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Delinquency in context; neighbourhood and gender interactions among adolescents

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SUMMARY. **Aim** – Delinquency among adolescents and antecedent conduct disorder among children has been recognized as a growing public mental health problem in contemporary societies. The contribution of the neighbourhood environment to delinquent behaviour was examined in a cohort of Dutch adolescents (aged approximately 11 years at baseline; n=394). **Methods** – Multilevel regression analyses estimated associations between baseline neighbourhood socioeconomic status and social capital, and delinquent behaviour two years later controlling for individual-level variables. **Results** – A significant interaction effect was found between neighbourhood environment variables and gender in models of delinquency, indicating that associations between neighbourhood environment variables and delinquency were apparent, for the most part, in girls only. However, higher level of neighbourhood informal social control was associated with increased delinquency rates in boys. **Conclusion** – In girls there is a longitudinal association between neighbourhood characteristics and delinquency, suggesting complex gender differences in the way the wider social environment impacts on behavioural outcomes.

Declaration of Interest: There are no conflicts of interest.

KEY WORDS: neighbourhood, juvenile delinquency, gender, cohort study.

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INTRODUCTION

Delinquency among adolescents has been recognized as a public mental health problem in contemporary societies. Shoplifting, bicycle theft and graffiti spraying are

examples of delinquent behaviour that have become commonplace nuisances on the urban landscape. Contextual factors such as neighbourhood environment characteristics have long been documented to facilitate or impede delinquent behaviour and its human development antecedents such as conduct disorder (Loeber & Wikstrom, 1993; Sampson & Groves, 1989; Shaw & Mc Kay, 1966). This is in agreement with a Dutch large-scale national study showing that both socioeconomic disadvantage and residential instability caused by gentrification and socioeconomic improvement are related to higher victimization risk for delinquency (Van Wilsem *et al.*, 2006).

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Most previous research on contextual factors affecting behavioural health outcomes has focused on concentrated poverty and neighbourhood socioeconomic disadvantage (NSD) (Kasarda, 1993; Leventhal & Brooks Gunn, 2000; Schneiders *et al.*, 2003; Schonberg & Shaw, 2007). NSD is synonymous with neighbourhood poverty and low neighbourhood socioeconomic status. It represents a different concept than individual-level socioeconomic status and can impact on all residents of a neighbourhood, both affluent and poor. Usually NSD is a summary score of a series of neighbourhood-level objective socioeconomic measures. Another important neighbourhood construct is social capital. This can be best measured by asking community members, as they are the best informants of their neighbourhood. Social capital can be seen as the “glue that holds society together” (McKenzie *et al.*, 2002). It has been defined as “those features of social organizations that act as resources for individuals and facilitate collective action, e.g. high levels of interpersonal trust and norms of mutual aid and reciprocity” (Coleman, 1990, Kawachi *et al.*, 1999; Putnam, 1993). Neighbourhood-level social capital has been found to be an important predictor of behavioural health outcomes (Drukker *et al.*, 2003; 2006). In the United States, two collective efficacy scales that assess social capital have been developed:

- i) informal social control and
- ii) social cohesion and trust (Sampson, 1997; Sampson *et al.*, 1997).

The first scale measures the willingness of neighbours to intervene in hypothetical neighbourhood-threatening situations, for example in the case of children misbehaving. The second scale measures bonds and trust among the residents of the neighbourhood. These social capital variables have been associated with community violence (Sampson, 1997; Sampson *et al.*, 1997).

An important methodological limitation of the research on adolescent delinquency is that it has largely been studied in male populations (Canter, 1982; Henggeler, 1989; Simons *et al.*, 1980). Furthermore, previous studies on gender differences in the association between neighbourhood factors and delinquency or problem behaviour did not include sufficient numbers of girls (Kroneman *et al.*, 2004). From the child and adolescent psychiatric literature, little evidence has been gathered to show whether disorders in girls differ in origin from those in boys (Wilson & Herrnstein, 1985; Smith & Paternoster, 1987; Rutter *et al.*, 1998). From a developmental viewpoint, there is

still a controversy about distinctive antisocial behaviour patterns in males and females (Connell & Halpern-Felsher, 1997; Giordano & Cernkovich, 1997). Several researchers have presented data that require other models and theories to account for antisocial behaviour in females compared to males (Wilson & Herrnstein, 1985; Zoccolillo, 1993; Gottfredson & Hirschi, 1990; Storvoll & Wichstrom, 2002; Storvoll *et al.*, 2002).

Many previous studies have reported greater effects of the neighbourhood on school achievement and conduct problems in boys as compared to girls (Schonberg & Shaw, 2007; Leventhal & Brooks Gunn, 2000). Therefore, an interaction with gender may be hypothesized when studying the association between neighbourhood-level variables and delinquency. It has been argued that the gender differences may result from the fact that boys spend more time in the neighbourhood than girls and therefore are more exposed to the influence of social disorganization processes that exist in these neighbourhoods (Connell & Halpern-Felsher, 1997; Ensminger *et al.*, 1996; Entwisle *et al.*, 1994; Leventhal & Brooks Gunn, 2000). These results suggest that the gender-neighbourhood cross-level interaction effect may be specific for delinquency and not other conduct problems.

Generally, research on neighbourhood-level variables and behavioural health outcomes aims to determine the effects of the neighbourhood over and above individual differences. Methodologically, this implies not only controlling for or factoring in specific individual-level variables, but also including an individual-level equivalent of the neighbourhood variables under investigation. The present study included socioeconomic status as the individual equivalent of NSD and the methods of upbringing within the family (family level interactive processes) as the individual equivalent social capital (Drukker *et al.*, 2003; Duncan *et al.*, 1999; Kawachi *et al.*, 1999; Snijders & Bosker, 1999).

Using longitudinal data on adolescents, the influence of neighbourhood variables on delinquency was investigated, controlling for specific individual-level variables, particularly variables representing the individual-level equivalents of neighbourhood-level variables, in order to address confounding by individual-level differences. In addition and going beyond most previous research, interactions between gender and neighbourhood variables were studied in order to confirm the hypothesis that neighbourhood context variables are important moderators of the effect of gender on delinquency.

METHODS

Research design

The present study aimed to follow a cohort of adolescents living in all 36 Maastricht residential neighbourhoods and attending the same grade (Drukker *et al.*, 2003).

Maastricht is a small city located in the extreme south of the Netherlands (122 000 inhabitants) with a predominantly white population. Twenty percent have a non-Dutch nationality with six percent of these having a non-Western origin. These percentages are low compared to large Dutch cities like Amsterdam (44%, 31% respectively) and Rotterdam (40%, 30%), but similar to the percentages in most other small cities in the Netherlands. The boundaries of the Maastricht neighbourhoods follow main roads and are ecologically meaningful. Each of the 36 neighbourhoods houses between 300 and 8500 inhabitants (all ages). Population density is 2077 per square kilometre (neighbourhood range between 9 and 8671, year 2008) (CBS, 2009). In the Dutch capital, Amsterdam, the population density is twice as high (4500 per square kilometre) as in Maastricht. In Maastricht, approximately 18% is aged over 65 years (neighbourhoods range 4–43%, year 2008). In addition, 33% of all inhabitants aged between 15 and 64 receive welfare benefits (neighbourhoods range between 9 and 49%, year 2007) (CBS, 2009).

Both at baseline (11 years) and follow-up (13–14 years), adolescents were asked to fill in a questionnaire. At baseline, parents received a questionnaire including socioeconomic measures. All adolescents, regardless of baseline responder status, were asked to fill in the follow-up questionnaire. The present paper reports on the follow-up measurement two to three years after baseline (2002/2003).

Adolescent delinquency and baseline individual-level behaviour

Both baseline and follow-up questionnaires consisted mainly of the Child Health Questionnaire (CHQ) child form (87 items) (Landgraf *et al.*, 1996). The CHQ-sub-scales general health, mental health, and self-esteem were selected for analyses as described earlier (Drukker *et al.*, 2003). Behaviour was also assessed using the CHQ. The sum score included items such as “argued”, “wanted to be alone” and “stole things outside home” (how many times during the past four weeks; answers on 5 item likert scales 1=very often 5=never). In addition, the follow-up questionnaire included items on delinquent behaviour.

The delinquency items were adapted from youth health survey questionnaires developed by Public Health Services

in the Netherlands (e.g. Derkx, 1998). The translated items of the delinquency questionnaire are presented in the appendix. A sum score was constructed using all items. Because two thirds of the adolescents scored 0, delinquency was dichotomized for the analyses: 0 no delinquency, 1 at least once at least one act of delinquency (past year).

The baseline questionnaire did not include this delinquency scale because of the assumption that, at age 11 years, the frequency of delinquency items that were not already in the GHQ-behaviour scale (such as stealing from parents) would be too low to be of value. This assumption was validated by the low prevalence of delinquent behaviour in the cohort at ages 13–14 years.

Neighbourhood-level variables

The measure of NSD was based on various neighbourhood socioeconomic characteristics obtained from the Maastricht Statistics Department and Statistics Netherlands (CBS) as described earlier (Drukker *et al.*, 2003). In order to summarize these data, an exploratory factor analysis (principal factors without rotation) was carried out. Two identified factors explained 70.0% of the total variance (Drukker *et al.*, 2003). Percentage single parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactive loaded on the first factor “NSD”. Single persons and various mobility variables loaded on “residential instability”. Regression factor scores were calculated for NSD, yielding a continuous variable with mean 0 and unity standard deviation. Higher scores indicated more socioeconomic disadvantage. This variable had a normal distribution.

In order to assess social capital, approximately 200 inhabitants aged 20 to 65 years were randomly selected from each of the 36 Maastricht neighbourhoods, using the municipal database. Forty-eight percent of the 7236 selected inhabitants responded (hereafter: community survey). These inhabitants received a questionnaire on social capital which they were asked to send back. Social capital was measured using the two collective efficacy scales: informal social control (ISC) and social cohesion and trust (SC&T), developed by Sampson and colleagues (Sampson, 1997). The two sum scores were obtained from individual answers in the community survey and aggregated to the neighbourhood level as described previously (Drukker *et al.*, 2003). The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example in the case of

children misbehaving. The SC&T scale measures bonds and trust among neighbourhood residents.

Previous analyses revealed that NSD, ISC, and SC&T were highly, but not perfectly correlated (Drukker *et al.*, 2003). Higher scores indicated more NSD. For reasons of clarity, the original coding (1 strongly agree – 5 strongly disagree) of the social capital variables was reversed so that a higher sum scores indicated higher levels of social capital. The three neighbourhood variables were standardized to mean zero and unity standard deviation.

Individual and family variables

Family socioeconomic status was assessed using occupational status and educational status. Occupational status was measured using the current or last profession of the parents and scored according to the International Socioeconomic Index of occupational status ISEI-92 (Ganzeboom *et al.*, 1992). If baseline occupational status was not available, occupational status was estimated using adolescents' answers on a similar question at follow-up. Baseline parental questionnaires also assessed the highest level of completed education, welfare recipient status and single parent family. Family occupational and educational status were based on the parent with the highest score. In order to ensure control for family level interactive processes, a variable measuring the quality of child-parent interaction at baseline was included in the models as the family-level equivalent of neighbourhood social capital. This variable, parental perceived difficulty (in child raising), was measured using the NOSIK (Nijmegen Parental Stress Index Short Version), a Dutch 25 item questionnaire (items such as "I have much more problems raising my child than expected", and "I notice that I am less able to take care of my child than expected") (Brock *et al.*, 1992). Sum scores of the 11 items of the parent domain were used in the present analyses.

Statistical analysis

All analyses were performed using Stata (version 8/SE) (StataCorp, 2004). Hierarchically structured data were subjected to multilevel logistic regression analysis in order to investigate neighbourhood effects while controlling for individual effects (Snijders & Bosker, 1999). Multilevel or hierarchical regression techniques are a variant of the more often used unilevel regression analyses and are ideally suited for analysis of clustered data, in this case consisting of multiple persons clustered within

neighbourhoods. The odds ratios (OR) are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the odds ratios in unilevel logistic regression analyses.

Regression models analyzing delinquency (dependent variable) included baseline behaviour, parental occupational status, parental educational status, parental welfare recipient status, single parent family status, gender, grade retention, and parental perceived difficulty in raising the child. Occupational status, parental perceived difficulty, and parental educational status were entered in the equation as dummy variables with respectively high occupational status, high educational status, and low perceived difficulty as reference categories. The above-mentioned individual and family variables were all individual-level variables in the analysis because only one child per family was included in the cohort. Neighbourhood-level variables were NSD, ISC and SC&T (included separately).

A priori gender by neighbourhood interaction terms for each neighbourhood variable were added to the models. Because all neighbourhood variables were entered into the models separately, these interaction terms were also entered one at a time. When interaction terms were below a preset α (<0.1) the Stata LINCOM procedure was used to present outcomes for girls and boys separately.

RESULTS

Descriptives

Of the 1007 adolescents in the cohort, 598 responded at baseline (59%) and 703 (70%) at follow-up. Of these, 672 (67% of the total cohort) answered the delinquency questions. In 94% of respondents, address or neighbourhood remained the same from baseline to follow-up. Baseline and follow-up data as well as delinquency data were available for 394 adolescents (66% of baseline respondents, living in 35 neighbourhoods). Fifty-two percent of the respondents at follow-up were girls (351 of 672). Thirty-three percent of the adolescents reported being involved in at least one of the list of delinquency items at least once (table I). The delinquency score in boys was 1.12 (95% confidence interval 0.86-1.37); almost twice as high as in girls (0.59; 95% confidence interval 0.45-0.74). Table II presents descriptives and Pearson correlations of the neighbourhood variables. A more detailed account of these results is described in a previous paper (Drukker *et al.*, 2003).

Figure 1, 2, and 3 show variation in neighbourhood socioeconomic deprivation, informal social control, and delinquency rates, respectively.

Table I – Descriptives of the study sample at baseline and at follow-up.

	N	mean	sd	range
Sum score delinquency number of activities* number of times	672	0.85	1.9	0 - 17
This sum score in the subgroup of adolescents involved in at least one activity	225	2.5	2.6	1 - 17
This sum score in boys	319	1.12	2.32	0 - 17
This sum score in girls	351	0.59	1.40	0 - 11
Age at baseline	664	11.3	.52	10 - 13
Age at follow-up	662	13.6	.62	12 - 16
CHQ behaviour sum score (baseline)	454	87.4	8.9	48.8 - 100

Table II – Means, standard deviations (stdev) and Pearson correlation coefficients of socioeconomic and social capital variables (neighbourhood layout).

	descriptives				Pearson correlation	
	n	mean	stdev	range	ISC	SC&T
Socioeconomic deprivation	34	0.07	1.0	-1.7 - 1.7	-0.69 ^b	-0.96 ^b
Informal social control ^b	35	0.02	1.0	-1.96 - 2.54	1.0	0.68 ^b
Social cohesion and trust ^a	35	0.03	1.0	-1.79 - 1.56		1.0

^aStandardized before analyses (standard deviation=1).

^bp<0.001

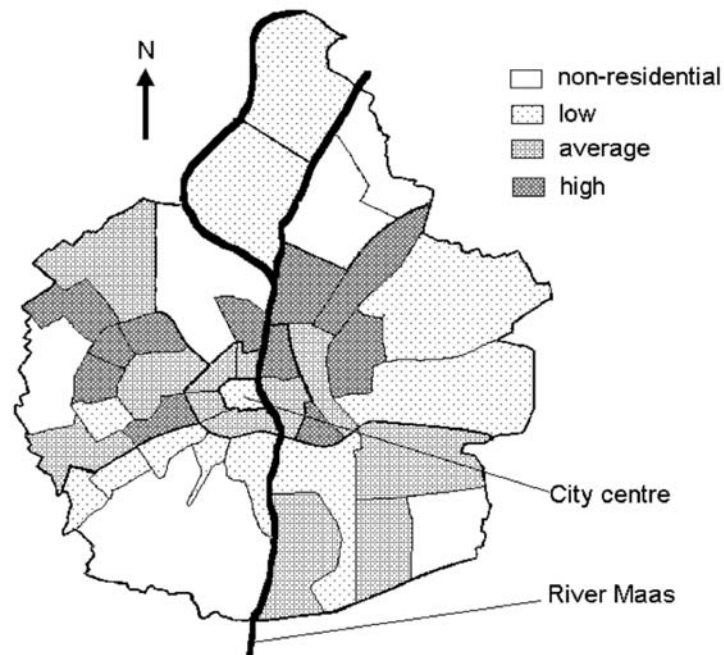


Figure 1 - Neighbourhood variation in socioeconomic deprivation.

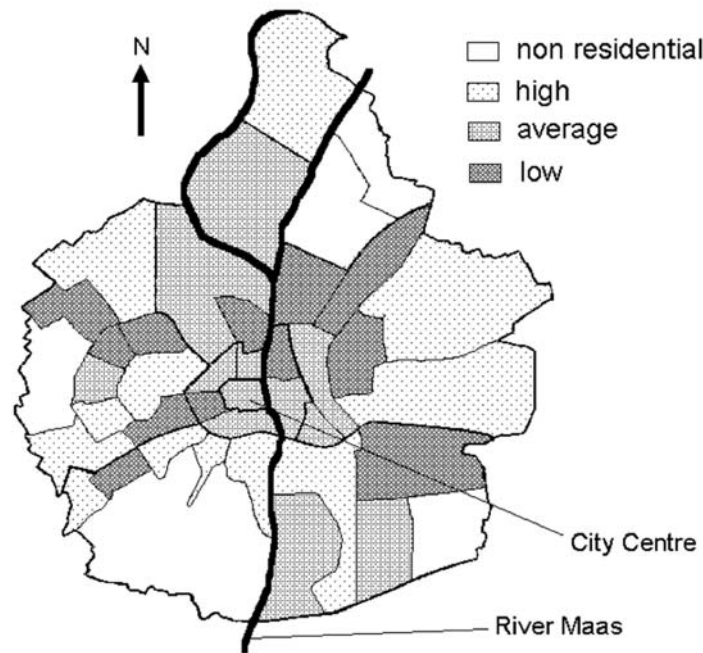


Figure 2 - Neighbourhood variation in informal social control (ISC).

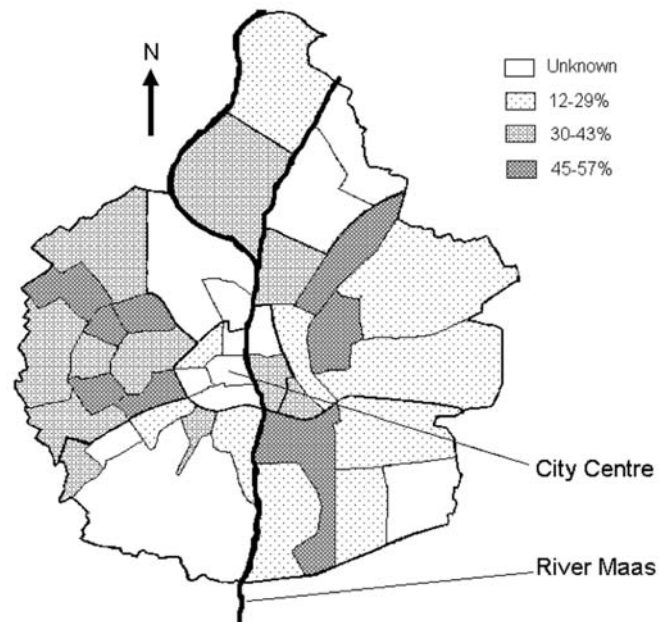


Figure 3 - Neighbourhood variation in delinquency (i.e. percentage of respondents answering "yes" on any of the delinquency items). Unknown if data from <7 respondents.

Neighbourhood variables and delinquency

Associations between background variables and delinquency are presented in table III. This table also presents associations between neighbourhood variables and delinquency before including confounding variables and interaction terms in the models. When parental educational status was lower, adolescents were more frequently involved in delinquency than when one of the parents had a university degree (OR lower secondary education 3.38;

OR elementary education 3.06, Table III). In addition, more boys were involved in delinquent activities than girls (OR=1.89) and children of parents that perceived more difficulties in child-raising were also more frequently involved in delinquent activities (most difficulties: OR=1.99). When analyzing changes after controlling for baseline behaviour, the odds of reporting delinquency remained higher in boys (OR=1.84), while the other variables no longer showed a statistically significant association (Table III).

Table III – Multilevel regression analysis: the association between neighbourhood variables and delinquency rates; odds ratios (OR) and 95% confidence intervals (CI).

	OR	CI	OR ^a	CI
(1) Crude analyses (n=645 and 440 ^b)				
NSD	1.44 ^b	1.19-1.73	1.50 ^c	1.11-2.03
informal social control	0.90	0.72-1.13	0.96	0.70-1.33
social cohesion and trust	0.72 ^b	0.60-0.86	0.68 ^a	0.51-0.92
(2) confounders only (n=394)				
Behaviour at baseline			0.96 ^c	0.93-0.98
Family welfare recipient status (yes cf no)	1.28	0.49-3.31	1.26	0.48-3.32
Occupational status				
high (reference)	1		1	
high intermediate	0.60	0.27-1.33	0.68	0.31-1.52
intermediate	0.67	0.29-1.57	0.79	0.34-1.86
low intermediate	0.80	0.34-1.88	0.88	0.37-2.08
low	0.95	0.39-2.35	1.08	0.44-2.70
Educational status				
university (reference)	1		1	
higher vocational	1.60	0.69-3.69	1.39	0.69-3.69
higher secondary	1.27	0.46-3.50	1.15	0.46-3.50
intermediate vocational	2.39	0.87-6.53	2.19	0.87-6.53
lower secondary	3.38 ^a	1.16-9.83	2.74	1.16-9.83
elementary	3.06 ^a	1.11-8.43	2.22	1.11-8.43
Single-parent family (yes cf no)	0.82	0.39-1.75	0.70	0.32-1.53
Child's gender (1=♂ 0=♀)	1.89 ^c	1.21-2.95	1.84 ^c	1.18-2.89
Grade retention	1.82	0.44-7.55	2.15	0.52-8.98
Parental perceived difficulty				
few problems (reference)	1		1	
2	0.84	0.40-1.76	0.90	0.43-1.88
intermediate	1.78	0.91-3.50	1.77	0.90-3.51
4	1.35	0.68-2.70	1.21	0.60-2.44
most problems	1.99 ^a	1.01-3.92	1.71	0.86-3.42

^acontrolled for behaviour at baseline (CHQ); ^bp<0.001; ^cp<0.01; ^dp<0.05.

All neighbourhood variables showed interaction with gender in the association with delinquency ($p \leq 0.001$) and, therefore, the associations between neighbourhood variables and delinquency are presented for boys and girls separately (Table IV). In girls, a one standard deviation higher level of NSD was associated with almost doubled odds of involvement in delinquency (OR=1.92, $p < 0.001$; table IV). When controlling for baseline behaviour, the association was even stronger (OR=2.23, $p < 0.001$). No such difference was apparent for boys. Results for social cohesion and trust (OR=0.52; after controlling for base-

line behaviour OR=0.46) also showed that girls living in disadvantaged neighbourhoods (i.e. low trust) were more often involved in delinquent activities. The association between informal social control and delinquency was in the same direction, but after controlling for baseline behaviour this association was statistically imprecise by conventional alpha (OR=0.66, $p = 0.059$; Table IV). In boys, there was a statistically significant reverse association between social control and delinquency (more control predicting more delinquency), when additionally controlling for NSD (OR=1.73, $p = 0.021$).

Table IV – Multilevel logistic regression analysis: the association between neighbourhood variables and odds of delinquency behaviour stratified by gender, odds ratios (OR) and 95% confidence intervals (CI).

Controlled for confounders (n=635)	girls		boys	
	OR	CI	OR	CI
NSD	1.92 ^a	1.45-2.54	0.99	0.77-1.27
informal social control	0.68 ^c	0.49-0.93	1.22	0.93-1.58
social cohesion and trust	0.52 ^a	0.39-0.68	1.09	0.84-1.40
NSD	2.07 ^a	1.42-3.00	1.27	0.90-1.79
informal social control	1.10	0.74-1.63	1.40 ^c	1.01-1.92
Controlled for confounders and baseline behaviour score (n=438)	girls		boys	
	OR	CI	OR	CI
NSD	2.23 ^a	1.47-3.37	0.96	0.67-1.38
informal social control	0.66	0.43-1.02	1.35	0.94-1.94
social cohesion and trust	0.46 ^a	0.31-0.69	1.08	0.76-1.53
NSD	2.75 ^a	1.57-4.82	1.52	0.91-2.52
informal social control	1.28	0.74-2.20	1.73 ^c	1.09-2.76

^ap<0.001; ^bp<0.01; ^cp<0.05.

DISCUSSION

As expected (e.g. (Chesney-Lind *et al.*, 2007)), delinquency scores were higher in boys than in girls. However, a negative neighbourhood social environment (high NSD, low social cohesion and trust) was associated with an increase in delinquency in girls, but not in boys. On the other hand, high social control was associated with increased delinquency rates in boys. The analyses strongly suggest that the determinants of delinquency in girls and boys are at least, in part, different with regards to the influence of the wider social environment. The results also contribute to the growing literature on the importance of studying interactions between individual-level characteristics, family functioning and neighbourhood-level conditions in order to obtain a more comprehensive understanding of delinquency, as opposed to studying each domain separately (Schuck & Widom, 2005).

Gender differences in the influence of the social environment

Similar findings when studying analogous outcomes can strengthen conclusions (Rothman & Greenland, 1998). However, while research on school achievement consistently reported a positive influence of the social environment in boys (Leventhal & Brooks Gunn, 2000; Flouri & Erekly-Stevens, 2009; Drukker *et al.*, 2009), the present study and previous research on delinquency and conduct problems demonstrated a positive influence of the social environment in girls (Zalot *et al.*, 2007; Meier

et al., 2008). However, one study also presented other analyses showing an effect of the neighbourhood social environment on delinquency in boys (Meier *et al.*, 2008). Nevertheless, although delinquency and school achievement are related concepts, only the presence of interaction seems similar, but not the direction. Apparently, there are different mechanisms at work and future research needs to identify the specific neighbourhood pathways linking various outcomes to gender.

Differential exposure provides a plausible starting point for an explanation for differences between boys and girls. Boys, in general, tend to spend more time in the neighbourhood than girls (Connell & Halpern-Felsher, 1997; Ensminger *et al.*, 1996; Entwisle *et al.*, 1994; Leventhal & Brooks Gunn, 2000). However, this cannot fully explain the association between a social environment and relatively lower delinquency rates in girls. Another mechanism may be differential vulnerability to risk factors (Kroneman *et al.*, 2004). Our results suggest that girls may be more vulnerable to neighbourhood risk factors associated with social disorganization having been more protected and controlled by their families. Thirdly, it is never one risk factor that determines the outcome, it is a set of risk and protective factors (Rothman & Greenland, 1998). Perhaps the balance between these factors or the speed of accumulation is different between boys and girls (Kroneman *et al.*, 2004; Mannuzza & Gittelman, 1984).

The explanation of why high levels of social control increase delinquency in boys is complex, as this finding may appear counterintuitive at first. It could be that in high social capital neighbourhoods, boys find more social

support for developing peer groups, but that subsequently these peer groups may increase the chances of adolescent boys getting into mischief.

Methodological issues

The strength of the present paper is the longitudinal design that included a baseline and a follow-up measurement. Because we could control for baseline behaviour, the results show changes between baseline and follow-up. Although empirical research can never ultimately prove causality, these longitudinal analyses provide stronger evidence for causality than cross-sectional research. The baseline questionnaire did not include delinquency questions, because Maastricht 11-year olds are rarely involved in such activities. Furthermore, a principle objective of our methodology was to examine effects of neighbourhood variables that were obtained independently of the responding adolescents. Because perceptions of social capital are always biased by individual mental health status, it is difficult to disentangle cause and effect. The purpose of studying more distal mechanisms constituting objective social capital was realized by measuring social capital scale items in a group of informants that was different than the cohort investigated (Buka *et al.*, 2003).

The paper has some limitations. First, delinquency rates in 13/14 year-old Maastricht adolescents were rather low. Thus, results may not be representative for older adolescents. However, because 33% were involved in at least one activity, variance is sufficiently high to perform analyses with the dichotomous delinquency variable. These analyses did show associations, demonstrating the validity of the use of the delinquency measure in the analyses.

Second, some variables had many missing values limiting the analyses to 438 adolescents as soon as baseline characteristics (baseline behaviour) were added to the model. Therefore, additional sensitivity analyses were conducted using the Stata HOTDECK procedure. This procedure is used several times within a multiple imputation sequence since missing data are imputed stochastically rather than deterministically. For both research questions, ten imputation sequences were run, yielding 10 data sets in which the analyses presented in the current paper were repeated. In these analyses the interaction between neighbourhood variables and gender remained statistically significant (all neighbourhood variables * gender p -values < 0.001). In addition, all results of the analyses were very similar to the original analyses ($n=815$ boys and girls).

Third, in a longitudinal study there is always drop-out at follow-up. Although 79% of the baseline responders also responded at follow-up (a relatively high percentage) parental educational status differed between those who dropped out after baseline and those who responded to the follow-up questionnaire (t -test, $p=0.01$). In addition, response at follow-up was lower in disadvantaged neighbourhoods (high socioeconomic disadvantage or low social capital). This could have influenced the results if non-response was also higher in delinquency-involved adolescents, as in that case both adolescents living in disadvantaged neighbourhoods and adolescents involved in delinquency would be under-represented in the data (selective drop out). However, because response at follow-up was sufficiently high (79%), it is very unlikely that non-response at follow-up would have resulted in spurious results.

The response rate in the social capital community survey in adults was only 48% (Drukker *et al.*, 2003). However, the community sample respondents and the general population between 20 and 65 years of age have similar distributions in age, gender and ethnicity. Furthermore, all respondents were considered to be "key" informants about their own neighbourhood with the implicit assumption that responders gave the same information about the neighbourhood as the non-responders would have given. The validity of the sample might have been judged differently if the principle objective was to obtain information on the person not his or her neighbourhood. Thus, this information is more or less independent of the response rate. In order to verify this assumption, we examined *post hoc* reproducibility of neighbourhood scores of ISC and SC&T. Not only responders of the community survey, but also parents of the adolescent cohort filled in the social capital questions. Neighbourhood scores on ISC and SC&T based on these two questionnaires were highly correlated (Drukker *et al.*, 2003).

Finally, associations between NSD, informal social control, and social cohesion and trust were so strong that collinearity problems would likely have arisen had these three variables been entered jointly in one regression model.

Because previous research reported an interaction effect between neighbourhood socioeconomic deprivation and residential instability (Drukker *et al.*, 2005; Ross *et al.*, 2000) this interaction term was also added to the present analyses. However, there were no differences in association between NSD and delinquency, depending on the stability of the neighbourhood.

Delinquency prevention and implications

Juvenile delinquency is a highly frequent and serious form of problem behaviour that is often associated with other types of conduct problems and can develop from less severe to more severe delinquency that involves more serious crime. The fact that gender-specific aetiologies may exist has implications for treatment and prevention as different intervention strategies for boys and girls may apply. Until recently, theoretical frameworks for the development of delinquent behaviour in girls were not developed and thus gender-specific intervention strategies are not available (Kroneman *et al.*, 2004).

The present findings may suggest that boys organize themselves in peer groups and that to the degree that high social capital neighbourhoods may be conducive to this, and assuming that peer group formation may facilitate collective delinquent behaviour, the probability of adolescent boys to become involved in delinquent activities is increased. On the other hand, girls may only join risk groups associated with juvenile delinquency in disadvantaged neighbourhoods where poverty is high or where neighbours do not exercise informal social control and intervene when children are misbehaving. This complex hypothesis assuming differential gender effects needs to be tested in future research.

While neighbourhood level interventions have been found effective in reducing delinquency, policy makers may be advised by our findings that such programs may be more effective in modifying female behaviour than for males where individual interventions may be more effective (Black, 1997).

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Appendix: translation of the delinquency questionnaire

Sometimes you do things that are against the rules. This questionnaire is related to this kind of behaviour. Could you indicate how many times you did the following activities in the past year? (0, 1 to 2, 3 to 5, 6 or more)

- a. Stole a bicycle or moped
- b. Shoplifting
- c. Vandalized something in the streets
- d. Spray-painted graffiti on walls
- e. Made off with money from a family member
- f. Made off with money from a stranger
- g. Fought at school
- h. Fought during a night out
- i. Brought along a knife or weapon
- j. Got physically violent, harassed someone

Note: the original delinquency question included one item more ("used a knife or a weapon"). This item was excluded from the questionnaire to avoid offending the parents.

REFERENCES

- Black T. (1997). The handwriting's on the wall: Cities can win the graffiti war. *American City & County* 112, 22.
- Brock A.J.L.L., Vermulst A.A., Gerris J.R.M. & Abidin R.R. (1992). *NOSI Nijmeegse Ouderlijke Stress Index*. Swets en Zeitlinger: Lisse.
- Buka S.L., Brennan R.T., Rich-Edwards J.W., Raudenbush S.W. & Earls F. (2003). Neighborhood support and the birth weight of urban infants. *American Journal of Epidemiology* 157, 1-8.
- Canter R. (1982). Family correlates of male and female delinquency. *Criminology* 20, 149-167.
- CBS (Statistics Netherlands) (2009). StatLine. Retrieved October 2, 2009, from <http://statline.cbs.nl/>
- Chesney-Lind M., Morash M. & Irwin K. (2007). Policing girlhood? Relational aggression and violence prevention. *Youth Violence and Juvenile Justice* 5, 328-345.
- Coleman J.S. (1990). *The Foundations of Social Theory*. Harvard University Press: Cambridge.
- Connell J.P. & Halpern-Felsher B. (1997). How neighborhoods affect educational outcomes in middle childhood and adolescence: Conceptual issues and an empirical example. In *Neighborhood Poverty. Context and Consequences for Children*, Vol. 1 (ed. J. Brooks-Gunn, G.J. Duncan and J.L. Aber), pp. 174-199. Russell Sage Foundation: New York.
- Derckx R.M.J. (1998). *Regiorapport jeugd en genotmiddelen, resultaten van een onderzoek onder scholieren in de Westelijke Mijnstreek*. GGD Westelijke Mijnstreek: Geleen.
- Drukker M., Kaplan C.D., Feron F.J.M. & Van Os J. (2003). Children's health-related quality of life, neighbourhood socio-economic deprivation and social capital; a contextual analysis. *Social Science and Medicine* 57, 825-841.
- Drukker M., Kaplan C.D. & Van Os J. (2005). Residential instability in socioeconomically deprived neighbourhoods, good or bad? *Health and Place* 11, 121-129.
- Drukker M., Kaplan C.D. & Van Os J. (2006). Chapter 5: Social capital and quality of life and mental health in Maastricht, The Netherlands; the neighbourhood matters. In *Social Capital and Mental Health* (ed. T. Harpham and K. McKenzie), pp. 86-108. Jessica Kingsley: London.
- Drukker M., Feron F.J.M. & Van Os J. (2009). Neighbourhood socio-economic and social factors and school achievement in boys and girls; a cross-level analysis at neighbourhood-, school- and individual-level. *Journal of Early Adolescence* 29, 285-306.
- Duncan C., Jones K. & Moon G. (1999). Smoking and deprivation: are there neighbourhood effects? *Social Science and Medicine* 48, 497-505.

- Ensminger M.E., Lamkin R.P. & Jacobson N. (1996). School leaving: A longitudinal perspective including neighborhood effects. *Child Development* 67, 2400-2416.
- Entwisle D.R., Alexander K.L. & Olson L.S. (1994). The gender gap in math: Its possible origins in neighborhood effects. *American Sociological Review* 59, 822-838.
- Flouri E. & Erekly-Stevens K. (2009). Urban neighbourhood quality and school leaving age: gender differences and some hypotheses. *Oxford Review of Education* 34, 203-216.
- Ganzeboom H.B.G., De Graaf P.M. & Treiman D.J. (1992). A standard international socio-economic index of occupational status. *Social Science Research* 21, 1-56.
- Giordano P.C. & Cernkovich S.A. (1997). Gender and antisocial behavior. In *Handbook of Antisocial Behavior* (ed. D.M.Stoff, J. Breiling, and J.D. Maser), pp. 496-510. John Wiley and Sons: New York.
- Gottfredson M.R. & Hirschi T. (1990). *A General Theory of Crime*. Stanford University Press: Palo Alto, CA.
- Henggeler S.W. (1989). *Delinquency in Adolescence*. Sage Publications: Newbury Park, CA.
- Kasarda J. (1993). Inner-city concentrated poverty and neighborhood distress: 1970-1990. *Housing Policy Debate* 4, 253-302.
- Kawachi I., Kennedy B.P. & Wilkinson R.G., (1999). *The Society and Population Health Reader – Income Inequality and Health*. The New Press: New York.
- Kroneman L., Loeber R. & Hipwell A.E. (2004). Is neighborhood context differently related to externalizing problems and delinquency for girls compared with boys? *Clinical Child and Family Psychology Review* 7, 109-122.
- Landgraf J.M., Abetz L. & Ware J.E., Jr. (1996). *Child Health Questionnaire (CHQ) a Users Manual*. The Health Institute, New England Medical Center: Boston, MA.
- Leventhal T. & Brooks Gunn J. (2000). The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. *Psychological Bulletin* 126, 309-337.
- Loeber R. & Wikstrom P.-O.H. (1993). Individual pathways to crime in different types of neighborhood. In *Integrating Individual and Ecological Aspects of Crime* (ed. D.P. Farrington, R.J. Sampson and P.H. Wikstrom), pp. 169-207. National Council for Crime Prevention: Stockholm.
- Mannuzza S. & Gittelman R. (1984). The adolescent outcome of hyperactive girls. *Psychiatry Research* 13, 19-29.
- McKenzie K., Whitley R. & Weich S. (2002). Social capital and mental health. *British Journal of Psychiatry* 181, 280-283.
- Meier M.H., Slutske W.S., Arndt S. & Cadoret R.J. (2008). Impulsive and callous traits are more strongly associated with delinquent behavior in higher risk neighborhoods among boys and girls. *Journal of Abnormal Psychology* 117, 377-385.
- Putnam R.D. (1993). *Making Democracy Work. Civic Traditions in Modern Italy*. Princeton University Press: Princeton, NJ.
- Ross C.E., Reynolds J.R. & Geis K.J. (2000). The contingent meaning of neighborhood stability for residents' psychological well-being. *American Sociological Review* 65, 581-597.
- Rothman K.J. & Greenland S. (1998). *Modern Epidemiology*. Lippincott-Raven: Philadelphia.
- Rutter M., Giller H. & Hagell A. (1998). *Antisocial Behavior by Young People*. Cambridge University Press: New York.
- Sampson R.J. (1997). Collective regulation of adolescent misbehavior: Validation results from eighty Chicago neighborhoods. *Journal of Adolescent Research* 12, 227-244.
- Sampson R.J. & Groves W.B. (1989). Community structure and crime: Testing social-disorganization theory. *American Journal of Sociology* 94, 774-802.
- Sampson R.J., Raudenbush S.W. & Earls F. (1997). Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science* 277, 918-924.
- Schneiders J., Drukker M., Van der Ende J., Verhulst F.C., Van Os J. & Nicolson N., (2003). Neighbourhood socioeconomic disadvantage and behavioural problems from late childhood into early adolescence. *Journal of Epidemiology and Community Health* 57, 699-703.
- Schonberg M.A. & Shaw D.S. (2007). Risk factors for boy's conduct problems in poor and lower-middle-class neighborhoods. *Journal of Abnormal Child Psychology* 35, 759-772.
- Schuck A.M. & Widom C. (2005). Understanding the role of neighborhood context in the long-term criminal consequences of child maltreatment. *American Journal of Community Psychology* 36, 207-222.
- Shaw C. & Mc Kay H. (1966). *An Ecological Approach to Juvenile Delinquency*. Columbia University Press: New York.
- Simons R.L., Miller M.G. & Aigner S.M. (1980). Contemporary theories of deviance and female delinquency: an empirical test. *Journal of Research in Crime and Delinquency* 17, 42-53.
- Smith D.A. & Paternoster R. (1987). The gender gap in theories of deviance: issues and evidence. *Journal of Research in Crime and Delinquency* 24, 140-172.
- Snijders T. & Bosker R. (1999). *Multilevel analysis, an introduction to basic and advanced modeling*. SAGE Publications: London.
- StataCorp (2004). *Stata Statistical Software Version 8.2*. Stata Corporation: College Station, TX.
- Storvoll E.E. & Wichstrom L. (2002). Do the risk factors associated with conduct problems in adolescents vary according to gender? *Journal of Adolescence* 25, 183-202.
- Storvoll E.E., Wichstrom L. & Pape H. (2002). Gender differences in the association between conduct problems and other problems among adolescents. *Journal of Scandinavian Studies in Criminology & Crime Prevention* 3, 194-209.
- Van Wilsem J., Wittebrood K. & De Graaf N.D. (2006). Socioeconomic Dynamics of neighborhoods and the risk of crime victimization: A multilevel study of improving, declining, and stable areas in the Netherlands. *Social Problems* 53, 226-247.
- Wilson J.Q. & Herrnstein R.J. (1985). *Crime and Human Nature*. Simon and Schuster: New York.
- Zalot A.A., Jones D.J., Forehand R. & Brody G., (2007). Self-regulation and conduct problems among low-income African American youth from single-mother homes: The roles of perceived neighborhood context and child gender. *Journal of Black Psychology* 33, 239-259.
- Zoccolillo M., (1993). Gender and the development of conduct disorder. *Development and Psychopathology* 5, 65-78.