Goldacre, 2006; Roberts & Pless, 1995; Sellström, O'Campo, Muntaner, Arnoldsson, & Hjern, 2011). For example, Faelker, Pickett, and Brison (2000) found that socioeconomic status at census tract level consistently predicted child injury risk, such that children between the

ages of 0 and 19 were more likely to be injured if living in less socioeconomically advantaged areas in Ontario, Canada. This finding held across several types of injury outcomes (e.g., fall injuries, injuries sustained during play, injuries of both minor and moderate severities). Given this fact, it would be expected that socio-contextual factors would be important in models predicting injury risk. On the other hand, however, ample evidence exists to suggest that family-level SES indicators are stronger predictors of health outcomes than area-level variables, which rarely predict much variance in health-related outcomes when individual-level social variables are also included in the model (e.g., Kendrick, Mulvaney, Burton, & Watson, 2005; Reading et al., 1999; Ross, Tremblay, & Graham, 2004). Evidence from the current study suggests that area-level variables are not good predictors of adolescent injury risk when considered as main effects, or outside of interaction with individual characteristic variables. However, it is important to keep in mind the small number of areas investigated.

Another interesting pattern appearing through analysis of main effects is that individual characteristics (e.g., male gender) failed to predict more serious injury-related outcomes, such as numbers of injury-related medical appointments or having ever been hospitalized due to injury. In contrast, a substantial proportion of the variance in injury-related risk-taking behaviour was predicted by individual traits (e.g., male gender, sensation seeking, aggressive/oppositional behaviour). It is unclear why this might be, however it seems that correlations among the injury outcome variables cluster somewhat into two groups: risk-taking and history of alcohol-related injury versus recent injuries and history of injury-related hospitalization (see Table 6). It may be that these injury outcomes are tapping different aspects of injury risk (e.g., risk-taker versus those who

report actual injury history) that are best predicted by different independent variables. Indeed, as anticipated, scores on the measure of risk taking at home and during leisure were moderately correlated with one another, with alcohol-related injury, and with sensation seeking (see Tables 4 and 6).

Finally, given that males tend to be at greater risk of injury (e.g., Lalloo et al., 2003), it is surprising that being female significantly increased the risk of both having experienced a minor injury and of having experienced an alcohol-related injury. When considering these injury outcome variables in particular, however, the findings may not be unexpected. In terms of experiencing minor injuries, evidence exists that school-age girls tend to rate their day-to-day injuries as more severe than boys and are also more likely to report their injuries to parents (Morrongiello, 1997). It may be that, compared to teenage boys, teenage girls are also more likely to consider minor injuries to be more severe and to discuss these injuries with others. If this is the case, then minor injuries may be more salient and easier to recall for females versus males. In addition, it may be that what constitutes an injury that "requires treatment at home" differs between males and females. Indeed, evidence exists that females tend to have lower pain tolerance (Fransson-Hall & Kilbom, 1993) and are also more conscientious in terms of engaging in health-promoting behaviours (von Bothmer & Fridlund, 2005), which suggests that females may be more likely to pay attention to and treat minor cuts, burns, etc., while males might be more likely to ignore and/or play down their injuries. Future research should make use of actual medical records to reduce the risk of gender-related biases in self-report of injuries and to ensure accurate data (Morrongiello, 1997). Gender role expectations for how males and females should experience pain likely affect sex

differences in how injuries are perceived across the lifespan; as men are expected to be more stoic and tolerate higher pain levels (Robinson, Gagnon, Riley, & Price, 2003), they are also likely expected to set a higher bar for what should be considered a minor injury.

The finding that being female is a significant risk factor for having experienced an alcohol-related injury may also be less surprising on closer examination. Females experience higher blood alcohol levels than males given the same amount of alcohol consumption per kg of body weight (Baraona et al., 2001; Nolen-Hoeksema, 2004), which may make females more prone to experience serious intoxication than their male counterparts. If this is the case, then teenage girls might also be expected to be more likely to be injured due to impaired judgement and physical coordination while drinking. Some evidence also suggests that there has been a recent increase in adolescent females' exposure to advertising for alcoholic beverages and that adolescent girls have begun surpassing boys in terms of their alcohol consumption in some areas (Jernigan, Ostroff, Ross, & O'Hara, 2004). Conflicting evidence, however, indicates that adolescent girls' drinking has not recently become more problematic, but has rather been gaining more attention in society (Zhong & Schwartz, 2010). Regardless of how widespread and/or problematic alcohol consumption is for adolescent females versus males, it seems plausible that sex differences in the pharmacokinetics of alcohol might explain some differences in risk of injury while drinking. Also important to consider is the wording of the question "have you ever been injured as a result of alcohol use (your own use of alcohol or someone else's)?" It may be that females are more likely to suffer unintentional injuries as a result of someone else's impaired judgment while drinking (e.g., being passenger in a car with a drunk driver). In a study of maxillofacial injuries

resulting from motor vehicle accidents in Australia, it was found that car passengers were most at risk for sustaining such injuries (as compared to those injured as drivers, pedestrians, motorcyclists, or bicyclists) and that females who had been injured were more likely to be passengers than males (Wood & Freer, 2001). Also, although the intent was to assess unintentional injury, it may be that respondents also considered situations in which they were intentionally aggressed. Evidence suggests that females are at greater risk for sexual and physical assault while they and/or their aggressor are intoxicated (Nolen-Hoeksema, 2004) and that females are more at risk for injury through dating violence (Foshee, 1996). These factors might place females at greater risk than males for being injured through violence when alcohol is being consumed. Finally, it may be that females interpreted the question about having experienced an "injury" related to alcohol use differently from males. For example, females may have a lower threshold for what they consider to be an "injury" when given no parameters related to severity and they may be recalling more minor injuries incurred while they or others were drinking. If this is the case, then points outlined in the earlier discussion of why females might report more minor injuries than males may be relevant.

Analyses exploring whether interactions exist between individual and contextual characteristics in predicting injury outcomes suggest that certain personal characteristics may predict injury risk differently, depending on attributes of the environment. Specifically, six of thirty interactions between personal characteristics and Neighbourhood Cohesion and three of thirty interactions between a personal characteristic and FSA-level SES were discovered. All personal characteristics predicted injury risk outcome in the expected direction at one or more level(s) of the contextual

variable, with the exception of the finding that females reported more minor injuries and were more likely to have experienced alcohol-related injury within certain contexts. This suggests that the interactions between personal and contextual variables detected in this dataset are likely to be 'true' effects.

The type of context in which individual characteristics predicted injury risk differed across the interactions identified; in certain cases, individual characteristics were predictors only at lower levels of Neighbourhood Cohesion or SES, while in others, individual characteristics were predictors only at higher levels of Neighbourhood Cohesion. Cases in which individual characteristics predicted injury risk outcomes at low levels of Neighbourhood Cohesion (i.e., higher age predicting more Risk Taking at Home, more Sensation Seeking predicting more Risk Taking during Leisure, and being female predicting more alcohol-related injury) would seem to support the theory discussed previously that lower perceived social constraints allow for a larger role of genetic influences on behaviour when these lowered constraints provide more opportunity for expression of individual difference (Rutter et al., 2006; Shanahan & Hofer, 2005), insofar as individual characteristics are genetically based. In areas in which neighbours are perceived to be less interested in youth and/or do not monitor their behaviour as closely, youth with a given predisposition may be freer to behave in ways consistent with their natural inclinations, without fear of reprisal due to social constraints against risky behaviour. Whereas age may not be a good predictor of risk taking around the home where neighbours demonstrate more monitoring and impose social constraints on all youth regardless of age, age may become a better predictor in areas in which neighbours are less cohesive and monitoring of youth is left to individual parents, school

staff, and/or other caregivers who may be inclined to leave adolescents more to their own devices as they age. Similarly, when neighbours are perceived to be less cohesive and assertive in monitoring youth, those teens who are sensation seekers are more likely to be able to act on their dispositions and thus have more opportunity to become injured, while areas in which neighbours are seen as more involved in monitoring local teens' behaviour may provide fewer opportunities for sensation seekers to take risks in their leisure time.

The finding that girls are more likely to have experienced an alcohol-related injury in neighbourhoods that are less cohesive is somewhat more difficult to explain, in the sense that it is less clear why, given less perceived supervision by neighbours, girls would be at greater risk than boys. One possibility is that perception of others' monitoring affects girls drinking more seriously than boys, such that within less cohesive areas, girls are drinking more heavily than in more highly cohesive areas and then are sustaining more injuries for reasons discussed previously relating to girls overall greater risk of alcohol-related injury. Some evidence does suggest that girls' drinking is more affected than boys by social pressures and monitoring (e.g., within a rural setting, girls were found to be more influenced by peers' disapproval than boys in terms of their drinking, Pope, Smith, & Wayne, 1994; girls' lower levels of drinking were found to be mediated by perceptions of higher monitoring by mothers, Webb et al., 2002). In a large national sample of U.S. youth (N >10,000, nested within >100 schools), certain characteristics of school contexts, which are likely to also describe to an extent the schools that participated (i.e., SES advantage, higher proportions of White residents, located in more suburban vs urban areas) were found to be associated with increased alcohol use (Botticello, 2009). It may be that youth in the present sample are all at

generally greater risk for alcohol use, but that lower perceived adult monitoring and social cohesion within a generally well-off neighbourhood puts girls and boys at differential risk.

For those cases in which individual characteristics predicted injury risk outcomes only at higher levels of Neighbourhood Cohesion (i.e., being male predicting more Risk Taking during Leisure, higher levels of Sensation Seeking predicting more injury-related medical appointments, and being male predicting having been hospitalized due to injury), the notion that greater neighbourhood cohesion leads to greater social constraint on risky behaviour generated by individual inclinations would seem to be contested. However, other models of how genes and environment interact (beyond that of lowered social constraints leading to greater opportunities for expression of genetic difference) may also be important to consider when interpreting person x environment interaction findings. For example, certain researchers have put forward models of environmental contexts that can enhance the expression of individual traits through means other than perceived social control (e.g., Bronfenbrenner and Ceci's (1994) "proximal processes," which are social processes that have more impact on heritability within good environments; Rutter et al., 2006). It may be the case that social cohesion/monitoring of youth is a social process that works within certain environments to affect expression of group differences associated with gender. Or, it may be that social constraints influence people's behaviour in ways that emphasize group differences under certain circumstances, for example promoting or constraining behaviour for just one gender (constraints against alcoholism among women being particularly strong in the early 1900s; Rutter et al., 2006). The finding that males are only more likely to engage in risk-taking during leisure when social constraints are

high suggests that social pressures are in place to encourage male risk-taking during leisure activities and/or discourage similar behaviour among females. Research findings relating to neighbourhood environment effects on adult health suggest that there are gender differences in the way perceived neighbourhood social and physical characteristics influence health of men and women, although different characteristics of neighbourhoods appear to have somewhat different effects across genders and studies (Stafford, Cummins, Macintyre, Ellaway, & Marmot, 2005). Although it is yet unclear how this might be so, adolescent males' and females' injury-related outcomes may be differentially affected by social conditions such as higher or lower neighbourhood social cohesion/monitoring of youth. Closer-knit communities in which neighbours share values and perhaps common interests might exert more pressures towards gender-stereotyped behaviour (e.g., men getting adolescent boys involved in outdoor activities outside of the neighbourhood, such as hunting and fishing, with women spending more time at home). Within less cohesive environments, then, males may not be actively socialized to become involved in outdoor activities that pose risk of injury, especially within the less experienced adolescent population (e.g., riding ATVs, snowmobiling). It may also be that males and females differ in their behavioural responses to perceived higher social cohesion/monitoring levels, such that boys are not deterred from greater risk-taking by neighbours' perceived monitoring. Certain evidence from the parental monitoring literature suggests that, in general, females tend to perceive themselves as more highly monitored than their male counterparts (Svensson, 2003; Webb, Bray, Getz, & Adams, 2002). In addition, research findings suggest that there may be gender differences in terms of how important parental monitoring is in predicting behavioural

outcomes for adolescents, however these gender differences are difficult to interpret, as they are not consistently in the same direction and may be moderated by other factors such as age (Jacobsen & Crockett, 2000). In a study that may be particularly relevant to the present findings relating to adolescent girls' alcohol related injuries within neighbourhoods that monitor their youth less, Svensson (2003) found that females who were in contact with deviant peers were more likely to use illicit drugs only when they were less highly monitored by parents, but that this did not hold for males. Similarly, another research team found that perceived maternal monitoring mediated between adolescent gender and alcohol consumption, such that girls' lower levels of drinking were explained by their perceptions of higher monitoring (Webb et al., 2002). In a study specifically related to unintentional injury among toddlers, Morrongiello and colleagues (2004) found that girls had the same low rates of injuries when their mothers checked in on them intermittently as when their mothers supervised them continuously. For boys, on the other hand, intermittent checking was associated with similar levels of injuries as occurred when mothers were not supervising (Morrongiello, Ondejko, & Littlejohn, 2004). These results also suggest that perceptions of parents' monitoring might differentially influence boys' and girls' injury risk.

It may be that females are particularly influenced by their perceptions of monitoring in terms of the risks that they are willing to take and that perceptions of monitoring extend beyond the family to neighbours and other members of their community. If less monitoring is perceived, on the other hand, it may be that females have more opportunity to engage in risk taking that is less socially acceptable in more cohesive communities and/or that has been less socially acceptable in past generations

(for a discussion of evidence for a closing gap between adolescent male and female rates of risk-taking, with girls taking more risks in certain areas than their mothers, see Abbott-Chapman, Denholm, & Wyld, 2008).

With respect to the findings that sensation seekers are more likely to report having a medically-attended injury and males are more likely to be hospitalized in more highly socially cohesive neighbourhoods, it may be that social pressures exist to seek medical attention following injury in neighbourhoods with more monitoring of youth, or that youth being hurt are more likely to be observed by others in these neighborhoods and they are then aided in seeking medical treatment. Indeed, while many studies addressing neighbourhood effects on health focus on risk factors (e.g., Cutrona, Wallace, & Wesner, 2006; Dupéré et al., 2008), the neighbourhood context is also acknowledged as a potential enabler of positive health-related behaviour through features such as nearness to fitness centres and interpersonal modelling of health behaviours (Stokols, 1996). As such, although males and sensation seekers may be more likely than their female and low-sensation seeker counterparts to be seriously injured in neighbourhoods regardless of cohesion levels, it may be that such injuries are more likely to come to the attention of medical professionals when social pressures dictate greater concern about injuries and/or seeking out medical services for their treatment.

In three situations, individual characteristics interacted with FSA-level SES: girls had higher numbers of minor injuries when SES was higher, while greater impulsivity predicted greater numbers of recent injury-related medical appointments and also risk of having experienced an alcohol-related injury in areas of lower SES.

With respect to the finding that girls experience more minor injuries in areas of higher SES, it may be that social processes related to more socioeconomically advantaged areas (but not encompassed by the Neighbourhood Social Cohesion construct) play a role in making minor injuries more salient and/or memorable to females (see earlier discussion regarding main effect of gender in predicting minor injury). It is interesting, however, that such putative social processes do not seem to operate within the areas of lower SES. This may tie in to the finding that girls are more likely to have experienced an alcohol-related injury in less cohesive neighbourhoods, which are also of greater SES in the present sample, and that the alcohol-related injuries recalled are by and large minor.

In terms of impulsivity predicting injury outcomes only within areas of lower SES, one might have expected a similar interaction to exist between neighbourhood social cohesion and impulsivity if lower social constraints were a key factor in creating an environment in which impulsive youth were freer to engage in excessive dangerous behaviour that might put them at risk for an alcohol-related or medically serious injury. However, social processes related to SES may still provide a potential explanation for this finding. For example, socialization models of how neighbourhoods affect antisocial outcomes for youth propose that children growing up in economically disadvantaged areas are more likely to be exposed to role models engaging in antisocial activities and to consider such behaviour as normative and/or an attractive alternative to mainstream prosocial behaviour, particularly as neighbourhoods become more segregated with respect to economic opportunity versus disadvantage (Small & Newman, 2001). Evidence also suggests that youth growing up in poorer communities are more likely to

socialize with older peers, who are more likely to engage in alcohol use and other risky behaviour (Harding, 2009). On the other hand, youth within the present study did not appear to be living within neighbourhoods that were particularly disadvantaged socioeconomically (see Limitations and future directions section). Also, as previously mentioned, school contexts characterized by higher SES tended to have students engaging in more heavy drinking in a large, national sample of youth in the U.S. (Botticello, 2009). It may be that higher SES neighbourhoods exert social pressures not encompassed within the "Neighbourhood social cohesion" construct, such that most youth, regardless of individual characteristics, engage in the behaviour. It could be that within somewhat less socioeconomically advantaged areas in this sample, risky activity such as youth drinking may be less of a social norm and related medical appointments and injuries are therefore able to be better predicted using individual differences in impulsivity levels.

Limitations and future directions

Certain limitations warrant consideration when interpreting the current findings. To begin, the limited number of available participants and corresponding FSAs in this study did not allow for building more complex statistical models of interest (e.g., multi-level models). Replicating this type of study with larger samples would be helpful in potentially detecting more interactive effects and in building confidence that interactions detected in the current data are robust. Given that interactions are notoriously difficult to detect in field studies, as they tend to have lower statistical power than experimental designs (McClelland & Judd, 1993), studies including larger numbers of participants

would have greater statistical power and greater likelihood of detecting effects. In addition, given a greater number of participants, 3-way interactions, such as potential differences in how individual and social process variables (e.g., Neighbourhood Social Cohesion) interact based on community-level SES could be examined. There is a substantial body of evidence that suggests various interactions between individual, social process, and SES variables predict various health and behavioural outcomes (e.g., Caughy et al., 2008; Schonberg & Shaw, 2007). For example, research findings indicate that certain family-level social processes become more important in explaining variance in adolescent outcomes depending on neighbourhood-level SES (Cleveland, 2003). It seems likely, therefore, that models incorporating more complex interactive effects would add to our understanding of the seemingly complex interplay among these factors.

Data were largely based on responses to self-report questionnaires, which have some inherent limitations. Reports of one's own behaviour may not relate to more objective third party observations of behaviour; as such, it is possible that adolescents over- or under-reported their experiences or actions based on inaccurate self-perceptions or memories and/or concerns related to social desirability. An unanticipated limitation of collecting self-report data from adolescents involved the proportion of those surveyed (~10%) who were unaware of or chose not to report on their home postal code. In addition, a larger than expected proportion (45%) of participants reported having been hospitalized due to injury. It may be that adolescents misinterpreted the question and considered any outpatient visit to the hospital due to injury as constituting a "hospitalization." In terms of risk-taking, however, evidence suggests that adolescents are valid reporters of their own risky behaviours (e.g., adequate test-retest reliability for self-

report of risky behaviour; Flisher et al., 2004; evidence for convergent validity among risk-taking scales, Vrouva et al., 2010).

Given that the majority of variables were based entirely on survey data, there is also a potential for same source bias to occur, meaning that spurious relations may be observed between variables because of potentially correlated error variance (e.g., error variance attributable to measurement method, i.e., surveying, is not independent across measures), as well as the potential for respondents' answers on one variable to affect their perceptions related to another variable (Diez-Roux, 2007). One bit of evidence that same source bias may have affected results is the fact that more individual-context interactions were revealed when using the context variable based on self-report (perceptions of neighbourhood social cohesion), rather than the context variable, which was based on more objective data (census data linked to postal code area). On the other hand, perceptions of social processes operating in one's neighbourhood may actually be better predictors in interaction with individual characteristics in predicting injury risk. Indeed, theory related to social constraint or facilitation of behaviour would suggest that the perceptions of how others perceive given behaviour are important, as even potentially inaccurate perceptions of others' approval or disapproval can shape behaviour. Relatedly, it is possible that social processes are more important in interaction with individual characteristics than are SES indicators. Indeed, theorists attempting to make sense of SES-injury risk associations often discuss the importance of examining factors related to SES, such as lack of safe play space in the home (Olsen et al., 2008) or, as in this study, neighbourhood social cohesion, in order to shed light on relevant process underlying the SES-injury connection.

In addition, fewer SES effects may have been detected due to features of the current study. For example, some evidence exists to suggest that SES may vary across causes of injury, which were not differentiated (e.g., different classes of unintentional injury, violence-related or self-inflicted injury; Laflamme, Hasselberg, Reimers, Cavalini, & Ponce de Leon, 2009; area-level increased concentrations of low SES families not affecting rates of traffic or fall-class injuries, Reimers & Laflamme, 2005). Also, it may be that SES is less important as a predictor of injury in adolescence as compared to during early childhood (Chen, Matthews, & Boyce, 2002; see however findings of SES disadvantage-injury associations appearing during adolescence by Chen, Martin, & Matthews, 2006). There are some inconsistencies in research findings linking SES to non-fatal injuries among adolescents, for example, with some studies failing to observe a typical inverse SES-injury gradient for such injuries (Potter et al., 2005). Relations between health risk behaviour and SES also seem less evident during adolescence than they appear to be in adulthood, with inconsistent findings in the literature and some research showing lack of effect of SES on behaviours such as smoking and alcohol use among teens (Tuinstra, Groothoff, Van den Heuvel, & Post, 1998). It may be that adolescence is a time of increased risk taking across SES groups and that this makes finding consistent, clear SES-injury risk relations more difficult; specifically, these findings might imply that statistical interactions with SES variables would be less likely to be uncovered in the present study.

In addition, features of the SES variable in this study may have contributed to the lack of interactive effects between individual characteristics and FSA-level SES. Although the aggregate variable demonstrated adequate variability, arguably it did not

encompass extremes of area-level wealth and/or poverty within the Canadian context. For example, the range of after-tax family incomes included within the 18 postal code areas examined spanned from approximately $44,000 to $80,000, a range that does not include extremes. Future research into injury risk and area-level SES should attempt to include a wider range of SES levels, which might provide a better chance for individual x SES interactions to emerge.

Given that SES was linked to geographic area (i.e., indicators from Census linked to Forward Sortation Areas) while the neighbourhood social process variable, Neighbourhood Social Cohesion, was based on youth perceptions, it is difficult to interpret associations between these two contextual factors. It is possible, for example, that adolescents considered smaller than FSA-level geographic areas when thinking about their neighbourhoods, and that expected associations between SES and social processes could not be detected due to this misalignment. Future studies examining such relations should attempt to define 'neighbourhood' similarly across contextual measures, so that relations among them can be more easily disentangled.

A further limitation of the current dataset relates to its focus on chronological age of the adolescent participants, rather than considering developmental stage, which is of arguably greater importance during this period of development. Developmental stage, meaning the level of development reached in various domains, such as physical, psychological, and social, is observed to vary widely across adolescents of the same chronological age (Galambos, Barker, & Tilton-Weaver, 2003). For example, within a group of 15-year-olds, large variance would be expected to emerge in areas of physical development (e.g., stage of puberty reached), cognitive development (e.g., maturity of

executive control systems), and social-emotional development (e.g., extent to which teen is stepping into adult-like roles, such as being employed and/or financially independent of parents, initiating intimate relationships, etc.). A question was originally included in the present study that asked participants about their "subjective age" (i.e., "Compared to most boys/girls my age, most of the time I feel..." on a scale of 1(*a lot younger*) to 5(*a lot older*); Arbeau, Galambos, & Jansson, 2007; Galambos, Albrecht, & Jansson, 2009) in an effort to assess self-perceived developmental stage. In simple bivariate correlations, this variable did not relate to injury-related risk-taking or to individual characteristics such as sensation seeking, aggression/oppositionality, impulsivity, or even chronological age. However, it did relate to having experienced an alcohol-related injury ($r(154) = .18$, $p = .01$), which is in line with research findings that teens who view themselves as older than their chronologically same-aged peers are more likely to engage in activities such as drug and alcohol use (Galambos et al., 2009). Although the decision was made to exclude this variable from analyses given the previously discussed need to simplify statistical models, considering how adolescents view themselves in terms of their developmental level as compared to their peers may be a promising avenue for researchers interested in unintentional injury risk. A more thorough assessment of teens' developmental level in studies of unintentional injury risk could allow for better understanding of how individual variation in development interacts with contextual risk factors (e.g., peer presence) and engagement in risk-taking behaviour (e.g., alcohol use) that could relate directly to injury risk.

Certain measures included in the study have not been validated in previous research (e.g., Neighbourhood Social Cohesion/Informal Social Control of Youth; Risk

Taking Behaviour Scales). Although items used in the Neighbourhood Social Cohesion scale were taken from previously validated measures, and appeared to be understood by the small number of youth interviewed, more thorough methods should be used to strengthen confidence in its validity. Similarly, although Risk Taking behaviour items exhibit face validity in terms of measuring injury-related risk taking, further work should be done with respect to justification of the items chosen to represent the construct and corroboration of their link to injury risk.

A final limitation of the present study relates to the generalizability of findings to non-maritime Canadian youth. Given that the majority of participants were from Newfoundland, a Province which is largely rural (i.e., largest City has a population of under 200,000; Economics and Statistics Branch, 2010), it may be that interaction effects observed in the current sample may not be detected within populations of urban youth or rural youth living in other areas of Canada or the world. Indeed, contextual variables such as urban or rural setting may be of particular interest when examining injury risk, given that some differences have been found between such settings in terms of rates of certain types of injury (e.g., hospitalization due to bicycling-related injury, Macpherson et al., 2004). In addition, rural versus urban context might be of particular importance when studying person-environment interactions, given that social processes within neighbourhoods might be expected to vary across such milieus. Some evidence from heritability of antisocial behaviour suggests, for example, that rural environments either reduce genetic influences on adolescent antisocial behaviour (effect for adolescent males, Legrand et al., 2007), including alcohol use (Rose, Dick, Viken, & Kaprio, 2001),

or increase the heritability of certain antisocial behaviour (Christiansen, 1973). Although it is unclear how rural versus urban contexts might influence the kinds of person-environment interactions that might predict injury-related risk-taking in adolescence, it is likely an important factor to consider in future research in an effort to generate more generalizable results.

Along similar lines, the fact that participants were primarily living in rural areas may have implications for interpreting the effects of and/or interplay between neighbourhood social and socioeconomic characteristics. Given that the majority of research relating to neighbourhood effects on youth behaviour thus far has been conducted within cities (De Marco & De Marco, 2010; Vazsonyi, Trejos-Castillo, & Young, 2008), the ways in which social processes and socioeconomic characteristics of rural areas relate in predicting outcomes are even less well understood. The small number of studies examining contextual effects on youth behaviour either across urban and rural settings (e.g., Vazsonyi et al., 2008) or within rural settings only (e.g., Karriker-Jaffe, Foshee, Ennett, & Suchindran, 2009) yield inconsistent results, with some findings suggesting unexpected relations between social process and socioeconomic variables within rural areas (e.g., no interactions between SES disadvantage and social organization; Karriker-Jaffe et al., 2009), and some findings suggesting similar processes underlying outcomes for youth in both urban and rural areas (e.g., adolescent delinquency predicted by similar social process variables in both rural and urban areas; Vazsonyi et al., 2008). More inclusion of rural youth in research examining 'neighbourhood' effects is called for, in order to further disentangle the relations between socioeconomic

characteristics and social processes in non-urban settings and to clarify how adolescent outcomes may be affected by such contextual variables within these understudied areas.

Conclusion

There has been increasing recognition of the need to study interactions among risk factors to better capture the complexity of injury risk processes (Morrongiello, 2005; Morrongiello & Schwebel, 2008; Schwebel & Barton, 2005). The findings of the present study address this need and highlight that not only is adolescent injury risk influenced by factors that operate at different levels, but these factors interact in complex ways. Indeed, different patterns emerge when predictor variables are considered as main effects versus in interaction with one another. Different types of contexts allow for better or worse prediction of risk based on individual characteristics, however, as yet there is no one theory that appears to account for the different ways contextual and individual predictors interact across risk outcomes. As such, it is incumbent upon researchers to continue to develop and test more complex models that allow for better prediction of injury risk and, in turn, improved potential for limiting this risk.

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Footnotes

[1]A full 209 respondents completed the majority of the questionnaire in the current study, however only 170 of 209 respondents reported their postal code. As postal code (or, more specifically, FSA SES) was an important variable in the majority of analyses, this sample of 170 adolescents is the one examined.

Respondents who had not reported on their postal codes were compared to those who had to see if differences existed between the groups on any of the predictor or outcome variables of interest. Logistic regression analyses suggest that older adolescents were significantly more likely to not report their postal code (B = .783, SE = .24, p = .001, Exp(B) = 2.19). Reported analyses are therefore based on a part of the overall sample of respondents that is younger.

[2]The full questionnaire presented to adolescents included items that were not used in the present analyses. Items that were not used in the final analyses include those relating to a SMARTRISK program evaluation project (e.g., questions regarding attitudes and beliefs about risk-taking), as well as 3 questions related to past alcohol/drug-related injuries, a question related to "subjective age" and a questionnaire scale related to inhibition/disinhibition.

Two questions relating to others' drug/alcohol related injuries were dropped, as it was of more interest to predict injuries experienced by adolescents themselves. The third question related to own history of drug-related injuries was also dropped, as few adolescents (5 %) reported having experienced such an injury.

A question related to "subjective age" was initially included in acknowledgement of the wide range of psychosocial developmental levels that exist within a population of adolescents. Also, a questionnaire scale assessing a second facet of impulsivity or inhibition/disinhibition called "Negative Urgency" was initially included. Due to a need to simplify statistical models being examined (see limitations section for further detail) it was decided that "subjective age" and "Negative Urgency" would not be included as predictors. See limitations section for a discussion of why "subjective age" was excluded and how such a concept might be included in future research. With respect to Negative Urgency, a decision was made to exclude one of the two original inhibition/disinhibition-related constructs and "Lack of Premeditation" seemed theoretically closer to the concept of "impulsivity" in the sense of exhibiting a general failure to approach situations with caution. "Negative Urgency," however, specifically relates to how one approaches situations when experiencing negative affect (e.g., behaving in disinhibited ways when upset/anxious, etc.).

[3]This categorization of occupations as belonging to "Professional, Scientific, and Technical Services" is based on the most recent North American Industry Classification System (NAICS 2002), which is used by government agencies in Canada, the United States, and Mexico and largely replaces an earlier classification system [Standard Industrial Classifications (SIC)] in Canada (Statistics Canada, 2002).

[4]Principal Components Analysis (PCA) was also conducted with FSAs within each of these three provinces (i.e., Newfoundland, New Brunswick, Prince Edward Island) to compare solutions for each of the provinces with the overall solution for all

three provinces combined. Component loadings for each of the five SES indicators identified in the overall solution were high for each province [|.21| to |.25| for FSAs in Newfoundland (N = 35); |.19| to |.24| for FSAs in PEI (N = 7); and |.22| to |.29| for FSAs in New Brunswick (N = 109)] and comparable to loadings in the PCA involving all three provinces' FSAs (|.22| to |.28|, N = 151).

Similarly, PCA run with only those 18 FSAs included in the current dataset revealed a solution comparable to that obtained using all FSAs in the region. The five SES indicators identified as loading on the first component were the same as in the overall solution. Final component loadings for each of the 5 indicators were high and also comparable to the overall solution (|.21| to |.28|, N = 18).

[5]Logarithmic transformations were used to correct for the significantly positively skewed nature of the injury count variables (Howell, 2002) for all analyses. Few differences were seen between correlations using transformed and non-transformed injury count variables (see Appendix C). Only one correlation no longer reached statistical significance when using untransformed data (impulsivity – minor injuries) and one correlation became statistically significant (hospitalization – minor injuries).

[6]Given the large number of regression analyses conducted, correction for Type I error was considered, due to higher potential for finding false positive results. However, given that detecting interactions in field research is notoriously difficult (McClelland & Judd, 1993) and that the current study is of a more exploratory nature, testing a general hypothesis (i.e,. does context moderate individual characteristic-injury risk link?), the decision was made to minimize risk of Type II error (i.e., failing to detect true effects)

rather than inadvertently overcorrect for Type I error. There is a possibility, therefore, that results include false positives (i.e., detecting interactions where none exist). The fact that most analyses uncovered effects in the expected direction, with the exception that females experienced higher injury risk in certain situations, supports confidence in the "true" nature of significant results herein.

[7]The data were, in fact, examined for evidence of nesting within FSAs. It was not possible to build multi-level models, which correct for nested data, using the current dataset, given an insufficient sample size (e.g., N at level 2 (i.e., FSAs) < 50; Maas & Hox, 2005). However, specifying multi-level models without predictors (i.e., including only clustering variable and continuous criterion variable of interest) allows for calculating indicators such as (1) the design effect (Bickel, 2007) and (2) the deviance difference, which provide evidence for nested data.

(1) The equation for calculating the design effect is as follows (from Bickel, 2007):

design effect = 1 + [(n-1) * intraclass correlation]

where n = average # of observations per group and
intraclass correlation = the proportion of between group variance to between group and within group variance added together

It is suggested by certain authors that that a design effect of 2.0 is small (Muthén & Satorra, 1995 as cited in Maas & Hox, 2005), so that if it exceeds 2.0, then nesting is likely occurring within a dataset and it is advisable to correct for this in order to obtain unbiased standard error estimates. By this criterion, the design effect was sufficiently

large when examining the model with Risk Taking during Leisure (design effect = 2.06), however it was <2.0 for the model including Risk Taking at Home. An attempt was also made to calculate a design effect for each of the non-normally distributed count variables: number of Injury-related Medical appointments within the past 12 months and number of Minor Injuries within the past 3 months. The design effect was <2.0 for Injury-related Medical appointments. No design effect could be calculated for Minor Injuries, as the initial multi-level model could not be accurately calculated.

(2) The deviance difference was calculated next, by comparing multi-level models with and without a random intercept included. If the deviance (i.e., "-2 Restricted log likelihood" on SPSS output) for the model with the intercept included is significantly lower than the deviance in the model without the intercept included, then there is evidence for individual data nested within groups. The deviance difference was significant for each of 3 models (Risk Taking at Home, Risk Taking during Leisure, Injury-related Medical appointments; for each $\chi^2 > 90$, $p < .05$).

Using the design effect criterion, nested data appear only to be a problem when examining models predicting Risk Taking during Leisure. However, deviance difference calculations suggest that nesting may also be of concern in models predicting Risk Taking at Home and Injury-related Medical appointments.

Because grouping of individuals within different areas was of theoretical interest in the present study and some empirical evidence exists for nesting within the data collected, it was decided that all analyses would be conducted using corrections that allow for more accurate standard error estimation. Correcting for nested data tends to be

a more conservative approach, as regression analyses which do not take clustering into account (e.g., typical Ordinary Least Squares estimates) tend to produce deflated standard errors, and are, in turn, more likely to reject the null hypothesis when it should not be rejected (Bickel, 2007).

[8]The correction procedure used was applied through the "Complex Samples" modules within the software package PASW Statistics version 17.0. As a cautionary note, SPSS presents this procedure not as a way to correct for nested data, per se, but rather to account for complex sampling designs (e.g., clustered sampling, in which a certain number of groups or "clusters" are randomly selected out of a total population of clusters, then individual data points are collected within these selected clusters; SPSS, n.d.). However, given that a generally recommended way to correct for potential non-independence of observations (for example, due to nested data) is to use Huber-White robust standard error estimates and that SPSS Complex Samples makes use of this type of estimate (Höfler, Pfister, Lieb, & Wittchen, 2005), analyses were conducted using this procedure.

[9]All individual and contextual-level variables were centered (i.e., mean of variable is subtracted from itself) in anticipation of building models including interaction terms. Centering helps to avoid concerns that could arise due to high correlations between an interaction term and the main effect independent variables that were used to create the interaction (Bickel, 2007).

[10]Given that specifying models assuming Poisson distribution is recommended as an appropriate way of dealing with positively skewed count data and has been used by

injury risk researchers (e.g., Faelker, Pickett, & Brison, 2000; O'Campo et al., 2006; Shenassa, Stubbendick, & Brown, 2004), analyses using this method were also conducted in predicting the two injury count outcomes (i.e., Number of injury-related medical appointments within the past 12 months and Number of minor injuries treated at home within the past 3 months). Few differences in significance test results were seen between analyses using Complex Samples general linear models predicting log transformed variables and generalized linear models assuming a Poisson distribution and applying robust standard error estimates in estimating models with count variables not log transformed (see Appendix C for tables showing estimates assuming Poisson distribution and robust standard error estimates). When using log transformed variables, parameter estimates were slightly more likely to reach statistical significance, with gender and impulsivity predicting number of Minor Injuries in main effects models (female gender and being more highly impulsive as risk factors) and two further interactions being identified, beyond that of Impulsivity x SES predicting Injury-related Medical Appointments (Sensation Seeking x Neighbourhood Social Cohesion predicting Injury-related Medical Appointments, with Sensation Seeking being a significant predictor at mid and high levels of Neighbourhood Social Cohesion and Gender x SES predicting Minor Injuries, with girls being more likely to have more minor injuries only at mid and high area-level SES).

Given that interaction effects are known to be difficult to detect within field research due to lower power as compared to experimental study designs, it was decided that the seemingly less conservative statistical approach (i.e., predicting log transformed injury outcomes, making correction for nested data using Complex Samples).

Tables and Figures

Table 1

Percentage of sample by gender and age

		% sample	N
Gender			
	Male	47.6	81
	Female	51.2	87
	missing	1.2	2
Age			
	14	5.3	9
	15	50	85
	16	33.5	57
	17	9.4	16
	18	.6	1
	missing	1.2	2

Table 2

Means and standard deviations for independent and dependent continuous variables

		Mean	SD	Min	Max
Independent variables					
	Sensation Seeking	3.70	.67	1.88	5
	Aggression/ Oppositionality	1.89	1.90	0	7
	Impulsivity	2.45	.50	1.20	4
	Neighbourhood	3.51	.62	1.67	5
Dependent variables					
	Risk Taking at Home	2.30	.82	1	4.38
	Risk Taking during Leisure	2.39	.99	1	5
	Injury-related Medical Appointments	2.73	5.81	0	50
	Minor injuries	4.36	10.77	0	100

Note. **Sensation Seeking** coded on a scale of 1 to 5 with higher values representing higher levels of sensation seeking; **Aggression/Oppositionality** coded on a scale of 0 to 7 with higher values representing more aggressive/oppositional behaviour; **Impulsivity** coded on a scale of 1 to 4 with higher values representing greater impulsivity; **Neighbourhood** coded on a scale of 1 to 5 with higher values representing higher levels of neighbourhood social cohesion/informal social control of youth; **Risk Taking at Home** coded on a scale of 1 to 5 with higher values representing higher levels of risk taking at home/in the neighbourhood; **Risk Taking during Leisure** coded on a scale of 1 to 5 with higher values representing higher levels of risk taking during leisure activities; **Injury-related Medical Appointments** is a count variable with participants reporting on the number of such appointments had in the past 12 months; **Minor Injuries** is a count variable with participants reporting on the number of such injuries occurring in the past 3 months.

Table 3

Percentage of sample by categorical injury history variable [a]

		% sample
Injury-related medical appointments		
	0	35.9
	1-4	44.2
	5+	14.3
	missing	5.9
Minor injuries		
	0	25.9
	1-4	44.8
	5+	20.3
	missing	8.8
Ever been hospitalized		
	Yes	45.0
	No	55.0
	missing	0
Ever been injured, alcohol involved		
	Yes	23.0
	No	76.1
	missing	1.0

[a]Injury-related Medical appointments and Minor Injuries are treated as count variables rather than categorical variables in analyses.

Table 4

Bivariate correlations between independent and dependent variables

		Injury Risk Outcome Variables					
		RT - Home	RT - Leisure	Injury Med appts	Minor injuries	Ever hospitalized[b]	Alc-related injury[b]
Predictor Variables	Age	.14	.07	-.07	-.10	.03	.27**
	Gender [a]	-.29**	-.25**	-.04	.15	-.19**	.05
	SS	.34**	.15*	.13	.16	.05	.33**
	Agg/Opp	.56**	.25**	.15	.03	.21**	.31**
	Impulsivity	.43**	.16*	.11	.22**	.09	.23**
	NH	-.01	.12	-.002	-.04	-.10	-.11
	SES	.06	-.05	.03	.12	.14	.14

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth; SES = FSA-level Socioeconomic status aggregate; RT – Home = Risk Taking at home/in the neighbourhood; RT – Leisure = Risk Taking during leisure activities; Injury Med appts = number of injury-related medical appointments within past year (log transformed); Minor injury = number of minor injuries within past 3 months (log transformed); Ever Hospitalized = Ever been hospitalized due to injury?; Alc-related injury = Ever experienced alcohol-related injury?

[a]Male coded as 1, Female coded as 2. [b]No coded as 1, Yes coded as 2.

* p <.05 level. ** p <.01 level.

Table 5

Bivariate correlations among independent variables

		Predictor Variables					
		Age	Gender[a]	SS	Agg/Opp	Impulsivity	NH
Predictor Variables	Gender[a]	-.13					
	SS	.06	.01				
	Agg/Opp	.22**	-.30**	.23**			
	Impulsivity	-.02	-.20**	.38**	.46**		
	NH	-.20**	.01	.09	-.21**	-.13	
	SES	.39**	-.01	.02	.13	.10	-.30**

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth; SES = FSA-level Socioeconomic status aggregate.

[a]Male coded as 1, Female coded as 2.

* p <.05 level. ** p <.01 level.

Table 6

Bivariate correlations among dependent variables

		Injury Risk Outcome Variables				
		RT - Home	RT - Leisure	Injury Med appts	Minor injuries	Ever hospitalized[a]
	RT - Leisure	.47**				
	Injury Med appt[a]	.12	.13			
Injury Risk Outcome Variables	Minor injury[a]	-.03	-.04	.25**		
	Ever hospitalized[a]	.13	.17*	.21**	.15	
	Alc-related injury[a]	.31**	.19**	.02	.12	.04

Note. RT – Home = Risk Taking at home/in the neighbourhood; RT – Leisure = Risk Taking during leisure activities; Injury Med appts = number of injury-related medical appointments within past year (log transformed); Minor injury = number of minor injuries within past 3 months (log transformed); Ever Hospitalized = Ever been hospitalized due to injury?; Alc-related injury = Ever experienced alcohol-related injury?

[a]No coded as 1, Yes coded as 2

* p <.05 level. ** p <.01 level.

Table 7

Main effects linear regression models predicting Risk Taking at home/in the neighbourhood and Risk Taking during leisure activities

Model		R^2	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	t	*p*
RT Home	Model Summary	.39	7	11	63.69	<.001				
	Constant						2.34	.04		
	Age		1	17	.15		.04	.11	.39	.70
	Gender		1	17	.84		-.12	.13	-.91	.37
	SS		1	17	6.74		.21	.08	2.60	.019
	Agg/Opp		1	17	54.84		.18	.02	7.41	<.001
	Impulsivity		1	17	12.25		.33	.09	3.50	.003
	NH		1	17	2.45		.14	.09	1.57	.14
	SES		1	17	.08		-.02	.07	-.28	.78

Model		R^2	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	t	*p*
RT Leisure	Model Summary	.14	7	11	2.80	.06				
	Constant						2.42	.10		
	Age		1	17	.68		.14	.17	.82	.42
	Gender		1	17	15.48		-.39	.10	-3.93	.001
	SS		1	17	6.28		.18	.07	2.51	.023
	Agg/Opp		1	17	1.62		.07	.06	1.27	.22
	Impulsivity		1	17	<.001		.00	.17	.02	.98
	NH		1	17	1.08		.20	.19	1.04	.31
	SES		1	17	.23		-.09	.18	-.48	.64

Table 8

Main effects linear regression models predicting Number of injury-related Medical appointments and Number of Minor injuries using Log Transformed dependent variables.

Model		R^2	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	t	*p*
	Model Summary	.04	7	11	1.50	.26				
Injury-related Medical Appts past year	Constant						-2.40	.35		
	Age		1	17			-.62	.52	-1.19	.25
	Gender		1	17			-.48	.55	-.87	.40
	SS		1	17			.42	.37	1.13	.28
	Agg/Opp		1	17			.27	.16	1.68	.11
	Impulsivity		1	17			-.08	.68	-.12	.90
	NH		1	17			.07	.35	.21	.84
	SES		1	17			.19	.43	.44	.67

Model		R^2	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	t	*p*
Minor injuries past 3 months	Model Summary	.11	7	11	4.66	.01				
	Constant						-1.84	.27		
	Age		1	17			-.19	.38	-.49	.63
	Gender		1	17			1.58	.48	3.33	.004
	SS		1	17			.28	.37	.77	.45
	Agg/Opp		1	17			-.04	.20	-.21	.84
	Impulsivity		1	17			1.84	.60	3.08	.007
	NH		1	17			-.10	.49	-.19	.85
	SES		1	17			-.08	.45	-.17	.87

Table 9

Main effects logistic regression models predicting Hospitalization due to injury and Alcohol-related injury

Model		Cox & Snell	df 1	df 2	Wald F	*p*	Complex Samples Estimate (B)	SE	t	*p*	Exp (B)
	Model Summary	.09	7	11	7.04	.002					
	Constant						.26	.16			
	Age		1	17			-.11	.22	-.48	.64	.90
Ever hospital-ized due to injury?	Gender		1	17			.66	.36	1.84	.08	1.93
	SS		1	17			-.48	.32	-1.53	.14	.62
	Agg/Opp		1	17			-.09	.11	-.78	.45	.92
	Impulsivity		1	17			.41	.30	1.34	.20	1.50
	NH		1	17			.36	.27	1.35	.20	1.44
	SES		1	17			-.33	.23	-1.44	.17	.72

Model		Cox & Snell	df 1	df 2	Wald F	*p*	Complex Samples Estimate (B)	SE	t	*p*	Exp (B)
Ever had alcohol related injury?	Model Summary	.21	7	11	13.25	<.01					
	Constant						1.51	.32			
	Age		1	17			-.81	.34	-2.42	.03	.44
	Gender		1	17			-1.29	.47	-2.73	.01	.27
	SS		1	17			-.94	.37	-2.58	.02	.39
	Agg/Opp		1	17			-.25	.18	-1.35	.20	.78
	Impulsivity		1	17			-.76	.84	-.90	.38	.47
	NH		1	17			-.05	.28	-.17	.87	.95
	SES		1	17			-.20	.37	-.54	.60	.82

Table 10

Individual characteristics x Neighbourhood social cohesion predicting Risk Taking at home/in the neighbourhood and Risk Taking during leisure activities

DV	Interaction term [a]	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE
RT Home	Age x NH[b]	1	17	6.00	.03	-.20	.08
	Gender x NH	1	17	.30	.59	-.07	.12
	SS x NH	1	17	.11	.74	-.04	.11
	Agg/Opp x NH	1	17	.002	.97	-.002	.04
	Impulsivity x NH	1	17	.26	.62	-.08	.16
RT Leisure	Age x NH	1	17	3.05	.10	.12	.16
	Gender x NH[b]	1	17	5.70	.03	-.41	.17
	SS x NH [b]	1	17	7.83	.01	-.21	.08
	Agg/Opp x NH	1	17	.001	.97	.002	.05
	Impulsivity x NH	1	17	1.41	.25	-.20	.17

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.
[b]Significant interaction effect that was investigated further through simple slopes analyses.

Table 11

Individual characteristics x Neighbourhood social cohesion predicting recent Injury-related medical appointments and Minor injuries (Log transformed dependent variables)

DV	Interaction term[a]	df 1	df 2	Complex Samples Estimate (B)	SE	Wald F (Corrected Model)	*p*
Injury-related Medical Appts past year	Age x NH	1	17	-.82	.49	2.83	.11
	Gender x NH	1	17	.51	.93	.30	.59
	SS x NH [b]	1	17	.88	.40	4.87	.04
	Agg/Opp x NH	1	17	-.12	.17	.52	.48
	Impulsivity x NH	1	17	.30	.99	.09	.77
Minor injuries past 3 months	Age x NH	1	17	-.07	.52	.02	.90
	Gender x NH	1	17	-1.12	.94	1.43	.25
	SS x NH	1	17	-.08	.31	.06	.81
	Agg/Opp x NH	1	17	-.17	.28	.37	.55
	Impulsivity x NH	1	17	.17	.67	.06	.80

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.
[b]Significant interaction effect that was investigated further through simple slopes analyses.

Table 12

Individual characteristics x Neighbourhood social cohesion predicting Hospitalization due to injury and Alcohol-related injury

DV	Interaction term[a]	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	Exp (B)
Ever been hospital-ized due to injury?	Age x NH	1	17	1.23	.28	-.37	.33	.69
	Gender x NH[b]	1	17	7.61	.01	1.24	.45	3.45
	SS x NH	1	17	.61	.45	-.26	.33	.78
	Agg/Opp x NH	1	17	.15	.70	.05	.13	1.10
	Impulsivity x NH	1	17	.17	.69	-.23	.56	.79
Ever had alcohol-related injury?	Age x NH	1	17	.19	.67	-.09	.21	.91
	Gender x NH[b]	1	17	16.14	.001	1.35	.34	3.84
	SS x NH	1	17	.27	.61	-.20	.38	.82
	Agg/Opp x NH	1	17	.20	.66	.06	.14	1.07
	Impulsivity x NH	1	17	.14	.71	-.16	.44	.85

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.
[b]Significant interaction effect that was investigated further through simple slopes analyses.

Table 13

Simple slopes: Age x Neighbourhood social cohesion predicting Risk Taking at home/in the neighbourhood

DV	NH Level	Predictor	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE
RT Home	Low	Age	1	17	6.39	.02	.28	.11
	Mid	Age	1	17	1.67	.21	.15	.12
	High	Age	1	17	.02	.88	.02	.15

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean.

Table 14

Simple slopes: Gender x Neighbourhood social cohesion predicting Risk Taking during leisure activities

DV	NH Level	Predictor*	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE
RT Leisure	Low	Gender	1	17	.55	.47	-.17	.23
	Mid	Gender	1	17	6.82	.02	-.49	.19
	High	Gender	1	17	12.58	.002	-.80	.23

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean.

Table 15

Simple slopes: Sensation Seeking x Neighbourhood social cohesion predicting Risk Taking during leisure activities

DV	NH Level	Predictor	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE
RT Leisure	Low	SS	1	17	7.83	.01	.29	.10
	Mid	SS	1	17	5.43	.03	.24	.10
	High	SS	1	17	2.42	.14	.20	.13

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean; SS = Sensation Seeking.

Table 16

Simple slopes: Sensation Seeking x Neighbourhood social cohesion predicting Medically-attended Injuries (Log transformed dependent variables)

DV	NH Level	Predictor	df 1	df 2	Complex Samples Estimate (B)	SE	Wald F (Corrected Model)	*p*
Injury-related Medical Appts past year	Low	SS	1	17	.04	.43	.01	.92
	Mid	SS	1	17	.61	.32	3.53	.08
	High	SS	1	17	1.17	.37	10.29	.005

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean; SS = Sensation Seeking.

Table 17

Simple slopes: Gender x Neighbourhood social cohesion predicting Hospitalization due to injury

DV	NH Level	Predictor	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	Exp (B)
Ever been hospital-ized due to injury?	Low	Gender	1	17	.001	.98	.01	.40	1.01
	Mid	Gender	1	17	7.44	.01	.83	.31	2.30
	High	Gender	1	17	19.26	.00	1.65	.38	5.22

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean.

Table 18

Simple slopes: Gender x Neighbourhood social cohesion predicting Alcohol-related injury

DV	NH Level	Predictor	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	Exp (B)
Ever had alcohol-related injury?	Low	Gender	1	17	8.82	.009	-1.48	.50	.23
	Mid	Gender	1	17	.81	.38	-.40	.45	.67
	High	Gender	1	17	1.24	.28	.68	.61	1.97

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean.

Table 19

Individual characteristics x SES predicting Risk Taking at home/in the neighbourhood and Risk Taking during leisure activities

DV	Interaction term[a]	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE
RT Home	Age x SES	1	17	.42	.53	.05	.08
	Gender x SES	1	17	.10	.76	-.05	.15
	SS x SES	1	17	.62	.44	.07	.09
	Agg/Opp x SES	1	17	.48	.50	.02	.03
	Impulsivity x SES	1	17	.13	.72	.03	.09
RT Leisure	Age x SES	1	17	2.50	.13	.28	.18
	Gender x SES	1	17	.78	.39	-.17	.20
	SS x SES	1	17	.35	.56	-.09	.15
	Agg/Opp x SES	1	17	.02	.91	.01	.07
	Impulsivity x SES	1	17	2.31	.15	-.23	.15

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; SES = FSA-level Socioeconomic status aggregate

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.

Table 20

Individual characteristics x SES predicting recent Injury-related medical appointments and Minor injuries (Log transformed dependent variables)

DV	Interaction term[a]	df 1	df 2	Complex Samples Estimate (B)	SE	Wald F (Corrected Model)	*p*
Injury-related Medical Appts past year	Age x SES	1	17	.52	.58	.81	.38
	Gender x SES	1	17	.69	.57	1.44	.25
	SS x SES	1	17	-.19	.48	.16	.70
	Agg/Opp x SES	1	17	-.07	.17	.19	.67
	Impulsivity x SES[b]	1	17	-1.51	.61	6.09	.02
Minor injuries past 3 months	Age x SES	1	17	-.34	.46	.54	.47
	Gender x SES[b]	1	17	1.24	.50	6.28	.02
	SS x SES	1	17	.37	.34	1.16	.30
	Agg/Opp x SES	1	17	-.15	.26	.35	.56
	Impulsivity x SES	1	17	-.44	.46	.91	.35

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; SES = FSA-level Socioeconomic status aggregate

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.
[b]Significant interaction effect that was investigated further through simple slopes analyses.

Table 21

Individual characteristics x SES predicting Hospitalization due to injury and Alcohol-related injury

DV	Interaction term[a]	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	Exp (B)
Ever been hospital-ized due to injury?	Age x SES	1	17	.14	.72	-.10	.26	.91
	Gender x SES	1	17	2.89	.11	-.50	.29	.61
	SS x SES	1	17	2.05	.17	.44	.31	1.56
	Agg/Opp x SES	1	17	2.98	.10	-.18	.11	.83
	Impulsivity x SES	1	17	.78	.39	.35	.40	1.42
Ever had alcohol-related injury?	Age x SES	1	17	.98	.34	-.27	.28	.76
	Gender x SES	1	17	.01	.91	.04	.38	1.04
	SS x SES	1	17	.02	.88	-.05	.32	.95
	Agg/Opp x SES	1	17	.39	.54	.11	.17	1.11
	Impulsivity x SES[b]	1	17	9.78	.006	1.18	.38	3.24

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; SES = FSA-level Socioeconomic status aggregate

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.

[b]Significant interaction effect that was investigated further through simple slopes analyses.

Table 22

Simple slopes: Impulsivity x SES predicting Medically-attended Injuries (Log transformed)

DV	SES Level	Predictor	df 1	df 2	Complex Samples Estimate (B)	SE	Wald F (Corrected Model)	*p*
Injury-related Medical Appts past year	Low	Impulsivity	1	17	1.84	.73	6.35	.02
	Mid	Impulsivity	1	17	1.02	.51	4.04	.06
	High	Impulsivity	1	17	.20	.55	.13	.73

Note. SES = FSA-level Socioeconomic status aggregate; SES Low = 1 SD below mean; SES Mid = mean; SES High = 1 SD above mean.

Table 23

Simple slopes: Gender x SES predicting Minor Injuries (Log transformed)

DV	SES Level	Predictor	df 1	df 2	Complex Samples Estimate (B)	SE	Wald F (Corrected Model)	*p*
Minor injuries past 3 months	Low	Gender	1	17	.38	.53	.50	.49
	Mid	Gender	1	17	1.04	.45	5.38	.03
	High	Gender	1	17	1.70	.71	5.81	.03

Note. SES = FSA-level Socioeconomic status aggregate; SES Low = 1 SD below mean; SES Mid = mean; SES High = 1 SD above mean.

Table 24

Simple slopes: Impulsivity x SES predicting Alcohol-related injury

DV	SES Level	Predictor	df 1	df 2	Wald F (Corrected Model)	*p*	Complex Samples Estimate (B)	SE	Exp (B)
Ever had alcohol-related injury?	Low	Impulsivity	1	17	13.24	.002	-2.16	.59	.12
	Mid	Impulsivity	1	17	10.29	.005	-1.38	.43	.25
	High	Impulsivity	1	17	3.02	.10	1.06	.31	2.88

Note. NH = Neighbourhood social cohesion/informal control of youth; NH Low = 1 SD below mean; NH Mid = mean; NH High = 1 SD above mean.

Table 25

Neighbourhood social cohesion/informal control of youth and FSA-level SES predicting Risk Taking at Home and Risk Taking during Leisure activities.

Model		R^2	df 1	df 2	Wald F	*p*	Complex Samples Estimate (B)	SE
RT Home	Model Summary	.004						
	Constant		1	17			2.32	.08
	NH		1	17	.12	.73	.04	.11
	SES		1	17	.40	.54	.07	.11
RT Leisure	Model Summary	.01						
	Constant		1	17			2.38	.11
	NH		1	17	1.29	.27	.16	.14
	SES		1	17	.001	.97	.006	.15

Table 26

Neighbourhood social cohesion/informal control of youth and FSA-level SES predicting Numbers of Injury-related Medical Appointments and Minor Injuries..

Model		Goodness of Fit (Deviance)	B	SE	Wald Chi-Square	df	*p*
Injury-related Medical Appts past year	Model Summary	550.21					
	Constant		1.25	.12			
	NH		.03	.14	.04	1	.85
	SES		.18	.19	.82	1	.36
Minor injuries past 3 months	Model Summary	1233.18					
	Constant		1.68	.16			
	NH		.14	.29	.21	1	.65
	SES		.21	.17	1.53	1	.22

Table 27

Neighbourhood social cohesion/informal control of youth and FSA-level SES predicting Injury-related Hospitalization and Alcohol-related Injury.

Model		Cox & Snell	df 1	df 2	Wald F	p	Complex Samples Estimate (B)	SE	Exp (B)
Ever been hospitalized due to injury?	Model Summary	.03							
	Constant		1	17			.25	.14	1.29
	NH		1	17	1.85	.19	.33	.24	1.39
	SES		1	17	4.83	.04	-.32	.15	.73
Ever had alcohol-related injury?	Model Summary	.02							
	Constant		1	17			1.21	.26	3.36
	NH		1	17	.41	.53	.17	.27	1.19
	SES		1	17	1.68	.21	-.41	.32	.66

Figure 1. Illustration of context as moderator of the established link between individual traits and individual injury risk.

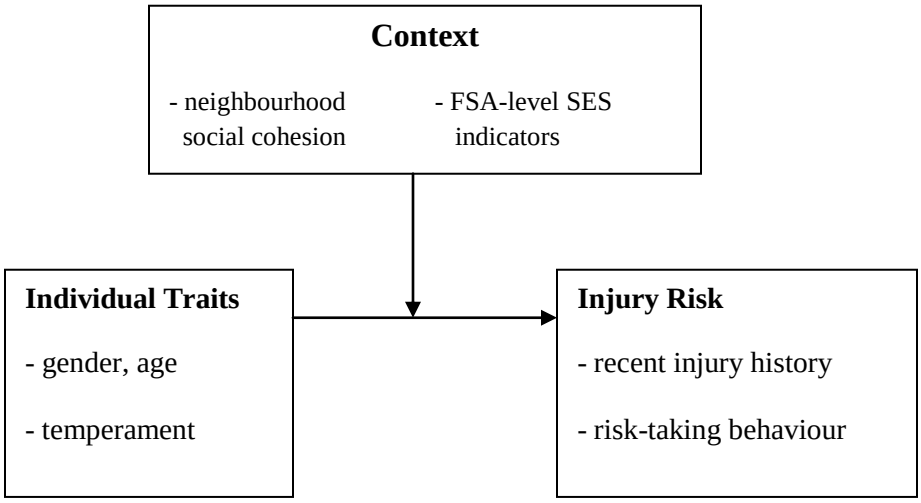


Figure 2. Age x Neighbourhood social cohesion predicting Risk Taking at home/in the neighbourhood.

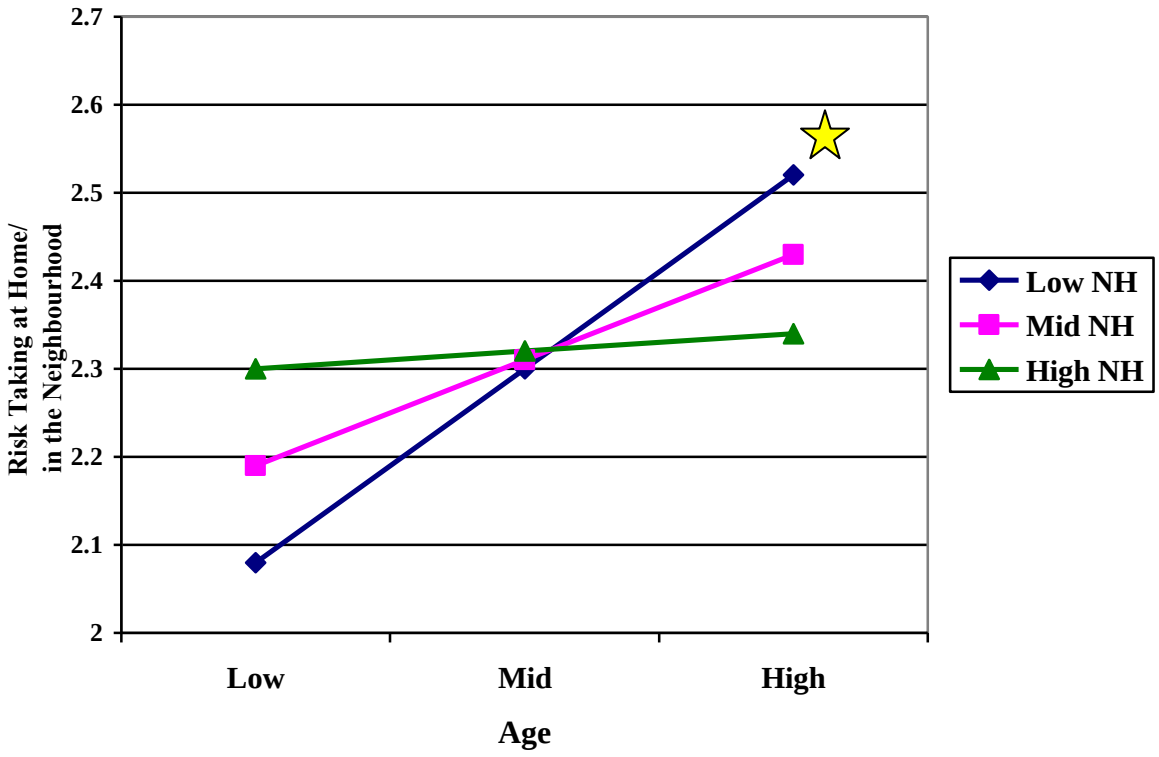


Figure 3. Gender x Neighbourhood social cohesion predicting Risk Taking during leisure activities.

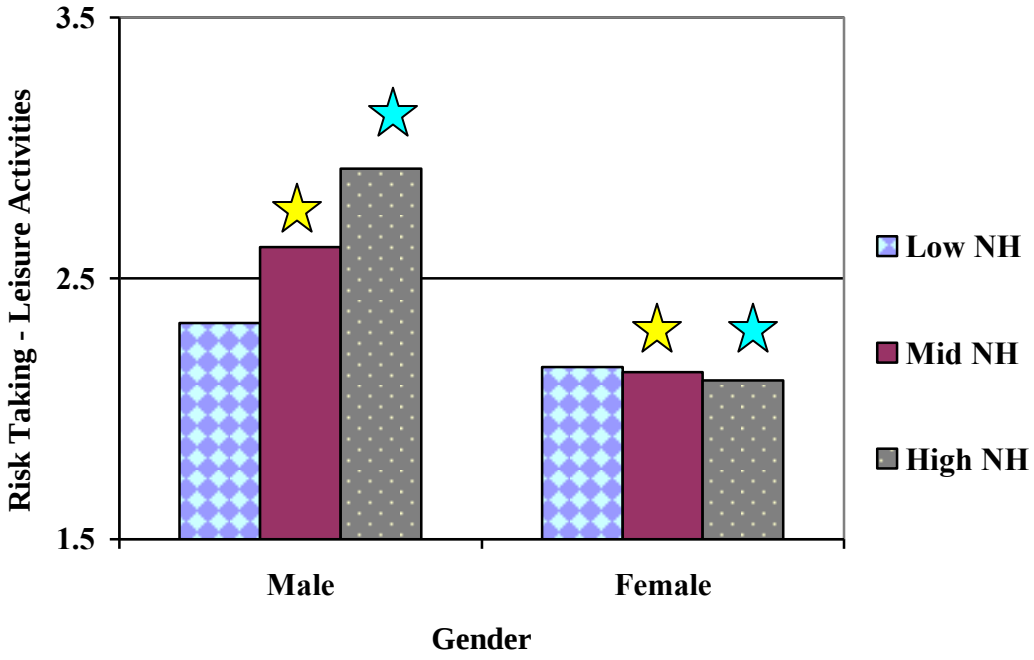


Figure 4. Sensation Seeking x Neighbourhood social cohesion predicting Risk Taking during leisure activities.

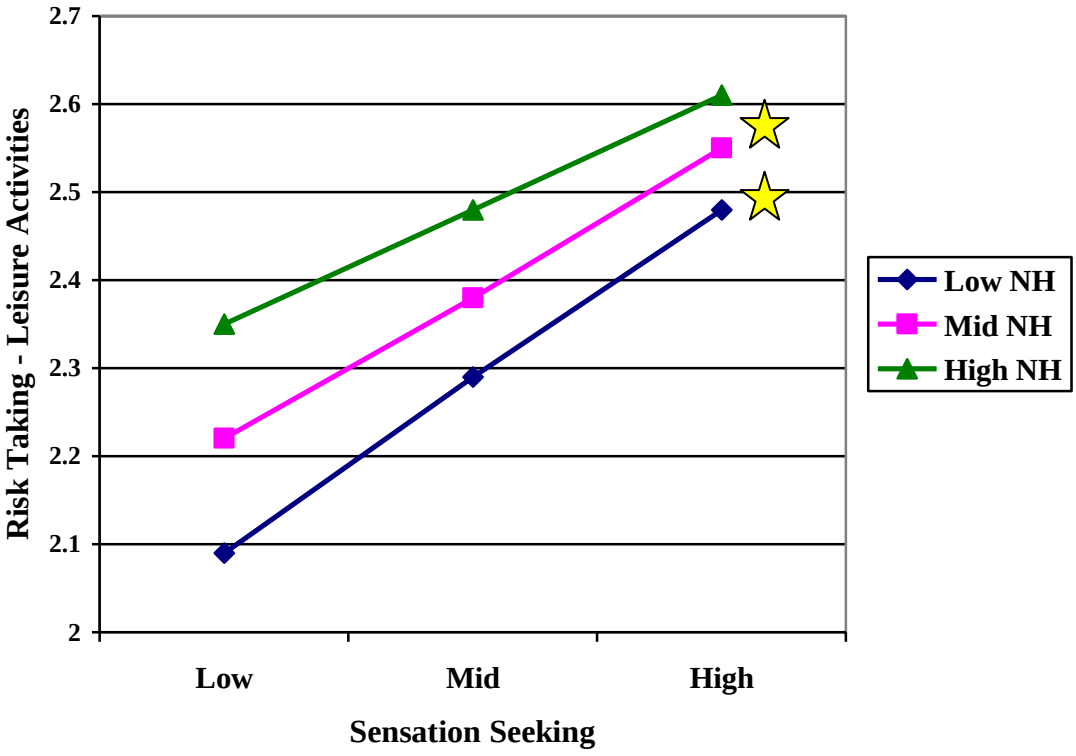


Figure 5. Sensation Seeking x Neighbourhood social cohesion predicting Injury-related Medical appointments.

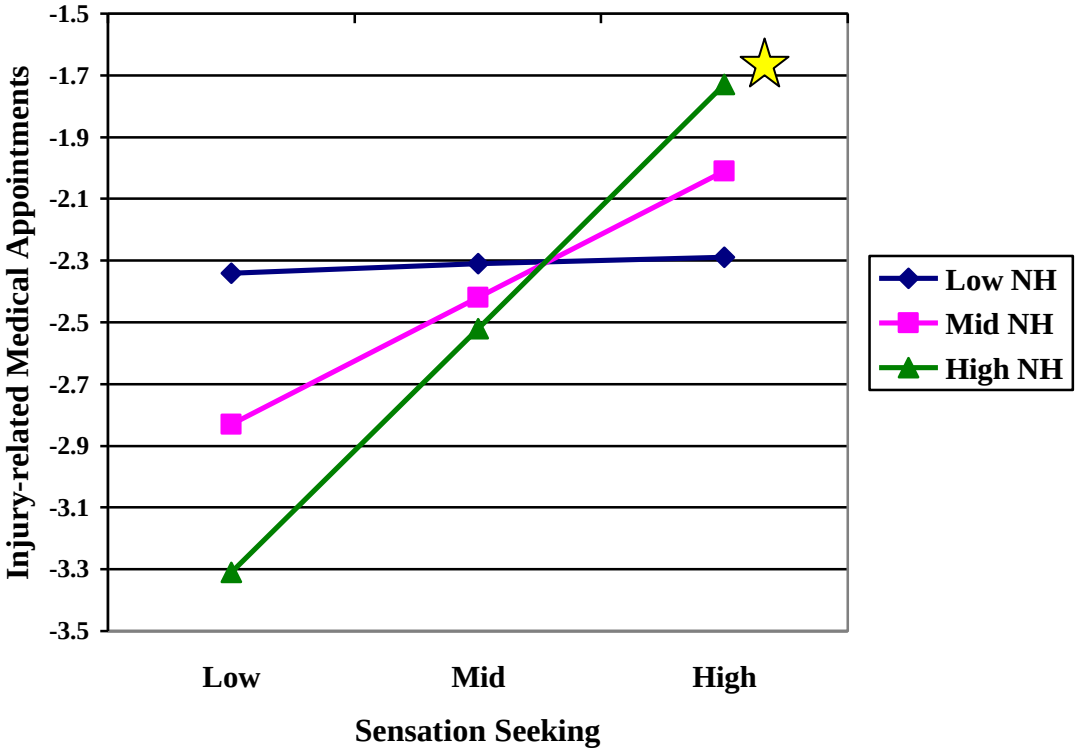


Figure 6. Gender x Neighbourhood social cohesion predicting Hospitalization due to injury.

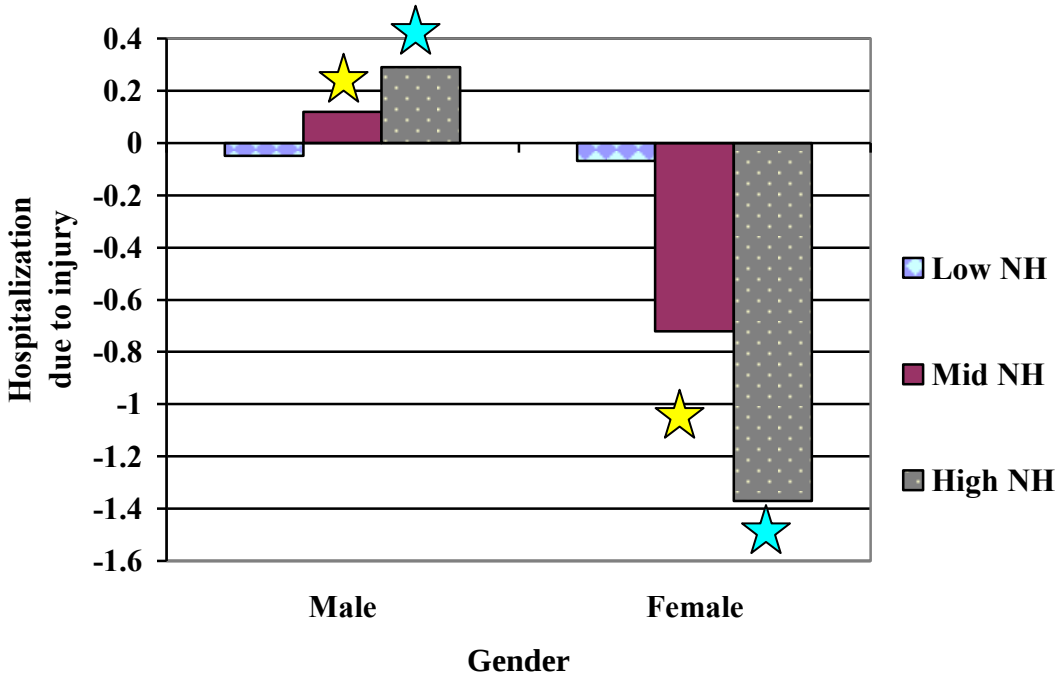


Figure 7. Gender x Neighbourhood social cohesion predicting Alcohol-related injury.

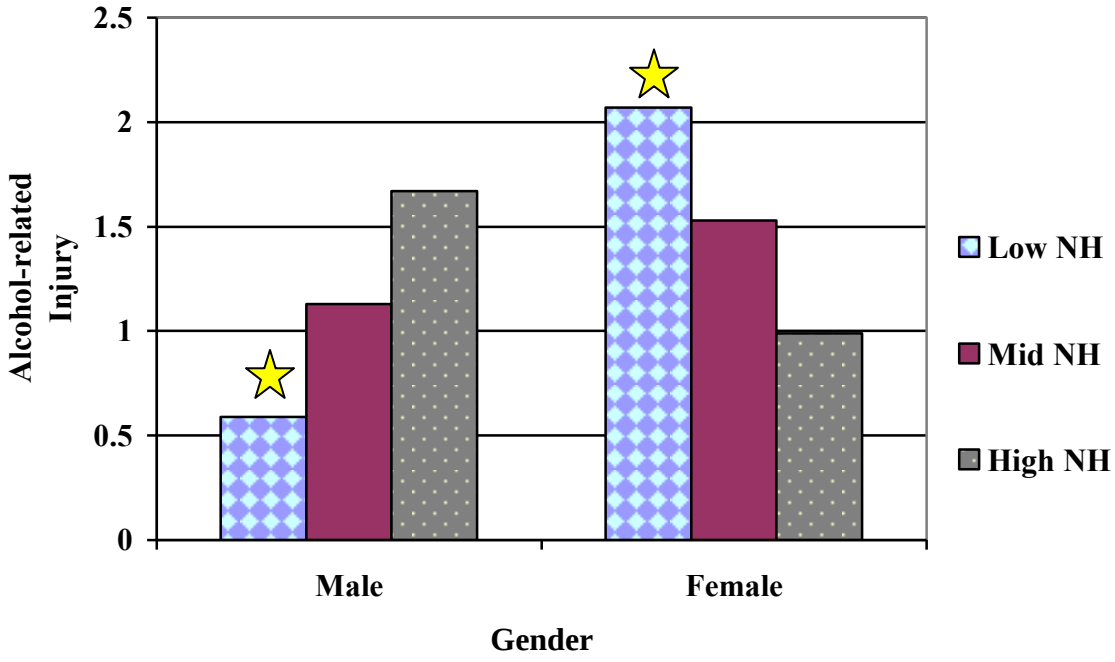


Figure 8. Impulsivity x SES predicting Injury related Medical Appointments.

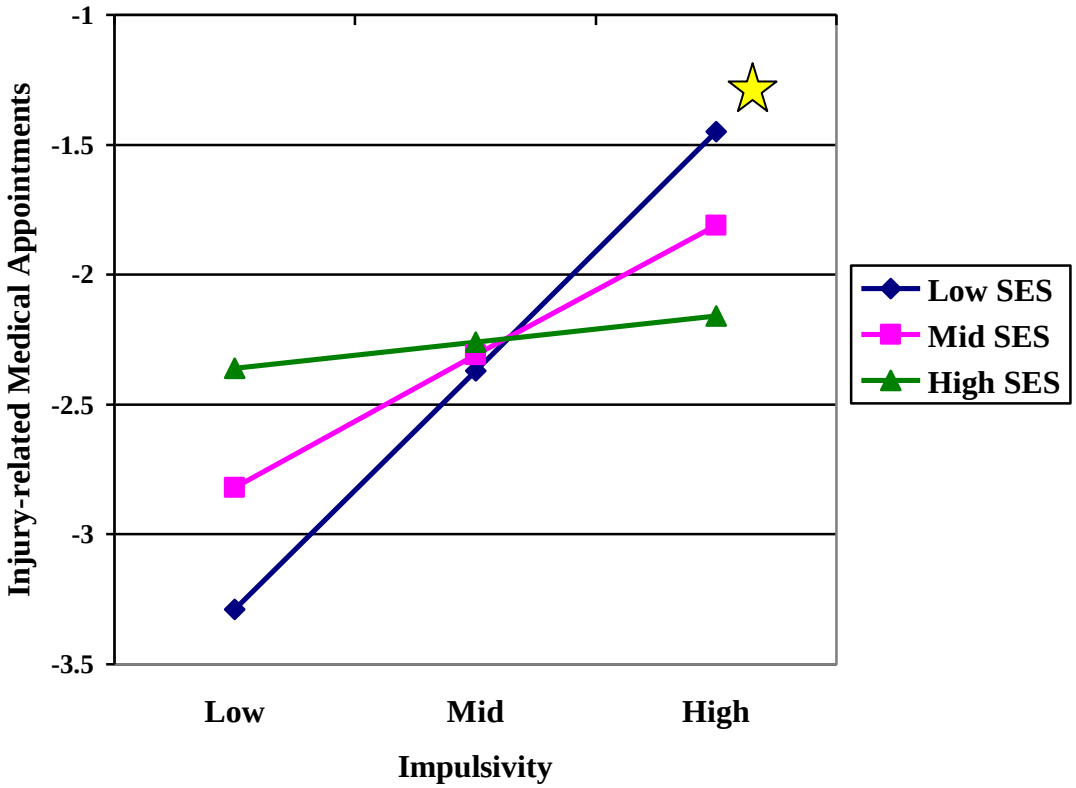


Figure 9. Gender x SES predicting Minor Injuries.

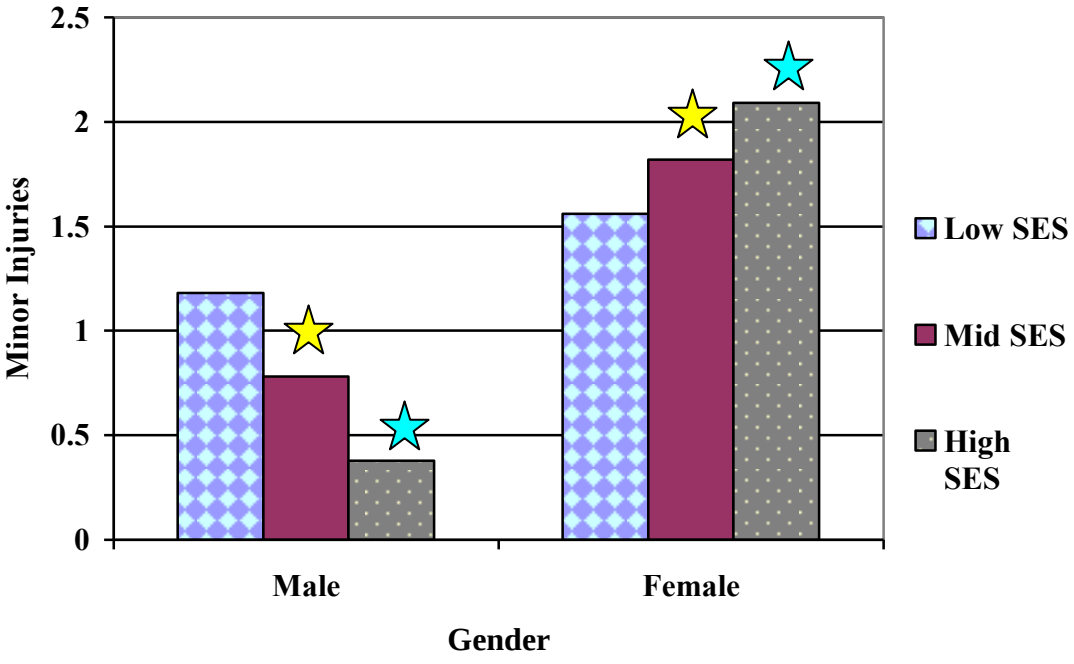
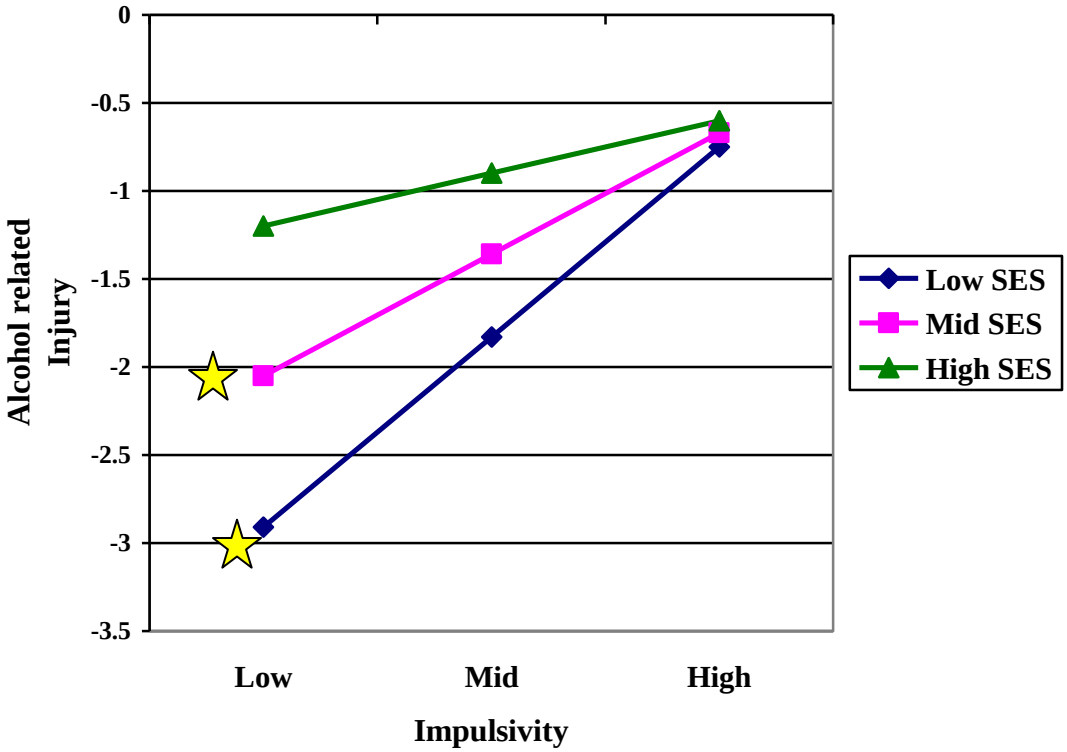


Figure 10. Impulsivity x SES predicting Alcohol-related injury.



Appendix A

Measures

Demographics and Neighbourhood SES

Please answer the following questions about yourself:

1 How old are you?

2 What grade are you in at school? _____

3 What is your gender? (please circle one) _____ male female

4 What is your postal code? (home address) _____

Injuries.

Please answer the following questions about physical injuries:

1a	In the past 12 months, how many times have you seen a doctor or dentist for an injury of ANY type?			
1b	In the past 3 months, how many times have you had an injury of ANY type that you treated at home (e.g., bandage, ice pack)?			
2	Have **you** ever been injured as a result of alcohol use (your own use of alcohol or someone else's)?	No	Yes, but not within the past 3 months	Yes, within the past 3 months
5	Have you ever been hospitalized due to injury?	Yes	No	

Injury-Related Risk-Taking

Please look at the following list of activities that teens sometimes do and indicate how often you do each one.

AT HOME/IN THE NEIGHBOURHOOD….

6	play-fighting with friends/family	never	rarely	some-times	often	very often
7	fooling around with tools (e.g., hammer, saw, power tools) for fun	never	rarely	some-times	often	very often
8	climbing on a roof (e.g., house, garage, apartment) for fun	never	rarely	some-times	often	very often
9	fooling around with others on a balcony (e.g., pushing, climbing)	never	rarely	some-times	often	very often
10	fooling around with a lawnmower or other appliances for fun	never	rarely	some-times	often	very often

11	fooling around with matches/lighters for fun	never	rarely	some-times	often	very often
12	lighting fires for the fun of it	never	rarely	some-times	often	very often
13	setting off explosives such as fireworks	never	rarely	some-times	often	very often

SPORTS AND LEISURE ACTIVITIES…

Please indicate how often you do the following sports and leisure activities:

49	participate in 'extreme' sports (e.g., BMX, skydiving, bungee jumping, scuba diving, surfing, rock/ice climbing, aggressive inline skating)	never	rarely	some-times	often	very often
50	race or do tricks on motorcycle (motocross, BMX, track racing)	never	rarely	some-times	often	very often
51	drive dirt bikes or ATVs (quads, four-wheelers and other outdoor vehicles)[i]	never	rarely	some-times	often	very often

52	drive or ride as passenger on snowmobile	never	rarely	some-times	often	very often
53	race or do tricks on snowmobile (e.g., “snowcross”)	never	rarely	some-times	often	very often
54	fool around on any motorized recreational vehicle (e.g., ATV, motorcycle, motorboat, snowmobile) in a way that a parent would say was ‘risky’ (i.e., “you could get hurt doing that”)	never	rarely	some-times	often	very often

Sensation Seeking

Please indicate how much you agree with the following statements by circling your response:

A 1	I would like to explore unusual or exotic places I haven’t been before.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
A 2	I get restless when I spend too much time at home.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
A 3	I like to do things that frighten me.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

A4	I'm the kind of person who would like wild parties.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
A5	I would like to take off on a trip with no pre-planned routes or timetables.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
A6	I prefer friends who are exciting and unpredictable.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
A7	I would like to try bungee jumping.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
A8	I would love to have new and exciting experiences, even if they are illegal.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

Impulsivity

Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement. Be sure to circle your agreement or disagreement for every statement below.

D 1	I have a reserved and cautious attitude toward life. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 6	My thinking is usually careful and purposeful. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 11	I am not one of those people who blurt out things without thinking. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 16	I like to stop and think things over before I do them. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 21	I don't like to start a project until I know exactly how to proceed. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 28	I tend to value and follow a rational, "sensible" approach to things. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly

D 33	I usually make up my mind through careful reasoning. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 38	I am a cautious person. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 43	Before I get into a new situation I like to find out what to expect from it. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 48	I usually think carefully before doing anything. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
D 49	Before making up my mind, I consider all the advantages and disadvantages. (Premeditation)	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly

Aggression/Oppositionality

Please read over the following items and indicate whether you have done any of them over the past year:

B 1	Verbally threatened to physically harm someone.	Yes	No

B2	Beaten up or fought someone because they made you angry.	Yes	No
B3	Stolen something.	Yes	No
B4	Damaged property just for fun (like breaking windows).	Yes	No
B5	Been disciplined at school for fighting, theft, or damaging property.	Yes	No
B6	Carried a gun, knife, club, or other weapon somewhere.	Yes	No
B7	Used a weapon, force, or threats to get money or things.	Yes	No

Neighbourhood social cohesion/Informal social control of youth

The following questions regarding neighbourhood in this part of the survey refer to the adults (age 21 and over) who currently live near you. If you live in the country, your neighbourhood includes the adults who live closest to you.

How much do you agree with the following statements:

H 1	People around here are willing to help their neighbours.[1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H 2	I have a close-knit neighbourhood. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H 3	People in my neighbourhood can be trusted. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H 4	People in my neighbourhood generally don't get along with each other. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H 5	People in my neighbourhood do not share the same values. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

H6	Parents in my neighbourhood know their children's friends. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H7	Adults in my neighbourhood know who the local children are. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H8	There are adults in my neighbourhood that children can look up to. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H9	Parents in my neighbourhood generally know each other. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H10	You can count on adults in my neighbourhood to watch out that children are safe and don't get in trouble. [1]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

H 11	If someone in my neighbourhood or community saw me doing something wrong, they would tell one of my parents (or adults who live with me).[2]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
H 12	Adults in my community care about people my age.[2]	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

[1]Items from Browning et al. (2008)

[2]Items from Meier et al. (2008)

Appendix B

Cognitive interviewing re: measure of *Neighbourhood Social Cohesion/Monitoring of Youth*

The following 12 questions from the current study's *Neighbourhood Social Cohesion/Monitoring of Youth* measure were discussed with 8 adolescent participants. Youth were asked open-ended questions such as "What goes through your mind as you read this question?", as well as follow-up probes such as "Could you tell if {neighbours share values…} if you were walking down the street in an area you weren't familiar with? If yes, how could you tell?" to help reveal specific examples of behaviours that relate to the items.
Examples of quotes from participants highlight the way these youth understood the questionnaire items.

Q1: People around here are willing to help their neighbours.

"doing little favours" "sharing stuff with each other" "watering the lawn, mowing each other's lawn, shovel each other's driveway" "neighbours give vegetables from their garden, and we do the same for them. One time I had a bee's nest, and they helped"

Q2: I have a close-knit neighbourhood.

"knowing each other & getting together with each other – having a barbecue" "become friends with neighbours" "we're all kind of like friends & know each other – we have neighbourhood barbecues" "everyone in the community is involved with each other" "we get along" "street parties, hanging out"

Q3: People in my neighbourhood can be trusted.

"trust neighbours to look after house while away – ask them to get mail & feed the cat" "if you're in trouble, go to them" "I can go to their house and not feel uncomfortable" "we know they're not bad people, because they treat us good" "neighbours protect against break-ins"

Q4: People in my neighbourhood generally don't get along with each other.

"not this way in my neighbourhood, but you would see everyone not saying "hi", having conversations" "I have difficulty imagining this… maybe not much activity on the street, not much helping" "social disconnect – not much social communication"

Q5: People in my neighbourhood do not share the same values.

"having different age groups, political views, different backgrounds geographically" "if you had a seniors' home beside student housing" "not interested in the same things… morally, how things are right and wrong" "we all value being able to trust & respect our neighbours" "religious views – neighbours

go to church, but we don't" "values like how to bring up kids, caring about school, education, family time" "we all like gardening and organic food"

Q6: Parents in my neighbourhood know their children's friends.

"not just random kids that come - parents know which kids should be hanging out with them" "here they generally do – take kids to each other's houses, call children by name" "other kids/parents on the street generally know where you live" "here there's not a lot of kids… I know most people and people know me & my brother"

Q7: Adults in my neighbourhood know who the local children are.

"everyone knows my boyfriend… they see his car and ask about him… neighbours know who's connected to who" "kids introduce kids to other parents, so could trust other adults and get help if needed"

Q8: There are adults in my neighbourhood that children can look up to.

"former athletes or musicians, kids may want to follow" "adults, without kids maybe, who are hiring kids, giving them more money than they deserve, maybe…giving advice that wouldn't be taken easily from parents" "role models – good people, don't have trouble with drugs or alcohol" "can see the different kinds of values people can have" "my neighbour gave me tennis lessons… if they're good at something that I'd want to get good at, I'd look up to them" "on this street there are policemen, firefighter, doctors… all professions you can look up to – all keeping us safe"

Q9: Parents in my neighbourhood generally know each other.

"parents go for tea at the neighbours'" "street parties…can talk if see someone who's gardening while you're going to your car" "I think they know each other – we babysit for families" "they come over for a barbecue… talk to each other every day"

Q10: I can count on adults in my neighbourhood to watch out that children are safe and don't get in trouble.

"if kids bike past without a helmet, children have enough respect for other adults…" "all the parents are good people and care about people here – if someone was in danger, they would help them, regardless of age" "neighbour across the street is older, always watching – they come and tell us if they see something kind of weird… see someone skulking around"

Q11: If someone in my neighbourhood or community saw me doing something wrong, they would tell one of my parents (or adults who live with me).

"there were kids out throwing snowballs at houses – adults on the street told them to leave" "adults are able to tell kid, but if they didn't listen, could tell parent, because they respect kid and don't want them getting hurt – neighbours are respectful of one another, including children"

Q12: Adults in my community care about people my age.

“adults don’t just say hi to adults – also say hi to children & teenagers” “have enough respect for teenager & say hi because know he’s a good person, instead of caring just about parents” “where more kids have positive role models in community… help out when youth need help… communicate with them” “adults care about all children in the neighbourhood, not specifically teens – care about them all equally” “they’re polite, so obvious they care” “I’m asked to babysit kids – shows trust in people my age”

Appendix C

Comparing log transformed and non-log transformed injury count variables in bivariate correlations

	Injury Med appts		Minor injuries	
	Not Transformed	Transformed	Not Transformed	Transformed
Age	-.10	-.07	-.06	-.10
Gender [a]	-.01	-.04	.07	.15
SS	.08	.13	.10	.16
Agg/Opp	.10	.15	.02	.03
Impulsivity	.07	.11	.11	.22**
NH	-.02	-.002	.02	-.04
SES	.05	.03	.07	.12
RT Home	.09	.12	.01	-.03
RT Leisure	.03	.13	-.03	-.04
Ever Hospitalized	.30**	.21**	.18*	.15
Alc-related injury	-.02	.02	.03	.12
Injury Med Appts	–	–	.22**	.25**

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth; SES = FSA-level Socioeconomic status aggregate; RT – Home = Risk Taking at home/in the neighbourhood; RT – Leisure = Risk Taking during leisure activities; Injury Med appts = number of injury-related medical appointments within past year (log transformed); Minor injury = number of minor injuries within past 3 months (log transformed); Ever Hospitalized = Ever been hospitalized due to injury?; Alc-related injury = Ever experienced alcohol-related injury?

[a]Male coded as 1, Female coded as 2. [b]No coded as 1, Yes coded as 2.

* p <.05 level. ** p <.01 level.

Main effects generalized linear regression models (assuming Poisson distribution; robust error estimates) predicting Number of injury-related Medical appointments and Number of Minor injuries

Model		Goodness of Fit Deviance (df)	B	SE	Wald Chi-Square	df	*p*
	Model Summary	495.79 (132)					
Injury-related Medical Appts past year	Constant		1.22	.10			
	Age		-.29	.18	2.57	1	.11
	Gender		-.02	.28	.01	1	.93
	SS		.27	.16	3.02	1	.08
	Agg/Opp		.10	.07	2.25	1	.13
	Impulsivity		-.21	.24	.80	1	.37
	NH		.01	.14	.002	1	.97
	SES		.28	.25	1.27	1	.26

Model		Goodness of Fit Deviance (df)	B	SE	Wald Chi-Square	df	*p*
	Model Summary	1036.61 (128)					
	Constant		1.55	.13			
	Age		-.20	.17	1.41	1	.24
Minor injuries past 3 months	Gender		.30	.33	.80	1	.37
	SS		.27	.26	1.08	1	.30
	Agg/Opp		-.08	.09	.68	1	.41
	Impulsivity		.15	.17	.78	1	.38
	NH		.14	.26	.29	1	.59
	SES		.12	.17	.53	1	.47

Individual characteristics x Neighbourhood social cohesion predicting recent Injury-related medical appointments and Minor injuries (Generalized linear regression models assuming Poisson distribution; robust error estimates).

DV	Interaction term[a]	B	SE	Wald Chi-Square	df	*p*
Injury-related Medical Appts past year	Age x NH	-.08	.21	.14	1	.71
	Gender x NH	-.42	.23	3.22	1	.07
	SS x NH	.21	.20	1.12	1	.29
	Agg/Opp x NH	.09	.06	2.21	1	.14
	Impulsivity x NH	.17	.15	1.16	1	.28
Minor injuries past 3 months	Age x NH	-.15	.23	.42	1	.52
	Gender x NH	.40	.52	.61	1	.44
	SS x NH	.42	.32	1.76	1	.19
	Agg/Opp x NH	-.15	.16	.81	1	.37
	Impulsivity x NH	.07	.20	.11	1	.74

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; NH = Neighbourhood social cohesion/informal control of youth

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.
[b]Significant interaction effect that was investigated further through simple slopes analyses.

Individual characteristics x SES predicting recent Injury-related medical appointments and Minor injuries (Generalized linear regression models assuming Poisson distribution; robust error estimates)

DV	Interaction term[a]	B	SE	Wald Chi-Square	df	*p*
Injury-related Medical Appts past year	Age x SES	-.02	.29	.003	1	.96
	Gender x SES	.70	.37	3.53	1	.06
	SS x SES	-.13	.16	.65	1	.42
	Agg/Opp x SES	-.09	.09	.86	1	.35
	Impulsivity x SES[b]	-.32	.14	4.90	1	.03
Minor injuries past 3 months	Age x SES	-.30	.21	2.07	1	.15
	Gender x SES	.22	.33	.46	1	.50
	SS x SES	.01	.18	.002	1	.96
	Agg/Opp x SES	.003	.09	.001	1	.97
	Impulsivity x SES	-.05	.16	.11	1	.75

Note. SS = Sensation Seeking; Agg/Opp = Aggression/Oppositionality; SES = FSA-level Socioeconomic status aggregate

[a]Each interaction term was added to its own regression model which included all previously examined individual characteristics (i.e., age, gender, SS, Agg/Opp, Impulsivity) as well as the NH variable.
[b]Significant interaction effect that was investigated further through simple slopes analyses.

Simple slopes: Impulsivity x SES predicting Injury-related Medical appointments (Generalized linear regression models assuming Poisson distribution; robust error estimates)

DV	SES level	Predictor	B	SE	Wald Chi-Square	df	*p*
Injury-related Medical Appts past year	Low	Impulsivity	.47	.16	8.22	1	.004
	Mid	Impulsivity	.26	.11	5.57	1	.02
	High	Impulsivity	.05	.13	.15	1	.70