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## Relationships among negative and positive behaviours in adolescence

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### Abstract

The authors calculated binary indicators of seven positive and 23 negative behaviours for 22,898 8th and 15,828 11th grade students who participated in the Oregon Healthy Teens Survey across two school years. Relationships among these variables, using both the Jaccard measure of co-occurrence and the relative risk for each member of each variable pair, given exposure to the other, showed strong inter-relationships within, but not between, the sets of behaviours. The likelihood of negative behaviours given negative behaviours was much stronger than the likelihood of positive behaviours given positive behaviours. Positive behaviours provided little protection against the likelihood of negative behaviours.

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### Introduction

This paper presents an analysis of the relationships among adolescent behaviours. The seminal work of the Jessors ([Jessor & Jessor, 1977](#)) helped to establish that youth engaging in a given problem behaviour are likely to engage in other problem behaviours ([Biglan et al., 2004](#)). However, most studies have focused on the relationships among substance use and antisocial behaviour (e.g., [Ary et al., 1999](#); [Dishion, Capaldi, Spracklen, & Li, 1995](#); [Windle, 1990](#)), or psychological problems such as depression ([White, Xie, Thompson, Loeber, & Stouthamer-](#)

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Loeber, 2001). We analysed the relationships among a larger set of problems (23 behaviours) than has typically been studied. Moreover, only a few studies have included behaviours considered socially desirable (Benson, 1998; Jessor, 1987a, b). In the present paper, we include a set of seven items representing behaviours generally considered desirable. We then examine relationships between this set of behaviours and the other sets of problem behaviours.

Understanding the relationships among adolescent behaviours could contribute to strategies for preventing, ameliorating, and understanding the development of both problem behaviour and more socially desirable behaviour. To the extent that problem behaviours co-occur, it is important to develop treatment and prevention interventions that address the entire range of problems and to evaluate those interventions in terms of their effect on all problems (Biglan et al., 2004). Moreover, precise understanding of the inter-relationship among adolescent behaviours supports a key task for developmental research, namely, analysis of the factors that influence the sequencing and clustering of behaviours.

Recently, interest in relationships among desirable behaviours and the relationships between such behaviours and problem behaviours has increased. There has been concern that a restricted focus on problem behaviour may stigmatize youth and undermine efforts to promote support for their successful development (Benson, 1998). In this context, many advocate promotion of positive social behaviour (e.g., Catalano, Hawkins, Berglund, Pollard, & Arthur, 2002; National Research Council & Institute of Medicine, 2002). The extent to which positive or socially desirable behaviours are inter-related and negatively associated with problem behaviours is relevant to this issue. If behaviours such as volunteer work and academic achievement are highly related, it may be possible to promote them and achieve the general development of civically valuable behaviours. If high levels of engagement in desirable behaviours relate negatively to problem behaviours, it may be possible to prevent problems by promoting these desirable behaviours. However, if positive and problem behaviours are generally unrelated, the promotion of positive behaviours may have little benefit in preventing problematic adolescent behaviour.

We assessed a set of social behaviours that appears advantageous to adolescents and those around them. These are academic performance, religious involvement, participation in sports and volunteer activities, and involvement in paid work and chores at home. For clarity, we label these positive behaviours “desirable.” The behaviours cover a range of facets of adolescent life, including school, home, community, work, and recreation. If these behaviours were highly inter-related, it would suggest the value of further studying the sequence of their development and the influences on such development. These behaviours are a small sample of those we might assess, such as reading, helping a friend with homework, or participating in a social club.

It is important to acknowledge that the distinction between “positive” or desirable and “negative” behaviours is, in some cases, arbitrary. For example, although we assessed not wearing seatbelts, we could also have used a reversed coding scheme and labelled the variable, “wearing seatbelts.” Moreover, the benefit or harm of certain behaviours remains debatable. For example, while there is an obvious financial benefit to paid work, the literature indicates that many of the consequences of employment for adolescents may be deleterious (Greenberger & Steinberg, 1986; Steinberg & Dornbusch, 1991; Staff & Uggen, 2003).

In the present study, we found that paid work among 11th grade students was associated with an elevated risk of substance use, sexual involvement, and truancy. We therefore treated the ‘paid work’ item as negative and included it with other indicators of poor time use. Finally, in the same

sense that health is more than the absence of illness (*Encyclopædia Britannica*, 2004), for some variables (e.g., antisocial behaviour), absence does not imply the complementary state.

There may be gender differences in the relationships among behaviours. For example, it is possible that weapon carrying is more highly associated with other forms of antisocial behaviour among boys than it is among girls. Differences in such patterns could provide clues regarding the processes involved in the development of behaviours and would indicate ways in which prevention and treatment interventions might need to be different, depending on gender.

It also seems likely that there will be developmental differences in the co-occurrence of problem behaviours. It is known that there is a higher prevalence of antisocial behaviour and substance use in mid-adolescence than there is in early adolescence (*Biglan et al.*, 2004) and that later starting delinquents are less likely to become career criminals (*Patterson & Yoerger*, 1997; *Moffitt & Caspi*, 2001). Therefore, it is possible there will be higher levels of co-occurrence among problems for younger adolescents because engaging in problem behaviour at a younger age reflects membership in a “hard core” group with multiple problems.

Most analyses of the inter-relationships among harmful behaviours have employed correlational procedures. Such analyses make it impossible to tell how likely a particular behaviour is, given that the young person is engaging in another behaviour. Nor do these analyses allow an estimation of the proportion of the population that engages in multiple problem behaviours. This is important since, if multiple harmful behaviours are concentrated in a small number of young people, it could be appropriate to target this group with the limited treatment and prevention resources available. To the extent that problems do not co-occur, it would be better to expend resources on interventions that are more inclusive. For this reason, the present paper examines relationships among measures of adolescent behaviour that were dichotomized to reflect the presence or absence of the behaviour or a level of the behaviour that is deemed likely to be of significance for the well-being of the adolescent.

In this paper, we first provide population-based estimates of the occurrence and co-occurrence of desirable and problem behaviours among Oregon adolescents in grades 8 and 11. Then, we analyse the relative risk of behaviours given other behaviours, with particular attention to grade and gender differences. We examine relative risk among antisocial behaviours, among substance use behaviours, and among other sets of problem behaviours. Next, we examine relative risks among socially desirable behaviours. Finally, we present relative risks between sets of problem behaviours and between sets of desirable behaviours.

## **Methods**

Oregon Healthy Teens (OHT) is an annual population-based survey designed to monitor adolescent well-being in Oregon. The survey is a collaborative effort of Oregon Research Institute, the Oregon Department of Human Resources, the Oregon Department of Education, and the Oregon Commission on Children and Families. The National Cancer Institute funded the project to support the analysis of factors influencing youthful tobacco use. Here we present results from the first two years of the survey (2001, 2002).

We identified the sampling frame as the entire set of 231 youth communities in Oregon, defining a youth community as a public high school and the middle, junior, or elementary schools that feed into it. In the first year, we drew a probability sample, proportional to enrolment size, of 115

youth communities and successfully recruited the schools in 79 (69%) of those communities to participate in the survey. In the second year, we recruited schools in 14 additional communities from the original sample. However, three schools dropped out, giving us 78% of the original community sample in the second year.

We attempted to survey all 8th and 11th grade students in the participating communities annually, using local Institutional Review Board-approved procedures. Approximately four weeks before survey administration, parents of each student received notification letters at their homes, with instructions to notify the school if they wished their child not to participate. Research staff administered anonymous student questionnaires in classrooms during regular school periods and instructed students that their participation was voluntary. There were 52,579 8th and 11th grade students enrolled during the first two years of the survey. Parents of 5% of the enrolled students wished their child not to participate and an additional 2% of enrolled students chose not to participate. In addition, another 14% of the students listed on the class rosters were not present on the day of the survey, bringing the student participation rate to 79%. Student participation rates did not vary systematically across years or communities.

### *The student questionnaire*

The OHT questionnaire consists of a demographics section and six health area content modules. Alternate survey forms included the demographics section and three systematically rotated content modules. Students received one of these 20 alternate forms at random. This permitted collection of data on a wide range of aspects of adolescent well-being, as well as data about risk and protective factors. The combination of the modular design and administration protocol assured that approximately 50% of all students surveyed answered data for each item in any content module. Aspects of youth functioning addressed by survey items were identified based on evidence about the most common and costly problems of youth ([Biglan et al., 2004](#)) and on research on indicators of positive youth development ([Benson, 1990, 1998](#); [National Research Council & Institute of Medicine, 2002](#)). Items came from the Youth Risk Behavior Survey ([Kann et al., 2000](#)), the Communities That Care assessment ([Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002](#)), and questionnaires developed at ORI in previous studies of tobacco use ([Biglan, Ary, Smolkowski, Duncan, & Black, 2000](#)) and other substance use ([Metzler, Biglan, Ary, & Li, 1998](#)).

### *Sample*

The Oregon Healthy Teens student sample consisted of 41,538 students in 8th and 11th grades from the first two assessment years (T1 and T2). Of those students, we eliminated 791 (1.9%) due to invalid response patterns—either inconsistent or bogus response patterns. For the former, we removed students with repeated inconsistent responses, such as when students reported no alcohol use in the past 30 days but then said they drank alcohol on school property 20 or more days in the same time frame. The number of inconsistencies required to remove a case varied by survey module, as some modules contained fewer unambiguous questions, but generally, we removed students with five to nine inconsistencies.

We also removed students if they supplied bogus response patterns. These patterns consisted of an unattainable number of problem behaviours, such as students who marked the maximum on

all marijuana items. This bogus response would include smoking marijuana 20 or more times in the past 24 hours and smoking marijuana 40 or more times on school property in the past 30 days. As with inconsistent responses, the number of bogus responses varied depending on survey form. Some forms allowed fewer questions we could code as bogus. In general, we removed students with 4 to 11 bogus responses from the sample.

Finally, we removed 1896 students who failed to report their gender and 125 students for whom all of the 30 variables of interest were missing. The final sample included 38,726 students: 17,122 (44.2%) at T1 and 21,604 (55.8%) at T2; 22,898 (59.1%) in 8th grade and 15,828 (40.9%) in 11th grade; 19,560 (50.5%) female and 19,166 (49.5%) male. Five percent were Native American, 4% Asian, 2% Hawaiian or Pacific Islanders, 3% African American, 10% Hispanic, and 83% were White, non-Hispanic. Seventy-two percent of the students lived in two parent households. Eighty-eight percent of the students' parents had completed high school, and 18% had completed college. Seventy-two percent of the participating students lived in an urbanized area. These sample demographics are representative of the state as a whole.

### *Data preparation and analytic methods*

Student responses to 30 of the items<sup>1</sup> from OHT survey modules collected across the 2000–2001 and 2001–2002 school years for 8th and 11th grade classes were recast as binary items based on inspection of the distribution of responses, professional judgment, and/or natural division points.<sup>2</sup> Variables having to do with substance use, drunk driving, weapon carrying, gang involvement, setting fires, condom use, pregnancy, extreme dieting, bike helmet use, seatbelt use, and truancy, we coded to distinguish any involvement from no involvement in the behaviour. We coded exercise to distinguish those who exercised four or fewer days (in the past 7 days) from those who exercised more. We dichotomized paid work based on having averaged three or more hours of work per week in the past month. Sports, volunteer participation, doing homework, and household chores were split at five or fewer hours per month. Religious participation split at rarely or never vs. more-frequent participation. We dichotomized watching television to distinguish those who reported watching four or more hours a day of TV from everyone else. The grade variable distinguished students who reported their grades as much better than those of their peers from those who reported their grades as only slightly better or worse than their peers.

We coded the weight variable to distinguish those reporting being “very overweight” from everyone else. We dichotomized on the sex partner variable to distinguish those who had any intercourse in the past three months from those who had not. We classed respondents as having engaged in antisocial behaviour if they reported having engaged in three or more of the following behaviours in the past three months: suspended from school, stolen something worth more than \$10, stolen motor vehicle, attacked someone, stopped by police, arrested, or used a weapon in a fight. If they reported fewer than two of these behaviours, they received a zero.

We organized the 30 negative behaviour items into eight groups for analysis and explication purposes. These item sets are representative of the survey content modules and indicate areas of youth functioning thought to be important measures of adolescent health and well-being (**Biglan**

<sup>1</sup>Module items and response categories for OHT Survey are at <http://www.ori.org/oh/studentquestion.html>.

<sup>2</sup>Criteria for dichotomization and full item definitions are at <http://www.ori.org/oh/som>.

et al., 2004). The seven sets of negative items were substance use (7 items), antisocial behaviour (4 items), depression (2 items), high-risk sexual behaviour (3 items), eating disorders (2 items), safety (2 items), and poor time use (3 items). The seven desirable items constituted the eighth set.

We report on two methods<sup>3</sup> we used to explore the relationships among these items, analysis of co-occurrence and calculation of the relative risk of each behaviour given each other behaviour.

#### *Co-occurrence*

There are several methods for characterizing co-occurrence. One could examine the proportion of all members of the population with both behaviours. However, for relatively rare events, this approach may give undue weight to the cases that exhibited neither behaviour (Kaufman & Rousseeuw, 1990). An alternative is the Jaccard method, which calculates the proportion of those who have one or the other problem to those who have both problems (Kaufman & Rousseeuw, 1990). The relative prevalence of the two behaviours affects the results of this method. This is the metric used in this paper. We calculated co-occurrence for the complete set of 30 behaviours for the 8th and 11th grades separately.

#### *Relative risk*

We calculated the relative risk for each variable given each other variable using the SAS FREQ Procedure (Stokes, Davis, & Koch, 1995). In the case of 8th graders, we did not include drunk driving and condom use because so few youth reported these behaviours.<sup>4</sup> Each table entry indicates the risk of the problem shown in the column, given the problem shown in the row. Relative risk indices provide a better statistical test of co-occurrence than does the odds ratio, because a relative risk index indicates the relative likelihood that a person will have problem B, given that he has problem A. It is often not recognized that this index is not the same as the relative likelihood that a person will have problem A, given that she has problem B. The odds ratio is often interpreted as providing relative risk indices of one event given another in a symmetrical way. Fleiss (1981) points out that the odds ratio is an estimate of the relative risk. While both the odds ratio and the relative risk compare the likelihood of an event occurring between two distinct groups, the relative risk is easier to interpret (van Belle, 2002; Children's Mercy Hospital & Clinics, 2003).

## **Results**

### *Prevalence*

Table 1 provides the 8th and 11th grade prevalence estimates and number of valid responses for OHT survey items across 2 years, recast as binary indicators of either negative (n. prefix) or desirable (positive; p. prefix) behaviours. The prevalence of negative behaviours, expressed as the percentage of students who evidenced the behaviour, ranged from 2% for pregnancy to 28% for

<sup>3</sup>We also conducted exploratory agglomerative hierarchical clustering analyses for both the 8th and 11th grade data sets. Results and discussion of these analyses are in supporting online materials, <http://www.ori.org/oht/som>.

<sup>4</sup>The full table for these pairs, together with their 99% confidence bounds and Breslow-Day tests of homogeneity of estimates for males and females, is located at <http://www.ori.org/oht/som>.

Table 1  
Prevalence of negative and positive behaviours in adolescence

Binary item	Description	8th grade		11th grade	
		N	Prevalence (%)**	N	Prevalence (%)**
<i>Substance use</i>					
n.smoking30	Smoked tobacco in past 30 days? <sup>a</sup>	11,327	11	7976	20
n.smokeless30	Used smokeless tobacco in past 30 days? <sup>a</sup>	11,285	2	7973	6
n.alcohol30	At least one drink in past 30 days? <sup>a</sup>	11,065	24	7905	43
n.binge30	Drank more than 5 drinks in past 30 days? <sup>a</sup>	11,133	10	7908	25
n.marijuana30	Used marijuana in past 30 days? <sup>a</sup>	11,177	12	7930	22
n.harddrugs30	Used hard drugs in past 30 days? <sup>a</sup>	10,731	4	7790	4
n.drunkdrive	Drove drunk in last 30 days? <sup>a</sup>	N/A*	N/A*	7604	9
<i>Anti-social behaviour</i>					
n.antisocial	Antisocial behaviour past 3 months? <sup>a</sup>	10,552	6	7556	4
n.weapon	Carried a weapon past 30 days? <sup>a</sup>	10,397	18	7517	15
n.ingang	Gang member? <sup>a</sup>	9891	3	7372	2
n.setfire	Set fire in the past three months? <sup>a</sup>	10,359	17	7503	10
<i>Sexual behaviour</i>					
n.sexpartner	Sexual partners in the past three months? <sup>a</sup>	10,008	9	7432	29
n.condom	Condom used last time of intercourse? <sup>b</sup>	N/A*	N/A*	7417	14
n.pregnancy	Been pregnant or gotten someone pregnant? <sup>a</sup>	9813	2	7293	4
<i>Depression</i>					
n.cesd	Felt depressed, sad, low energy, past week? <sup>a</sup>	10,791	14	7621	15
n.suicide	Attempted suicide past 12 months? <sup>a</sup>	10,467	8	7532	6
<i>Eating disorder</i>					
n.weight	Describes self as overweight? <sup>a</sup>	10,666	5	7695	4
n.diet	Extreme dieting in past 30 days? <sup>a</sup>	10,367	13	7605	14
<i>Safety</i>					
n.helmet	Wore bike helmet in past 12 months? <sup>b</sup>	9928	28	7377	37
n.seatbelt	Wore seatbelt when passenger in car? <sup>b</sup>	10,274	7	7496	4
<i>Poor time use</i>					
n.truant	Skipped school in last 4 weeks? <sup>a</sup>	10,514	22	7428	37
n.paidwork	Paid work in past month? <sup>a</sup>	10,170	17	7537	43
n.tv	Excessive TV watching per day? <sup>a</sup>	10,470	14	7618	8
<i>Positive activity</i>					
p.exercise	Participated in physical activity past 7 days? <sup>a</sup>	10,701	57	7693	42
p.volunteer	Volunteered in past month? <sup>a</sup>	10,114	17	7512	26
p.sport	Participated in sports in past month? <sup>a</sup>	10,051	31	7464	31
p.church	Took part in religious activities past month? <sup>a</sup>	10,290	49	7336	46
p.chore	Did chores in past month? <sup>a</sup>	10,078	32	7505	31
p.hmwork	Did homework in past month? <sup>a</sup>	9991	40	7437	44
p.academic	Good grades in school past 12 months? <sup>a</sup>	10,296	16	7373	19

\*Not included for 8th grade.

\*\*Rounded to nearest whole percent.

<sup>a</sup>Yes = 1; No = 0.

<sup>b</sup>Yes = 0; No = 1.

non-use of bike helmet in the 8th grade and from 2% for gang membership to 43% for alcohol use in 11th grade. The prevalence of positive behaviours ranged from 16% for academic success to 57% for exercise in 8th grade and from 19% for good grades to 46% for church attendance in the 11th grade.

### *Occurrence and co-occurrence*

Fig. 1 presents information for 8th grade students about the self-reported prevalence of each behaviour as well as the rates of their co-occurrence using the Jaccard index of similarity. We present prevalence rates on the diagonal and co-occurrence on the off diagonals, with five shading levels used to indicate quintile membership of each value.

This figure provides co-occurrence information for each pair of behaviours. Starting at the diagonal, one can note the prevalence of a behaviour and then read the off-diagonal row/column to see its rate of co-occurrence with every other behaviour. For example, the 8th grade prevalence of alcohol use is 0.24 and the Jaccard coefficient of co-occurrence for this behaviour with binge drinking (value at the intersection of n.binge30 row and n.alcohol 30 column) is 0.40, indicating that 40% of those students who were alcohol drinkers or binge drinkers were both.

Co-occurrence for 8th grade students across the two years ranged from 1% (e.g., getting good grades and engaging in antisocial behaviour) to 44% (doing chores and doing homework). The average co-occurrence between any two behaviours was 11% (interquartile range 5%, 15%). Fig. 1 presents two clear patterns. First, positive behaviours co-occur with one another more than with negative behaviours. The only clear exception is that alcohol use co-occurs more than 16% with each of the positive behaviours except volunteering (10%) and academic performance (7%). Second, the negative behaviours involving substance use have very high co-occurrences with one another, with the exception of smokeless tobacco use.

Fig. 2 shows co-occurrence for 11th grade respondents. Co-occurrences range from 1% (e.g., getting good grades and using hard drugs) to 57% (alcohol use and binge drinking). The average co-occurrence value (11%) and interquartile range (5%, 15%) are similar to those for 8th grade. The patterns obtained for the 11th grade are also similar to those for 8th grade.

Differences in co-occurrence rates for the two grades resulted from subtracting the 11th grade values from the 8th grade values, using scores for all 30 variables in the 8th grade. Of the 435 (30\*(29/2)) possible co-occurrence pairs, 207 are higher in the 11th grade (mean difference = -5%) and 228 are higher in the 8th grade (mean difference = 4%). Although the magnitudes of the differences are very similar, and a binomial test of these differences is not significant ( $p = 0.33$ ), the patterns of the differences are strikingly different for individual behaviours. A binomial test of each of the 30 variables for differences between grades in the direction of co-occurrence with all other variables, using a Bonferroni corrected  $\alpha$  of 0.00167 (0.05/30), identified 10 behaviours that differ significantly between grades. Nine of these 10 show higher co-occurrence with other behaviours in the 8th than 11th grade: use of hard drugs, antisocial behaviour, weapon carrying, gang participation, fire setting, suicide attempts, weight concerns, wearing a seatbelt, and TV watching. As might be expected, the 11th grade co-occurrence of driving while drunk with other behaviours is consistently higher than in 8th grade (28 of 29 pairs). No significant differences co-occur between the two grades for any of the seven desirable behaviours.



n.smoking30	6	3	12	10	9	1	1	7	2	5	6	8	5	2	6	2	3	6	11	2	9	15	2	16	18	17	18	13	22	19	Good grades in school in past 12 months
n.smokeless30	12	3	23	14	14	3	2	10	1	5	6	16	9	3	12	4	4	11	20	2	17	25	6	29	28	28	33	39	44	Did homework in past month	
n.alcohol30	12	5	21	13	12	3	3	13	1	7	8	17	10	4	13	5	4	12	20	3	19	22	6	23	24	20	25	31	Did chores in past month		
n.binge30	10	4	21	12	10	2	2	11	2	6	8	14	8	2	11	5	4	9	24	3	22	28	5	31	35	28	46	Took part in religious activities past month			
n.alcohol30	10	6	20	16	13	2	3	10	1	8	6	16	8	2	9	4	2	10	20	3	16	19	4	48	18	31	Participated in sports in past month				
n.smokeless30	8	4	13	8	9	2	1	8	1	3	5	10	7	2	11	3	4	10	16	1	14	20	3	18	26	Volunteered in past month					
n.binge30	14	7	27	20	18	3	4	15	1	8	8	21	10	3	12	4	2	11	27	3	21	25	6	42	Participated in physical activity past seven days						
n.alcohol30	7	3	7	7	6	5	8	3	4	5	7	6	4	6	5	6	6	8	5	8	6	8	Excessive TV watching per day								
n.smoking30	19	7	31	22	20	5	4	12	1	9	9	26	13	4	14	5	4	13	26	3	29	43	Paid work in past month								
n.smokeless30	25	8	39	31	28	6	6	15	2	13	13	30	16	7	16	7	3	15	28	5	37	Skipped school in last four weeks									
n.binge30	7	8	6	8	10	10	8	8	7	6	5	14	5	5	6	4	5	4	5	4	Wore seatbelt when passenger in car										
n.alcohol30	21	8	32	24	23	6	5	17	2	11	12	25	15	5	13	5	4	13	37	Wore bike helmet in past 12 months											
n.smokeless30	16	4	17	15	14	8	7	8	3	11	8	16	12	7	19	13	10	14	Extreme dieting in past 30 days												
n.binge30	5	2	4	4	3	5	4	4	5	3	4	3	4	5	8	7	4	Describes self as overweight													
n.alcohol30	9	4	7	7	10	8	7	4	7	8	9	10	9	16	6	Attempted suicide in past 12 months															
n.smokeless30	15	6	15	13	14	7	6	13	3	9	13	16	13	8	15	Felt depressed, sad, low energy past week															
n.binge30	10	7	7	8	9	13	16	9	8	9	8	12	13	4	Been pregnant or gotten someone pregnant																
n.alcohol30	21	5	19	18	18	8	6	9	2	13	9	35	14	Condom used last time of intercourse																	
n.smokeless30	30	9	35	31	30	10	8	13	3	15	9	29	Sexual partners in the past three months																		
n.binge30	12	9	13	15	14	10	12	22	7	10	10	Set fire in the past three months																			
n.alcohol30	22	16	20	27	18	12	12	12	5	9	Drove drunk in last 30 days																				
n.smokeless30	4	5	3	3	4	11	11	6	2	In gang																					
n.binge30	14	13	18	17	14	8	12	15	Carried a weapon in the past 30 days																						
n.alcohol30	9	9	6	9	10	18	4	Antisocial behavior in the past three months																							
n.smokeless30	14	9	9	12	15	4	Used hard drugs in the past 30 days																								
n.binge30	40	11	41	41	22	Used marijuana in the past 30 days																									
n.alcohol30	36	16	57	25	Drank more than five drinks in past 30 days																										
n.smokeless30	35	12	43	At least one drink of alcohol in past 30 days																											
n.binge30	16	6	Used smokeless tobacco in the past 30 days																												
n.smoking30	20	Smoked tobacco in the past 30 days																													

Fig. 2. Occurrence and co-occurrence of negative and positive behaviours—11th Grade.

### *Relative risk analyses*

We first report the relative risks within each of three sets of conceptually similar behaviours (substance use, antisocial behaviours, and positive behaviours). Next, we present some of the relative risks within the other sets of behaviours (sexual behaviour, depression, eating disorder, safety, and poor time use). Finally, we report on grade differences, relationships among the 8 sets of behaviours themselves, and gender differences.

#### *Substance use*

Table 2 presents relative risk ratios among measures of substance use for 8th and 11th grade. The column means in this table indicate the average risk of the behaviour in the column given other substance use behaviours; the row means indicate the average risk of other substance-using behaviours given the substance-use behaviour in that row. As expected, for the 8th grade, the use of cigarettes, alcohol, marijuana, and hard drugs, as well as binge drinking, are each more likely in the presence of the use of another substance, with all of the risk ratios except alcohol use given smokeless tobacco use ( $RR = 3.71$ ) exceeding four. The risk of hard drug use is especially high given marijuana or alcohol use. The average relative risk of hard drug use given other substance use behaviours (21.67) is substantially higher than the average risk of any other substance use behaviour given the other behaviours. The average risk of other substance use is highest given alcohol use (15.14) and next highest given marijuana use. For 11th grade, the pattern of relationships is essentially the same, but the risk ratios are consistently lower.

#### *Antisocial behaviours*

Table 3 presents risk ratios among antisocial behaviours. Recall that the variable n.antisocial was a composite on which respondents received a 1 if they reported three or more of the following in the past three months: suspended from school, stolen something worth more than \$10, stolen a motor vehicle, attacked someone, stopped by police, arrested, or used a weapon in a fight. If they reported two or fewer of these behaviours, they received a zero.

For both 8th and 11th grades, these behaviours are significantly inter-related. Gang membership given antisocial behaviour has the highest ratio ( $RR = 12.81$ ). In both grades, there is a significant risk of fire setting given antisocial behaviour.

#### *Positive behaviours*

Table 4 presents risk ratios among positive behaviours for 8th and 11th grade. It includes the average risk ratio for each column and each row. These behaviours are not as inter-related as are negative behaviours. Among 8th grade students, the mean relative risk for positive behaviours given a specific behaviour (the row means) ranged from 1.34 to 1.90. For 11th grade, the average relative risks ranged from 1.28 to 1.73. Doing homework and chores were the most highly related behaviours for 8th grade. Doing chores was more than three times more likely among those who reported doing homework; this effect was stronger for males than females. In 11th grade, involvement in sports and involvement in exercise were mutually related, as were doing homework and chores. However, the risk ratios in both directions exceeded 2.0 in no other instances.

Table 2  
Eighth and 11th grade relative risk of substance abuse items

	n.smoking 30	n.smokeless 30	n.alcohol 30	n.binge 30	n.marijuana 30	n.harddrugs 30	Row mean	
<i>8th grade</i>								
n.smoking30		14.84*	4.36*	9.03*	9.27*	17.90*	11.08	
n.smokeless30	6.91*		3.71*	7.22*	5.45*	14.43*	7.54	
n.alcohol30	10.24*	14.00*		<sup>a</sup>	10.78*	25.56*	15.14	
n.binge30	7.94*	13.08*	6.23*		8.46*	16.76*	10.49	
n.marijuana30	10.45*	10.07*	4.73*	11.06*		33.71*	14.00	
n.harddrugs30	7.83*	16.20*	4.12*	8.73*	8.64*		9.10	
Column mean	8.67	13.64	4.63	9.01	8.52	21.67	11.13	
	n.smoke 30	n.smokeless 30	n.alcohol 30	n.binge 30	n.marijuana 30	n.harddrugs 30	n.drunkdrive	Row mean
<i>11th grade</i>								
n.smoking30		5.84*	2.48*	3.70*	4.74*	9.46*	5.76*	5.33
n.smokeless30	3.70*		2.20*	3.21*	2.25*	4.27*	4.89*	3.42
n.alcohol30	5.96*	7.91*		<sup>a</sup>	7.29*	12.32*	<sup>a</sup>	8.37
n.binge30	4.51*	6.73*	4.12*		4.90*	8.49*	13.13*	6.98
n.marijuana30	5.37*	2.90*	2.76*	4.36*		15.75*	4.37*	5.92
n.harddrugs30	4.00*	3.69*	2.21*	3.23*	4.15*		4.14*	3.57
n.drunkdrive	3.65*	5.18*	2.76*	4.18*	2.89*	4.93*		3.93
Column mean	4.53	5.38	2.76	3.74	4.37	9.2	6.46	5.28

Note: The table presents the risk of behaviours in each column given exposure to the behaviour in each row.

\* $p < 0.01$ .

<sup>a</sup>Inherent dependence.

Table 3  
Eighth and 11th grade relative risk of antisocial behaviour items

	n.antisocial	n.weapon	n.ingang	n.setfire	Row mean
<i>8th grade</i>					
n.antisocial		3.54*	12.18*	3.29*	6.34
n.weapon	7.96*		7.06*	3.39*	6.14
n.ingang	8.72*	3.14*		2.53*	4.80
n.setfire	5.44*	3.00*	3.75*		4.06
Column mean	7.37	3.23	7.66	3.07	5.33
<i>11th grade</i>					
n.antisocial		3.00*	9.65*	3.55*	5.4
n.weapon	5.47*		4.72*	3.54*	4.58
n.ingang	7.96*	2.65*		3.38*	4.66
n.setfire	4.82*	2.81*	5.12*		4.25
Column mean	6.08	2.82	6.5	3.49	4.72

Note: The table presents the risk of behaviours in each column given exposure to the behaviour in each row.

\* $p < 0.01$ .

Significant Breslow-Day test statistic ( $p < 0.001$ ) indicating difference in risk for males and females are given in italics.

Table 4  
Eighth and 11th grade relative risk of positive behaviour items

	p.exercise	p.volunteer	p.sport	p.church	p.chore	p.homework	p.academic	Row mean
<i>8th grade</i>								
p.exercise		1.33*	2.77*	1.06	1.37*	1.21*	1.36*	1.52
p.volunteer	1.14*		1.58*	1.56*	1.93*	1.73*	1.76*	1.62
p.sport	1.61*	1.78*		1.17*	1.57*	1.67*	1.94*	1.62
p.church	1.05	2.31*	1.24*		1.04	1.10	1.28*	1.34
p.chore	1.21*	2.39*	1.59*	1.03		2.54*	1.06	1.64
p.homework	1.14*	2.42*	1.86*	1.09	3.24*		1.62*	1.9
p.academic	1.15*	1.70*	1.64*	1.15*	1.04	1.36*		1.34
Col. mean	1.22	1.99	1.78	1.18	1.70	1.60	1.50	1.57
<i>11th grade</i>								
p.exercise		0.99	4.40*	1.17*	1.12*	1.18*	1.23	1.68
p.volunteer	0.99		1.14*	1.74*	1.51*	1.48*	1.57*	1.4
p.sport	2.60*	1.16*		1.28*	1.13*	1.37*	1.49*	1.5
p.church	1.16*	2.22*	1.37*		1.16*	1.19*	1.28*	1.4
p.chore	1.10*	1.55*	1.13*	1.12*		2.03*	0.98	1.32
p.homework	1.17*	1.75*	1.50*	1.19*	2.72*		2.03*	1.73
p.academic	1.14*	1.45*	1.38*	1.17*	0.99	1.52*		1.28
Col. mean	1.36	1.52	1.82	1.28	1.44	1.46	1.43	1.47

Note: The table presents the risk of behaviours in each column given exposure to the behaviour in each row.

\* $p < 0.01$ .

Significant Breslow-Day test statistic ( $p < 0.001$ ) indicating difference in risk for males and females are given in italics.

#### *Relative risks within other sets of problem behaviours*

For the sake of brevity, we do not table the risk ratios within the other sets of behaviours. As expected, the risk of suicidal behaviour given depression was significant in both 8th grade (RR = 7.03) and 11th grade (RR = 6.12), as was the risk of depression given suicidal behaviour (RR = 5.22, 8th grade; RR = 4.16, 11th grade).

There were significant relationships between weight and dieting in both 8th and 11th grades. The risk of extreme dieting given self-reports of being overweight were significant for both 8th (RR = 2.88) and 11th grade (RR = 2.74). Similarly, the relative risk of being overweight given extreme dieting was 3.76 in 8th grade and 3.86 in 11th grade.

There were three items involving use of time—truancy, engagement in paid work, and watching TV more than one hour/day. These variables were not highly related. In 8th grade, only TV watching and truancy were significantly related (RR = 1.54 for TV watching given truancy and RR = 1.49 for truancy given TV watching). In 11th grade, TV watching and truancy were unrelated, but paid work was related to TV watching and truancy. High levels of TV watching were significantly less likely given paid work (RR = .71) and paid work was significantly less likely given high levels of TV watching (RR = .80). Truancy was slightly, but significantly, more likely given paid work (RR = 1.34) and conversely (RR = 1.29 for paid work given truancy).

Finally, in 8th grade, the risk of no seatbelt use was considerably higher among those who reported not using bike helmets (RR = 6.61) and no helmet use was higher among non-seatbelt

users (RR = 2.50). Relationships were similar, though not as high, in 11th grade (RR = 4.34 for no seatbelt use given no bike helmet use; RR = 1.47 for no helmet use given no seatbelt use).

#### *Differences between grades*

We conducted tests of the differences in relative risk between grades for the three sets of behaviours described above (substance use, antisocial behaviours, and positive behaviours) using a paired Wilcoxon signed rank test (Hollander & Wolfe, 1973; Siegel, 1956). We applied the test to vectors constructed for each grade using the cell value at the intersection of each of the variables with the other variables. Values at the same position in the vector for each grade comprised the pairs tested. Results of this test for each of the three sets of behaviours (Bonferroni corrected  $\alpha$  of 0.0167 (.05/3)) indicate a significant difference between grades for the substance abuse items ( $p < 0.00001$ ) but not the antisocial items ( $p = 0.17$ ) or the positive behaviour items, although the latter is close to significance ( $p = 0.02$ ).

#### *Relationships among sets of behaviours*

Table 5 presents average relative risk ratios among the sets of behaviours discussed above. For example, the number 5.52 in the first row, second column, for 8th grade is the average relative risk for all antisocial behaviour measures given all substance use measures. Thus, the numbers indicate the general tendency for members of one set of behaviours to relate to the other set.

Among the negative behaviours, the risk of one problem given another is consistently greater in the 8th grade than in the 11th grade. The risk ratios are higher in all but 2 of 42 cases and the average relative risk of negative behaviour given negative behaviour for the 8th grade was nearly twice as great as that of the 11th grade (4.34/2.57). The difference is particularly noteworthy for risky sexual behaviour. The average risk of risky sexual behaviour given substance use behaviour is 8.54 in 8th grade and 2.41 in 11th grade. The average risk of risky sexual behaviour given antisocial behaviour is 7.80 in 8th grade, but only 2.94 in 11th grade. The risk of risky sexual behaviour given depression is also higher in 8th grade (RR = 5.79) than in 11th grade (RR = 2.16).

In general, there is a risk of any given negative behaviour given another negative behaviour. In 8th grade, substance use, antisocial behaviour, sexual behaviour, and depression are particularly inter-related. In 11th grade, the highest average risk ratios involve antisocial behaviours; the risk of substance use given antisocial behaviour is greater than 3.00 and the risk of antisocial behaviour given substance use, high-risk sexual behaviour, or depression problems are all greater than 3.00.

Eating disorders are associated with higher levels of all other behaviours, with depression particularly likely in the presence of eating disorders.

Low levels of safety behaviours (bike helmet and seatbelt use) relate to other negative behaviours. It is interesting that the risk of most negative behaviours given low levels of safety behaviours is higher than the risk of poor safety behaviour given the other problems.

Time use behaviours are not as highly related to other problems as to other behaviours, although the risk of substance use, antisocial behaviour, and high-risk sexual behaviour are all greater than 2.00 in 8th grade.

Positive behaviours are not as highly related to negative behaviours as negative behaviours are to each other. On average, engagement in positive behaviours is associated with lower levels of

Table 5  
Average relative risk of subsets of items

	Substance use	Antisocial behaviour	Sexual behaviour	Depression	Eating disorder	Safety	Time use	Positive behaviour
<i>8th grade</i>								
Substance use		5.52	8.54	3.66	2.29	3.06	1.95	0.79
Antisocial behaviour	5.42		7.80	3.74	2.62	2.87	1.94	0.81
Sexual behaviour	6.86	7.11		4.46	3.08	3.72	2.01	0.81
Depression	3.93	3.85	5.79		3.64	2.20	1.63	0.88
Eating disorder	2.45	2.89	3.59	4.00		1.96	1.59	0.92
Safety	3.93	3.29	4.47	2.28	1.98		1.82	0.78
Time use	2.39	2.39	2.60	1.76	1.70	1.86		0.97
Positive behaviour	0.75	0.76	0.74	0.85	0.89	0.75	0.97	
<i>11th grade</i>								
Substance use		3.66	2.41	2.21	1.70	2.37	1.40	0.78
Antisocial behaviour	3.03		2.94	2.96	2.63	2.60	1.46	0.88
Sexual behaviour	2.55	3.41		2.27	1.59	1.67	1.32	0.84
Depression	2.08	3.01	2.16		2.64	1.84	1.23	0.85
Eating disorder	1.73	2.90	1.60	2.95		1.76	1.38	0.92
Safety	2.63	2.83	1.85	1.89	1.83		1.51	0.80
Time use	1.63	1.86	1.50	1.29	1.45	1.41		0.81
Positive behaviour	0.74	0.84	0.81	0.81	0.89	0.80	0.78	

substance use, antisocial behaviour, sexual behaviour, depression, eating disorders, and unsafe behaviours. For example, the average risk of antisocial behaviours given positive behaviours is 0.76 in 8th grade, indicating that the average risk of an antisocial behaviour is about 24% less given positive behaviours. In contrast, the negative behaviour with the lowest risk ratio for antisocial behaviour in 8th grade is 2.39 for time use (for comparison, the inverse of 0.76 is 1.32).

A Wilcoxon paired signed rank test of the differences between the 8th and 11th grades for the eight sets of behaviours is highly significant ( $p < 0.00001$ ), confirming that the within set average relative risks are larger in the 8th than in the 11th grade.

Although the risk ratios among individual behaviours are not shown in Table 5,<sup>5</sup> several of them seem worthy of mention. Suicide attempts were seven times more likely among 8th graders who were depressed than those who were not. However, they were also seven times more likely among those experiencing or causing a pregnancy and were six times more likely if they reported hard drug use or antisocial behaviour.

<sup>5</sup>Available at <http://www.ori.org/oht/som>.

In both grades, the positive behaviour associated with the greatest average reduction in the risk of negative behaviours is academic performance (0.61 for 8th grade and 0.70 for 11th grade). It is striking that students in the 8th grade who are achieving academically are 25% less likely to engage in antisocial behaviour as those who are not successful academically, but, by the 11th grade, this protective effect is lost. In both grades, those who participate in sports are half as likely to be smokers. However, sports participation does not appear to confer protection against any of the other problems, with the exception of hard drug use in the 11th grade.

In 11th grade, paid work was a small, but significant, risk factor for smoking (RR = 1.30), smokeless tobacco use (RR = 1.72), alcohol use (RR = 1.20), binge drinking (RR = 1.31), marijuana use (RR = 1.20), sexual involvement (RR = 1.39), and truancy (RR = 1.34), but not for hard drug use, antisocial behaviour, weapon carrying, gang membership, or setting fires.

Extensive TV watching was modestly associated (all risk ratios below 2) with all but four of the other negative problems for 8th grade students, the exceptions being smokeless tobacco use, alcohol use, carrying weapons, and paid work.

#### *Gender differences*

We used the Breslow-Day test (Breslow & Day, 1994) to assess whether the odds ratios formed from the relative risks differed according to gender. In the 8th grade, nine risk estimates differed at  $p < 0.001$ . Given there were 378 comparisons, this is nearly 24 times the number we would expect at the 0.001 level. In eight of these cases, the risk ratios were higher for girls than for boys. Girls carrying weapons was more highly related to antisocial behaviour, gang membership, fire setting, and not using bike helmets than it was for boys. Girls' alcohol use was more highly related to fire setting and extreme dieting than was true for boys. Moreover, risk ratios indicated stronger (higher) relationships for girls than boys for fire setting with non-use of bike helmets, and doing chores with doing homework. For truancy with academic performance, girls had significantly smaller relationships. That is, for them the likelihood of good academic performance given truancy and the relationship between truancy given good academic performance was smaller for girls than boys. It should be noted, however, that in all cases, the relationships were significant and in the same direction for both genders.

For 11th grade students, five relationships out of a possible 435 differed by gender. By chance, there would be less than one. For weapon carrying and setting fires, the relationships were stronger for girls than for boys. For girls, sports participation was associated with having fewer sex partners and watching less TV than was true for boys; the risk ratios for boys that involved number of sex partners were not even significant. Exercise positively related to number of sex partners for boys, but not for girls, while exercise was associated with less paid work for girls, but not for boys.

There were significant gender differences in the risk of weapon carrying given other antisocial behaviours. In 8th grade, the risk of weapon carrying was significantly higher for boys than for girls given any of the other behaviours and the risk of other behaviours given weapon carrying was higher for boys. In 11th grade, the risk of fire setting given weapon carrying was higher for boys as was the risk of weapon carrying given fire setting.

## Discussion

The study provides population-based estimates of the co-occurrence of adolescent negative and positive behaviours in 8th and 11th grade students in Oregon. The results are consistent with numerous prior studies (Donovan & Jessor, 1985; Jessor, 1986; Jessor, 1987a, b; Biglan et al., 2004) in showing that substance use behaviours co-occur and are more likely among youth involved in antisocial behaviour. Fewer studies, however, have shown that substance use and antisocial behaviours co-occur with depression, truancy, and high-risk sexual behaviour. We are unaware of any studies showing that these behaviours co-occur significantly with obesity, extreme dieting, and failure to use bike helmets and seatbelts.

The results suggest that antisocial behaviour co-occurs with other behaviours more in 8th grade than in 11th grade. This is probably due to the greater prevalence of certain forms of antisocial behaviour in mid-adolescence. Moffitt and colleagues (Moffitt, Caspi, Harrington, & Milne, 2002) review evidence that early offenders are significantly more likely to continue to offend, whereas adolescents who begin antisocial behaviour later in adolescence are less likely to do so. The present finding indicates that antisocial behaviour in early adolescence is also a greater risk factor for most other problems than it is later in adolescence. This is further reason to target this problem in early adolescence.

The findings provide some clarification of the significance of paid work in adolescence. Generally, engaging in paid work is associated with positive behaviours in 8th grade, but for 11th grade, it is either unrelated or—in the case of sports participation and doing homework—is associated with significantly less of the behaviour. Where paid work is associated with problems, the associations are consistently positive in both grades, with one exception. That means that those who work more also report more problems, though only two of the relationships exceeded 2.0. The exception was, in 11th grade, more paid work was associated with less TV watching.

The results also provide new information about the associations among positive behaviours. These behaviours are not nearly as inter-related as problem behaviours are and not as strongly associated with engaging in fewer problem behaviours as one might have hoped. Academic achievement is the positive behaviour most associated with a lower likelihood of problems, but the associations are stronger in 8th than in 11th grade. In particular, achievement is not protective of antisocial behaviour in 11th grade. Religious participation is protective for most aspects of substance use and for antisocial behaviour in 8th grade and for depression and pregnancy in 11th grade, although the sizes of the associations are not great. Volunteering is generally not protective in 8th grade, but is protective for most substance use and antisocial behaviour in 11th grade. Sports participation and exercise are generally associated with little or no protection against problems.

These results prompt us to ask whether there is a coherent theoretical explanation for why sets of problem behaviours would be more inter-related than would positive behaviours. We suspect that the situational influences on behaviours account for at least part of this difference. In support of this explanation, we note that many substance use, antisocial, and high-risk sexual behaviours co-occur literally at the same time and place (Metzler, Noell, Biglan, Ary, & Smolkowski, 1994). Other problem behaviours (such as eating disorders, safety, and time use), that typically are not engaged in with peers, tend to show less relation to each other and to the substance use or antisocial behaviour sets. The positive behaviours we examined also generally occur in different

settings and at different times. Thus, their literal co-occurrence is less likely and that alone could account for the generally lower level of inter-relationships both among positive behaviours and between positive and negative behaviours. Moreover, the occurrence of some problem behaviours appears to contribute to the development of others. For example, [Fergusson, Banner, Vitaro, Horwood, and Swain-Campbell \(2003\)](#) found that deviant peer affiliations were associated with higher rates of depression because those affiliations contributed to externalizing behaviours that in turn led to depression.

Whatever the underlying explanation for these results, they suggest that efforts to promote positive youth development ([Benson, 1998](#); [National Research Council & Institute of Medicine, 2002](#)) may have a limited impact in preventing youth problem behaviours. It is unquestionably worthwhile for schools and communities to promote academic achievement, volunteering, exercise, and sports participation, but doing so may have only a small impact in lowering the risk of engagement in youth problem behaviours.

Recognizing the co-occurrence of problem behaviours is important because of what it implies for research and practice in prevention and treatment. Youth who enter treatment with a given problem are likely to have at least one other problem ([Biglan et al., 2004](#)). In providing psychological treatment, practitioners need to assess young people for all of the problems that they might have and provide treatment that addresses the range of their problems. This issue generally falls under the rubric of “comorbidities” ([Kessler & Zhao, 1999](#)). It is possible that youth with multiple problems will be less responsive to treatment that addresses only one of their problems. Consider a youth who is depressed and engaging in antisocial behaviour. How likely is it that this youth’s depression will lessen if no one addresses the antisocial behaviour that puts him at risk for depressogenic situations?

At a minimum, treatment research needs to examine how well treatments for specific problems ameliorate other problems. There may be problems that, when treated, bring about improvements in concomitant problems. Moreover, some treatment procedures may be more effective than others are in ameliorating multiple problems.

With respect to prevention, interventions are necessary to address the entire range of problems. Unfortunately, much prevention programming focuses narrowly on single problems. For example, research on school-based tobacco curricula has identified some resistance to comprehensive life skills programs because components of them do not seem to address tobacco use directly ([Biglan & Dent, in preparation](#)). Yet, increasingly, there is reason to believe that such programs prevent use of any substance, by helping young people to cope with social pressures and stressors that make involvement in substance use more likely. Rather than thinking about curricula in terms of lessons that explicitly talk about each of the behaviours we wish to prevent, we may need to focus on having programs that alter the likelihood that youth will be influenced to try diverse problem behaviours.

The phenomenon of multiple problem behaviours also has implications for research on prevention. Given their impact on substance use and the apparent mechanisms of effect (e.g., stress reduction, alteration of peer group processes), comprehensive life skills programs are likely to help prevent high-risk sexual behaviour, antisocial behaviour, and depression. Yet, we are unaware of any evaluations of such programs that assessed their impact on these problems. The next generation of school-based prevention research will need to evaluate program effects on the entire range of youth problems—as well as aspects of desirable behaviour.

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