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Preference formation, school dissatisfaction and risky behavior of adolescents

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Abstract

School dissatisfaction is an important component of the subjective well-being of adolescents associated with "risky behavior" like drug use, unprotected sex, norm violations and illegal behavior. We extend the standard human capital model to joint human investment (education) and disinvestment (risky behavior). Based on this model, we develop a general dynamic framework to analyze the preference formation of children and behavioral change at school. Once an educational norm is set by adults, children can rationally deviate from this norm, while staying at school, after experiencing bad surprises like a school failure. The same type of dynamic equation can be used in a sequence to predict education, satisfaction with school, and a host of risky behavior. We test these assumptions with a unique panel data set on American adolescents attending middle or high school. School dissatisfaction is found to have a significant positive effect upon nine different types of risky behavior.

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Keywords: Education; Satisfaction; Risky behavior; Preference formation; Economic behavior of children

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1. Introduction

Children's behavior has received little attention in economic studies, partly because it does not fit with basic assumptions of the economic theory of choice. Children have been implicitly described as "decision-takers" whom their parents can control, manipulate or make decisions for, having no budget constraint and no preference of their own. Given the central place of children in many human investments and consumer expenditures, and the growing prevalence among adolescents of "risky behavior" like drug use, unprotected sex, norm violations and illegal behavior, the neglect of children's behavior does not seem to be warranted. Teenagers have some control of their own time and effort and make decisions within bounds set by adults. For example, parents may impose school enrollment and the postponement of regular legal work upon their children, but the latter are able to skip classes, choose their friends and in-groups, have sex, smoke cigarettes or marijuana, steal in supermarkets, etc. While adults set and inculcate the norms and sanctions, adolescents make decisions of their own and may rationally choose to deviate from these norms. However, their rationality is moderated by the fact that children do have malleable preferences, discovering their unknown tastes and forming their future habits through their own contingent experiences and exposure to other information. Therefore, the conventional economic assumption of given and known preferences would lead to extreme and unacceptable conclusions in the context of children's behavior. Few would accept the claim that a child will base her behavior once and for all over an extended period of schooling on the expectations that she formed upon entering school without ever wanting to revise the latter. And equally few would accept the alternative conclusion that a child will adopt the highly unstable point expectations and behavior which would closely reflect her contingent perceptions at any moment in time. It is certainly more reasonable to believe that the child, submitted to a sequence of dissonant cognitions, will feel uncertain of her own true preference and revise her expectations and preference consistently conditional on personal experience and other information (Lévy-Garboua & Montmarquette, 1996).

We develop a general dynamic framework to analyze the preference formation of children and behavioral change at school. This theory is applied here to model the interaction between education and risky behavior and show the causality exerted by school disorders on risky behavior. In order to examine the trade-off between education and risky behavior of adolescents, we posit these terms in the standard human capital framework. Risky behavior is defined as any potential human disinvestment as opposed to education which is what parents, teachers and legislators alike normatively view as human investment. Risky behavior brings utility to an adolescent while at school at the cost of depreciating her stock of human capital in the future. The main prediction of our model of preference formation is that children, on experiencing bad surprises like a school failure, may rationally deviate from the educational norm set by adults while staying at school by substituting risky behavior for education.

However, testing the latter prediction directly is not an easy task because many surprises experienced by children at school and in other activities are not usually observed in surveys. We propose to use self-reported school satisfaction as a convenient variable for predicting changes in schooling and risky behavior of adolescents. This follows Lévy-Garboua and Montmarquette's (2004) interpretation of job satisfaction as the worker's experienced or post-decisional preference for her job in comparison with alternatives. By a straightforward adaptation to children's behavior, we claim that the child who reports her satisfaction or dissatisfaction with school manifests her intention to either respect the current educational norm or deviate from it in the near future in specified directions. Moreover, as the intention and subsequent behavior reveal successive states of the child's preference, *the same type of equations* can be used *in a sequence* to predict both school satisfaction and future risky behavior. This is implemented with unique panel data (*Add Health* survey) on the health-related behaviors of US adolescents attending middle or high school. School dissatisfaction is found to have a significant positive effect upon nine different types of risky behavior.

The theoretical foundations of the paper are provided in Sections 2 and 3. We extend the standard human capital model to joint human investment (education) and disinvestment (risky behavior). Based on this model, we develop a general dynamic framework to analyze the preference formation of children and behavioral change at school. Data and empirical strategy are described in Section 4. Then the main results are presented and discussed in Sections 5 and 6. Section 7 concludes.

2. A dynamic model of education and risky behavior of adolescents

2.1. A human capital model of investment in education and disinvestment in risky behavior

We describe the rational behavior of adolescents who should normally attend middle or high school. It is assumed that they are conscious of the investment value of schooling and devote time and effort to their own education in relation with the returns that they expect to derive from the latter in their future working life. However, in contrast with older students and adult workers, they depend materially and financially on one parent or tutor at least, and are unwilling or unable to work for their living.[1] The child lives $T+1$ periods. Schooling is the current period followed by T periods of working life. In order to examine the trade-off between education and risky behavior of adolescents, we posit these terms in the standard human capital framework. "Education" is taken in the broad sense of human capital, which includes schooling, a healthy lifestyle and all leisure activities (e.g., sports, piano lessons) that parents and teachers normally consider as investments in health,

[1] Summer and occasional work is allowed insofar it does not prevent the adolescent from performing any of her school duties.

education and cultivation of taste. Symmetrically, activities which do not fit into this normative definition are "risky behavior" that parents and teachers view, from their own perspective, as a potential *human disinvestment*. This meaning of risky behavior is much broader than the economic usage of risk-taking activities like gambling as it applies to a variety of activities that bear a deferred risk of capital loss or social sanction, like drug use, unprotected sex, norm violations and illegal behavior. However, the explicit treatment of risk would not change our main conclusions, and will not be pursued here for expositional convenience. Consequently, the trade-off between education and "risky behavior" can be studied very simply with a human capital model by allowing for the possibility of both investing *and* disinvesting in human capital. The future returns to human disinvestments are negative, and can be viewed as positive depreciation of the stock of human capital.

Let e denote the time devoted to education and l the time devoted to risky behavior by an adolescent attending school, with

$$e + l = 1, \quad 0 \leqslant e, \ l \leqslant 1. \tag{1}$$

The normative expectation of child's behavior is

$$l^{*} = 0. \tag{2}$$

However, parents and teachers are unable to monitor the child in such a way that she educates full time. They merely see to her attending school and not working (even beyond the age of compulsory education). The child remains free to allocate her own time between education and risky behavior under the constraint: $e > 0$, $l < 1$. Her utility function can be described by the expected present value of school

$$V = v(l) + \frac{y}{i} \quad (v' > 0, v'' < 0). \tag{3}$$

In Eq. (3), y designates the expected permanent earnings of the child in her working life, i the child's positive discount rate (corrected for the finiteness of life) and $v(l)$ the utility that the child derives from time devoted to risky behavior during the schooling period. Future earnings of the child are produced by the initial stock of human capital and ability, denoted h, as well as by further investments in education and disinvestments in risky behavior:

$$y = h(1 + re - al). \tag{4}$$

The rate of return to education r is assumed to be positive, and the rate of depreciation due to risky behavior a is typically positive but might be negative for illegal behavior. The maximization problem which conditions the child's allocation of time is easily derived from Eqs. (1), (3), (4) and $l < 1$

$$\begin{aligned} &\operatorname*{Max}_{l} \quad V(l) \equiv v(l) + \frac{h(1 + r - (r + a)l)}{i} \\ &\text{s.t.} \quad\quad l \geqslant 0. \end{aligned} \tag{5}$$

It does not follow from (5) that the child's optimum must coincide with the educational norm (2) prescribed by her parents and teachers. This would only happen if

$$h\frac{r+a}{i} \geqslant v'(0). \tag{6}$$

For adolescents who adhere to the educational norm set by parents, teachers and legislators, the present value of education outweighs the marginal present value of risky activities net of future depreciation of human capital. The depreciation of human capital caused by risky behavior facilitates the child's compliance with the educational norm. Eq. (6) allows us to define the latent *decision variable of the child* which conditions her education and risky behavior within the schooling period as

$$S^* \equiv h\frac{r+a}{i} - v'(0). \tag{7}$$

This latent variable is unobservable, but adherence to the educational norm (and risky behavior) is captured by a variable S which takes a discrete number of values. With just two values for instance

$$\begin{cases} S = 1 & \text{if } S^* \geqslant 0, \\ S = 0 & \text{if } S^* < 0. \end{cases} \tag{8}$$

2.2. A dynamic model of behavioral change at school

The new important point we wish to make at this stage is that all the parameters entering the child's latent decision variable (7) and conditioning the discrete choice (8) are revisable cognitions conditional on personal experience and other information. The static model of investment/disinvestment presented in the last sub-section would obtain if the latter were known with certainty at any moment in time. However, given the great amount of experience that a child may encounter over her extended period of schooling and the contingent nature of perception, it is more reasonable to believe that the child has no given preferences and feels uncertain of her own true preference. This general assumption is introduced by treating the child's expectation $E\tilde{S}^*$ as *stochastic* (Lévy-Garboua & Montmarquette, 1996). Thus, surprises experienced by an adolescent at school may lead to revised expectations and behavioral change within the boundaries of schooling.[2]

To model this, we divide the schooling period into a number of sub-periods which usually coincide with grades and school years. The decision process is illustrated by Fig. 1. The child makes a decision of education and risky behavior at the beginning of sub-period t ($1 \leqslant t \leqslant n$) which is dictated by ES^*_{t-1}, then experiences a contingent value of the decision variable $S^*(t)$ during sub-period t, revises her expectation into ES^*_t in the light of this new information, makes a new decision at the beginning of sub-period $t+1$ and so on. For a quadratic cost of error, the rational expectation at the beginning of any sub-period is also the mean value at this date. It will be

[2] Lévy-Garboua (1976) has used a similar argument to explain the anomalous behavior of French students in the 1970s, confronted with an unexpected decline in the rate of return to education (a bad surprise) at the upsurge of mass universities. Students reacted by diminishing their education time and effort while staying at university.

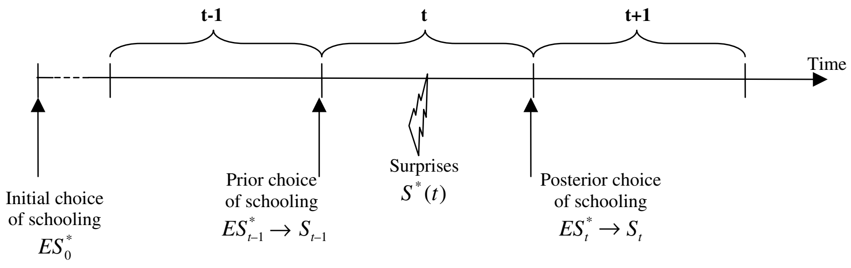

Fig. 1. The child's decision process.

assumed that the sequence $S^*(1), \ldots, S^*(n)$ is a random sample from a stable normal distribution $\tilde{S}^*$ with an unknown value of the mean $E\tilde{S}^*$ and precision (inverse of variance) $\tilde{\theta}$. Suppose also that the prior joint distribution of $E\tilde{S}^*$ and $\tilde{\theta}$ is as follows: the conditional distribution of $E\tilde{S}^*$ when $\tilde{\theta} = \theta$ $(\theta > 0)$ is a normal distribution with a finite mean ES_0^* and precision $\tau\theta$ $(\tau > 0)$ and the marginal distribution of $\tilde{\theta}$ is a gamma distribution with parameters α and β $(\alpha, \beta > 0)$. Given the ordinal nature of the decision variable, we choose a monotonic transformation of (7) such that the prior mean can be assumed to be normal

$$ES_0^* = \log h_0 + \log(r_0 + a_0) - \log i_0 - \log v_0'.$$

Then, assuming a Bayesian revision of the probability distribution (see, for instance, DeGroot, 1970, chap. 9), the posterior conditional distribution of $E\tilde{S}^*$ after t random *i.i.d.* experiences is also a normal distribution with mean:

$$ES_t^* = \frac{\tau + (t-1)}{\tau + t} ES_{t-1}^* + \frac{1}{\tau + t} S^*(t), \tag{9}$$

and precision: $(\tau + t)\theta$. This can also be written[3]:

$$ES_t^* - ES_{t-1}^* = \frac{1}{\tau + t}\left(S^*(t) - ES_{t-1}^*\right) = \frac{\varepsilon_t}{\tau + t}, \tag{10}$$

with $\varepsilon_t \equiv S^*(t) - ES_{t-1}^*$ designating the surprise experienced by the individual during her tth experience. Eq. (10) depicts how the latent decision variable of a rational child confronted with dynamic uncertainty (surprises) changes with her experience of school and risky behavior. Behavioral change is *caused*, literally speaking (see Granger's Nobel lecture, 2004), by the experienced surprises in the short run, and behavior converges to a stable habit in the long run when surprises are serially independent. For instance, a school failure is a bad surprise that diminishes expectations of ability and educational returns. Bad surprises will drive the child to reduce the time and effort devoted to education and to increase the time and effort devoted to risky behavior. By iteration of Eq. (10), we get

[3] The marginal distribution of $\tilde{\theta}$ is a gamma distribution with an experience-dependent mean value of the posterior distribution which increases indefinitely with experience.

$$ES_t^* = ES_0^* + \frac{1}{\tau+1}\varepsilon_1 + \cdots + \frac{1}{\tau+t}\varepsilon_t. \tag{11}$$

This last formulation of the decision process shows that an accumulation of bad surprises (for instance $\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_t < 0$) may eventually lead ES_t^* to become negative even when ES_0^* was not. The adolescent is driven by the succession of bad experiences to breach the educational norm and indulge in risky behavior.

3. School dissatisfaction as a predictor of risky behavior

Since the decision variables ES_t^* are unobservable, a convenient variable for predicting schooling and risky behavior of adolescents has to be found. A few psychological studies have shown a significant positive relationship between life dissatisfaction of adolescents attending high school and their use of drugs (Zullig, Vallois, Huebner, Oeltmann, & Drane, 2001) and alcohol (Clark & Kirisci, 1996; Newcomb, Bentler, & Collins, 1986). Zullig et al. (2001) also suggest that risky behavior forms a bundle of correlated activities such that dissatisfaction with life might be related to other kinds of risky behavior as well. The results of Coker et al. (2000) from the same data set support the view that the causality runs from satisfaction to behavior but this causal link has not been firmly established by lack of a proper theory of risky behavior. Previous studies have generally taken a broad view of satisfaction and quality of life while they focused on a single aspect of risky behavior like alcohol and substance abuse. In contrast with earlier studies, we adopt here a narrower view of satisfaction with school but we examine its full impact on a very wide spectrum of risky behavior. By narrowing the scope of satisfaction to school, we gain insight on the interaction between education and risky behavior; by broadening the scope of risky behavior, we capture the multi-faceted nature of the latter. If risky behavior is a substitute for education, school satisfaction will be a more specific predictor for the risky behavior of adolescents than is life satisfaction.

The reason why dissatisfaction with school should *predict* risky behavior is simply that it reveals the child's *intention* to deviate from the current educational norm in the near future. This statement follows from a new interpretation of satisfaction judgments with respect to an individual experience (Lévy-Garboua & Montmarquette, 2004). Self-reported satisfaction is identified to the discrete variable (S in Eq. (8)) which relates to the decision of repeating the experience in the near future. For instance, job satisfaction expresses a worker's experienced or post-decisional preference for her job in comparison with alternatives. The model presented in Section 2 posits that such preference is known imperfectly and subject to changes caused by the surprises that were experienced in the past. Thus *the same* equations (8) and (9) can be used *in a sequence* to predict prior school choices (just before t), school satisfaction (between t and $t+1$), and future school choices or risky behavior (just before $t+1$). Panel data are especially appropriate for this purpose.

Since this is perhaps the first economic investigation of school satisfaction whereas job satisfaction has been extensively studied by economists in recent years under the impetus of Clark and Oswald (1996), it can be useful to draw the parallel between education and jobs in order to distinguish the specificities of school satisfaction and school choices. The main similarity is that school choices and job choices are decisions to invest in the future which can both be described in a human capital framework. However, the returns to schooling lie essentially in the future since investment in schooling is made early in life, while a 40-year old worker would have already experienced a great part of the returns from her job decisions in the past. School satisfaction is prospective whereas job satisfaction is partly retrospective. As a result, school satisfaction should be a more accurate predictor of future education behavior than is job satisfaction with respect to job mobility (Lévy-Garboua, Montmarquette, & Simonnet, 2004). Another important difference between education and jobs which is perhaps less visible is the following: a child who feels unhappy at school will typically have fewer schooling alternatives than a worker who can turn to the job market. A dissatisfied adolescent unable to shift from school to work is almost inevitably confronted with risky alternatives, all the more so as people who face the risk of a large loss become risk-seeking (Kahneman & Tversky, 1979). Lastly, risky behavior breaking the educational norm is by nature more hidden and diffuse than the simple exit-voice alternative to a bad job postulated by Hirshman (1970). Our data set enables us to observe many types of risky behavior which correlate with school dissatisfaction.

4. Data and empirical strategy

We used a unique large-scale survey, the National Longitudinal Survey of Adolescent Health (*Add Health*, contractual data; Udry, 2003), which was carefully designed to explore the causes of health-related behaviors of US adolescents attending middle or high school (grades 7 to 12). Schools and students were drawn from the US population with unequal probabilities in order to over-represent small categories and obtain unbiased estimates by region, urbanization, school type, school size, and ethnic origin (Harris et al., 2003). The same questionnaire was administered in-home to a large sample of adolescents clustered in 52 middle schools and 80 high schools. On the same occasion, another questionnaire was administered to parents. The children who responded to the in-home questionnaire were observed in two waves, in 1995 and 1996,[4] with 14 738 adolescents still present in the second wave out of 20 745 who had been participating to the first wave. Their educational status and school satisfaction is described from the first wave of in-home interviews. Eighteen manifestations of risky behavior (aggregated in eleven categories) are then described from the second wave of in-home interviews.

Survey administrators took several steps to secure confidentiality of the data and minimize biases from self-reporting. Respondents were not provided with any

[4] A shorter questionnaire was administered in-school to 90 118 adolescents drawn from the same sample of schools about six months before the first in-home questionnaire. This questionnaire will not be used here.

printed questionnaire. The interviewer read the questions aloud and entered the respondent's answers on a laptop computer. For sensitive topics like sexual and illegal behavior or substance use, the adolescents even listened to pre-recorded questions through earphones and entered their answers directly on the laptops.

Since we interpret adolescents' satisfaction with school as their experienced preference for education versus risky behavior at the date of the first in-home survey, we can use Eq. (11) of the theoretical model to predict school satisfaction. The latter is explained by the prior value of this variable and by the sum of school surprises. The prior schooling decision variable can be related to the child's background (sex, ethnic origin). The sum of school surprises is partly captured by the gap between the child's current school status and her normative expectation, which we call the "education gap", and unexpected family events (absent father, absent mother). In addition, school fixed-effects control for the child's specific school environment; and satisfaction with health, parents, friends and neighborhood all together control for unobservable personality traits of the child and for her specific non-school environment.

We first estimate the education level and take the regression's residual to measure the education gap. The latter is then incorporated in the school satisfaction equation along with the other explanatory variables. It should have a positive effect on school satisfaction. Testing the satisfaction equation permits to validate the suggested interpretation of satisfaction judgments in a new domain. Finally, a wide spectrum of risky behavior can be predicted one period ahead by the dynamic equation (9). Each form of risky behavior is explained by the same one-year lagged variable which defines the child's prior state, school satisfaction one year back that captures the child's intention to deviate from this prior state after experiencing surprises at school and in other activities, and individual characteristics (age, grade, sex, ethnic origin, health and family status) which may have a differential effect on each specific risky behavior.

5. Education and school satisfaction

Table 1 shows the education equation and summary statistics. The dependent variable of the education equation is the school grade that children had reached at the time of the in-home survey. The education level of children is estimated by an ordered Probit since we observe six education grades (from 7 to 12) and the latter are not entirely determined by age in the American educational system (20.10% of the sample have repeated or been held back one grade, and 2.37% have skipped one grade). After controlling for children's age, the results are in line with those which have been commonly found in the economic literature. The role of differences in economic opportunities across families is attested by the significant effect of parental income (with a positive sign) and number of siblings (with a negative sign), school size and region (South). The role of differences in school choices and norms is also present through the strong positive coefficients of parents' education, suburban residence and private school. The child's health captures an important aspect of ability.

Table 1
Estimation of school grade: Ordered Probit (6 levels) analysis (Add Health, In-Home I)

Variable	Description mean (%)	Estimation	
		Coefficient	(Standard error)
Female	50.03	0.304***	(0.021)
White	56.30	*Reference*	
Black	18.97	0.021	(0.029)
Hispanic	13.72	0.184***	(0.036)
Asian	4.66	0.156***	(0.053)
Other origin	6.35	0.041	(0.044)
Good general health	68.80	0.120***	(0.023)
Cohort: 11–13 years	12.33	*Reference*	
Cohort: 14 years	13.90	2.098***	(0.051)
Cohort: 15 years	18.21	3.788***	(0.060)
Cohort: 16 years	20.31	5.495***	(0.067)
Cohort: 17 years	19.18	7.148***	(0.073)
Cohort: 18–21 years	16.07	8.852***	(0.079)
Parents: education 1[a]	11.68	*Reference*	
Parents: education 2[a]	29.16	0.167***	(0.037)
Parents: education 3[a]	22.13	0.319***	(0.040)
Parents: education 4[a]	24.26	0.329***	(0.041)
Parents: education 5[a]	12.77	0.376***	(0.047)
Parents: income 1[b]	20.81	*Reference*	
Parents: income 2[b]	28.61	0.204***	(0.031)
Parents: income 3[b]	24.37	0.307***	(0.033)
Parents: income 4[b]	26.21	0.336***	(0.035)
No brother neither sister	20.41	*Reference*	
One brother or sister	39.21	−0.04	(0.028)
Two brothers or sisters	25.21	−0.11***	(0.031)
More than 2 brothers or sisters	15.17	−0.23***	(0.035)
Region: North-East	14.77	*Reference*	
Region: West	22.88	0.074**	(0.036)
Region: Middle-West	25.91	−0.02	(0.034)
Region: South	36.44	−0.17***	(0.033)
School: small	14.56	−0.12***	(0.035)
School: medium	37.64	*Reference*	
School: big	47.80	0.310***	(0.026)
Rural area	17.25	0.021	(0.035)
Suburban area	53.73	0.154***	(0.026)
Urban area	29.02	*Reference*	
Private school	7.48	0.356***	(0.045)
Level 1		1.968***	(0.070)
Level 2		3.789***	(0.079)
Level 3		5.675***	(0.087)
Level 4		7.380***	(0.092)
Level 5		9.051***	(0.097)
N		13626	
Log-likelihood		−11081.079	
$\chi^2_{(29)}$		26382.424	

Significance levels: * = 10%; ** = 5%; *** = 1%.

[a] Highest school level of parents: 1 = more than 8th but not graduated from high school, 2 = high school graduate, 3 = went to college or other school, 4 = graduated from college or university, 5 = professional training beyond a 4 year college or university.

[b] Parents' disposable income in 1994 (thousand US dollars): 1 = less than 20, 2 = between 20 and 40, 3 = between 40 and 60, 4 = more than 60.

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Finally, the higher education level of girls, *ceteris paribus*, may be the consequence of girls' human capital being more severely depreciated than boys' by risky behavior like substance use, unprotected sex and violent behavior.

The education equation will now be used to calculate the education gap as the estimated residual. The predicted level of education for one adolescent $i(\hat{s}_i)$ is defined as her *expected* grade among six possible grades:

$$\hat{s}_i = \sum_{k=7}^{12} k \cdot P \quad (s = k/i). \tag{12}$$

Probabilities of being in each grade k are computed from Table 1 given the observable characteristics of adolescent i. This is more robust than the simple linear estimator (see Choi, Laibson, Madrian, & Metrick, 2003, for a recent application). The education gap is a continuous variable measured by the difference between the observed grade of adolescent (s_i) and her predicted level of education ($\hat{s}_i$).

In order to study school satisfaction, we use the following question from the *Add Health In-Home I* survey: "How do you agree or disagree with the following: You are happy to be at your school". Five ordinal answers are allowed: "strongly disagree", "disagree", "neither agree nor disagree", "agree", and "strongly agree". Two-thirds of the respondents were unambiguously "satisfied" as they agreed or strongly agreed with this statement. In Table 2, two decompositions of school satisfaction, which both respect the ordinal nature of the dependent variable, are introduced. The more detailed variable (5 levels) is estimated by an ordered Probit in the first two columns, and a simple dummy variable (satisfied/not satisfied) is estimated by a Probit in the next three columns. Including satisfaction as a dummy makes the presentation and interpretation of marginal effects of the explanatory variables very straightforward. It is reassuring to verify that these two regressions yield similar results. Since reporting one's satisfaction with school is like repeating one's prior decision of schooling in the light of additional experience, the satisfaction equation at date $t + 1$ is basically like the education equation at date t plus the additional effect of relevant surprises that occurred in the meantime. The addition of these contemporaneous surprises and other variables in the regression permits the identification of all coefficients.

As predicted by Eq. (11), the education gap has a positive effect on 5-level school satisfaction which is significant at the 1% threshold (5% only for 2-level satisfaction). Since the education gap is uncorrelated with the education level, this result shows that satisfaction is caused by surprises, i.e., unexpected deviations from one's normative expectation. Moreover, since two-thirds of adolescents are satisfied with their school, the average positive effect of good surprises on the satisfaction variable should be less than the average negative effect of bad surprises. We tested this conjecture by splitting the education gap into two continuous variables, one for a positive gap and another for a negative gap (regression not shown). Indeed, a positive gap had no effect on school satisfaction while a negative gap had a strong negative effect (significant at the 1% level). Adolescents should be more vulnerable to unobservable negative shocks on their expected returns to education as the latter get smal-

Table 2
School Satisfaction equation: Ordered Probit (5 levels) and Probit analysis (Add Health, In-Home I)

Variables	5 level-school satisfaction		School satisfaction dummy		
	Coefficient	(Standard error)	Coefficient	(Standard error)	Marginal effect
Education gap	0.085***	(0.031)	0.083**	(0.038)	0.0300**
Female	−0.041	(0.019)	−0.036	(0.024)	−0.0131
White	*Reference*				
African-American	−0.071**	(0.033)	−0.089**	(0.041)	−0.0324**
Hispanic	0.006	(0.036)	0.039	(0.045)	0.0140
Asian	0.043	(0.052)	0.019	(0.065)	0.0070
Other origin	−0.042	(0.041)	−0.062	(0.051)	−0.0225
Education: grade 7	*Reference*				
Education: grade 8	−0.138***	(0.052)	−0.186***	(0.066)	−0.0688***
Education: grade 9	−0.205***	(0.080)	−0.266***	(0.100)	−0.0985***
Education: grade 10	−0.331***	(0.100)	−0.376***	(0.125)	−0.1404***
Education: grade 11	−0.403***	(0.122)	−0.461***	(0.153)	−0.1735***
Education: grade 12	−0.469***	(0.147)	−0.568***	(0.183)	−0.2160***
Age: between 11 and 13	*Reference*				
Age: 14	0.001	(0.051)	0.004	(0.064)	0.0016
Age: 15	0.040	(0.071)	0.051	(0.089)	0.0184
Age: 16	0.115	(0.091)	0.122	(0.113)	0.0430
Age: 17	0.150	(0.112)	0.164	(0.139)	0.0573
Age: between 18 and 21	0.154	(0.131)	0.189	(0.163)	0.0654
Satisfaction: parents[a]	0.232***	(0.027)	0.263***	(0.032)	0.0980***
Satisfaction: friends[b]	0.148***	(0.019)	0.141***	(0.024)	0.0503***
Satisfaction: neighborhood[c]	0.449***	(0.021)	0.467***	(0.026)	0.1599***
Good general health	0.286***	(0.020)	0.318***	(0.025)	0.1165***
Religion: attend services	0.146***	(0.020)	0.169***	(0.024)	0.0612***
No father	−0.067***	(0.019)	−0.096***	(0.024)	−0.0346***
No mother	−0.011	(0.028)	−0.014	(0.035)	−0.0052
(131 School dummies)					
Constant			0.035	(0.087)	
Level 1	−1.344***	(0.071)			
Level 2	−0.691***	(0.070)			
Level 3	−0.051	(0.070)			
Level 4	1.144***	(0.071)			
N	13545		13545		
Log-likelihood	−18173.14		−7977.70		
$\chi^2_{(154)}$	1767.95		1335.87		

Significance levels: * = 10%; ** = 5%; *** = 1%.

Note: For each of these three variables, there are five response options: "not at all", "very little", "somewhat", "quite a bit", "very much". We dichotomized the scores as "satisfied" ("very much") versus "dissatisfied" (other responses) based on subjects' item responses.

[a] "How much do you feel that your parents care about you?" (satisfied = 85.50%).

[b] "How much do you feel that your friends care about you?" (satisfied = 43.23%).

[c] "On the whole, how happy are you with living in your neighborhood?" (satisfied = 33.14%).

ler. Since the marginal rate of return to education is steadily decreasing with the education level (Becker, 1993), children become increasingly vulnerable to bad surprises as they reach higher grades. Thus, in Table 2, school satisfaction is found consistently to correlate negatively and strongly with education levels. The cumulated effect of climbing from grade 7 to grade 12 is to diminish the probability of being satisfied with school by as much as 21.60%.

Additional variables were introduced in the regression to capture the effect of contemporaneous surprises and personality. First of all, 131 dummy variables were included to control for the fixed effect of the child's school on her satisfaction with school. A likelihood ratio test ($\chi^2(131) = 345.60$) validates the specific role of school. The fixed effect of school aggregates factors not accounted for by the education gap or level, like school quality and peer group effects (e.g., Gaviria & Raphael, 2001; Hanushek, Kain, Markman, & Rivkin, 2003). Other variables were included to grasp the specific non-school environment of the child. Four school-related satisfaction variables are highly significant with the expected sign: satisfaction with parents, satisfaction with friends, satisfaction with neighborhood, and self-reported health. They describe the preference for present non-pecuniary components of education at large over risky behavior and may also capture the effect of unobservable personality traits on reported satisfaction (Diener, Suh, Lucas, & Smith, 1999). All of these "environmental" variables have large marginal effects on how the child feels at school. As does religion, measured by attendance to church (at least once a month), which is consistent with many other studies. Lastly, the absence of father (but marginally so the absence of mother) can be seen as another bad surprise that diminishes the child's satisfaction with school.

6. School satisfaction and risky behavior

In this section, we demonstrate empirically that the risky behavior of adolescents can be statistically predicted *in all domains* by their dissatisfaction with school. The problem of endogeneity is addressed by taking school satisfaction from the first in-home survey and risky behavior from the second, one year later. The problem of causality is solved because the school satisfaction variable contains information about current surprises at school and in school-related activities that is unique, and in no other variable (Eq. (10)), so that school satisfaction truly causes risky behavior.

The Add Health survey enabled us to observe 18 types of risky behavior which we aggregated in 11 categories: school absenteeism, cigarette smoking (over the last 30 days), alcohol drinking (over the last year), drunkenness (over the last year), marijuana (over the last 30 days), other drugs, drug selling, illegal or violent behavior (tagging, vandalism, running away from home, driving without license, group fighting, and making a din), stealing (shoplifting, stealing private property, and armed robbery), unprotected sex, and suicide attempt. Since alcohol drinking and drunkenness are highly correlated, we decided to consider them as a single behavior and retain only alcohol drinking. This leaves us finally with 10 categories.

Table 3 shows that the prevalence of risky behavior is quite substantial among adolescents attending middle or high school. For instance, 30% of these adolescents did not attend courses, 32% smoked cigarettes and 16% smoked marijuana, 53% had some kind of illegal or violent behavior, 24% stole something and 27% of those who reported a sexual relationship had unprotected sex. 76% of adolescents had one risky behavior at least (excluding unprotected sex). Indeed, many adolescents break the educational norm in one way or another. Moreover, as suggested by Zullig et al. (2001), different types of risky behavior correlate with each other. However, these correlations follow a distinctive pattern. Table 4 shows the correlation matrix for nine types of risky behavior (excluding unprotected sex). Substantial correlations can be seen within three groups of risky behavior: (i) cigarette, alcohol, marijuana; (ii) marijuana, other drugs, selling drugs; (iii) selling drugs, illegal or violent behavior. School absenteeism, stealing, and suicide attempts are more loosely related to other types of risky behavior.

Table 3
Effect of school satisfaction and risky behavior in year t on the proportion adopting risky behavior in year $t+1$ (Add Health)

	Satisfaction and behavior in t (proportions in %)				All sample	N
Risky behavior in $t+1$	Satisfied No risk	Dissatisfied No risk	Dissatisfied Risk	Satisfied Risk		
School absenteeism	17.29	23.95	64.69	61.34	29.52	9232
Cigarette (30 days)	16.55	20.75	78.55	74.23	32.33	9788
Alcohol (365 days)	19.79	23.05	64.40	64.67	37.89	9864
Marijuana (30 days)	8.57	13.18	56.61	57.48	16.02	9663
Other drugs	4.37	9.97	18.85	9.73	7.91	9686
Selling drugs	3.55	6.71	52.22	41.64	7.46	9684
Illegal, violent behavior	27.91	33.33	70.43	66.05	52.54	9678
Stealing	11.92	14.51	52.85	49.20	24.23	9686
Unprotected sex	18.99	24.74	44.30	37.40	27.32	2207
Suicide attempt	1.98	3.03	31.41	28.22	3.32	9665
All behaviors (except sex)	40.22	45.43	89.68	85.34	75.85	8722

Table 4
Correlation between nine types of risky behavior at time $t+1$ (Add Health, In-Home II) ($n = 8810$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
School absenteeism (1)	1								
Cigarette (2)	0.205	1							
Alcohol (3)	0.201	0.373	1						
Marijuana (4)	0.235	0.389	0.320	1					
Other drugs (5)	0.137	0.243	0.234	0.354	1				
Selling drugs (6)	0.163	0.222	0.190	0.419	0.322	1			
Illegal, violent behavior (7)	0.132	0.186	0.219	0.192	0.141	0.331	1		
Stealing (8)	0.156	0.205	0.226	0.236	0.202	0.264	0.186	1	
Suicide attempt (9)	0.040	0.099	0.078	0.114	0.140	0.087	0.097	0.086	1

Table 3 indicates that school satisfaction in period t has a clear influence on adoption of a risky behavior in $t+1$, whatever was the child's behavior in t. This is true for all types of risky behavior with the exception of alcohol drinking. Among those who had not adopted a given risky behavior in t, school dissatisfaction markedly increases the likelihood of adopting this behavior one year later (columns 1 and 2); and, among those adopting a given risky behavior in t, school satisfaction markedly decreases the likelihood of adoption of this behavior one year later (columns 3 and 4). To go further, let $R^*_{ij,t+1}$ denote the adolescent (i)'s latent decision variable for adopting risky behavior j in sub-period $t+1$, R_{ijt} her observable discrete analog in t (defined as (8)), S_{it} school satisfaction, $X_{i,t+1}$ a vector of individual variables in $t+1$, $u_{ij,t+1}$ an error term and α_j, β_j, ρ_j constant risk-specific (vector of) coefficients. Since all risky behaviors are measured with dummy variables, and school satisfaction is supposed to indicate a general aversion toward risky behaviors, we chose to measure also school satisfaction in binary form in these regressions (after checking that the main results were virtually identical when a 5-level satisfaction index was included in the regressions). We estimate the following adaptation of Eq. (10) for 10 types of risky behavior in sub-period $t+1$:

$$R^*_{ij,t+1} = \beta_j R_{ijt} + \rho_j S_{it} + \alpha_j X_{i,t+1} + u_{ij,t+1}. \tag{13}$$

In Table 5, based on a Probit estimation of $R_{ij,t+1}$, we report only the two coefficients β_j and ρ_j which describe the respective effects of habit and school satisfaction on a specific risky behavior. The regression results confirm the indications of Table 3. With the exception of alcohol drinking, school dissatisfaction predicts risky behavior in all domains one year ahead (the same result held when risky behavior was disaggregated in 18 categories). The coefficients are usually statistically significant at the 1% level (at the 5% level only for unprotected sex). In conformity with Eq. (10) that predicts a dampening effect of surprises with the duration of habit, it is worth noting that the higher coefficients of school satisfaction obtain for the low-frequency types of behavior (other drugs and drug selling). A strong prediction of Eq. (10) is that the habit coefficient should be equal to 1 in the long run, holding surprises experienced in the last year constant through the school satisfaction variable (the precise timing of effects is described in Fig. 1). This conclusion would hold if all risk-specific experiences were stochastically independent. Thus, habit coefficients which significantly differ from one indicate that experiences are serially correlated, positively when the coefficient exceeds one and negatively when the coefficient is below one. Interestingly, the habit coefficient is much greater than one for cigarettes, marijuana, other drugs, and drug selling, which are clearly addictive behaviors. Suicidal experiences also correlate positively, but unprotected sex exhibits strong negative serial correlation which indicates fast learning. The assumption of serial independence of experiences applies essentially to school absenteeism, stealing and illegal or violent behavior. These results make a lot of sense, thereby suggesting that the assumptions of rational expectations and Bayesian updating are not grossly inadequate. Thus a future extension of the stochastic model of preference formation presented here should allow for serial dependence of surprises in order to accommodate addictive behavior as one particular kind of risky behavior.

Table 5
Coefficients (satisfaction and habit) of behavioral equations: Probit (Add Health, In-Home II)

Behavior ($t+1$)	Satisfaction coefficient (t)	Habit coefficient (t)	N	Log-likelihood	$\chi^2_{(39)}$
School absenteeism	−0.140***	1.006***	7392	−3685.80	1381.35
	(0.036)	(0.038)			
	[−0.046]	[0.362]			
Cigarette smoking	−0.134***	1.502***	7700	−3582.74	2137.85
	(0.036)	(0.038)			
	[−0.046]	[0.540]			
Alcohol drinking	−0.048	1.090***	7765	−4275.69	1608.68
	(0.034)	(0.033)			
	[−0.018]	[0.408]			
Marijuana	−0.119***	1.331***	7610	−2671.23	1137.84
	(0.040)	(0.048)			
	[−0.025]	[0.410]			
Other drugs	−0.311***	1.189***	7747	−1735.10	765.61
	(0.047)	(0.052)			
	[−0.036]	[0.243]			
Selling drugs	−0.294***	1.378***	7795	−1617.90	822.22
	(0.048)	(0.064)			
	[−0.032]	[0.309]			
Illegal, violent behavior	−0.122***	0.955***	7787	−4754.47	1197.85
	(0.032)	(0.031)			
	[−0.048]	[0.366]			
Stealing	−0.115***	1.091***	7780	−3635.05	1255.60
	(0.036)	(0.034)			
	[−0.033]	[0.353]			
Unprotected Sex	−0.137***	0.510***	1823	−1006.09	123.12
	(0.066)	(0.068)			
	[−0.045]	[0.174]			
Suicide attempt	−0.186***	1.331***	7781	−965.76	382.58
	(0.061)	(0.087)			
	[−0.010]	[0.211]			

Robust standard error in parentheses (Huber–White–Sandwich).
Marginal effect in brackets.
Significance levels: * = 10%; ** = 5%; *** = 1%.
Other variables: Female, Black, Hispanic, Asian, Other origin, Age, Education, Good health, One parent, weekly earnings; PARENTS: Age, Born in USA, Public assistance, Work outside home, Unemployed, Full-time work, PTA member, Choice of neighborhood for less delinquency, Choice of neighborhood for better school, Disposable income, No money problems, Tobacco, Alcohol; SCHOOL: Private, Rural, Urban, Small, Medium, West, Middle-West, North-East.

Many controls were introduced in the regressions to account for additional factors which favor or impede the adoption of specific risky behavior. For instance, parents' smoking and drinking indicates a lenient educational norm, which facilitates the similar attitude of their children. And girls would be less prone to adopt some risky behaviors (and more eager to study) if they suffered from a higher depreciation of their human capital than boys. However, additional effects of this kind might as well reflect spurious correlations. A given control may be significant if it correlates with unobservable surprises. Only are (norm-dependent) surprises the true causes of the revealed preference at a given moment in time.

7. Conclusion

Even though children's behavior is often constrained by adults, there remains considerable degrees of freedom and scope for rational behavior which deserve systematic exploration. The behavioral model of choice and school satisfaction of children presented here yields a joint prediction of education and risky behavior. School (dis)satisfaction expresses an experienced or post-decisional preference for education (risky behavior), that is an intention to respect (deviate from) the educational norm in the near future. Thus educational choices, school satisfaction, and risky behavior share the same dynamics which can be recovered on panel data as successive revealed preferences of children.

The preference formation process that we described is remarkably simple: all preference and behavioral changes are caused in the short run by unexpected deviations from one's current normative expectations (surprises, or stress). Bad surprises immediately drive the child away from the educational norm and toward risky behavior. However, since this causal effect fades away with experience, rational behavior will converge to a stable habit in the long run if surprises occur independently over time. A specific behavioral episode would turn into an addiction (e.g., drug use) if surprises were serially positively correlated and into a "durable" experience which should not be repeated (e.g., unprotected sex) if surprises were negatively correlated.

This model of behavioral change is an economic model, building on human capital theory and assuming rational behavior, with a psychological twist, uncertain and constructed preferences. A major implication of this theory is that rational persons with uncertain preferences will behave in ways which are not consistent in general with constrained maximization of a given utility function. The dynamic uncertainty which results from the continual occurrence of surprises generates apparent time inconsistencies which are particularly salient in children's and addictive behavior.

Our analysis of school satisfaction offers another instance of the duality between economics and psychology by reconciling the affective (hot) and cognitive (cold) nature of satisfaction and choice. Satisfaction is the affect caused by the disclosure of unexpected information which drives individuals into an immediate preference change, as noted by Zajonc (1980).

The fact that our interpretation of school satisfaction judgments was empirically validated is an example of the fruit borne by this duality. For predictive and policy purposes, it may be valuable to rely on the child-specific and easy-to-collect judgment of school satisfaction for predicting a general propensity to risky behavior. Lastly, as a theoretical note, the dynamic approach to preference formation and satisfaction which has been developed here can be applied generally to other contexts, and we hope that it will prove useful in future behavioral research.

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