

**Social Contagion and High School Dropout:
The Role of Friends, Romantic Partners, and Siblings**

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Abstract

Social contagion theories suggest that adolescents in relationships with same-age high school dropouts should be at a greater risk of dropping out themselves. Yet, few studies have examined this premise, and none have considered all potentially influential same-age intimates, focusing instead on only either friends or siblings. Moreover, a key influence in adolescents' social worlds, romantic partners, has been ignored. The goal of this study was to provide a comprehensive view of dropout contagion by considering occurrences of dropout among friends, siblings, and romantic partners. Data came from a sample of Canadian adolescents ($N = 545$) comprising one third of high school dropouts; a second third of carefully matched at-risk but persevering schoolmates; and a last third of average, not-at-risk students. As predicted, adolescents were at greater risk of dropping out when a member of their network had recently left school (i.e., in the past year, $OR = 3.11$; 95% CI: 1.78-6.27), with independent associations of non-trivial sizes for occurrences of dropout among friends, romantic partners, and siblings (ORs between 1.97 [95% CI: 1.25-3.41] and 3.12 [95% CI: 1.23-11.0]). Moreover, adolescents seemed particularly at risk of quitting school ($OR = 4.88$; 95% CI: 2.54-12.5) when their networks included more than one type of same-age intimate (e.g., a friend *and* a sibling) who had recently dropped out. Findings suggest that social contagion of dropout is a pervasive phenomenon in low-income schools and that prevention programs should target adolescents with same-age intimates who have recently left school.

Keywords: high school dropout, friends, siblings, romantic partners, social contagion

Educational Impact and Implications Statement

An adolescent's decision to leave high school without a diploma is unlikely to be made in a social vacuum, especially in areas characterized by low graduation rates. Our interview-based findings indicate that in comparison with students who stay in school, adolescents who drop out are at a greater risk of having a friend, a romantic partner, or a sibling who had themselves recently left school without a diploma. Dropout thus appears to be socially contagious over a short period of time. In order to prevent this outcome, it may be necessary to limit its spread from one adolescent to another.

Social Contagion and High School Dropout: The Role of Friends, Romantic Partners, and Siblings

High school dropout is associated with a host of negative lifelong consequences, and thus represents a primary target for prevention in many Western countries (Lansford, Dodge, Pettit, & Bates, 2016; OECD, 2018). Even though national high school graduation rates are generally on the rise and have reached 90% in some countries (Snyder, de Brey, & Dillow, 2019), dropout rates remain high in many disadvantaged communities (Nieuwenhuis & Hooimeijer, 2016). Understanding the factors responsible for the high prevalence of dropout in these communities appears especially urgent in today's context of rising socioeconomic inequality and segregation (Leventhal & Dupéré, 2019). Social contagion is one important factor that might lead to the geographical concentration of dropout. Yet, even in communities where this outcome is relatively prevalent, most adolescents do graduate from high school (Harding, 2011), possibly because not all young residents are equally exposed to dropout via their social networks. During adolescence, social networks are complex and include different types of same-age intimates that all could, to varying degrees, influence each other's educational decision-making process (Furman & Rose, 2015; Shortt, Capaldi, Dishion, Bank, & Owen, 2003), perhaps most vividly by opting to stay in school or not.

The goal of the present study is to determine the extent to which adolescents who drop out of high school have friends, romantic partners, or siblings who have themselves recently left school. Dropout has typically been viewed as the terminal point of an educational trajectory marred by difficulties from the beginning (Alexander, Entwisle, & Kabbani, 2001; Finn, 1989). However, this educational outcome does not seem to be strictly determined by enduring individual characteristics. In fact, it is not always preceded by a long accumulation of failures,

frustrations, and acting out in school: between one third and one half of dropout cases involve adolescents without obvious long-term problems (for reviews, see Bowers & Sprott, 2012; Dupéré et al., 2015; McDermott, Anderson, & Zaff, 2018). In these cases, theories suggest that dropout may come about in the wake of recent disruptions, to which adolescents are highly sensitive, especially when they pertain to their social world (Dupéré et al., 2015; Romeo, 2017; Steinberg, 2014). In support of this view, empirical findings highlight strong links between very recent (e.g., in the past few months) stressful disruptions and dropout (Dupéré et al., 2018; Samuel & Burger, 2019). Similarly, the negative impact of grade retention is most acute in the few months surrounding the event and then recedes, resulting in a “motivational dip [that] is temporary and overcome within a year or two” (Kretschmann, Vock, Lüdtke, Jansen, & Gronostaj, 2019, p. 1441). Thus, theory and empirical results suggest that dropout can occur as a response to immediate circumstances, including, perhaps, events in adolescents’ social networks.

Social Contagion

Social contagion refers to the transmission of behaviors through contact with others who exhibit these behaviors (Dishion & Tipsord, 2011). For some behaviors, contagion could occur through attempts to imitate others perceived as desirable models (Akers, 2017; Bandura, 2016), and studies confirm that adolescents frequently adopt their high-status (popular) peers’ behaviors and attitudes, apparently in order to improve their own status in school (Brechtwald & Prinstein, 2011). Dropping out, however, seems unlikely to be imitated for this reason because it is either uncorrelated or negatively correlated with status in the peer group as a whole, and because it represents an exit from the school’s social world (French & Conrad, 2001; Lansford et al., 2016; Véronneau, Vitaro, Pedersen, & Tremblay, 2008). Alternatively, contagion could occur via the transmission of educational norms. Harding (2011) has suggested that in communities where

dropout is prevalent, adolescents are exposed to conflicting local norms concerning the acceptability of dropout, perhaps through their peer networks.

Regardless of the mechanism involved, little is known with respect to the specific networks potentially implicated in the transmission of dropout. Figuring out which specific actors play a role, whether alone or jointly, may prove important for prevention. For instance, Lonardo, Giordano, Longmore, and Manning (2009) have shown that adolescents are at higher risk of being involved in delinquent activities when their network includes more than one type of delinquent intimate (e.g., friends and romantic partners), possibly because the diversity of models makes the problematic behavior both more ubiquitous and more socially acceptable (see Haynie, Silver, & Teasdale, 2006; Simon, Aikins, & Prinstein, 2008).

In public health, contagion is often considered to occur through recent contact between carriers and recipients (Heyman, 2014). Social contagion could also depend on recency of exposure, especially for events that happen at a specific point in time, like suicide or dropout. In fact, suicidal attempts by friends and family members seem to increase adolescents' own attempts and suicidal thoughts only during a one-year period (Abrutyn & Mueller, 2014). Similarly, and as noted previously, risk of dropout is exacerbated by disruptions such as conflicts at school, but only for a short time window spanning a few months to a few years (Dupéré et al., 2018; Kretschmann et al., 2019). More generally, treatment effects frequently fade out after a year or two (Bailey, Duncan, Odgers, & Yu, 2017). Dropout may thus be socially contagious for just a short period of time.

Social contagion is evidently not the sole process that could explain why adolescents who drop out tend to be part of the same social networks. Within the larger heterogeneous group of their schoolmates, adolescents tend to gravitate toward peers presenting behaviors and attitudes

(e.g., regarding school perseverance) compatible with their own (Brechwald & Prinstein, 2011). This similarity-based selection, or homophily, does not preclude social contagion. In fact, contagion may be especially likely to occur when adolescents with pre-existing vulnerabilities are in contact (Dishion & Tipsord, 2011). Only experimental or detailed longitudinal evidence, with proper statistical controls, can help disentangle the relative contribution of social influences and homophily and similarity-based selection (Burgess, Riddell, Fancourt, & Murayama, 2018). When these designs are not feasible, researchers trying to isolate risk factors for dropout should take into account key individual (e.g., placement in special education, retention, grades, school engagement) and family (e.g., structure, parental education, immigration status) characteristics associated with this outcome (What Works Clearinghouse, 2014).

Same-Age Intimates and Contagion of High School Dropout

Despite the well-documented concentration of dropout in some communities, very few studies have attempted to determine the role played by the social networks of same-age intimates in the contagion of dropout. None of the few existing studies, reviewed next, have considered the issue of recency of exposure or have attempted to include all key same-age intimates in their analysis.

Friends. Despite the diverse composition of adolescents' networks, studies on the social contagion of problematic behaviors have focused almost exclusively on friends (Brechwald & Prinstein, 2011). These studies show that adolescents who drop out of high school tend to befriend peers who are involved in deviant activities or who have left school themselves, with particularly strong associations for the latter (Battin-Pearson et al., 2000; Cairns, Cairns, & Neckerman, 1989; Kaplan, Peck, & Kaplan, 1997; Staff & Kreager, 2008; Traag, Lubbers, & van der Velden, 2012; Véronneau et al., 2008; Vitaro, Larocque, Janosz, & Tremblay, 2001). In

Carbonaro's (1998) study, for instance, the odds of dropping out were more than three times greater among adolescents who had dropout friends than among those who did not.

These findings could either over- or underestimate social contagion of dropout between friends, for two reasons. First, it has not been demonstrated that there is a temporal proximity between friends' and participants' dropout. Friends' characteristics were either measured years before participants had left school (Battin-Pearson et al., 2000; Cairns et al., 1989; Kaplan et al., 1997; Staff & Kreager, 2008; Traag et al., 2012; Véronneau et al., 2008; Vitaro et al., 2001) or without demonstrating that participants' departure from school had actually occurred *after* they had started befriending dropouts, and not the reverse (Carbonaro, 1998). Considering that adolescent friendships are only moderately stable even in normal circumstances (Meter & Card, 2016), the composition of the group of friends could have changed substantially over the years preceding the departure from school and be affected by this departure. Second, while it is clear that friends occupy an important place in adolescents' social networks, they are not the only same-age intimates with whom adolescents spend a substantial amount of time (Christakis & Fowler, 2007; Larson, Richards, Sims, & Dworkin, 2001; Larson & Verma, 1999). As discussed next, romantic partners and siblings are also significant same-age actors.

Romantic partners. In contrast with friends, romantic partners have been completely ignored in the literature on dropout contagion. This omission is surprising given the otherwise well-documented association between precocious sexual activity, teenage parenthood, and dropout (Dupéré et al., 2015; Frisco, 2008; Steward, Farkas, & Bingenheimer, 2009). Romantic relationships and friendships overlap to a significant extent: romantic partners are often part of the same larger group of friends, partners are frequently former friends, and ex-partners sometimes remain friends (Furman & Collibee, 2018; Furman & Rose, 2015). Moreover, both

types of relationships are intimate and recognized as sources of potential social influences, at least for outcomes other than dropout (Brechwald & Prinstein, 2011; Christakis & Fowler, 2007; Dishion & Tipsord, 2011; Kreager & Haynie, 2011; Wesche, Kreager, & Lefkowitz, 2019).

Nonetheless, being romantically involved with a dropout peer may not have the same implications as being friends with one. On the one hand, adolescents typically feel less close to their romantic partners than to their friends, and during adolescence, romantic relationships are usually of shorter duration than friendships (Connolly & McIsaac, 2011; Laursen & Williams, 1997). On the other hand, for an adolescent who considers quitting school, romantic involvement with a dropout partner may serve as a special source of support and validation in the transition to life out of school (e.g., through cohabitation; see Manning, Cohen, & Smock, 2011; Thorsen, 2017). Romantic partners could thus play a key role in dropout contagion.

Siblings. Families are thought to powerfully shape adolescents' educational trajectories. Hundreds of studies have indeed linked low parental education with dropout (Björklund & Salvanes, 2011; Rumberger, 2011). Yet, parents are not the only significant actors in a family. In fact, siblings' low educational attainment may be the family's structural characteristic most strongly related to dropout, more so than parental education, single parenthood, or receipt of public assistance (Gleason & Dynarski, 2002).

The few studies on dropout contagion that have specifically considered siblings have shown that the odds of dropping out were higher among adolescents with a sibling who had dropped out than among those who did not (Jacob, 2001; Kaufman, Bradbury, & Owings, 1992; Levine & Painter, 1999; Oettinger, 2000; Rumberger & Thomas, 2000; but see Stone, 2006; Teachman, Paasch, & Carver, 1996, 1997). Although informative, these few studies are limited in several ways, notably because they are based on only two data sets dating from the 1970s and

1980s. Recent demographic changes (e.g., regarding family size and living arrangements; Cherlin, 2010) could have altered the significance of siblings' school perseverance. Sibling contagion was also treated as a nuisance in these studies, and no efforts were made to examine its potentially distinct role. In contrast with friends and romantic partners, siblings are not selected by adolescents among their schoolmates. Furthermore, adolescents typically interact with their siblings at home rather than in a school context. For these reasons, dropout among siblings may represent an additional risk factor that operates independently of dropout among friends or romantic partners.

The Present Study

The goal of the present study was to examine the social contagion of dropout through adolescents' social networks, more specifically through recent or ongoing relationships with all key same-age intimates (friends, siblings, and romantic partners). Three hypotheses were examined. First, since the extant literature did not allow specific predictions, it was expected that dropout among any type of same-age intimates would be independently associated with dropout among participants. Second, it was hypothesized that dropout among two types of same-age intimates would be associated, in a cumulative fashion, with a greater risk of dropout for participants than dropout among a single type of intimates. Third, it was expected that only recent occurrences of dropout in one's social network would be associated with a greater risk of dropout for participants.

Given the goal and hypotheses of the study, adopting a traditional longitudinal cohort design would have been impractical on at least three counts. First, it would have required following a large sample for a long period because dropout can occur at any time during a multi-year developmental period (roughly between ages 14 and 20), and as such it is relatively rare

during any given year, even in communities where it is common overall (Alexander et al., 2001). In epidemiological terms, dropout has a low yearly incidence of new cases even in a context of high lifetime prevalence. Second, apart from being labor-intensive, following up on a large sample for many years is likely to introduce biases given that adolescents at risk of dropping out of school also tend to stop participating in longitudinal follow-ups. In this population, 50% attrition rates between two annual waves of data collection are not uncommon (Mühlböck, Steiber, & Kittel, 2018; see also Beaver, 2013; Delfabbro, Winefield, Winefield, Malvaso, & Plueckhahn, 2017). Third, dropout and events of potential significance (e.g., witnessing a friend's departure from school) can occur between annual or biannual waves of longitudinal data collection, making it difficult to determine their temporal order of occurrence months or even years after the fact. In many cases, events of potential significance are simply unrecorded (Dupéré et al., 2015), giving the impression that a substantial proportion of participants in longitudinal studies drop out without reasons (e.g., Bowers & Sprott, 2012).

Based on these considerations, we adopted a matched case-control design. Although this design is rarely used in educational psychology, its relevance is well established in certain subfields of clinical psychology (Kazdin, 2017) and, more generally, in epidemiology (Rothman, Greenland, & Lash, 2008a). A matched case-control design is especially useful for examining whether recent exposure to an event of potential significance (e.g., dropout among siblings) could precipitate a relatively rare dichotomous outcome with a clear time of onset (e.g., Rothman et al., 2008a; Schulz & Grimes, 2002). Using this type of design, recent exposures to events of potential significance can be retrospectively documented and compared among cases (e.g. dropouts) and closely matched controls (e.g. non-dropouts) who have not experienced the outcome under study despite having a background similar to that of cases in terms of risk factors.

Method

The Institutional Review Board of the first author's university approved the present study. Informed consent was obtained from the participants at both the screening and interview phases of the study, described next.

Study Design and Participant Selection

Two-stage case-control designs: General principles. The present study relies on a subtype of case-control design. Our two-stage sample design (Breslow, 2014) involved an initial screening stage to assess the matching factors and other potential confounders in the targeted population as a whole (e.g., students attending participating high schools), and a second stage dedicated to measuring, in a subsample of cases and controls, exposure to events of potential significance – that is, occurrences of high school dropout among participants' friends, romantic partners, and siblings.

Before describing how these two stages were implemented, it is important to note that key design recommendations aimed at ensuring validity of findings were carefully followed (Rothman et al., 2008a; Schulz & Grimes, 2002). First, cases and matched controls were recruited from the same well-defined source population, regardless of their exposure to the events of potential significance (e.g., so that dropouts with dropout friends would not be more likely to be recruited than dropouts without such friends). Second, dropout cases were interviewed right after they had left school, and life calendar techniques (Axinn et al., 2019; Caspi et al., 1996) were used to establish that exposure to the event of potential significance had occurred *before* the outcome (i.e., that adolescents were exposed to dropout through their social networks before they dropped out themselves). Finally, confounding was addressed both at the design and analytical levels. At the design level, we selected matching variables (e.g., low school

engagement, grade retention, placement in special education) likely to be true potential confounders, known to predict both exposure and the outcome in extant studies (see Gifford-Smith, Dodge, Dishion, & McCord, 2005; What Works Clearinghouse, 2014) and in the present sample (results available upon request). At the analytical level, these variables and other potential confounders were also controlled for in multiple logistic regressions (see *Analytic Strategy* section). Also, additional analyses and robustness checks were conducted to rule out other potential threats to validity, for instance to make sure that the main results were not solely reflecting reverse causation problems arising when the exposure to events of potential significance determines the matching variables rather than the reverse (see *Result* section).

Two-stage case-control designs: Sample. First-stage screening (of the source population) was conducted in 12 francophone public high schools in and around the city of Montreal, Canada. On average, the schools had high cumulative dropout rates ($M = 36\%$) more than twice the provincial average, and close to the threshold of 40% used in the United States to classify high schools as “dropout factories” (DePaoli et al., 2015). Based on provincial official data, 10 of the 12 schools were located in areas of concentrated disadvantage (with high proportions of families with low-educated and nonworking parents), and two served lower to middle-class communities. On average, 31% of the families in the school’s catchment areas had incomes below Statistics Canada’s poverty threshold. Three schools participated in the fall of 2012, four in the fall of 2013, and five in the fall of 2015. Early in the school year, all students of at least 14 years of age were asked to complete a short questionnaire that measured their initial risk for dropout, as well as basic sociodemographics (see *Measures*). The vast majority (97%) agreed ($N_{\text{screened}} = 6,773$).

Second-stage interviewing of cases and controls occurred all through the school year, with a participation rate of 70%, a high rate given the overrepresentation of socioeconomically disadvantaged, academically vulnerable adolescents. Regarding dropout cases ($n = 183$), school staff informed the research team as soon as a student had filed an official notice of termination before obtaining a diploma, had stopped attending school for at least one month without justification, or had asked for a transfer to the adult sector (GED equivalent), GED graduates being more similar to dropouts than to high school graduates on a number of outcomes (Heckman, Humphries, & Kautz, 2014).

Two groups of controls were interviewed. After interviewing each dropout case, an interview was conducted with a matched persevering (non-dropout) control from the same school, the same program (regular or special education placement), of the same sex, and with a similar score on the dropout risk index administered within the first-stage screening questionnaire ($n = 183$). To the extent possible, these matched controls were also similar to dropout cases in terms of family background. Additionally, an unmatched, contrasted not-at-risk group of controls ($n = 179$) was formed by interviewing students with screening risk index scores close to their school's average (calculated separately by sex). This second group was interviewed for descriptive purposes, and for use in robustness checks (see Results section). Table 1 summarizes the family and individual characteristics of the three groups of interviewed dropout cases, matched at-risk controls and contrasted normative controls.

Measures

Outcome: Dropout status (administrative data). Interviewees were considered to have dropped out when, according to school staff, they met one of the three already mentioned criteria

(notice of termination, prolonged unjustified absence, or request for a transfer to adult education).

Control variables on which participants were strictly matched: Individual risk for dropout and sex (self-reported data from screening questionnaire). The screening questionnaire included a *dropout risk index* combining answers from seven questions about major risk factors for dropout that concerned educational achievement (e.g., grades), attainment (e.g., retention), and engagement (e.g., aspirations). In its initial validation, conducted in a sample of about 35,000 high school students recruited across the province of Québec, this index was found to have a good reliability and predictive validity (Archambault & Janosz, 2009). In the current sample, predictive validity and internal consistency were similarly good (area under the ROC curve = 0.81; $\alpha = 0.76$), and scores on the index predicted dropout more accurately than administrative data on failures, truancy, and suspensions (Gagnon et al., 2015).

Answers to other questions from the screening questionnaire were also used for matching. *Special education placement* and *sex* were considered, as the risk for dropout is higher among students with learning disabilities or behavior problems and among males (Rumberger, 2011).

Control variables on which participants were matched to the extent possible: Sociodemographics (self-reported data from screening questionnaire). In addition to sex, the screening questionnaire included questions about other sociodemographics that were used for matching to the extent possible, including participants' *age* and *immigration status* (immigrants were defined as youth with at least one parent born outside of Canada). Family background characteristics were also covered via questions about *parental education* (this variable was recoded to represent the higher level of education attained by one parent on a scale ranging from

1 = primary to 4 = university), *maternal and paternal employment* (unemployed vs. employed), and *family structure* (divorced or separated parents vs. intact, two-parent families).

Control variables on which participants were not matched (interview data). Other relevant background variables were measured during the individual interviews, and could thus not be used for matching. *Visible minority* status, defined as “persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour” (Statistics Canada, 2017), was determined by asking participants to indicate whether they belonged to a visible minority group or not (interviewers separately corroborated the information). Participants also provided information about *sibship size* by indicating the total number of siblings (full, half, or step) in their primary (and, if applicable, secondary) home.

Previous analyses conducted in the present sample showed that recent exposure to acute or chronic stressors was independently associated with high school dropout (Dupéré et al., 2018). Accordingly, two variables capturing acute and chronic stressor exposure were incorporated as potential confounders (number of severe events and of severe ongoing chronic difficulties). These exposures (in the past six months) were measured during the interview with the adolescent version of the Life Events and Difficulties Schedule (Brown et al., 1992; Frank, Matty, & Anderson, 1997). In the present sample, this instrument showed good interrater reliability (ranging between .79 and .90) and concurrent validity (Dupéré et al., 2017).

Occurrences of dropout among friends, romantic partners, and siblings (interview data). During the interview, participants were asked whether some of their close friends, romantic partners, or siblings had dropped out of high school, and if so, how many. When applicable, participants were asked when each reported same-age intimate had dropped out. Life history calendar techniques (i.e., visual cues) were used (see Axinn et al., 2019). A dichotomous

variable was computed to capture the overall presence of at least one dropout in any of these three relational settings (friendships, romantic relationships, or sibling relationships). In addition, three distinct dichotomous variables were computed to indicate the presence of at least one close friend, romantic partner, or sibling who had dropped out at some point in the past.

Two polytomous variables were computed to capture potential cumulative and recency effects. For cumulative effects, a three-level categorical variable was computed distinguishing 1) those with no dropouts in their network, 2) those who reported the presence of dropouts in only one of the three types of same-age affiliates (e.g., among friends but not among romantic partners or siblings), and 3) those who reported the presence of dropouts among at least two types of same-age affiliates (e.g., among friends *and* among siblings). For recency effects, a variable with five levels was prepared, distinguishing 1) those with no dropouts in their network, 2) those for whom the most recent dropout event in their network had occurred in the past year, 3) those for whom this event had occurred one to two years ago, 4) those for whom it had occurred more than two years ago, and 5) those who were not able to recall when dropout events in their network had occurred.

Analytic Strategy

The analytic strategy relies on two types of analyses recommended for case-control designs. Data from such designs can be first analysed via simple bivariate techniques (e.g., chi-square comparisons, bivariate odds ratio [OR]) comparing cases and controls on their level of exposure to the events of potential significance – that is, exposure to dropouts among friends, romantic partners, and siblings (Rothman, Greenland, & Lash, 2008b). Although useful for basic descriptive purposes, these analyses are insufficient for rigorous hypothesis testing.

Beyond simple bivariate associations, methodologists indeed recommend that researchers estimate the link between events of potential significance and outcome while accounting for potentially confounding risk factors (Rothman et al., 2008b). Multiple logistic regression techniques are typically used to that end (Greenland, 2008; Kuo, Duan, & Grady, 2018; Pearce, 2016). The regression-based adjusted odds ratios obtained with matched data are akin to those that would be obtained with data from a longitudinal cohort design, and can be essentially interpreted as they would in the latter case (Rothman et al., 2008a). In other words, case-control odds ratios obtained from multiple logistic regressions capture the degree to which exposed participants are more at risk than unexposed ones of developing the problem under study. Our analytic strategy thus includes multiple logistic regression techniques. Regular logistic regressions were preferred over other commonly used options (i.e., conditional logistic regressions) because they are parsimonious and flexible (e.g., they allow for bootstrapping; Kuo et al., 2018; Pearce, 2016). Robustness checks were conducted to ensure that the result remained the same with alternative analytical techniques often used in case-control designed data, like conditional logistic regression (see *Results* section).

Results

Bivariate Results

Preliminary bivariate comparisons focusing on control variables. Before implementing the two steps of the main analytic strategy just described, preliminary bivariate comparisons focusing on the control variables were conducted, to verify that the matching procedure functioned properly. The results are reported in Table 1. By design, dropout cases and matched controls were not different on the variables strictly used for matching. Similarly, no differences emerged between these two groups for most of the variables used for matching to the

extent possible (age, visible minority, parental education and maternal employment), although significant differences were found for two variables (paternal employment and separated/divorced parents). The fact that the matching procedure functioned well but not perfectly further underscores the need to control for background variables in the final regression models.

For the interview-based control variables not used for matching, significant differences between dropout cases and matched controls were found for recent stressor exposure, as expected based on published reports (Dupéré et al., 2018). Results for the unmatched contrasted controls also corresponds to expectations, as this group tended to be more advantaged than the two others, in terms of both individual dropout risk and sociodemographics, for instance because this group's parents had higher level of education on average compared to dropout cases.

Bivariate comparisons focusing on potential social influences. Bivariate comparisons that did not control for potentially confounding variables (Table 2) show that in comparison with matched and contrasted controls, dropout cases had been significantly more exposed to occurrences of dropout among their friends, romantic partners, or siblings. These comparisons also show that dropout cases had more frequently witnessed occurrences of dropout among one type (e.g., friends only) or two or more types (e.g., both friends *and* siblings) of same-age intimates than matched or contrasted controls. The magnitude of the difference was particularly large in the latter case: dropout cases were 2.6 times (19.7% / 7.7%) more likely than matched controls to report occurrences of dropout for two or more types of same-age intimates. Also, dropout cases reported more occurrences of recent (within the past year) dropout in their network than matched or contrasted controls. In contrast, the proportions were not significantly different for occurrences of dropout dating back more than a year.

Logistic Regression Analyses

As in previous published analysis based on the present data set (e.g., Dupéré et al., 2018), regression analyses controlling for potential confounders were conducted only with dropout cases and matched controls ($n = 366$) because it was suspected that unmeasured (and uncontrollable) differences were more likely to affect the findings if contrasted (unmatched) controls were included (but see the *Sensitivity and Robustness Checks* section). Because only dropout cases and matched controls were incorporated in the analysis, the control variables used for matching the two groups should not be expected to be significantly associated with the outcome, even though these variables are strong predictors of dropout in the general population (see Table 1 and *Preliminary bivariate comparisons* subsection). In the regression analyses, standard errors were bootstrapped to account for the clustering of participants within schools (Cameron & Miller, 2015).

The results of the regression models are presented in Table 3. The first model (Model 1) shows that after inserting potential confounders, occurrences of dropout in one's social network, irrespective of the same-age intimates involved, were independently associated with dropout among participants, with a non-trivial effect size (OR = 2.85, 95% CI 1.77-5.05). In the second model (Model 2), a distinction was made between occurrences of dropout among friends, romantic partners, and siblings. Occurrences of dropout among each type of intimate were independently associated with early school leaving, with non-trivial ORs ranging from 1.97 (95% CI 1.25-3.41) for friends, to 3.12 (95% CI 1.23-11.01) for romantic partners. In Model 3, the OR for the occurrences of dropout among two types of intimates or more was particularly large — almost twice the OR estimated for the occurrence of dropout in only one type of intimate ($4.88/2.53 = 1.93$) — although both were significantly associated with dropout among

participants. Finally, in Model 4, only recent (within the past year) occurrences of dropout in one's network predicted dropout among participants (OR = 3.11; 95% CI 1.78-6.27).

Additional exploratory analyses were conducted to determine whether the main regression findings held for both boys and girls, and for participants from the regular and special education sectors. Moderation was tested by rerunning the four Table 3 models while including interaction terms between the tested moderator and the characteristics of social networks. To illustrate, Model 1 was rerun with an interaction term between gender and the occurrence of dropout (i.e., male X at least one occurrence of dropout among friends, romantic partners, or siblings). Similar interaction terms were introduced in Model 2 (e.g., male X occurrence of dropout among friends) and in Model 3. No significant interactions emerged (full results available upon request).

Sensitivity and Robustness Checks

Omitted variable bias arises in non-experimental studies when an observed link between two variables of interest is in fact due to a confounding variable or third factor – for instance, because placement in special education could both heighten the risk of dropout among participants (e.g., through stigma/labelling effects) and limit their opportunities to develop friendships with students at low risk of dropping out. As previously explained, attempts to control for such bias were made at both the design (e.g., matching dropout cases and controls on educational sector) and analytical (i.e. statistically controlling for educational sector) levels. Yet, these attempts cannot entirely eliminate bias, and can even introduce distortions (Rose & Van der Laan, 2009). Multiple robustness tests were thus performed to build confidence in our main findings. Specifically, the main regression analyses (Table 3) were rerun under alternative specifications.

Two of the robustness tests were conducted to probe the soundness of the matching strategy. First, to verify whether the results would have remained similar without matching or with a different matching strategy, the regression analyses were rerun on the full sample ($N = 545$), including unmatched controls. Second, to examine the likelihood of reverse causality between matching variables and events of potential significance (e.g., that having dropout friends lead to higher scores on the dropout risk index, see Rose & Van der Laan, 2009), regression analyses were rerun while focusing on exposures that occurred *after* the administration of the risk index (i.e., in the past 6 months), and thus that could not have influenced it. In both tests, the effect sizes and significance levels tended to be stronger, a result consistent with scholarship showing that matching tends to yield conservative estimates (Bowers, Spratt, & Taff, 2013).

Two other robustness tests were conducted to probe the stability of the results with alternative methods for accounting for potential confounders in the regression analyses. First, the models were rerun with, in lieu of the global score, each of the items comprising the dropout risk index as separate variables. Second, the models were rerun while applying inverse probability for treatment weighting (IPTW), a technique based on propensity scores and designed to account for the differential propensities of individuals to be exposed or not to the events of potential significance – in the present instance, exposure to dropout in one's social network (Austin & Stuart, 2015; Guo & Fraser, 2015). Exposed and non-exposed participants were successfully rebalanced on the potential confounders after applying IPTW. With both tests, the main findings were essentially unaffected.

One last robustness test was conducted to make sure that the results were stable under different regression techniques. Specifically, the models were rerun using conditional rather than regular regression modelling, an analysis specifically tailored for matched data (Kuo et al.,

2018). Again, the results were essentially unchanged (the full results of the five robustness checks are available upon request). Overall, these supplemental findings thus support the robustness of the results, and reduce the plausibility of potential threats to validity common in matched case-control studies.

Discussion

The goal of this study was to provide an integrated view of how a critical educational outcome, high school dropout, propagates through contact with key same-age intimates in adolescents' social networks: friends, romantic partners, and siblings. Findings were consistent with the hypotheses, as they showed that dropout among any of these intimates was independently associated with an increased risk of dropout. Moreover, relative to participants exposed to dropout via contact with only one type of same-age intimate, those with a more varied exposure (through two types or more) were especially at risk of dropping out. Timing of exposure also seemed to matter. Only relatively recent occurrences of dropout were associated with an increased risk of dropout among participants. Overall, adolescents typically left school when someone close to them had taken this path within the previous year. In fact, only one early school leaver out of four was part of a network in which all members were still in school. Social contagion operating within adolescents' networks of same-age intimates may thus contribute to the concentration of dropout within certain segments of disadvantaged communities.

Theoretical Implications

The complexity of adolescents' social worlds is probably both a sign and a cause of their expanding capacities to understand relationships (Eccles & Roeser, 2011; Steinberg, 2014). Adolescents' diverse relationships expose them to multiple influences, including positive ones. However, the present findings support theories positing that relationships can sometimes operate

in a coordinated manner to negatively influence adolescents and that social contagion occurs through diverse channels (Brechwald & Prinstein, 2011; Overton, 2015). As observed for delinquency (Lonardo et al., 2009), adolescents in fact seemed especially at risk of dropping out when they were “encapsulated” in networks in which various actors had made this behavior conspicuous by quitting school within the previous year.

The apparent synergistic impact of dropout among different types of same-aged intimates may nevertheless mask subtle differences in the mechanisms involved (Shortt et al., 2003). Because adolescents usually have more friends than romantic partners or siblings, friendships may play a key role in spreading, over a relatively large number of contacts, the idea that dropping out is a definite and unexceptional option. By contrast, the dropout of a romantic partner should have a more localized impact, given the exclusive nature of the relationship. Finally, as suggested by McHale, Updegraff, and Whiteman (2012), adolescents may correctly interpret a sibling’s dropout as a confirmation that their parents are unwilling or unable to keep them in school through graduation, for instance because the family is disorganized by stressful economic circumstances (Black, Devereux, & Salvanes, 2005; Conger, Conger, & Martin, 2010). Each type of same-age intimate could thus provide potential dropouts with complementary but equally potent justifications for leaving school.

Researchers have insisted on the importance of elucidating the mechanisms responsible for social contagion, including the motivational processes involved (Burgess et al., 2018). For school dropout, an explanation of these mechanisms must consider how adolescents (e.g., rather than educators) are likely to perceive the short-term consequences of quitting school without a diploma. It is important to note in this regard that over the short term, an adolescent who quit school can appear to have improved her or his situation, for instance by escaping bullying (e.g.,

Dupéré et al., 2018) or by starting to earn a salary, however modest. Given such short-term benefits, an adolescent with same-age intimates who have just left school may come to consider dropout as a relatively unproblematic option (see also Harding, 2011).

In contrast with its short-term benefits, the costs of dropout (e.g., chronically unstable and low paid employment; Rumberger, 2011) generally become apparent only a few years later. This means that dropout peers could become less attractive models over time, which would explain why, in the present study, older occurrences of dropout in one's social network were not associated with dropout. This fading over time may also be due to diminishing contact and growing social distance. For instance, adolescents who are still in school may spend less and less time with friends or ex-romantic partners who no longer are. Such mechanisms could even apply to siblings, as after being out of school for some time, many may live independently, outside of the family home.

Strengths, Limitations, and Future Research

The present study relied on a matched case-control design to assess adolescents' social circumstances during the period just preceding dropout. It was designed to capture, among all of adolescents' key same-age intimates, recent occurrences of dropout including those emerging shortly before school attendance was discontinued. With data collected for this specific purpose, it was possible to draw a reasonably exhaustive portrait of dropout contagion occurring between adolescents, right up until departures from school actually took place. Despite their advantages, notably in terms of their capacity to capture recent exposures to potentially significant events, matched case-control designs are subject to various potential threats to validity. A number of strategies were implemented to manage these threats and improve confidence in the result.

One major threat to validity emerges in case-control studies when cases and controls are selected in ways bound to inflate hypothesized links between exposures of potential significance and the outcome (Rothman et al., 2008a; Schulz & Grimes, 2002). In the present study, this would have occurred, for instance, if dropouts had been recruited in a snowball fashion, as this would have led to an overrepresentation of dropouts belonging to shared networks, and thus involved in social relationships with other dropouts. To circumvent this problem, all new dropout cases were independently identified via comprehensive and highly reliable school administrative data, and individually recruited. Similarly, controls were selected individually from a well-defined population, again regardless of whether or not they had dropouts in their network.

Another major potential threat to validity in case-control studies is related to measurement issues, as retrospective assessments are prone to selective or inaccurate recall (Rothman et al., 2008a; Schulz & Grimes, 2002). Our main findings could be spurious if, for example, dropouts more readily recalled instances of dropout in their networks than controls – for instance, in an *a posteriori* justification for their departure from school. Three aspects reduce the potency of this validity threat. First, while this problem could in principle have occurred for friends, it is much less likely in the case of smaller, well-defined groups like siblings or romantic partners. Second, the goal of the study was presented in very general terms to the participants (e.g., as an examination of stress in adolescents' lives in general), and not as a study on the potential proximal causes of dropout. Third, to enhance recall accuracy, adolescents were interviewed immediately after they had dropped out (when applicable), with life calendar techniques facilitating recall (Axinn et al., 2019). These techniques function particularly well even long after the fact for time-delimited, salient, and easily observable behaviors, such as whether significant others attend school or not (Berney & Blane, 1997; Ward, 2011). In contrast,

concealed, fluctuating, and subjective behaviors or states like substance use or moods that are more prone to recall bias.

Finally, other potential threats to validity are related to omitted variables bias (Rothman et al., 2008a; Schulz & Grimes, 2002). As detailed in the *Method* and *Results* sections, considerable efforts were invested in the design and analytical stages to manage and curb such potential biases. Notably, multiple robustness checks were conducted to reduce the plausibility that the results were solely a reflection of selection processes. In the analyses, many potential confounders were taken into account, including both enduring risk factors (e.g., low parental education) as well as recent exposures other than to dropout peers (i.e., to negative life events) known to be associated with dropout (Dupéré et al., 2018; Samuel & Burger, 2019). Even so, relevant confounders may have been omitted. For instance, recent fluctuations in the dropout risk index were not assessed. That being said, given the non-negligible effect sizes associated with the main findings, these omitted confounders would need to have large independent associations with the outcome to nullify the results.

Future research is needed to build on the findings of the present study and address some of its limitations. Importantly, the mechanisms underlying contagion were not assessed in the present study. In addition, even though information about youths came from different sources (e.g., administrative records), characteristics of social networks were assessed exclusively through participants' self-reports (i.e., without cross-checking with friends, romantic partners, or siblings). Relying on a single informant to identify social networks and their characteristics is not ideal (Christakis & Fowler, 2013). In future studies, exhaustively and prospectively mapping networks based on information provided by all students (e.g., Haynie, Doogan, & Soller, 2014) would allow researchers to examine the broader social dynamics that constrain or facilitate social

contagion of dropout – for instance, the extent to which future dropouts tend to be central or peripheral in the social life of the school. To further understand the mechanisms in play, it would also be useful to ask adolescents how they interpret their peers' departure from school.

Practical and Policy Implications

The present non-experimental findings do not conclusively demonstrate that social contagion is a cause of dropout. They are nevertheless sufficiently robust to guide prevention efforts since they show that occurrences of dropout among friends, romantic partners, or siblings are at least important markers of risk for exposed adolescents. Such markers can be useful for allocating intervention resources. Information regarding dropout among siblings is readily available to school administrators and can thus be integrated into existing monitoring systems (see Bowers et al., 2013) designed to flag students at elevated risk of dropping out in the upcoming months. Fluctuating friendships and romantic relationships are, in contrast, much more difficult to track. Some members of the school team (e.g., school psychologists or teachers involved in extra-curricular activities) are nevertheless reasonably well informed on the social life of many students and could suggest prevention intervention for students who are friends or romantic partners of recent dropouts.

Targeting interventions more efficiently through improved monitoring is one avenue to boost the efficacy of existing policies and programs aimed at reducing high school dropout that currently leave much room for improvement (Freeman & Simonsen, 2015). Beyond improved monitoring, the results also point towards potential innovations in the content of prevention and intervention programs. They suggest that these programs could achieve better results by explicitly taking social networks into account. Interventions that directly leverage peer relationships have successfully improved peer norms and curbed the contagion of problematic

behaviors like substance use or suicide attempts (Cox et al., 2012; Osgood et al., 2013; Spoth et al., 2017). For instance, peer cooperation strategies fostering positive interactions between at-risk and well-adjusted youth in middle school has been found to reduce negative peer influences and, in turn, alcohol use (Van Ryzin & Roeth, 2018a, 2018b). Adaptation of such interventions for the high school context could similarly curtail the social contagion of dropout.

Besides school-based approaches, prevention avenues have also been proposed at the community level (Leventhal & Dupéré, 2019). Assuming that, at least in some disadvantaged communities, dropout can be “passed” from one adolescent to another, how then is the “virus” of dropout (the idea that quitting school is a possibility) initially take hold in the adolescent peer culture? Communities in which dropout is prevalent are not environments that generally encourage adolescents to leave school. In fact, most residents of these communities consider high school graduation to be important, and only a minority of adults expose adolescents to lifestyles incompatible with school perseverance (Harding, 2011). Some low-income communities are able to leverage collective strength to limit the extent to which unconventional lifestyles “contaminate” segments of the adolescent peer culture, for instance via concerted efforts from parents and community leaders, including school principals and teachers (for reviews, see Berkowitz, Moore, Astor, & Benbenishty, 2016; Leventhal & Dupéré, 2019). Detailed studies on how communities manage the contagion of dropout are needed.

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Table 1

Participant Characteristics

| Control variables on which participants were | Dropout cases (n = 183) | | Matched controls (n = 183) | | Contrasted controls (n = 179) | |
|---|-------------------------------|-----------|----------------------------------|-----------|-------------------------------------|-----------|
| | <i>M</i> / <i>%</i> | <i>SD</i> | <i>M</i> / <i>%</i> | <i>SD</i> | <i>M</i> / <i>%</i> | <i>SD</i> |
| Strictly matched | | | | | | |
| Dropout risk index | 1.1 _a | 2.1 | 1.3 _b | 1.9 | -0.6 _{a,b} | 0.5 |
| Special education | 42.6 _a | | 45.9 _b | | 4.5 _{a,b} | |
| Sex (male) | 54.1 | | 54.1 | | 48.6 | |
| Matched to the extent possible | | | | | | |
| Age | 16.5 _a | 0.9 | 16.4 _b | 1.0 | 16.0 _{a,b} | 0.8 |
| Visible minority | 19.1 | | 24.0 | | 26.8 | |
| Parental education ¹ | 2.5 _a | 1.0 | 2.6 | 0.9 | 2.7 _a | 1.0 |
| Maternal employment | 69.4 | | 70.5 | | 69.8 | |
| Paternal employment | 69.4 _a | | 80.3 _a | | 78.2 | |
| Separated/divorced parents | 69.9 _{a,b} | | 53.6 _a | | 50.8 _b | |
| Not matched (interview-based measures) | | | | | | |
| Immigrant status | 32.8 | | 35.0 | | 36.3 | |
| Sibship size | 1.8 | 1.6 | 1.8 | 1.5 | 2.0 | 1.6 |
| Recent stressor exposure | | | | | | |
| Acute stressors | 1.0 _{a,b} | 1.4 | 0.5 _a | 1.0 | 0.4 _b | 0.9 |
| Chronic stressors | 0.9 _{a,b} | 1.1 | 0.4 _a | 0.8 | 0.5 _b | 0.9 |

Note. Means and percentages sharing subscripts in each row differ significantly at $p < .05$, based on t tests (for means) or chi-2 tests (for percentages). ¹Maximum level of education attained by one parent; 1 = primary to 4 = university.

Table 2

Percentage of Participants with Dropouts among Their Friends, Romantic Partners, and/or Siblings, as a Function of Group

| | Group | | | Chi-2 test | |
|---|----------------------------|-------------------------------|----------------------------------|------------|----------|
| | Dropout cases (n = 183) | Matched controls (n = 183) | Contrasted controls (n = 179) | χ^2 | <i>p</i> |
| Proportion (%) with dropouts | | | | | |
| Among any type of same-age intimate (friends, romantic partners, or siblings) | 74.3 _{a,b} | 50.8 _a | 43.0 _b | 39.2 | .000 |
| Among specific types of same-age intimate | | | | | |
| Friends | 55.2 _a | 38.8 _a | 26.3 _a | 31.7 | .000 |
| Romantic partners | 9.8 _{a,b} | 4.4 _a | 3.4 _b | 8.0 | .018 |
| Siblings | 29.5 _a | 15.3 _a | 20.1 | 11.3 | .004 |
| In one vs. multiple types of same-age intimates ¹ | | | | | |
| Only among one type (friends <i>or</i> siblings <i>or</i> partners) | 54.6 _{a,b} | 43.2 _a | 36.3 _b | 45.7 | .000 |
| In two or more types (e.g., among friends <i>and</i> siblings) | 19.7 _{a,b} | 7.7 _a | 6.7 _b | | |
| Most recent dropout event occurred (among any type of intimate) ¹ | | | | | |
| In the past year | 43.7 _a | 28.4 _a | 12.3 _a | 63.4 | .000 |
| 1 to 2 years ago | 9.8 | 7.7 | 11.2 | | |
| ≥ 2 years ago | 6.6 | 6.6 | 11.7 | | |
| Unknown timing | 14.2 | 8.2 | 7.8 | | |

Note. Means and percentages sharing subscripts in each row differ significantly at $p < .05$. ¹Reference group: participants with no dropouts among friends, siblings, or romantic partners.

Table 3

Multiple Logistic Regression Models Linking Occurrences of Dropout among Same-Age Intimates (Friends, Romantic Partners, and Siblings) and Dropout, among Dropout Cases and Matched Controls (n = 366)

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---------|-------------|---------|-------------|---------|-------------|---------|-------------|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Potential social influences | | | | | | | | |
| At least one dropout among | | | | | | | | |
| Friends, romantic partners, or siblings | 2.85*** | [1.77-5.05] | | | | | | |
| Friends | | | 1.97** | [1.25-3.41] | | | | |
| Romantic partners | | | 3.12* | [1.23-11.0] | | | | |
| Siblings | | | 2.74*** | [1.63-5.47] | | | | |
| Dropout present ¹ | | | | | | | | |
| Only among one type of intimate | | | | | 2.53*** | [1.56-4.68] | | |
| In ≥ 2 types of intimates | | | | | 4.88*** | [2.54-12.5] | | |
| Most recent dropout event occurred ¹ | | | | | | | | |
| In the past year | | | | | | | 3.11** | [1.78-6.27] |
| 1 to 2 years ago | | | | | | | 2.33 | [0.98-6.49] |
| ≥ 2 years ago | | | | | | | 2.06 | [0.80-5.89] |
| Unknown timing | | | | | | | 3.01** | [1.30-7.73] |
| Control variables on which participants were | | | | | | | | |
| Strictly matched | | | | | | | | |
| Dropout risk index | 0.89 | [0.75-1.01] | 0.90 | [0.77-1.04] | 0.89 | [0.77-1.02] | 0.89 | [0.76-1.01] |
| Special education | 0.86 | [0.52-1.46] | 0.83 | [0.45-1.41] | 0.85 | [0.49-1.52] | 0.85 | [0.48-1.43] |
| Sex (male) | 1.19 | [0.73-1.95] | 1.22 | [0.71-2.10] | 1.18 | [0.72-1.90] | 1.17 | [0.67-2.02] |
| Matched to the extent possible | | | | | | | | |
| Age | 1.42** | [1.07-1.90] | 1.43** | [1.12-1.97] | 1.43** | [1.10-1.97] | 1.43** | [1.11-1.93] |
| Immigrant status | 1.32 | [0.58-2.87] | 1.44 | [0.68-3.39] | 1.41 | [0.63-3.36] | 1.34 | [0.61-3.17] |
| Parental education | 1.00 | [0.77-1.34] | 1.03 | [0.77-1.39] | 1.02 | [0.75-1.37] | 0.99 | [0.75-1.31] |
| Maternal employment | 1.02 | [0.56-1.79] | 1.04 | [0.57-1.88] | 1.02 | [0.57-1.84] | 1.01 | [0.54-1.81] |
| Paternal employment | 0.62 | [0.33-1.08] | 0.64 | [0.36-1.22] | 0.63 | [0.34-1.21] | 0.63 | [0.35-1.17] |
| Separated/divorced parents | 2.04** | [1.30-3.54] | 2.00** | [1.28-3.67] | 1.99** | [1.26-3.61] | 2.04** | [1.28-3.77] |
| Not matched | | | | | | | | |
| Visible minority | 0.74 | [0.31-1.69] | 0.72 | [0.31-1.72] | 0.72 | [0.28-1.73] | 0.74 | [0.30-1.79] |
| Sibship size | 0.99 | [0.84-1.18] | 0.96 | [0.81-1.14] | 0.97 | [0.83-1.17] | 0.99 | [0.83-1.19] |
| Acute stressor exposure | 1.42** | [1.11-2.01] | 1.43** | [1.13-2.01] | 1.42** | [1.09-1.93] | 1.42** | [1.12-2.00] |
| Chronic stressor exposure | 1.57** | [1.21-2.23] | 1.56*** | [1.17-2.18] | 1.56*** | [1.23-2.25] | 1.57** | [1.17-2.20] |

Note. ¹Reference group: participants with no dropout among friends, siblings, or romantic partners.
* $p < .05$. ** $p < .01$. *** $p < .001$