Social ties within school classes – the roles of gender, ethnicity, and having older siblings

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Abstract

In this paper we identify the lines along which social ties between high school teenagers are primarily formed. To this end, we introduce interaction weights between pupils in the same school class that are a function of exogenous individual background characteristics, like gender, ethnicity, and having older siblings.

The resulting model with endogenous interactions and school specific fixed effects is estimated using data from the Dutch National School Youth Survey (NSYS), a survey in which in principle all students in a sampled class are interviewed. By combining the 1992, 1996, 1999 and 2001 NSYS data, we are able identify trends in social relationships of teenagers.

We find that the roles that gender and ethnicity play in how teenagers interact varies strongly across different types of behavior. For example, going out shows strong within-ethnicity interactions, while expenditures on cell phone and on clothing exhibit mainly between-girls interactions. Having older siblings has a minor effect on within school class social interactions. There is weak evidence of decreased ethnic segregation within school classes during the decade considered.

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1 Introduction

In the past ten years, many empirical studies have shown the importance of social interactions in decision making.[1] With the use of clever designs, researchers have sometimes been able to disentangle social interaction effects from other effects.[2] Most of these studies look at social interaction effects either between neighboring households or between students in high schools or colleges.

There are three reasons why both places – neighborhoods and schools – are natural places to look for social interaction effects. First, people spend a considerable amount of their time in the neighborhood they live in and likewise, students spend a large percentage of their daily waking time at school. Second, the presence of interaction effects at the neighborhood or school level potentially has important implications for public policy. Neighborhood effects possibly enhance social inequality and poverty traps (Crane, 1991; Durlauf, 2002). Peer effects within schools may downplay the efficacy of public policy initiatives that are directed toward individual students, for example campaigns aimed at discouraging teenagers to engage in smoking by pointing out the health consequences. The third reason is a practical one: Of the social contexts that seem relevant for individual's behavior, neighborhoods and schools are the ones of which various data sets with the required degree of detail are available. One can for example imagine that an employee is affected by his co-workers in much the same way a student is affected by his classmates. Data on the level of the shop-floor however are much scarcer.[3]

The current paper makes a contribution to the empirical studies on social

[1] See e.g. Moffitt (2001), Glaeser and Scheinkman (2003) and Soetevent (2005) for surveys of this literature.

[2] For the specific problems in distinguishing genuine social interaction effects from spurious correlations in outcomes of group members, see the seminal work by Manski (1993, 2000).

[3] For an exception see Duflo and Saez (2003).

interactions within the realm of the school class. Despite the steady flow of empirical studies, a large number of questions regarding the nature of social interaction effects is still left unanswered. The question we set out to answer in this paper is to which extent sub-groups play a role at the level of the school class. To this end, we delineate sub-groups on the (exogenously given) lines of gender, ethnicity and having older siblings.

In this way, we try to answer questions like: Are boys primarily influenced by the behavior of the other boys in their class? Are differences in nationality important for the degree of interaction between class-mates? Are pupils with older siblings more or less influenced by the behavior of their classmates? By making the interaction structure within the school class not only dependent on gender, but also on nationality and family structure, we give heed to Akerlof and Kranton (2002, p. 1177) who propose that "...researchers use the same sort of information that accurately divides people into male and female to make other group identifications." Moreover, content is added to the discussion how important peer group effects are relative to family background traits (see e.g. Evans, Oates and Schwab, 1992, p. 970 and Clark and Lohéac, 2005).[4]

In Section 3 we present a model based on the assumption that observed choices represent the Nash equilibrium of a static game played by all pupils in a school class. We subsequently estimate this model for a number of decisions made by teenagers with regard to time use, income resources and expenditures using data from different years of the Dutch National School Youth Survey (NSYS). The circumstance that in this survey all students in a sampled class are interviewed in principle, gives the information on socially proximate economic agents that is necessary to estimate social interactions with background dependent interaction weights. Joint estimation of the

[4]To some extent, we take up Clark and Lohéac's (2005, p. 12) point that "future work should pay more attention to the identification of demographic groups which are more reactive to social pressure."

model is performed for the NSYS 1992, 1996, 1999, and 2001. Comparison of these estimates not only serves to check the accuracy of the model, but is also used to identify trends, if any, in the importance of social sub-groups within the school class as a determinant of the different types of non-cognitive behavior. This paper extends our previous research on social interactions among high school teenagers that only used the 1992 and 1999 data of the NSYS and only considered subgroups based on gender (Kooreman, 2005 and Soetevent and Kooreman, 2004).

Besides the more extensive division of class-mates into sub-groups, two other ingredients that we consider attractive are added to the current study. The first is that, due to the unusual richness of the data, we can introduce school-specific fixed effects. A general criticism to empirical studies on interaction effects is that significant social interaction effects may merely reflect the failure to control for unobserved effects at the group level. This caveat applies to the present study for correlated unobservables at the class level, but by adding school-specific fixed effects, we are at least able to pick up all biases caused by correlated unobservables at the school level. The inclusion of school-specific fixed effects to control for unobserved characteristics is common in studies on social interactions in which students are not randomly assigned to their peer groups (Arcidiacono and Nicholson, 2005 and Clark and Lohéac, 2005). The second is that this is to our knowledge the first study that considers (trends in) interaction effects over a time span of ten years. This enables us for example to observe whether interactions between pupils of different nationalities become more or less intense over time.

We find that the roles that gender and ethnicity play in how teenagers interact socially varies erratically across different types of behavior. For example, going out shows strong within-ethnicity interactions, while expenditures on cell phone and on clothing and shoes exhibit mainly between-girls

interactions. Having older siblings has a minor effect on within school class social interactions. There is weak evidence of increased interactions between ethnic groups during the period considered.

The paper proceeds as follows. A brief review of the relevant studies on social interactions among teenagers is given in section 2. Section 3 introduces our empirical model. Section 4 presents details of the NSYS data. Estimation results are presents in Section 5, and Section 6 concludes.

2 Social interactions among adolescents

The lion's share of the empirical literature on social interactions can be roughly divided into two parts. The first strand of literature has identified important neighborhood effects on a household's well-being, exposure to crime and on the educational attainment of children in the household (Katz, Kling and Liebman, 2001; Ludwig, Duncan and Hirshfield, 2001; Solon , Page and Duncan, 2000). Oreopoulos (2003) on the other hand does not find evidence that neighborhood quality plays a role in the labor market outcomes of children in the household. The current study however falls into a second strand of empirical studies that looks into the role social interactions play in the behavior and decisions of adolescents. Most of these studies focus on either "risky behavior", like smoking and drinking habits (e.g. Gaviria and Raphael, 2001; Kremer and Levy, 2003; Powell, Tauras and Ross, 2003; Sacerdote, 2001), or on student achievement in school, as measured by SAT and GPA scores (Arcidiacono and Nicholson, 2005; Boozer and Cacciola, 2001; Hanushek *et al.*, 2003; Hoxby, 2000; Zimmerman, 2003). The behaviors we consider are all of a non-cognitive nature and one of them, the monthly expenditure on alcoholic drinks, is related to risky behavior.[5] All of these studies find significant peer group effects for alcohol use.

[5]In sofar children are non-randomly assigned to classes within the school, this choice of outcome variables is likely to somewhat reduce the problem of selection effects, since selection most probably is based on children's cognitive abilities.

A small number of papers that study on interaction effects within schools also try to delineate along which lines sub-groups are formed. In a study on student's academic achievement and speciality choice in medical school, Arcidiacono and Nicholson (2005) do find some evidence of peer effects along gender lines, but they do not find that peer effects form along racial lines. With regard to smoking and drinking, Clark and Lohéac (2005) find that within-gender effects are larger than cross-gender effects and that boys are more influential than girls. They do not find differences in effects for households that recently moved, or between children of low and high income parents. As far as we know, our study is the first study that tests whether students with older siblings are more or less susceptible to peer group pressure.

In the current analysis, we define a student's class as his or here relevant reference group. As in principle all students within a sampled class are interviewed, the data can be considered as a reference group based sample. We readily admit that teenage behavior is also influenced by persons outside the class, but class mates probably play a dominant role in shaping teenagers' preferences and behavior.[6] Across years, the total time spent on school related activities is about 8 hours per weekday. For this reason, teenagers in the same class form social groups that are more clearly defined than in many other situations in which social interaction effects are likely to play a role.

3 The Model

In this section, we present our empirical model. Three specifications of this model are subsequently estimated to infer whether social interactions within

[6] In the 2001 NSYS, on the question *Where did you meet your friends? (multiple answers possible)*, 71 per cent of the respondents answered "in school", followed by "in the neighborhood I live in" (44%) and "through other friends" (40%). Krauth (2005) explicitly focuses on social interactions from friends.

the school can be delineated along lines of nationality, nationality and gender or the presence of older siblings.

Suppose we have $k = 1, 2, \ldots, K$ classes, with each class containing $i = 1, 2, \ldots, N_k$ pupils. Let y_{ik} be the outcome of interest, and $\mathbf{x_{ik}}$ a vector with individual background characteristics. The vector $\mathbf{z_{ik}} = (z_{ik}^1, z_{ik}^2, \ldots, z_{ik}^H)'$ contains the characteristics of pupil i in class k that possibly affect his receptiveness to the behavior of his or her class mates.

For pupils i ($i = 1, 2, \ldots, N$) in class k, the structural equation of interest can then be written as:[7]

$$y_i = \alpha' \mathbf{x_i} + \frac{\sum_{j \neq i} s_{ij} y_j}{N-1} + \epsilon_i \text{ for } i = 1, 2, \ldots, N \tag{1}$$

In this equation, the s_{ij}'s represent the endogenous social interaction effect pupil j exerts on pupil i. In matrix form, (1) can be rewritten as

$$\mathbf{y} = \mathbf{X}\alpha + \Gamma \mathbf{y} + \epsilon, \text{ with} \tag{2}$$

$$\Gamma = \frac{1}{N-1} \begin{bmatrix} 0 & s_{12} & \ldots & s_{1N} \\ s_{21} & \ddots & \ldots & \vdots \\ \vdots & \vdots & \ddots & \vdots \\ s_{N1} & s_{N2} & \ldots & 0 \end{bmatrix}.$$

We slightly extend the standard model by allowing the error terms of students within a class to be correlated. We use a one-factor model in which the correlation coefficient between the error terms of any pair of teenagers within a class is a single parameter ρ. More specifically, the vector of disturbances ϵ^k is assumed to be $\mathrm{N}(0, \Omega)$ distributed, with

$$\Omega = \begin{bmatrix} 1 & \rho & \ldots & \rho \\ \rho & \ddots & \ldots & \rho \\ \vdots & \vdots & \ddots & \vdots \\ \rho & \rho & \ldots & 1 \end{bmatrix}.$$

[7] In the equations that follow, the index k is suppressed for expositional reasons.

Moreover, we assume that $cov(\epsilon_i^k, \epsilon_j^k) = 0$ for $k \neq l$, that is, the disturbances of individuals not in the same class are assumed to be uncorrelated. Significant values for the correlation coefficient indicate the presence of unobserved variables that cause correlated behavior of pupils in the same school class. Examples include unmeasured teacher behavior or similar family backgrounds.

Let $A \equiv (1 - \Gamma)^{-1}$. Then the reduced form of (2) reads as,

$$\mathbf{y} = A\mathbf{X}\alpha + A\epsilon. \tag{3}$$

Before we can estimate the model, we have to impose some restrictions on the interaction parameters s_{ij} in the Γ-matrix. One restriction often imposed implicitly in empirical studies is $s_{ij} = \gamma$ for all $j \neq i$. In this instance, γ measures a general social effect.

In this study our objective is to answer how gender and ethnic differences and the presence of older siblings affect a teenager's receptiveness to the behavior of his class mates. To this end we estimate the reduced form (3) for the three specifications of the interaction matrix Γ which we introduce below.

Although we include school specific fixed effects in all our estimations, the models do not explicitly allow for exogenous (contextual) effects. From a conservative point of view one could therefore interpret the estimated coefficients as upper bounds on the true endogenous social interaction effects.

Ethnicity

One natural exogenous characteristic by which one can group individuals in a class is ethnicity.[8] The first specification makes a distinction between pupils that have the Dutch nationality and pupils that have not. A pupil's ethnicity is determined on basis of the answer given to the question: *What*

[8] We use 'ethnicity' and 'nationality' interchangeably.

is your nationality? We specify the elements of the interaction matrix as

$$s_{ij} = \begin{cases} \gamma_N + \delta_N t & \text{if } i \text{ and } j \text{ are both Dutch or both non-Dutch} \\ \gamma_{CN} + \delta_{CN} t & \text{otherwise} \end{cases}$$

Thus, this specification distinguishes between within-nationality and cross-nationality interactions: γ_N measures how a pupil is affected by the choices of other pupils with the same nationality, and γ_{CN} measures the cross-nationality interactions: how a Dutch (non-Dutch) pupil is affected by non-Dutch (Dutch) pupils in his or her class.

With respect to the size and nature of interactions along ethnic lines three different cases might be distinguished. In the first case ethnicity is irrelevant: $\gamma_N = \gamma_{CN}$. In the second case, there is complete ethnic segregation: $\gamma_N \neq 0$ and $\gamma_{CN} = 0$. In the third case, ethnic groups are opposed to each other; individuals imitate others with the same nationality, and make choice opposite to those of different nationality: $\gamma_N > 0$ and $\gamma_{CN} < 0$.

Trend variables (δ_N and δ_{CN}, with 1997 as reference year) are added to account for possible changes in the interactions over the different years.

Gender and ethnicity

The first specification is coarse in that it neglects another important individual characteristic along which sub-groups in school classes may be formed: gender. The second specification of the interaction matrix accounts for this by allowing interactions to differ on basis of both ethnicity and gender. We specify

$$s_{ij} = \begin{cases} \gamma_B & \text{if } i \text{ and } j \text{ are both boys of the same nationality} \\ \gamma_G & \text{if } i \text{ and } j \text{ are both girls of the same nationality} \\ \gamma_{cn} & \text{if } i \text{ and } j \text{ have the same gender and different nationalities} \\ \gamma_{cg} & \text{if } i \text{ and } j \text{ have the same nationality and different genders} \\ \gamma_{cncg} & \text{if } i \text{ and } j \text{ have different nationalities and different genders} \end{cases}$$

Thus we assume, firstly that there are no differences between within-gender interactions of Dutch boys (girls) and non-Dutch boys (girls); secondly that cross-gender interactions of same-nationality class mates and cross-nationality interactions of same gender class mates are symmetric. Finally, we assume that all cross-gender cross-nationality interactions have the same magnitude. This leaves us with 10 parameters to estimate (including trend parameters).

Having older siblings

In the third specification, we make the magnitude of interactions dependent on whether a pupil has older siblings. That is,

$$s_{ij} = \begin{cases} \gamma_B(1 - z_i) + \delta_{sB} z_i + \delta_B t & \text{if } i \text{ and } j \text{ are boys} \\ \gamma_G(1 - z_i) + \delta_{sG} z_i + \delta_G t & \text{if } i \text{ and } j \text{ are girls} \\ \gamma_{cg}(1 - z_i) + \delta_{scg} z_i + \delta_{cg} t & \text{if } i \text{ are of different gender,} \end{cases}$$

with z_i a dummy variable which is 1 if pupil i has older siblings and 0 otherwise. The older siblings of a pupil may constitute an alternative peer group that can both oppose or reinforce the social effects a pupils experiences from his class mates.[9] The objective of estimating this specification is to delineate whether the presence of older siblings affects the extent to which class mates serve as one's reference group with respect to time use and certain income and expenditure categories. We allow the effect of having older siblings to differ between within-gender and cross-gender interactions. Thus, together with the trend coefficients, in total 9 interaction parameters are estimated in this specification.

[9]The NSYS 2001 data also contain a variable for the distance to school on basis of zip-code information that could be included in the z-vector. We do not explore that possibility in this paper.

4 The Dutch National School Youth Survey

Our empirical analysis is based on the 1992, 1996, 1999 and 2001 shifts of the Dutch National School Youth Survey (NSYS). The survey was a joint effort of the Social and Cultural Planning Office of the Netherlands (SCP) and the Netherlands Institute for Family Finance Information (NIBUD). Each survey is based on a sample of some 500 high school classes with approximately 10,000 students. A school that participates is compensated by means of a report summarizing the survey results for that school. The series of surveys is not a panel, although some schools have participated more than once.[10]

The specific advantage of this survey for estimating interaction effects is the fact that in principle, all students in a sampled class participate in the survey. Yet, some of them may be excluded from the data, for example because a student was absent on the day the questionnaires were filled out. The survey contains a wealth of information on economic, social, and psychological aspects of teenage life. In this paper, we will focus on how teenagers spend their time and money, how they get their money, and how they assess their self-esteem and well-being. There is limited information on parents (education and working hours) and on siblings. All information is self-reported. Thus, strictly speaking, the analysis measures social interactions in how teenagers report on their behavior. A US data set which is comparable to the present one is the National Education and Longitudinal Study (NELS), see e.g. Gaviria and Raphael (2001). Both surveys focus on non-cognitive outcomes within schools. While the NELS contains information on school averages, these are not available per class, grade or gender. This precludes any analysis of social interactions within classes.

[10]NIBUD has decided to replace the written survey by an internet survey, the first of which has been completed by 5,500 pupils in 2004. However, this survey is not school class based.

Across the different years that the NSYS was held, changes in the phrasing and coding of questions have occurred as well as changes in the regional representation of schools. To give an example, almost no schools from the (rural) northern part and the (highly urbanized) western part of the Netherlands participated in the 2001 survey. Another circumstance that reduces the number of useful observations in the 2001 survey is that for many teenagers, no information is given on in which class they are. In the next two subsections in which we describe the data, we give an account on how we dealt with changes in the set up of the survey.

4.1 Data: time use, income and expenditures

Table 2 presents the sample statistics of the time, income and expenditure categories we study. In all years, the three most important time use categories for teenagers are sleep, school and screens. The latter is a summary term for time spent on watching TV and video and using a computer. The time spent on sleeping and school is fairly constant over years (60 and 38 hours a week, respectively). The time spent on screens is clearly increasing over years (from slightly over 3 hours a day in 1992 to over 4.5 hours a day in 2001), probably reflecting the higher prominence of computers in the household. The other categories – time spent on jobs, going out, sports and making (cell) phone calls or sending short messages (SMS) – are very much smaller. Data for time spent on phone calls are only available for the 2001 shift. The numbers refer to time spent during a "normal school week" (thus "jobs" excludes time spent on vacation jobs). In 1996, there was a notable change in the way time use questions were asked. In the 1992 survey, responses were based on hours plus minutes per week, while the surveys as of 1996 had responses based on hours plus quarters per day. The reported numbers are all in hours per week. Due to a change in the educational system in the Netherlands, the school time measure includes

the number of hours spent on self-study in the 1999 and 2001 survey. In the 1992 survey, time spent going out is an aggregate of the time spent watching live sports and movies, visiting discos and bars. From 1996 onwards, there is one general question on the time spent going out. The time spent on going out shows a decreasing trend.

Likewise, the 1992 data on income received from parents are the total of pocket money, money received for clothing and travel expenses and possible extra gifts from parents. From 1996 onwards, one question on money received from parents is asked. For income from jobs, in 1992, students are asked to state either their weekly or monthly net earnings. From 1996 onwards, the income from jobs is determined as the aggregate earnings of a number of separate job categories. The questions on the time spent on jobs, on expenditures on clothing and shoes and on self-esteem did not change in time.

4.2 Data: explanatory variables

The list of explanatory variables is largely determined by data availability: gender, age, non-Dutch, single parent family, family size, urbanization, the student's school level, father's and mother's education, father's and mother's weekly working time, whether they are self-employed or not, and religion. We discarded all observations from our analysis for which there is no information on gender and age (0.5 and 1.0 percent, respectively). Unfortunately, there is no direct measure of family income in the data. Consequently, coefficients on father's and mother's education and hours of work may partly pick up income effects. We excluded observations with missing information on father's and mother's working time (about 20 percent of the observations).

Table 2 reports the summary statistics of the explanatory variables. Whereas the working time of the parents was measured in hours per week

in 1992, respondents had to choose from a series of intervals in later years.[11] The urbanization measure has a value between 1 (large city) and 5 (rural area). The 1999 and 2001 surveys unfortunately no longer contain information on family size and urbanization. We introduce three dummy variables for the student's school level: MAVO (lower level), HAVO (intermediate level), VWO (higher level), with lower vocational education as reference category. We take up a dummy variable for three types of religion: Catholicism, Protestantism and Islam, with 'no-believe' as reference category.

5 Estimates

To get some first insights in the nature of the data, we first ran regressions at the individual level, without taking interactions into account, but allowing for school specific fixed effects. For the different behaviors, results are given in Table 3. The table shows plausible patterns that are largely similar to those reported in Kooreman (2005). We refrain from a detailed discussion here and focus on the interaction patterns.

5.1 Within-nationality versus cross-nationality interactions

Table 4 presents the within and cross nationality interaction parameters. The results vary strongly across the different types of behavior. Time spent on school shows highly significant interactions, with the difference between within and cross nationality parameters being insignificant. This result is as should be expected for students within the same school class, and primarily serves to support the validity of the modeling approach.

Time spent on jobs shows strong within nationality interactions. Interestingly, the trend coefficient of the cross nationality interaction is positive and significant. Its size implies that while cross nationality interactions

[11] 0 hours, 1-12 hours, 12-32, 32-40 or >40 hours in 1996, and 0, 1-12, 12-20, 20-32, 32-40, >40 in the 1999 and 2001 NSYS. In our analysis, we use the midpoints of these intervals and 45 hours for the interval ">40 hours".

with respect to jobs were insignificant in 1992, they were similar to within nationality interactions in 2001. This result suggests that the delineation of social interactions across ethnic lines has evaporated during the decade under consideration, at least for time spent on jobs.

A somewhat similar pattern appears for time spent on screens. Note that this may be related to computer work in school as well as to personal communication using the internet at home (*e.g.* MSN).

Income from jobs, expenditures on clothing and shoes, and expenditures on phone/SMS all show strong interaction within ethnic groups, somewhat surprisingly mainly through the trend coefficients. Interactions between ethnic groups appear to be virtually absent for these types of behavior. The result for time spent on phone/SMS – insignificant within- and a significant between-ethnic groups interactions – is somewhat puzzling, and at variance with the results for expenditures on cell phone. Note that the information on time spent on phone/SMS was collected in 2001 only, so that we cannot analyze changes across years.

5.2 Nationality and gender interactions

In earlier work using the NSYS (Soetevent and Kooreman (2004) and Kooreman (2005), we analyzed social interactions on the basis of gender. In this section we allow interactions to vary with both gender *and* ethnicity, as specified in section 3.

In terms of within gender and cross gender interactions, table 5 is largely consonant with our earlier results. For example, expenditures on cell phone and on clothing and shoes exhibit mainly between-girls interactions, while income from jobs is characterized by relatively strong between-boys interactions.

In addition to that, table 5 reveals that almost all cross-gender interactions take place between boys and girls of the same nationality. Social

interactions between students with different gender *and* different nationality are virtually non-existent: None of the γ_{cncg}'s and δ_{cncg}'s is significant, with the trend coefficient for screens being the single exception. As noted above, this may be related to computer use in school.

Tables 4 and 5 provide some weak evidence of increased interactions between ethnic groups during the period considered. In addition to increased interactions related to school work (time spent on school and on screens), there are positive and significant trend coefficients for cross nationality interactions related to time spent on jobs and money spent on alcohol.

5.3 Effects of having older siblings

Only the 1992 and 1996 NSYS contain information on whether an interviewed pupil does have older siblings. For three behaviors – the time spent on jobs, the spent going out and the expenditures on alcohol – we incorporate this information into our model. The idea is that older siblings possibly constitute an own peer group that complements or substitutes peer group effects experienced in class. For example, given that alcohol expenditures strongly increase with age, the threshold for a pupil to imitate the drinking behavior of his or her alcohol consuming class mates may be lower when he or she has older siblings. On the other hand, pupils that spend much of their time with their siblings are likely to be less susceptible to the behavior of their class mates.

Table 6 contains the results. We do not find a significant effect of having older siblings for the time spent on jobs. This is an indication that older siblings in general do not provide superior information on vacancies to their younger brothers and sisters. On the other hand, the presence of older siblings does seem to lower the threshold for going out: pupils that have older siblings are more likely to join class mates that go out. For boys, that also seems to hold for the expenditures on alcohol. The pattern of cross-

gender interactions is hard to interpret. As we saw previously, cross-gender interactions in alcohol expenditures increase over time.

6 Conclusions

In this paper we have estimated models to analyze the lines along which social ties between high school teenagers are formed. We focused on delineations by gender, ethnicity, and having older siblings.

We find these characteristics to play distinct roles in how teenagers interact socially. We also find them to vary strongly across types of behaviors. For example, going out shows strong within-ethnicity interactions, while expenditures on cell phone and on clothing and shoes exhibit mainly between-girls interactions. Having older siblings has a limited effect on within school class social interactions of teenagers.

Another empirical finding of interest is some (weak) evidence on increased interactions between ethnic groups during the period considered. At the same time, the results clearly show that ethnic segregation is much more prevalent in some behaviors (most notably time spent on going out) than in others (in particular school related work). Given the absence of significant negative between-ethnicity interaction coefficients, there is no evidence of what might be coined 'strong ethnic segregation': making choices opposite to those of students with a different ethnicity.

A general criticism to empirical studies on social interaction effects is that significant interactions may merely reflect the failure to control for unobserved effects at the group level. We have partly accommodated this criticism by adding school-specific fixed effects. Yet, we recognize that we are close to the limits of what can be inferred on the basis of non-experimental data from (repeated) cross-sections. It seems that by now the marginal returns of collecting appropriate data exceed the marginal returns of further model refinement in the production of new insights on social interactions

and teenage behavior.

Table 1: Summary statistics outcome variables (24,512 observations)

		min.	mean	median	max.	st. dev.	frac. zero's	*obs.*
				Time use				
Sleep	1992	35.00	59.94	59.50	94.50	6.94	0.000	*5983*
	1996	22.75	59.50	59.50	91.00	8.06	0.000	*4310*
	1999	22.75	59.74	59.50	97.98	9.67	0.000	*8106*
	2001	22.75	59.90	59.50	96.25	8.77	0.000	*3626*
Eating/	1992	0.70	9.41	7.00	31.50	5.52	0.000	*5962*
personal	1996	0.00	10.62	10.50	33.25	5.68	0.012	*4704*
care	1999	0.00	10.23	8.75	33.25	5.73	0.005	*7820*
	2001	0.00	11.41	10.50	34.98	5.91	0.009	*3301*
School	1992	15.00	38.76	38.00	70.00	6.40	0.000	*5850*
	1996	5.00	38.30	39.00	71.00	7.56	0.000	*4782*
	1999	5.00	40.42	40.00	100.00	10.78	0.000	*2831*
	2001	6.00	40.25	39.00	110.00	9.61	0.000	*3652*
Jobs	1992	0.00	3.99	2.00	48.00	5.09	0.364	*5950*
	1996	0.00	3.41	2.00	25.00	4.45	0.420	*4221*
	1999	0.00	3.68	2.00	29.00	4.76	0.405	*7494*
	2001	0.00	4.10	2.00	60.00	5.39	0.389	*3197*
Going out	1992	0.00	4.96	4.00	42.00	5.22	0.252	*5921*
	1996	0.00	4.03	4.00	30.00	4.13	0.295	*4699*
	1999	0.00	3.46	3.00	24.00	3.94	0.366	*7476*
	2001	0.00	3.65	2.00	66.00	4.76	0.374	*3107*
Screens	1992	0.70	21.99	17.50	119.00	14.98	0.000	*5968*
	1996	0.00	24.12	21.00	106.75	14.97	0.014	*3922*
	1999	0.00	26.40	24.43	108.50	15.71	0.010	*8716*
	2001	0.00	32.87	28.00	136.50	21.29	0.009	*2964*
Phone/SMS	2001	0.00	5.09	1.75	68.25	8.76	0.287	*3984*
Sports	1992	0.00	3.30	2.00	28.00	3.42	0.239	*6156*
	1996	0.00	3.56	3.00	20.00	3.64	0.233	*4458*
	1999	0.00	3.75	3.00	29.00	4.05	0.223	*7812*
	2001	0.00	3.71	3.00	40.00	4.71	0.275	*3191*
				Income				
Income from	1992	0.00	110.13	74.98	1205.00	109.14	0.029	*5991*
parents	1996	0.00	82.52	50.00	999.00	85.63	0.094	*5100*
(monthly)	1999	0.00	79.05	50.00	975.00	97.61	0.110	*9476*
	2001	0.00	75.84	50.00	999.00	88.65	0.159	*3945*
Income from	1992	0.00	21.43	4.60	494.46	34.88	0.479	*5972*
jobs	1996	0.00	25.45	0.00	1200.00	67.78	0.565	*5132*
(weekly)	1999	0.00	33.35	0.00	999.00	96.17	0.574	*9420*
	2001	0.00	31.31	0.00	1800.00	68.02	0.551	*3937*
				Expenditures				
Clothing and	1992	0.00	34.51	0.00	400.00	58.34	0.608	*6281*
shoes	1996	0.00	30.95	0.00	300.00	48.13	0.571	*2863*
	1999	0.00	33.68	0.00	300.00	53.59	0.586	*6624*
	2001	0.00	47.13	0.00	800.00	76.63	0.542	*2679*
Phone/SMS	1999	0.00	10.15	0.00	300.00	24.14	0.693	*6092*
	2001	0.00	21.57	10.00	500.00	35.99	0.392	*2791*
Alcohol	1992	0.00	22.97	0.00	425.70	50.85	0.675	*6201*
	1996	0.00	17.98	0.00	300.00	34.66	0.507	*3672*
	1999	0.00	29.32	0.00	430.18	63.76	0.671	*7168*
	2001	0.00	34.66	0.00	412.80	65.27	0.624	*2813*

Table 2: Summary statistics explanatory variables

		min.	mean	median	max.	st. dev.	frac. zero's	obs.
				Student and family characteristics				
Girl	1992	0	0.492	0	1	0.500	0.508	5991
	1996	0	0.509	1	1	0.500	0.491	5100
	1999	0	0.521	1	1	0.500	0.479	9476
	2001	0	0.511	1	1	0.500	0.489	3945
Age	1992	11	15.062	15	23	1.333	0.000	5991
	1996	11	14.935	15	20	1.417	0.000	5100
	1999	11	14.215	14	21	1.399	0.000	9476
	2001	11	14.393	14	19	1.398	0.000	3945
Non-Dutch	1992	0	0.035	0	1	0.183	0.965	5991
	1996	0	0.034	0	1	0.181	0.966	5100
	1999	0	0.058	0	1	0.234	0.942	9476
	2001	0	0.042	0	1	0.201	0.958	3945
Single parent	1992	0	0.058	0	1	0.234	0.942	5991
	1996	0	0.058	0	1	0.235	0.942	5100
	1999	0	0.055	0	1	0.228	0.945	9476
	2001	0	0.059	0	1	0.235	0.941	3945
				School level				
Bridge	1992	-	-	-	-	-	-	-
	1996	0	0.112	0	1	0.315	0.888	5100
	1999	0	0.146	0	1	0.353	0.854	9476
	2001	0	0.106	0	1	0.308	0.894	3945
Level 1 (MAVO)	1992	0	0.402	0	1	0.490	0.598	5991
	1996	0	0.245	0	1	0.430	0.755	5100
	1999	0	0.308	0	1	0.461	0.692	9476
	2001	0	0.160	0	1	0.367	0.840	3945
Level 2 (HAVO)	1992	0	0.270	0	1	0.444	0.730	5991
	1996	0	0.219	0	1	0.414	0.781	5100
	1999	0	0.187	0	1	0.390	0.813	9476
	2001	0	0.210	0	1	0.408	0.790	3945
Level 3 (VWO)	1992	0	0.187	0	1	0.390	0.813	5991
	1996	0	0.265	0	1	0.441	0.735	5100
	1999	0	0.154	0	1	0.361	0.846	9476
	2001	0	0.179	0	1	0.383	0.821	3945
				Hours of work				
Father	1992	0	41.879	40	90	16.651	0.059	5991
	1996	0	36.741	36	45	11.172	0.051	5100
	1999	0	36.395	38	45	12.429	0.067	9476
	2001	0	36.554	38	45	11.683	0.054	3945
Mother	1992	0	18.985	18	90	17.282	0.242	5991
	1996	0	17.045	10	45	14.680	0.267	5100
	1999	0	16.000	16	45	15.176	0.318	9476
	2001	0	16.831	16	45	14.883	0.285	3945
				College degree				
Father	1992	0	0.160	0	1	0.367	0.840	5991
	1996	0	0.184	0	1	0.388	0.816	5100
	1999	0	0.149	0	1	0.356	0.851	9476
	2001	0	0.186	0	1	0.389	0.814	3945

Table 2: (continued)

		min.	mean	median	max.	st. dev.	frac. zero's	obs.
Mother	1992	0	0.072	0	1	0.259	0.928	5991
	1996	0	0.098	0	1	0.298	0.902	5100
	1999	0	0.077	0	1	0.267	0.923	9476
	2001	0	0.109	0	1	0.312	0.891	3945
					Religion			
Catholic	1992	0	0.328	0	1	0.470	0.672	5991
	1996	0	0.301	0	1	0.459	0.699	5100
	1999	0	0.227	0	1	0.419	0.773	9476
	2001	0	0.330	0	1	0.470	0.670	3945
Protestant	1992	0	0.161	0	1	0.368	0.839	5991
	1996	0	0.145	0	1	0.353	0.855	5100
	1999	0	0.164	0	1	0.370	0.836	9476
	2001	0	0.213	0	1	0.409	0.787	3945
Islam	1992	0	0.021	0	1	0.144	0.979	5991
	1996	0	0.034	0	1	0.182	0.966	5100
	1999	0	0.056	0	1	0.230	0.944	9476
	2001	0	0.043	0	1	0.203	0.957	3945

Table 3: Estimates OLS-estimation with intra-class correlation

	Time use						*Income*		*Expenditures*		
	School	Jobs	Going out	Screens	Phone/SMS	Sports	from parents	from jobs	Clothing and shoes	(Cell) phone	Alcohol
Girl	1.352	-0.287	-0.120	-6.507	2.207	-0.787	5.300	-4.678	14.934	0.097	-12.742
	(11.551)	*(-4.588)*	*(-2.142)*	*(-30.928)*	*(7.342)*	*(-15.122)*	*(4.539)*	*(-4.731)*	*(18.767)*	*(0.376)*	*(-16.781)*
Age	-0.293	1.066	0.917	-0.313	0.373	0.005	11.811	9.933	9.882	2.142	12.195
	(-4.862)	*(39.697)*	*(35.215)*	*(-3.160)*	*(2.846)*	*(0.207)*	*(23.573)*	*(23.838)*	*(27.456)*	*(16.459)*	*(37.866)*
Non-Dutch	0.292	-0.594	0.483	1.245	2.101	0.184	3.786	-3.879	8.938	1.885	1.889
	(0.923)	*(-3.358)*	*(3.595)*	*(2.391)*	*(3.198)*	*(1.352)*	*(1.417)*	*(-1.535)*	*(5.058)*	*(2.991)*	*(1.025)*
Single Parent	0.076	-0.167	0.004	0.550	1.067	-0.581	13.499	-2.632	7.789	2.361	-1.618
	(0.273)	*(-1.212)*	*(0.031)*	*(1.189)*	*(1.866)*	*(-4.742)*	*(6.196)*	*(-1.178)*	*(4.815)*	*(3.998)*	*(-1.030)*
School level	0.448	-0.710	-0.964	-5.152	-0.553	0.120	-7.862	-6.557	-7.217	-5.668	-7.686
(bridge year)	*(1.061)*	*(-3.763)*	*(-6.008)*	*(-9.244)*	*(-0.785)*	*(0.799)*	*(-2.387)*	*(-2.426)*	*(-2.982)*	*(-8.615)*	*(-3.136)*
School level 1	0.600	-0.187	-0.315	-2.217	0.343	0.129	-5.858	-4.017	-1.203	-1.551	-0.375
(MAVO)	*(1.856)*	*(-1.329)*	*(-2.682)*	*(-5.155)*	*(0.722)*	*(1.068)*	*(-2.432)*	*(-1.995)*	*(-0.648)*	*(-2.901)*	*(-0.211)*
School level 2	2.2248	-0.370	-0.777	-5.284	-0.670	0.238	-8.083	-8.573	-4.477	-5.673	-4.266
(HAVO)	*(6.406)*	*(-2.530)*	*(-5.701)*	*(-10.051)*	*(-1.003)*	*(1.850)*	*(-3.051)*	*(-4.278)*	*(-2.280)*	*(-7.890)*	*(-2.303)*
School level 3	2.853	-0.931	-1.687	-8.115	-1.984	0.263	-13.749	-13.852	-8.024	-9.480	-12.971
(VWO)	*(7.857)*	*(-5.948)*	*(-11.324)*	*(-15.189)*	*(-2.461)*	*(1.951)*	*(-4.827)*	*(-5.552)*	*(-3.956)*	*(-12.437)*	*(-6.651)*
Father hrs. of work	0.002	0.016	0.010	-0.007	-0.019	0.009	0.207	0.066	-0.031	-0.023	0.094
	(0.307)	*(6.931)*	*(4.790)*	*(-0.828)*	*(-1.718)*	*(4.706)*	*(4.881)*	*(1.414)*	*(-1.008)*	*(-2.171)*	*(3.514)*
Mother hrs. of work	0.003	0.019	0.013	0.011	0.018	0.009	0.375	0.146	0.211	0.032	0.142
	(0.619)	*(9.855)*	*(7.014)*	*(1.639)*	*(1.644)*	*(5.599)*	*(10.303)*	*(4.430)*	*(8.234)*	*(3.441)*	*(6.438)*
Father's college degree	-0.086	-0.270	0.071	-1.242	-0.750	0.130	11.834	-1.239	1.921	-0.725	-0.068
	(-0.480)	*(-2.688)*	*(0.762)*	*(-3.644)*	*(-1.559)*	*(1.579)*	*(7.032)*	*(-0.799)*	*(1.603)*	*(-1.669)*	*(-0.065)*
Mother's college degree	-0.031	0.036	0.255	-0.608	0.842	0.207	4.634	2.151	3.802	-0.046	3.276
	(-0.132)	*(0.281)*	*(2.331)*	*(-1.421)*	*(1.554)*	*(2.073)*	*(2.027)*	*(1.087)*	*(2.358)*	*(-0.086)*	*(2.400)*
Catholic	0.439	0.301	-0.147	-0.909	0.008	0.255	-2.480	1.885	-0.757	0.697	0.100
	(2.697)	*(3.540)*	*(-1.881)*	*(-3.371)*	*(0.025)*	*(3.708)*	*(-1.614)*	*(1.393)*	*(-0.703)*	*(1.766)*	*(0.103)*
Protestant	0.341	0.093	-0.724	-1.829	-0.318	-0.080	-9.406	0.462	-3.471	-1.550	-5.342
	(1.485)	*(0.842)*	*(-7.063)*	*(-5.040)*	*(-0.542)*	*(-0.857)*	*(-4.013)*	*(0.272)*	*(-2.180)*	*(-2.439)*	*(-3.967)*
Islam	0.632	0.097	0.051	1.403	-0.615	0.140	3.190	-4.588	11.648	3.781	-7.677
	(1.932)	*(0.539)*	*(0.356)*	*(2.492)*	*(-0.837)*	*(0.913)*	*(1.236)*	*(-1.299)*	*(6.315)*	*(5.810)*	*(-3.746)*
$\hat{\rho}$	0.033	0.000	0.002	0.001	0.000	0.000	-0.004	0.002	0.000	0.008	0.022
	(9.229)	*(-0.035)*	*(0.946)*	*(0.559)*	*(0.108)*	*(-0.102)*	*(-2.385)*	*(1.351)*	*(-0.056)*	*(3.732)*	*(10.035)*
$\hat{\sigma}^2$	63.461	20.251	17.040	228.188	72.036	14.073	8419.171	5254.703	2915.926	334.166	2529.296
	(198.905)	*(243.935)*	*(248.511)*	*(216.932)*	*(135.704)*	*(269.430)*	*(382.665)*	*(720.494)*	*(278.936)*	*(558.762)*	*(307.099)*
R^2	0.101	0.164	0.172	0.174	0.067	0.057	0.116	0.060	0.161	0.118	0.192

Table 4: Estimates of within and cross nationality interaction parameters

				σ^2	R^2	p-value			fraction
			trend			$n = cn$	trend	all	*n-dutch zeros*
					Time use (hours per week)				
School	n	0.147	0.008	66.93	0.109	0.124	0.031	0.116	*0.000*
		(8.56)	(1.50)	(201.98)					*0.000*
	cn	0.243	0.041						
		(4.15)	(2.09)						
Jobs	n	0.047	0.020	20.09	0.166	0.068	0.000	0.000	*0.039*
		(3.19)	(5.11)	(246.80)					*0.394*
	cn	-0.084	0.066						
		(-1.20)	(2.85)						
Going out	n	0.056	0.005	17.02	0.173	0.017	0.504	0.007	*0.042*
		(3.52)	(1.14)	(250.51)					*0.320*
	cn	-0.073	-0.005						
		(-1.43)	(-0.35)						
Screens	n	-0.002	0.012	227.89	0.175	0.398	0.000	0.000	*0.044*
		(-0.10)	(2.14)	(214.24)					*0.007*
	cn	-0.039	0.054						
		(-0.71)	(3.36)						
Phone/	n	-0.045	-	72.18	0.068	0.026	-	-	*0.042*
SMS		(-0.78)	-	(118.86)					*0.287*
	cn	0.183	-						
		(2.73)	-						
Sports	n	-0.007	0.003	14.56	0.057	0.692	0.908	0.987	*0.040*
		(-0.35)	(0.41)	(259.89)					*0.237*
	cn	0.02	0.00						
		(0.30)	(0.15)						
					Income (in dutch guilders)				
From	n	-0.006	0.006	8424.54	0.116	0.417	0.088	0.196	*0.045*
parents		(-0.39)	(1.28)	(375.76)					*0.095*
	cn	-0.040	-0.019						
		(-1.10)	(-1.85)						
From	n	0.022	0.025	5243.10	0.062	0.494	0.038	0.000	*0.045*
jobs		(1.04)	(2.37)	(721.74)					*0.545*
	cn	-0.043	0.036						
		(-0.47)	(0.87)						
					Expenditures and savings (dutch guilders per month)				
Clothing	n	0.009	0.025	2913.06	0.163	0.221	0.000	0.000	*0.045*
and shoes		(0.53)	(5.63)	(271.77)					*0.545*
	cn	-0.051	-0.011						
		(-1.10)	(-0.89)						
Cell phone	n	0.135	0.115	350.50	0.117	0.000	0.000	0.000	*0.047*
		(9.48)	(9.03)	(505.99)					*0.598*
	cn	-0.062	-0.065						
		(-1.52)	(-1.61)						
Alcohol	n	0.138	0.039	2497.46	0.202	0.000	0.000	0.000	*0.040*
		(11.31)	(9.71)	(322.10)					*0.635*
	cn	-0.163	0.029						
		(-3.56)	(2.33)						
Savings	n	-0.040	0.024	7858.80	0.087	0.252	0.000	0.000	*0.040*
		(-2.04)	(3.98)	(395.84)					*0.061*
	cn	-0.135	0.008						
		(-1.67)	(0.26)						

Table 5: Estimates of within and cross nationality and gender interaction parameters

					trend				p-value			
		B	G	cg	B	G	cg	R^2	$B = G$	cn	trend	all
						Time use (hours per week)						
School	n	0.17	0.25	0.10	0.02	0.01	0.01	0.110	0.11	0.00	0.12	0.00
		(4.84)	(7.91)	(4.12)	(1.21)	(1.17)	(0.92)					
	cn	0.32		0.13	0.05		0.02					
		(4.72)		(1.60)	(1.81)		(0.84)					
Jobs	n	0.04	0.12	0.00	0.01	0.01	0.03	0.167	0.07	0.57	0.00	0.00
		(1.44)	(3.69)	(0.09)	(1.25)	(0.81)	(5.48)					
	cn	-0.09		-0.06	0.11		0.01					
		(-0.97)		(-0.61)	(3.57)		(0.50)					
Going out	n	0.12	0.15	-0.02	0.01	0.02	-0.01	0.173	0.54	0.20	0.02	0.00
		(4.99)	(4.30)	(-0.81)	(2.22)	(2.54)	(-1.48)					
	cn	-0.13		-0.02	0.01		-0.02					
		(-1.78)		(-0.25)	(0.36)		(-0.85)					
Screens	n	-0.01	0.05	-0.03	0.03	0.00	0.01	0.176	0.21	0.73	0.00	0.00
		(-0.19)	(1.37)	(-1.03)	(3.13)	(0.25)	(0.96)					
	cn	-0.01		-0.06	0.01		0.10					
		(-0.14)		(-0.77)	(0.63)		(4.07)					
Phone/ SMS	n	-0.09	0.04	-0.08	-	-	-	0.069	0.29	0.02	0.02	0.00
		(-0.83)	(0.54)	(-0.86)	-	-	-					
	cn	0.33		0.10	-		-					
		(2.01)		(0.75)	-		-					
Sports	n	0.05	-0.03	-0.03	0.02	0.00	0.00	0.058	0.16	0.52	0.82	0.70
		(1.30)	(-0.66)	(-0.99)	(1.36)	(0.03)	(-0.50)					
	cn	0.06		-0.04	0.00		0.01					
		(0.95)		(-0.40)	(-0.23)		(0.42)					
						Income (in dutch guilders)						
From parents	n	0.06	0.03	-0.07	0.02	0.01	-0.01	0.118	0.49	0.02	0.00	0.00
		(2.21)	(0.97)	(-2.69)	(3.23)	(1.11)	(-1.14)					
	cn	-0.16		0.06	-0.06		0.02					
		(-2.66)		(1.06)	(-3.94)		(1.13)					
From jobs	n	0.04	0.01	0.01	0.04	0.02	0.02	0.063	0.63	0.12	0.20	0.00
		(0.95)	(0.21)	(0.31)	(2.00)	(0.59)	(1.34)					
	cn	-0.20		0.14	0.02		0.06					
		(-1.65)		(0.90)	(0.38)		(0.73)					
						Expenditures (dutch guilders per month)						
Clothing and shoes	n	-0.04	0.14	-0.07	0.02	0.04	0.01	0.165	0.00	0.33	0.00	0.00
		(-1.16)	(4.91)	(-2.61)	(2.20)	(5.21)	(1.82)					
	cn	-0.07		-0.07	-0.05		0.03					
		(-1.12)		(-0.92)	(-3.00)		(1.44)					
Cell phone	n	-0.01	0.14	0.05	0.02	0.08	0.11	0.124	0.01	0.05	0.00	0.00
		(-0.26)	(3.39)	(1.43)	(0.53)	(1.93)	(3.37)					
	cn	-0.06		0.13	-0.20		0.02					
		(-0.62)		(1.80)	(-1.94)		(0.34)					
Alcohol	n	0.24	0.19	0.00	0.04	0.01	0.04	0.204	0.125	0.01	0.00	0.00
		(14.80)	(5.56)	(-0.15)	(7.73)	(1.00)	(6.54)					
	cn	-0.13		-0.18	0.03		0.02					
		(-2.15)		(-1.54)	(1.81)		(0.51)					

Table 6: Estimates of gender interaction parameters and the presence of older siblings

	older siblings					trend		R^2	p-value sibl.	*obs.*
		B	G	cg	B	G	cg			
Time jobs	no	0.07	0.14	-0.16	-0.03	-0.02	0.00	0.161	0.570	*10171*
		0.75	1.58	-2.48	-1.13	-0.82	0.15			
	yes	-0.06	0.07	-0.08						
		-0.92	0.69	-1.42						
Going out	no	-0.06	-0.08	0.06	-0.02	0.00	-0.03	0.174	0.029	*10233*
		-0.84	-0.90	1.04	-0.95	0.09	-1.36			
	yes	0.09	0.14	-0.11						
		1.48	1.82	-1.79						
Alcohol	no	-0.10	0.17	-0.11	-0.02	-0.04	0.05	0.191	0.008	*9540*
		-1.55	1.14	-1.40	-0.71	-0.99	1.93			
	yes	0.17	0.12	-0.20						
		3.14	0.84	-2.86						

Note: 1994 serves as reference year.

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