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Working Paper

The perils of returning to school: New insights into the seasonality of youth suicides

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The Perils of Returning to School - New Insights into the Seasonality of Youth Suicides

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Vincent Chandler, Dörte Heger, and Christiane Wuckel[1]

The Perils of Returning to School – New Insights into the Seasonality of Youth Suicides

Abstract

Taking advantage of temporal and geographical variations in the timing of school holidays in Germany, this paper finds that school holidays cause an 19 percent (0.03 percentage points) decrease in the probability of youth suicide. This effect is constant across different types of holidays (fall, Christmas, winter, Easter, Pentecost, and summer). Moreover, we find evidence of a spike in suicide propensity in the first two days following the end of school holidays. The results are robust to the inclusion of a series of control variables and to different definitions of youth. Overall, this paper suggests that school holidays have a beneficial impact on the well-being of students and that suicide prevention efforts are particularly important in the days following the end of holidays.

JEL Classification: I12, I21

Keywords: School; suicide; teenagers; bullying; stress

September 2019

1 Vincent Chandler, Université du Québec en Outaouais ; Dörte Heger, Leibniz ScienceCampus Ruhr and RWI; Christiane Wuckel, RWI. *- This research was partially funded through the Saint-Mary's University start-up grant.* *– All correspondence to: Christiane Wuckel, RWI, Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: christiane.wuckel@rwi-essen.de*

1 Introduction

School attendance is generally associated with positive outcomes; it improves the skill set of students, which then translates into higher wages on the labor market. Indeed, students who have gone to school for fewer days (Carlsson et al., 2015), those who have missed classes due to snowfall (Goodman, 2014), and those who have attended schools for fewer hours per week (Angrist et al., 2013; Dobbie and Fryer Jr, 2013) perform worse on standardized tests. Moreover, increasing the number of years of compulsory schooling has a positive causal impact on wages (Oreopoulos, 2006). These results strongly advocate that students should spend more time at school.

The benefits of schooling, however, might come at a cost to students, an issue that has received relatively little attention so far. Indeed, schooling imposes significant psychic costs to students (Heckman et al., 2006). First, 8.6% of students in Germany (Melzer et al., 2012) and 25.9% in the US (Schneider et al., 2012) report being the victim of bullying at high school. Second, due to high expectations from parents and teachers, performance anxiety can take an important toll on students(Wang, 2016). Both bullying and performance anxiety might create a stressful school environment for students.

While stress is difficult to observe, some of its consequences can be measured. The most salient of them is suicide, which is the third leading cause of death for students. Indeed, 3,041 suicide-attempts by students from grade 9 to 12 occur daily in the US (Kann et al., 2018) and 7.9% of German adolescents report having attempted a suicide (Brunner et al., 2007). Worldwide, suicide is one of the leading causes of death for this teenagers (WHO, 2014). Although significant progress has been made in understanding socio-cultural, developmental, psychiatric, psychological, and family-environmental risk factors of suicide (Bridge et al., 2006), the role of schools on youth suicide propensity is still unsettled. There is evidence that the number of suicides committed by teenagers is relatively low during the summer and then increases in the fall when the school year starts (Finland: Lahti et al. (2006), United States: Hansen and Lang (2011), Japan:

Matsubayashi et al. (2016)) and that the number of youths' visits to emergency rooms for self-harm is greater during the school year than during vacations (Lueck et al., 2015; Plemmons et al., 2018). Even though these findings suggest a relationship between school attendance and suicides, they are unable to clearly identify causality. The lack of variation in the timing of summer holidays makes it impossible to distinguish between seasonal and school patterns. Hence, it could be the case that the mood of school-aged individuals depends on seasons as is the case for adults (Christodoulou et al., 2012).

This paper is the first to address this empirical challenge by taking advantage of two particularities of the German school system. First, the timing of summer holidays varies across time and states. In 2019, for example, the German federal state of Rheinland-Palatinate had summer holidays from July 1st to August 9th, while Brandenburg had its holidays from June 20th to August 3rd. In 2015, however, Rheinland-Palatinate had summer holidays from July 27th to September 4th, while Brandenburg had its holidays from July 16th to August 28th. Second, the German school period comprises several holidays throughout the year, which further removes the link between seasons and school holidays. For example, German students typically enjoy a two-week fall holiday, a two-week Christmas holiday, a one-week winter holiday, and a one-week Easter holiday. These two characteristics make it is possible to avoid the usual collinearity between seasonal and school patterns and therefore enable us to disentangle the effects of both of these patterns on youth suicide propensity.

Overall, we find a significant decrease in the suicide propensity during holidays. The probability of at least one student committing suicide on a given day in a given district decreases by 0.029 percentage points during school holidays controlling for county, year, month, and day of week fixed effects, which corresponds to a 19% decrease in the probability of a suicide on a given day in a given district. This effect represents 0.12 fewer youth suicides across Germany during an average holiday. Moreover, we test whether this effect varies between the different holiday types. However, we find no evidence to support this hypothesis. In other words, the position of holidays throughout the year

does not seem to influence their impact on the probability of youth suicides. Finally, we find that the probability of suicides increases significantly by 33% (0.05 percentage points) during the first two days following the end of a holiday. This result suggests that schools should pay particular attention to the mental health of students following a school holiday to prevent suicides.

2 Background

School holidays could prevent suicides, because they enable students to take a break from school-related stress. One important stressor is the presence of examinations. Performance anxiety can cause an increase in stress, reducing cognitive abilities and leading to weaker academic results. Bad academic results in turn lead to further stress and a feeling of helplessness (McDonald, 2001). This vicious cycle and its possible long term consequences on a student's career might result in additional desperation for many teenagers. Besides performance anxiety, bullying is another important cause of school-related stress. It can take the form of physical/verbal attacks on the victim or isolation/exclusion. Kim and Leventhal (2008) find an empirical association between being bullied and suicidal thoughts among youths for both perpetrator and victim. In the former case, the students might feel remorse and in the latter case, they may simply find their life unbearable. By removing students from the school environment, holidays can help them heal and gain perspective on the issues facing them.

Stress can be seen as a latent variable for a number of behavioral issues. Once stress exceeds a certain personal threshold, individuals may start feeling uncomfortable. If it continues growing, they may start feeling hopeless that stress will ever return to a bearable level and they may entertain suicidal ideation. In such a difficult situation, any extra stress may simply overwhelm students and lead to a suicide attempt. In this study, we are unable to identify all the possible sources of stress that led to such a difficult situation. We can only identify whether attending school increased momentary stress

beyond the suicidal threshold of some individuals. Hence, this study is about the short term impact of school on stress and suicides.

The features of the German school system make it particularly well suited to study the link between (the timing of) school holidays and suicides. The organization of the education system is the responsibility of the sixteen states (*Bundesland*) and the federal government only plays a minor role. However, all states agreed on some harmonized rules (KMK, 1971). They all have 63 school free weekdays that are split between a six-week long summer holiday followed by fall, Christmas, winter and Easter holidays. The precise timing of holidays other than summer holidays is determined by each state individually and imposed on individual schools. The timing of the summer holidays is determined by the "Conference of German cultural ministers" several years in advance. A rotating system spreads out the holiday season across states to reduce traffic peaks on main highways and pressure on accommodation in popular tourist locations. The states are grouped into five groups that each take their summer holidays simultaneously: i) Brandenburg, Berlin, Hamburg, Mecklenburg Western Pomerania, Schleswig-Holstein, ii) Bremen, Lower Saxony, Saxony, Saxony-Anhalt, Thuringia, iii) Northrhine-Westphalia, iv) Hesse, Rhineland-Palatinate, Saarland, and v) Baden-Württemberg, Bavaria. The fifth group always takes the last slot, because both states give their students holidays around Pentecost in late May or early June. It would therefore be counterproductive to start summer holidays in late June so soon after the Pentecost holiday. Hence, we observe variation of holidays both within groups of states as well as throughout the calendar year, which allows to disentangle the effect of holidays from seasonal effects.

3 Data

The data on suicides stems from the German official causes of death statistics (*Todesursachenstatistik*), an administrative dataset containing all deaths in Germany, their date and place, the age of the deceased as well as the cause of death following the ICD-10. We

observe all deaths for the period stretching from January 1st 2001 to December 31st 2015. Suicides are coded X60–X84 depending on the suicide method used. We can therefore determine the number of suicides committed by individuals younger than a certain age on a given day in any of the 402 German counties (*Kreise*).[1]

To take advantage of this data, we need to make certain assumptions about the observed suicides. First, we assume that individuals younger than a certain age are students. In most German states, individuals can leave school after completing the academic year in which they turned 18 (KMK, 2018). We therefore define individuals aged 6 to 19 as students. To add robustness to our results, we also conduct regressions using the age of 16 as upper threshold[2]. Second, we assume that individuals commit suicide in the state in which they attend school. If students who are on holiday in their home state commit suicide in another state at a time when students in this other state are at school, our estimates would be biased. However, since 75% of adults commit suicides at home (Parks et al., 2014) and since teenagers are less mobile than adults, this assumption seems reasonable.

Holidays are defined using the exact timing of holidays in each state and year (Conference of German cultural ministers, 2003, 2012, 2017). Since holidays in Germany do not always start on the same day of the week, it is not possible to define a complete week as holiday or not. Hence, we transform the German official causes of death statistics into a daily panel at the district level. Following Hansen and Lang (2011), we add weather (precipitation and sunshine duration on a state and monthly basis (Climate Data Center, 2018, 2014)) and unemployment data (Bundesagentur für Arbeit, 2018) to control for their impact on suicides (Yang et al., 2011).

Descriptive statistics are shown in table I. Overall, 3,308 youth suicides by individuals aged 6 to 19 years took place between January 1st 2001 and December 31st 2015 which corresponds to 221 suicides per year, on average. Accordingly, the suicide probability

[1]County reforms in 2007 and 2008 combined several counties. The analysis uses the 402 counties existing in 2015 according to the Federal Institute for Research on Building, Urban Affairs and Spatial Development.

[2]Since homeschooling is illegal in Germany, all individuals below the age of 16 must attend a school.

per day in a given district of 0.16%.[3] While the total number of deaths does not display a distinct seasonal pattern for either adults or youths, the number of youth suicides was lowest in December, February (the shortest month), July and August. For adults, the fewest suicides occur in December, February, November, and September. July and August, the months where suicides a rare for youths but not for adults, is also the time of summer holidays. Likewise, in April and October where the number of holidays is relatively high, the number of youth suicides is also relatively low. These summary statistics suggest a relationship between school and youth suicide, which will be further explored using regression analysis.

Table I: Summary statistics

	Average number of deaths				Average number of suicides				Average
	Youths		Adults		Youths		Adults		holidays
Yearly avg.	1887	100%	828245	100%	221	100%	9493	100%	103
January	162.0	8.6%	75839.3	9.2%	23.7	10.7%	789.9	8.3%	6.8
February	146.2	7.7%	70341.7	8.5%	15.9	7.2%	716.5	7.5%	5.4
March	164.9	8.7%	76423.2	9.2%	20.0	9.1%	837.9	8.8%	4.4
April	160.1	8.5%	69040.7	8.3%	19.6	8.9%	832.9	8.8%	11.2
May	163.5	8.7%	67515.0	8.2%	19.8	9.0%	856.4	9.0%	3.0
June	163.7	8.7%	64162.0	7.7%	19.6	8.9%	796.4	8.4%	4.4
July	163.9	8.7%	66864.6	8.1%	16.0	7.3%	855.3	9.0%	16.0
August	160.5	8.5%	65488.0	7.9%	16.7	7.6%	816.4	8.6%	23.4
September	151.5	8.0%	63050.9	7.6%	18.1	8.2%	755.0	8.0%	4.9
October	153.4	8.1%	68118.1	8.2%	17.4	7.9%	773.8	8.2%	10.6
November	147.1	7.8%	67614.1	8.2%	18.9	8.6%	748.3	7.9%	2.4
December	150.1	8.0%	73786.9	8.9%	14.9	6.8%	713.9	7.5%	10.2

Note: Youths include individuals aged 6-19; adults includes individuals aged 20+. Holidays include weekends at the beginning and the end as well as during holidays.

4 Methodology

In a first step, we explain the number of youth suicides on a given day in a given district. Since youth suicides are very rare on a daily basis in a given district, the

[3]The probability of a suicide in a given district is given by the total number of suicides over the 15-year period per district divided by the number of days: (3308 suicides/402 districts)/(3*366+12*365 days) = 0.0015.

dependent variable only takes the value of 0 (no suicide) or 1 (a suicide). Using this de facto binary variable, we estimate the following linear probability model:

$$\begin{aligned}\text{Suicide}_{it} = \beta_0 &+ \beta_1 \text{School holidays}_{it} \\ &+ \beta_2 \text{Sunshine}_{it} + \beta_3 \text{Precipitation}_{it} + \beta_4 \text{Unemployment}_{it} \\ &+ \beta_5 \text{District FE}_i + \beta_6 \text{Year FE}_t + \beta_7 \text{Month FE}_t \\ &+ \beta_8 \text{Day of Week FE}_t + \epsilon_{it}\end{aligned}$$

The district fixed effects capture the fact that some districts have greater youth population[4] than others and that all districts have certain invariant characteristics (e.g. poverty), which could influence the probability of youth suicides on any given day. The year fixed effects capture the possible increase in population from one year to another. The month fixed effects control for the seasonality of suicide patterns. For example, there are more suicides in January than in other months. Moreover, there are peaks in the spring and fall. The day of the week fixed effects captures some intra-week pattern in suicides during the school week. For example, there could be more suicides on Monday than on Friday.

In a second step, we devote some attention to the days at the beginning and end of the holidays. Forward-looking students may not only care about the status (holiday or not) of the actual day, but also be influenced by the upcoming days. For example, students who know that holidays will start soon may feel some stress reduction even though they are still attending school. The positive psychological impact of school holidays could therefore influence suicide prevalence on school days preceding a holiday. In a similar fashion, students know that the days at the end of a holiday period bring them closer to a return to school stress. Even though these days are holidays, one would possibly expect an increase in the number of suicides on these days. The following linear probability

[4]For the Poisson regression, differences in youth population is captured by the exposure(population).

model takes into consideration such forward-looking behavior:

$$\begin{aligned}\text{Suicide}_{it} = \beta_0 &+ \beta_1\text{School holidays}_{it} \\ &+ \beta_2\text{Last 2 days school}_{it} + \beta_3\text{First 2 days holiday}_{it} \\ &+ \beta_4\text{Last 2 days holiday}_{it} + \beta_5\text{First 2 days of school}_{it} \\ &+ \beta_6\text{Sunshine}_{it} + \beta_7\text{Precipitation}_{it} + \beta_8\text{Unemployment}_{it} \\ &+ \beta_9\text{District FE}_i + \beta_{10}\text{Year FE}_t + \beta_{11}\text{Month FE}_t \\ &+ \beta_{12}\text{Day of Week FE}_t + \epsilon_{it}\end{aligned}$$

In a third step, we repeat the previous estimations but distinguish between the different types of holidays (fall, Christmas, winter, Easter, Pentecost, and summer holidays) to further disentangle the relationship between school holidays and seasons. Certain holidays may have a greater impact on suicide propensity than others. For example, Easter holidays and Pentecost holidays are at the end of the school year when students have already accumulated a lot of stress. These holidays may be more beneficial than fall holidays when the students are still fresh from the summer holidays.

In a final step, we separate between male and female suicides to conduct the analysis separately for both genders. In all regression standard errors are clustered at the month-year level to capture temporal shocks at the national level.

We also conduct several robustness analysis. First, we reduce the age limit to make sure our results are specific to students. In other words, we restrict the sample to suicides committed by individual younger than 16 years since school attendance is still compulsory for these individuals. Second, we conduct the same analysis with individuals aged between 20 and 30 years who are unlikely to still be in school but who are still similar in age. If the probability of suicide decreases during holidays for this sub-population, one could argue that our causal mechanism is unable to distinguish between seasonal and school patterns. Third, we test whether our results are robust to different methodolog-

ical specifications. For one, weekends represent a small methodological challenge. We assume that a weekend counts as a holiday if either the preceding Friday or the following Monday is a school holiday. If the preceding Friday and the following Monday are both school days, the weekend is considered a school day. Differences between work days and weekends during a school week are captured by the day of the week fixed effects. To add further robustness to our results, we also conduct the analysis without weekends and find similar results. Lastly, following Abadie et al. (2017), we also conduct the analysis with robust standard errors in a robustness check, since the data does not stem from a survey/experiment design.

5 Results

Table II shows our estimation results. The probability of a youth suicide on a given day in a given district decreases by approximately 0.029 percentage points during holidays (table II, column 1 and 2) with a variety of control variables. Knowing that the probability of a suicide on a given day in a given district is 0.15% over the period, this effect represents a 19% (0.00029/0.0015=0.19439) decrease in the probability of suicide or 0.12 fewer youth suicides across Germany during an average holiday.[5]

Column 2 further shows the results when we specify the beginning/end of holidays/school. The signs of the coefficients correspond to our hypotheses with respect to students' forward-looking behavior. The last two days of school and the first two days of holidays are associated with a decrease in the probability of suicides, even though these results are not statistically significant at conventional thresholds. Similarly, the last two days of holidays and the first two days of school are associated with an increase in the probability of suicide, though only the effect of the first two days of school is also statistically significant. Indeed, during the first two days of school, the probability of suicide increases by 0.049 percentage points, which corresponds to a 33% (0.00049/0.0015=0.3267)

[5] 402 districts * 0.00029 effect size = 0.11658.

increase in the probability of a suicide on a given day in a given district.

Columns 3 and 4 further expand the analysis by distinguishing between the six types of holidays. All holidays are associated with a negative effect on the probability of suicide. However, only coefficients for fall, Pentecost, and summer holidays are statistically significant at conventional thresholds. Interestingly, the fall and Pentecost holidays are respectively at the beginning and at the end of the school year. Possibly students benefit most from holidays at the beginning of a school year when they are still adapting to the new rhythm and at the end when they have accumulated a lot of fatigue. However, an F-test fails to reject any difference in the effects of different holidays suggesting not statistically significant difference between the types of holidays. Importantly, differentiating between the different types of holidays does not change our finding that the probability of suicide increases significantly during the first two days of school.

Lastly, columns 5 to 8 show the results separately for male and female students. While the general pattern also holds for girls, our results are clearly driven by the behavior of male students. Their suicidal behavior seems more influenced by school patterns than that of female students. A few reasons could explain this result. First, evidence suggests that school is failing young males (Tyre, 2008) and the positive relationship between school and male suicides could reflect this reality. Second, females may enjoy a larger social network that allows them to better absorb the short-term stress resulting from school. Third, school stress may lead female youths to other self-destructive behavior not captured in this study like anorexia and self-injury. Finally, in a world of social media, school stress may not stop during holidays for females. Cyber-bullying could extend the impact of school stress for females and less so for males.

Table II: Impact of holidays on youth suicides

					Female		Male	
	1	2	3	4	5	6	7	8
Holiday	-0.000294***	-0.000292***			-0.0000425		-0.000249***	
	(-4.26)	(-3.77)			(-1.19)		(-3.88)	
Fall			-0.000411**	-0.000423**		0.0000937		-0.000329**
			(-2.41)	(-2.56)		(-1.33)		(-2.38)
Christmas			-0.000192	-0.000205		-0.0000756		-0.000128
			(-1.42)	(-1.48)		(-1.05)		(-1.05)
Winter			-0.000193	-0.000204		0.000240*		-0.000443**
			(-0.89)	(-0.88)		(1.71)		(-2.46)
Easter			-0.000233	-0.000221		-0.0000482		-0.000172
			(-1.35)	(-1.25)		(-0.55)		(-1.09)
Pentecost			-0.000589**	-0.000605**		-0.000123*		-0.000489**
			(-3.09)	(-3.10)		(-1.66)		(-2.80)
Summer			-0.000281**	-0.000270**		-0.0000271		-0.000242**
			(-2.12)	(-2.00)		(-0.45)		(-2.11)
Last two schooldays		-0.000164		-0.000163	-0.0000724	0.0000694	-0.000237*	-0.000233*
		(-1.08)		(-1.07)	(-0.82)	(0.79)	(-1.83)	(-1.79)
First two holidays		-0.000119		-0.000106	-0.0000803	-0.0000884	-0.0000406	-0.0000200
		(-0.72)		(-0.64)	(-1.06)	(-1.15)	(-0.27)	(-0.13)
Last two holidays		0.000212		0.000226	0.0000213	0.0000157	0.000187	0.000208
		(1.30)		(1.38)	(0.25)	(0.18)	(1.37)	(1.52)
First two schooldays		0.000489**		0.000494**	0.0000721	0.0000732	0.000433**	0.000436**
		(2.55)		(2.56)	(0.87)	(0.88)	(2.53)	(2.53)
Constant	0.000175	0.000114	0.000149	0.0000899	-0.0003424	-0.000327*	0.000449	0.000410
	(0.41)	(0.27)	(0.35)	(0.21)	(-1.84)	(-1.74)	(1.20)	(1.10)
Adj. R-squared	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.001
AIC	-8080763.5	-8080775.6	-8080766.5	-8080778.9	-11706000.1	-11134497.0	-8706383.9	-8706387.7
BIC	-8078507.3	-8078519.3	-8078510.3	-8078522.6	-11703743.8	-11132240.7	-8704127.6	-8704131.5
Observations	2202156	2202156	2202156	2202156	2202156	2202156	2202156	2202156

Note: t-statistics in parentheses. * p<0.10, ** p<0.05,*** p<0.01. All regressions explain the probability that there is at least one suicide (ages 6 to 19) in a given district on a given day between 2001 and 2015. All regressions include weather, economic, county, year, month, and day of week fixed effects. Weather control include sunshine period and precipitation in a given month in a given state, and economic control include the monthly unemployment rate. All standard errors are clustered at the month/year level.

Table III shows the results from our robustness tests. To ensure our results are specific to students, we restrict the sample to suicides committed by individual younger than 16 years. Columns 1 and 2 show that the results are qualitatively similar to the ones found previously. The overall impact of holidays is -0.0142 percentage points. While this is half of the previous effect, it is strongly statistically significant despite the reduced sample size. Second, we conduct the regression using a group similar age but unlikely to be students: 20 to 29 year old individuals. Columns 3 and 4 show no effect of school holidays for this group except for the last two school days, an effect that has not been relevant in our main results for school-aged individuals. Third, in columns 5 and 6, all weekends have been removed from the sample. Again, we find very similar results suggesting that our results are not influenced by the definition of weekends. Fourth, we use robust standard errors instead of clustering them by year-month in (columns 7 and 8). The results are similar to the ones presented in table II.

Besides, our results are robust to removing the day of week fixed effect, replacing the month fixed effect by a week fixed effect or distinguishing between day of week for school days and for holidays. Results are presented in tables IV and V in the appendix. Finally, since the data is strictly speaking count data, we also conduct a Poisson regression. Again, the results are qualitatively similar to previous ones. School holidays decrease the probability by 21.2 percent (table VI, column 1 in the appendix) when including a variety of control variables.

Table III: Robustness checks

	6 - 19 Years		20 - 29 Years		Without Weekends		Robust SE	
	1	2	3	4	5	6	7	8
Holiday	-0.000142***		-0.0000488		-0.000228**		-0.000292***	
	(-4.70)		(-0.35)		(-2.83)		(-4.13)	
Fall		-0.000151**		-0.000116		-0.000445***		-0.000423**
		(-2.26)		(-0.44)		(-3.43)		(-2.73)
Christmas		-0.000149**		0.0000158		-0.000302*		-0.000205
		(-2.34)		(0.06)		(-1.90)		(-1.39)
Winter		-0.0000146		-0.000554		0.0000473		-0.000204
		(-0.13)		(-1.26)		(0.17)		(-0.83)
Easter		-0.000165**		-0.00000646		0.0000871		-0.000221
		(-2.17)		(-0.03)		(-0.40)		(-1.36)
Pentecost		-0.000116		0.000431		-0.000495**		-0.000605**
		(-0.95)		(1.09)		(-2.04)		(-2.93)
Summer		-0.000148**		-0.000101		0.000152		-0.000270**
		(-3.11)		(-0.42)		(-1.06)		(-2.36)
Last two schooldays	-0.000039	-0.0000404	-0.000849**	-0.000849**	0.000155	0.000159	-0.000164	-0.000163
	(-0.53)	(-0.55)	(-2.77)	(-2.77)	(-1.00)	(-1.02)	(-1.09)	(-1.08)
First two holidays	-0.0000291	-0.0000369	-0.000474	-0.000468	0.000109	0.000152	-0.000119	-0.000106
	(-0.48)	(-0.59)	(-1.65)	(-1.62)	(0.41)	(0.57)	(-0.78)	(-0.70)
Last two holidays	0.0000894	0.0000816	0.000336	0.000339	0.000198	0.000206	0.000212	0.000226
	-1.22	-1.13	(1.00)	(1.01)	(-0.57)	(-0.59)	(1.19)	(1.25)
First two schooldays	0.00000409	0.00000323	0.000465	0.000460	0.000524**	0.000532**	0.000489**	0.000494**
	-0.05	-0.04	(1.43)	(1.42)	(2.74)	(2.77)	(2.51)	(2.53)
Constant	-0.000137	-0.00013	0.00519***	0.00517***	0.000202	0.000220	0.000114	0.0000899
	(-1.05)	(-0.98)	(5.15)	(5.12)	(0.39)	(0.43)	(0.25)	(0.20)
Adj. R-squared	0.000	0.001	0.007	0.007	0.001	0.001	0.001	0.001
AIC	-11706000.1	-8080778.9	-5431739.7	-5431742.5	-5822979.0	-5822982.9	-8080251.6	-8080244.9
BIC	-11703743.8	-8078522.6	-5429483.4	-5429486.2	-5820782.9	-5820786.8	-8074692.8	-8074623.0
Observations	2202156	2202156	2202156	2202156	1573428	1573428	2202156	2202156

Note: t-statistics in parentheses. * p<0.10, ** p<0.05,*** p<0.01. All regressions explain the probability that there is at least one suicide (ages 6 to 19 unless otherwise stated) in a given district on a given day between 2001 and 2015. All regressions include weather, economic, county, year, month, and day of week fixed effects. Weather control include sunshine period and precipitation in a given month in a given state, and economic control include the monthly unemployment rate. In columns 1 to 6 standard errors are clustered at the month/year level.

6 Discussion and policy implications

Using daily observations of suicides committed by young people aged 6 through 19, we find a strong cyclical pattern with the lowest suicide rates during the summer month and in December. This finding is consistent with previous findings of seasonality (Matsubayashi et al., 2016; Hansen and Lang, 2011). Using temporal and geographic variation in timing of school holidays in Germany we are able to further disentangle the impact of holidays from other seasonal factors. We find a significant decline in suicide propensity during holidays. In addition, we observe an increase in suicides during the first two days after students return from holidays. The effect is robust to several alternative specifications. Our findings support the hypothesis that the holiday effect is distinct from other seasonal effects. Further, in line with Hansen and Lang (2011), we find that the effect is mainly driven by male youth. While seasonal affective disorders are more often found with female teenagers, suicide rates in general are much lower for girls. We do not find a significant holiday effect for girls.

A theory that is in line with our findings is the theory of a broken promises (Gabennesch, 1988). During holiday breaks, students that experience difficulties at school may hope that the new academic year will change their situation. In cases of bullying, students might hope for a better social environment or for an increase ability of self-defense. In cases of academic pressure, the work schedule might be less ambitious. However, the return to school after holidays might prove those hopes wrong. While an emotionally stable student might have sufficient resources to cope with this situation, it might serve as a trigger for suicidal ideation for students who are already in a psychologically vulnerable state. The broken promise effect is also in line with the increase that we observe in the first two days of school following a holiday.

Our work offers some important policy implications for students' well-being. Since school seems to be an important risk factor for suicide, school authorities should also view holidays as an investment in the mental health of their students and not only as a

loss in educational time. Moreover, since we observe a spike in suicides in the first few days after a holiday, suicide prevention programs should monitor students closely during these periods.

This study uses a causal framework that can be applied to similar questions. This study focused on a very extreme outcome of stress. Future studies will be able to determine the impact of holidays on other relevant medical outcomes, like medical visits or the prescription of drugs to youths. These variables could improve our understanding of the relationship between school and stress for youths and it could provide further insights into the differences between male and female youths. For example, if female youths are more prone to consult physicians in stress situations, differences in the relationship between school days and medical visits for both genders could help explain our results.

References

Abadie, A., Athey, S., Imbens, G. W., and Wooldridge, J. (2017). When should you adjust standard errors for clustering? Working Paper 24003, National Bureau of Economic Research.

Angrist, J. D., Pathak, P. A., and Walters, C. R. (2013). Explaining charter school effectiveness. American Economic Journal: Applied Economics, 5(4):1–27.

Bridge, J. A., Goldstein, T. R., and Brent, D. A. (2006). Adolescent suicide and suicidal behavior. Journal of child psychology and psychiatry, 47(3-4):372–394.

Brunner, R., Parzer, P., Haffner, J., Steen, R., Roos, J., Klett, M., and Resch, F. (2007). Prevalence and psychological correlates of occasional and repetitive deliberate self-harm in adolescents. Archives of pediatrics & adolescent medicine, 161(7):641–649.

Bundesagentur für Arbeit (2018). Arbeitslosenquote aller zivilen Erwerbspersonen. . Accessed: 2018-01-04.

Carlsson, M., Dahl, G. B., Öckert, B., and Rooth, D.-O. (2015). The effect of schooling on cognitive skills. Review of Economics and Statistics, 97(3):533–547.

Christodoulou, C., Douzenis, A., Papadopoulos, F. C., Papadopoulou, A., Bouras, G., Gournellis, R., and Lykouras, L. (2012). Suicide and seasonality. Acta Psychiatrica Scandinavica, 125(2):127–146.

Climate Data Center (2014). Regional monthly precipitation averages, Germany. `ftp://ftp-cdc.dwd.de/pub/CDC/regional_averages_DE/monthly/precipitation/`. Accessed: 2018-01-09.

Climate Data Center (2018). Regional monthly sunshine duration averages, Germany. `ftp://ftp-cdc.dwd.de/pub/CDC/regional_averages_DE/monthly/sunshine_duration/`. Accessed: 2018-01-09.

Conference of German cultural ministers (2003). Sommerferien 1955 bis 2003. `http://www.kmk.org/fileadmin/Dateien/pdf/Ferienkalender/Sommerferienregelung_1955bis2003.pdf`. Accessed: 2018-01-09.

Conference of German cultural ministers (2012). Sommerferien 2004 bis 2012. `http://www.kmk.org/fileadmin/Dateien/pdf/Ferienkalender/Sommerferienregelung_2004-2012.pdf`. Accessed: 2018-01-09.

Conference of German cultural ministers (2017). Sommerferien 2011 bis 2017. `https://www.kmk.org/fileadmin/Dateien/pdf/Ferienkalender/Sommerferienregelung_2011-2017.pdf`. Accessed: 2018-01-09.

Dobbie, W. and Fryer Jr, R. G. (2013). Getting beneath the veil of effective schools: Evidence from new york city. American Economic Journal: Applied Economics, 5(4):28–60.

Gabennesch, H. (1988). When promises fail: a theory of temporal fluctuations in suicide. Social Forces, 67(1):129–145.

Goodman, J. (2014). Flaking out: Student absences and snow days as disruptions of instructional time. Working Paper 20221, National Bureau of Economic Research.

Hansen, B. and Lang, M. (2011). Back to school blues: Seasonality of youth suicide and the academic calendar. Economics of Education Review, 30(5):850–861.

Heckman, J. J., Lochner, L. J., and Todd, P. E. (2006). Earnings functions, rates of return and treatment effects: The mincer equation and beyond. Handbook of the Economics of Education, 1:307–458.

Kann, L., McManus, T., Harris, W. A., Shanklin, S. L., Flint, K. H., Queen, B., Lowry, R., Chyen, D., Whittle, L., Thornton, J., et al. (2018). Youth risk behavior surveillanceâ€"united states, 2017. MMWR Surveillance Summaries, 67(8):1.

Kim, Y. S. and Leventhal, B. (2008). Bullying and suicide. a review. International journal of adolescent medicine and health, 20(2):133–154.

KMK (1971). Abkommen zwischen den Ländern der Bundesrepublik zur Vereinheitlichung auf dem Gebiete des Schulwesens. Beschluss der Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland vom 28.10. 1964 in der Fassung vom 14.10. 1971.

KMK (2018). Definitionenkatalog zur Schulstatistik 2018. Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland, Kommission für Statistik.

Lahti, A., Räsänen, P., Karvonen, K., Särkioja, T., Meyer-Rochow, V. B., and Hakko, H. (2006). Autumn peak in shooting suicides of children and adolescents from northern finland. Neuropsychobiology, 54(2):140–146.

Lueck, C., Kearl, L., Lam, C. N., and Claudius, I. (2015). Do emergency pediatric psychiatric visits for danger to self or others correspond to times of school attendance? The American journal of emergency medicine, 33(5):682–684.

Matsubayashi, T., Ueda, M., and Yoshikawa, K. (2016). School and seasonality in youth suicide: evidence from japan. J Epidemiol Community Health, 70(11):1122–1127.

McDonald, A. S. (2001). The prevalence and effects of test anxiety in school children. Educational psychology, 21(1):89–101.

Melzer, W., Oertel, L., Ottova, V., et al. (2012). Mobbing und Gewalt an Schulen. Entwicklungstrends von 2002 bis 2010. Das Gesundheitswesen, 74(S 01):S76–S83.

Oreopoulos, P. (2006). Estimating average and local average treatment effects of education when compulsory schooling laws really matter. American Economic Review, 96(1):152–175.

Parks, S. E., Johnson, L. L., McDaniel, D. D., and Gladden, M. (2014). Surveillance for violent deaths-national violent death reporting system, 16 states, 2010. Morbidity and Mortality Weekly Report: Surveillance Summaries, 63(1):1–33.

Plemmons, G., Hall, M., Doupnik, S., Gay, J., Brown, C., Browning, W., Casey, R., Freundlich, K., Johnson, D. P., Lind, C., et al. (2018). Hospitalization for suicide ideation or attempt: 2008–2015. Pediatrics, 141(6):e20172426.

Schneider, S. K., O'donnell, L., Stueve, A., and Coulter, R. W. (2012). Cyberbullying, school bullying, and psychological distress: A regional census of high school students. American journal of public health, 102(1):171–177.

Tyre, P. (2008). The trouble with boys: A surprising report card on our sons, their problems at school, and what parents and educators must do. Harmony.

Wang, L. C. (2016). The effect of high-stakes testing on suicidal ideation of teenagers with reference-dependent preferences. Journal of Population Economics, 29(2):345–364.

WHO (2014). Preventing suicide: A global imperative. Technical report, World Health Organization, Geneva.

Yang, A. C., Tsai, S.-J., and Huang, N. E. (2011). Decomposing the association of completed suicide with air pollution, weather, and unemployment data at different time scales. Journal of affective disorders, 129(1-3):275–281.

Appendix

Table IV: Impact of holidays on the probability of youth suicide: different specifications

	1	2	3	4
Holiday	-0.000280***	-0.000292***	-0.000324**	-0.000292***
	(-4.12)	(-3.81)	(-2.03)	(-4.13)
Last 2 school				-0.000164
				(-1.09)
First 2 holidays				-0.000119
				(-0.78)
Last 2 holidays				0.000212
				(1.19)
First 2 school				0.000489**
				(2.51)
Constant	-0.0000325	0.000134	0.000195	0.000114
	(-0.08)	(0.30)	(0.45)	(0.25)
Month FE	Yes	No	Yes	Yes
Week FE	No	Yes	No	No
Day of Week FE	No	No	No	Yes
Day of Week FE[1]	No	No	Yes	No
Adj. R-squared	0.001	0.001	0.001	0.001
AIC	-8080725.8	-8080775.5	-8080768.8	-8080251.6
BIC	-8078469.5	-8078519.2	-8078512.5	-8078519.3
Observations	2202156	2202156	2202156	2202156

Note: t-statistics in parentheses. * p<0.10, ** p<0.05,*** p<0.01. All regressions explain the probability that there is at least one suicide (ages 6 to 19) in a given district on a given day between 2001 and 2015. All regressions include weather, economic, county, and year fixed effects. Weather control include sunshine period and precipitation in a given month in a given state, and economic control include the monthly unemployment rate. Day of week FE[1] includes separate day of week fixed effects for school days and for holidays. In columns 1 to 3, the standard errors are clustered at the month/year level. In column 4, the standard errors are calculated using the HCCME.

Table V: Impact of specific holidays on youth suicides: different specifications

	1	2	3	4
Fall	-0.000385***	-0.000441***	-0.000441**	-0.000423***
	(-2.28)	(-2.82)	(-1.92)	(-2.73)
Christmas	-0.000180	0.000496	-0.000224	-0.000205
	(-1.34)	(0.12)	(-1.07)	(-1.39)
Winter	-0.000159	-0.000218	-0.000215	-0.000204
	(-0.73)	(-1.03)	(-0.86)	(-0.83)
Easter	-0.000216	-0.000213	-0.000262	-0.000221
	(-1.25)	(-1.30)	(-1.21)	(-1.36)
Pentecost	-0.000598**	-0.000554**	-0.000623**	-0.000605**
	(-3.13)	(-2.87)	(-2.56)	(-2.93)
Summer	-0.000272**	-0.000271*	-0.000313	-0.000270**
	(-2.06)	(-1.90)	(-1.62)	(-2.36)
Last 2 school				-0.000163
				(-1.08)
First 2 holidays				-0.000106
				(-0.70)
Last 2 holidays				0.000226
				(1.25)
First 2 school				0.000494
				(2.53)
Constant	-0.0000565	-0.000149	0.000171	0.000899
	(-0.13)	(-0.27)	(0.40)	(0.20)
Month FE	Yes	No	Yes	Yes
Week FE	No	Yes	No	No
Day of Week FE	No	No	No	Yes
Day of Week FE[1]	No	No	Yes	No
Adj. R-squared	0.001	0.001	0.001	0.001
AIC	-8080729.8	-8080779.3	-8080771.8	-8080244.9
BIC	-8078472.8	-8078523.1	8078515.5	-8074623
Observations	2202156	2202156	2202156	2202156

Note: t-statistics in parentheses. * p<0.10, ** p<0.05,*** p<0.01. All regressions explain the probability that there is at least one suicide (ages 6 to 19) in a given district on a given day between 2001 and 2015. All regressions include weather, economic, county, and year fixed effects. Weather control include sunshine period and precipitation in a given month in a given state, and economic control include the monthly unemployment rate. Day of week FE[1] includes separate day of week fixed effects for school days and for holidays. In columns 1 to 3, the standard errors are clustered at the month/year level. In column 4, the standard errors are calculated using the HCCME.

Table VI: Impact of specific holidays on youth suicides: Poisson regression

	1	2
Holiday	-0.212***	
	(-4.00)	
Fall		-0.324**
		(-2.59)
Christmas		-0.147
		(-1.37)
Winter		-0.157
		(0.87)
Easter		-0.139
		(-1.27)
Pentecost		-0.453**
		(-2.57)
Summer		-0.208**
		(-2.47)
Last two school days	-0.123	-0.123
	(-1.03)	(-1.03)
First two holidays	-0.827	-0.0740
	(-0.64)	(-0.56)
Last two holidays	0.150	0.158
	(1.34)	(1.38)
First two school days	0.258**	0.262**
	(2.75)	(2.78)
Constant	-22.17***	-22.18***
	(-36.16)	(-36.14)
AIC	48193.1	48199.1
BIC	53751.9	53820.9
Observations	2202156	2202156

Note: t-statistics in parentheses. * p<0.10, ** p<0.05,*** p<0.01. All regressions explain the probability that there is at least one suicide (ages 6 to 19) in a given district on a given day between 2001 and 2015. All regressions include weather, economic, county, year, month, and day of week fixed effects. Weather control include sunshine period and precipitation in a given month in a given state, and economic control include the monthly unemployment rate. All standard errors are clustered at the month/year level.