



Research report

Celebrity suicide on the railway network: Can one case trigger international effects?



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ARTICLE INFO

Article history:

Received 18 February 2015

Received in revised form

20 June 2015

Accepted 20 June 2015

Available online 25 June 2015

Keywords:

Railway suicide

Celebrity suicide

Copycat suicide

International imitation effects

Werther effect

Google Trends

ABSTRACT

Background: After the railway suicide of the German national goalkeeper Robert Enke in 2009, a significant increase of railway suicides was observed nationally. This study analyses whether this incident also triggered copycat effects in other European countries. Additionally, media coverage proxied by Google Trends and long-term changes taking into account general changes in suicide rates and kilometres driven by trains were examined.

Methods: The numbers of railway suicides before and after Enke's suicide were analysed for short and long-term periods (2 weeks and 2 years post-event) across five European countries. Incidence ratios and resulting percentage changes were computed.

Results: Similar to Germany, there were significant short and long-term effects for the combined data of the four other countries (increase of 93.9%; $p=0.004$ and 16.7%; $p=0.003$). There was no indication that long-term effects are a mere reflection of an overall increase in suicide frequencies or due to increased numbers of kilometres driven by trains. Analyses on country level revealed heterogeneous results.

Limitations: Due to incomplete data, analyses regarding age and gender were not performed. Media coverage was only proxied by a Google Trends analysis. The study includes a small sample of European countries.

Conclusions: Enke's suicide in 2009 was followed by increasing train suicide numbers in Europe. Although this incident may have reinforced an existing European trend of growing railway suicides, an international copycat effect and/or an increased overall awareness about this particular suicide method appears to be one likely explanation for the changes.

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1. Introduction

Suicide by collision with a train accounts for 1–12% of overall suicides internationally, with up to 94% of all attempts resulting in death (Krysinska and De Leo, 2008). According to the European Railway Agency (2014) they represent about 70% of all fatalities on European railways, and consequently are more impacting in terms

of lives lost than railway accidents. Overall, an upwards trend of railway suicide numbers was registered from 2006 (1878 cases) until 2012 (2997 cases) (ERA, 2014, data for the member states of the European Union). In 2013 a total of 2819 railway suicides were registered in the EU member states (Eurostat, 2014), representing an everyday average of nearly 8 cases. They have a significant human impact on families (Pitman et al., 2014), train drivers (Kim et al., 2013; Mehnert et al., 2012) and likely other groups such as passengers, train machinists and by-standers. Additionally, they have economic consequences (ERA, 2014).

Most suicides occur in the context of a psychiatric illness or disorder (Chesney et al., 2014; Yoshimasu et al., 2008). They might

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be partly avoided by better provision of mental health care and closer attention to vulnerable groups. A Dutch study reported that for train suicides, the proportion of patients with a psychiatric history is of 65% (van Houwelingen and Kerkhof, 2008). 53% of the people who died by train suicide received psychiatric care at the time of their death, and the most prevalent diagnoses being affective disorders and non-affective psychoses. Consequently, further research on aetiology, risk groups and treatment as well as the establishment of care models should be carried out with high priority.

One of the factors shown to have measurable influence on suicide rates is the availability of lethal means (for review see Sarchiapone et al. (2011) and Florentine and Crane (2010)). For railway suicides, a relationship to an increased availability of trains has been reported (van Houwelingen et al., 2013; Clarke, 1994). A recent review (Too et al., 2014), on the other hand, found weak and inconsistent evidence for associations of railway suicide numbers with railway environment parameters (availability of railways and trains, accessibility to railways and familiarity with trains) and population characteristics.

Another factor triggering an increased rate of suicides is imitation, leading to copycat suicides. In the case of a suicide of a prominent person (celebrity suicide), the occurrence of the “Werther effect” is likely. This term is related to Goethe's novel entitled “The sorrows of young Werther” and was introduced by Phillips (1974). It refers to an increase in suicides in the population triggered by (elaborate) media reporting on a suicide case. It has been reported for several suicide methods, including charcoal burning (e.g. Chen et al., 2012), jumping (e.g. Kim et al., 2013; Yip et al., 2006), hanging (e.g. Kim et al., 2013; Cheng et al., 2007; Tousignant et al., 2005) and railway suicides (e.g., Hegerl et al., 2013; Ladwig et al., 2012; Schmidtke and Häfner, 1988).

In terms of the latter, Schmidtke and Häfner (1988) documented a Werther effect for railway suicides after the TV broadcast of a fictional serial demonstrating the railway suicide of a male adolescent. Suicide rates increased temporarily after the broadcast of each of the six episodes. A pronounced increase of railway suicides following the (real) case of Robert Enke was shown in more recent publications (137% increase for the two weeks after the incidence (Hegerl et al., 2013) and 81% increase if analysed for a four-week period (Ladwig et al., 2012)). This internationally known football goalkeeper of the German national team died due to suicide in his home country on November 10, 2009. Although both studies did not include analyses of actual media reports, it can be assumed that the increase of railway suicides in Germany immediately after this event due to the extensive and long-lasting media reporting about Enke's suicide can be assumed (for review see Niederkrotenthaler et al. (2012)). This is especially true as it has been shown that most print press releases related to the case have violated available media guidelines (Teismann et al., 2013). For Germany, Schaefer and Quiring (2014) found that guideline non-compliant reporting of celebrity suicide, which has been observed in six cases, including the one of Enke, is associated with increases in overall suicides and suicides with similar methods.

Hegerl et al. (2013) also investigated long-term effects of Enke's suicide and found that the number of railway suicidal acts in the two-year-period following Enke's suicide increased by 18.8% compared to the two-year-period before this event. The median number of railway suicidal acts per day increased from 2.3 to 2.7 in Germany ($p < 0.001$). This effect remained significant after the exclusion of short-term effects of Enke's suicide from the statistic calculations, demonstrating the impact this particular case of celebrity suicide had on the subsequent suicide numbers.

An international effect might be presumed as Robert Enke was known beyond German borders. Active as a professional football player since 1995, he temporarily worked in teams in Portugal, Spain and Turkey, prior to his position in the German national

league. In 2008 and 2009 he was part of the German national football team (Reng, 2011). Thus, his suicide received media attention not only in his home country, but internationally. If this might have triggered similar copycat effects in terms of increased numbers of railway suicides after his suicide in other European countries is investigated by this study.

Unfortunately we were unable to directly investigate the relationship of media reporting to changed railway suicide numbers after Enke's suicide, because it was not possible to retrospectively obtain related international and comparable data about media reports with the given resources. However, as media reporting is known to influence public opinion (Vu et al., 2014; McCombs and Shaw, 1972), the latter might serve as a proxy marker towards media coverage. In research, public opinion is traditionally assessed by analysing opinion polls. In recent years, Google Trends (formerly Google Insights for Search) has been used increasingly to the same end. This is one of the services offered by the US-American Google Incorporation, which holds the worldwide most used internet search engine.² Google Trends provides data on the relative frequency of search terms entered into the Google search website, comparing the number of searches done for a specific term with the total number of searches in Google. While Google Trends' potential for assessing issue salience was on the one hand acknowledged in scientific studies (Scheitle, 2011), its liability in research was also questioned, when systematically compared to pollster trend data (Mellon, 2013). Nevertheless it is increasingly used with health care research representing one common field of interest (Nutti et al., 2014). In recent years studies include the subject of suicidal behaviour, such as one from Gunn III and Lester (2013) demonstrating a positive association between search volume for suicide related terms and suicide rates of the 50 federal states of the USA. In the present paper, Google Trends data were retrieved and used in an exploratory way. This was done with the assumption that searches in Google also reflect media attention to a specific event, such as the suicide of Robert Enke. As a significant influence of media attention to an issue on search interest has been shown (Liang and Scammon, 2013; Weeks et al., 2012), it is likely that the volume of internet searches, and consequently Google Trends data, might serve as a proxy marker to media coverage about an event. Consequently, they were included as such in this study.

To summarise, the main aim of this study was to analyse whether or not the celebrity suicide of Robert Enke had an influence on suicidal behaviour in the sense of a Werther effect not only in Germany but also in other European countries. The following question was addressed on a first level of interest:

1. Are there short-term effects of the suicide case of Robert Enke and subsequent media coverage on the number of railway suicides in the four European study countries other than Germany?

Additionally, the following questions were addressed:

2. Did long-term effects occur in the study countries other than Germany?
3. Are increased railway suicide numbers associated with changes in kilometres driven by trains in the study countries?
4. Are potential long-term changes of railway suicide numbers following Enke's suicide different from the overall changes of suicide numbers, and does this impression remain after changes in train kilometres are taken into account?
5. Is there a relationship between an increase in railway suicides and Google Trends data for defined search terms related to the case?

² Alexa Top Sites By Category-Search Engine Ranking. Retrieved December 15, 2014: http://www.alexa.com/topsites/category/Computers/Internet/Searching/Search_Engines

2. Methods

2.1. Study countries

Data on railway suicides, overall suicides and from Google Trends for Germany, Austria, Hungary, the Netherlands and Slovenia were included. Those countries have been chosen due to their participation in the “Optimising suicide prevention programs and their implementation in Europe” project (OSPI-Europe; Hegerl et al., 2009), out of which the study topic for the present work arose. The OSPI-Europe consortium consisted of 14 institutions in 12 European countries. The countries, in which partners were able to obtain data on railway suicides from their national railway companies were included in this study. Table 1 outlines railway related descriptive characteristics.

2.2. Definitions

In the context of this study, we refer to a railway suicide as a behavioural act on the railway track, carried out by a person with the intention to die and having a lethal outcome.

The term issue salience refers to the degree specific search terms were entered by internet users into the online search engine Google throughout the chosen study time period.

2.3. Study time periods

- Short-term effects on the absolute frequency of railway suicides were analysed by comparing the number of railway suicides during an eight-week period before and two-week period after Enke's suicide (incident: 10/11/2009; index time interval: 11/11/2009 to 24/11/2009; control time interval 15/09/2009 to 09/11/2009). The eight-week period prior to the incident was chosen in order to have a more representative baseline. For calculations, the means of four two-week intervals were used to have a comparable index.
- The association of railway suicide numbers with kilometres driven by trains in the study countries was analysed for the years 2006–2011.
- Long-term effects were analysed for a time span of two years before and after 10/11/2009.
- For the comparison of long-term effect data and overall suicide numbers, the medians of the years 2008/2009 were compared to those of 2010/2011. For the same two time spans, an analysis taking into account train kilometres was conducted.
- Issue salience for the chosen search terms was examined for the last ten weeks of the year 2009 (25/10/2009–02/01/2010), which also includes the date of the suicide of Robert Enke (10/11/2009).

2.4. Data assessment

• Railway suicides

Data on the daily numbers of railway suicides for Austria, Germany, Hungary, the Netherlands and Slovenia were

obtained from the official registries of the railway companies. For each country, the biggest railway company in terms of railway track coverage was approached.

• Train kilometres

Data about kilometres driven by trains in the study countries (per year, in million) were taken from the 2014 report of the European Railway Agency (ERA, 2014).

• Overall country suicide frequencies

Data on completed suicides per study country were obtained from the national statistic registries.

• Google Trends data

On 4 August, 2014, two searches were conducted via the “explore” function of Google Trends: (1) An exploratory web search including all categories and the time span of August 2009 through January 2010, comparing the five study countries for the term “Enke”. (2) A web search including ‘all categories’, but with the regional filter applied for each of the participating countries to obtain data on national level instead of worldwide search results for the two search terms “Enke” (for each of the five study countries separately) and “suicide” in the respective country languages (“Suizid” for Germany and Austria, “ön-gyilkosság” for Hungary, “zelfmoord” for the Netherlands and “samomor” for Slovenia). For this second search, the time span was limited to the year 2009. This revealed results on a weekly basis for all queries, with the exceptions of Slovenia and Austria. For Slovenia, the issue salience was not high enough to reveal any data and for Austria, results were only displayed on a monthly basis. Therefore, for Austria, for the term “Suizid”, the time span was set to ‘2004–present’ (instead of the year 2009 only), as then results were also displayed on a weekly basis. The individual data sets were retrieved as CSV-files and combined in one common table for the time span of interest for calculations.

2.5. Statistical analysis

The median daily numbers of railway suicides in the eight-week period before (means of four two-week intervals) and the two-week period after the day of Enke's suicide were computed and compared by Mann–Whitney tests (due to the rather small sample sizes, especially in Austria and Slovenia). In order to compute the incidence ratio of the daily number of railway suicides between the two-week index period and the eight-week control period in 2009, negative binomial regression analyses for count variables were selected. Using these models, the incidence ratios for the railway suicides (including 95% confidence intervals (95% CI) and the corresponding *p*-values) were computable.

The long-term effects of Enke's suicide and the related media reporting on the frequency of railway suicides were analysed in an analogous way.

In order to know whether long-term increases in railway suicide numbers following the incident might be a reflection of increasing train traffic intensity, the association of the two variables was analysed. This was done for the years 2006–2011 by using

Table 1
Railway characteristics from participating countries.

Country	Name of railway company	Length of railway track system in km ^a	Number of passengers/year ^a	Km driven by passengers/year ^a
Germany (2011)	DB: Deutsche Bahn	33,378	1,974,000,000	79,228,000,000
Austria (2011)	ÖBB: Österreichische Bundesbahnen	Approx. 5000	209,000,000	92,000,000
Hungary (2011)	MÁV: Magyar Államvasutak	7893 (2013)	142,100,000	5,760,000,000
Netherlands (2011)	NS/ProRail	3035	Not available	138,000,000
Slovenia (2011)	Slovenian Railways	1228	15,743,000	15,590,000

^a Data obtained from the railway companies or annual activity reports published by the companies.

Spearman–Brown correlation coefficients, due to non-normal distribution. In a second step it was of interest to estimate the influence of train traffic intensity on railway suicide numbers. Based on changes in the total number of driven train kilometres between the periods 2008–2009 and 2010–2011, the hypothetical number of railway suicides in the period 2010–2011 was calculated given a constant railway suicide/train kilometre ratio. Chi-square tests for two-by-two tables with “Number of railway suicides” (with versus without considering changes of the number of train kilometres) being the row variable and “Period” (2008–2009 versus 2010–2011) being the column variable, were computed in order to address the question whether changes in the frequency of railway suicides after Enke’s suicide were significantly more pronounced than would be expected if these changes would be a mere epiphenomenon of changes in the total number of driven train kilometres. Out of interest and as a matter of completeness, the study countries not showing significant long-term effects regarding railway suicide numbers were also included.

In order to know whether increased long-term effects of Enke’s suicide and subsequent media reporting in several European countries are potentially a reflection of an overall increased suicide frequency, the mean frequency of railway suicides in the periods 2008–2009 and 2010–2011 was compared to the total number of suicides in these periods. Again, this was done for all study countries. To determine whether the percentage of railway suicides in the period 2010–2011 (after Enke’s suicide) related to the total period 2008–2011 was significantly different from the corresponding probability derived from the overall suicide data, binomial tests were computed by using an online calculator ([http://](http://stattrek.com/online-calculator/binomial.aspx)

stattrek.com/online-calculator/binomial.aspx). In the cases where the number of railway suicides in the period 2008–2011 was greater than 1000, the afore-mentioned Binomial Calculator used a normal distribution for the estimation of the binomial probabilities.

The associations between the weekly numbers of railway suicides in the last ten weeks of the year 2009 and the corresponding weekly numbers of Google Trends searches regarding “Enke” and “suicide” were examined by using Spearman–Brown correlation coefficients.

For all statistical tests, the statistical software package for IBM SPSS Statistics 20™ for Windows (IBM, New York, USA) was utilised.

3. Results

1. Are there short-term effects of the suicide case of Robert Enke and subsequent media coverage on the number of railway suicides in the four European countries other than Germany?

In the eight-week interval before Enke’s suicide (15/09/2009–09/11/2009) in the four European study countries other than Germany, 16.5 railway suicides took place on average in each two-week period, whereas 32 railway suicides were registered in the two-week period after this incident (11/11/2009–24/11/2009) (see Table 2). The increase of 15.5 railway suicides (+93.9%; 95% CI: 23.9–203.6%) in the two-week period after Enke’s suicide was significant ($p=0.004$).

Table 2

Number of railway suicides in Germany, Austria, Hungary, the Netherlands and Slovenia for a short-term (2 weeks) and long-term (2 years) interval.

	Number of railway suicides	Daily mean (SD)	Daily median (range)	Mann–Whitney U test Z (p)	Percentage change (95% CI) (p)
Germany					
8 weeks ^a before 10/11/2009	30	2.14 (1.39)	2 (0–5)	Z = –3.37	113.3 (56.2; 191.4)
2 weeks after 10/11/2009	64	4.57 (2.56)	4.50 (1–9)	(p=0.001)	(p=0.000002)
2 years before 10/11/2009	1510	2.07 (1.45)	2 (0–7)	Z = –3.78	17.9 (9.7; 26.7)
2 years after 10/11/2009	1780	2.44 (1.71)	2 (0–11)	(p=0.0002)	(p=0.000008)
All 4 countries except Germany					
8 weeks ^a before 10/11/2009	16.5	1.18 (1.19)	1 (0–4)	Z = –2.70	93.9 (23.9; 203.6)
2 weeks after 10/11/2009	32	2.29 (1.44)	2.50 (0–5)	(p=0.007)	(p=0.004)
2 years before 10/11/2009	777	1.06 (1.08)	1 (0–8)	Z = –2.75	16.7 (5.6; 29.1)
2 years after 10/11/2009	907	1.24 (1.18)	1 (0–6)	(p=0.006)	(p=0.003)
Austria					
8 weeks ^a before 10/11/2009	4.25	0.30 (0.54)	0(0–2)	Z = –0.01	64.7 (–32.0; 298.7)
2 weeks after 10/11/2009	7	0.50 (1.02)	0 (0–3)	(p=0.99)	(p=0.27)
2 years before 10/11/2009	192	0.26 (0.53)	0 (0–3)	Z = –0.91	–8.9 (–26.2; 12.6)
2 years after 10/11/2009	175	0.24 (0.51)	0 (0–3)	(p=0.36)	(p=0.39)
Hungary					
8 weeks ^a before 10/11/2009	2.5	0.18 (0.39)	0 (0–1)	Z = –3.26	340.0 (86.9; 936.0)
2 weeks after 10/11/2009	11	0.79 (0.80)	1 (0–2)	(p=0.001)	(p=0.001)
2 years before 10/11/2009	209	0.29 (0.56)	0 (0–4)	Z = –3.15	31.1 (9.1; 57.5)
2 years after 10/11/2009	274	0.37 (0.61)	0 (0–4)	(p=0.002)	(p=0.004)
Netherlands					
8 weeks ^a before 10/11/2009	9.25	0.66 (0.94)	0 (0–4)	Z = –1.07	40.5 (–25.7; 165.9)
2 weeks after 10/11/2009	13	0.93 (1.00)	1 (0–3)	(p=0.28)	(p=0.30)
2 years before 10/11/2009	347	0.47 (0.70)	0 (0–4)	Z = –2.45	21.3 (4.9; 40.4)
2 years after 10/11/2009	421	0.58 (0.78)	0 (0–4)	(p=0.014)	(p=0.009)
Slovenia					
8 weeks ^a before 10/11/2009	0.5	0.04 (0.19)	0 (0–1)	Z = –0.59	100.0 (–81.9; 2105.6)
2 weeks after 10/11/2009	1	0.07 (0.27)	0 (0–1)	(p=0.56)	(p=0.57)
2 years before 10/11/2009	29	0.04 (0.20)	0 (0–2)	Z = –0.91	27.6 (–21.6; 107.5)
2 years after 10/11/2009	37	0.05 (0.23)	0 (0–2)	(p=0.37)	(p=0.33)

Notes: CI=confidence interval; SD=standard deviation.

The percentage changes of the number of railway suicides in the two-week index time interval after Enke’s suicide compared to the corresponding number in the eight-week control time interval before this incident as well as the respective two-year intervals are based on a negative binomial regression analysis.

^a For the eight-weeks interval means of four two-weeks intervals are presented.

On the level of the individual countries, in Hungary, the increase was of 340.0% (first 2.5, then 11 cases) and thereby significant (95% C.I.=86.9–936.0%; $p=0.001$). In Austria and the Netherlands, railway suicides increased in the index time interval compared to the eight-week period before Enke's suicide (64.7% and 40.5%); however, these increases failed to be significant ($p=0.27$ and $p=0.30$). In Slovenia, the median number of railway suicides in the control and index time interval remained unchanged in 2009 (median=0) (see Table 2).

2. Did long-term effects occur in the study countries other than Germany?

Combining data from the four countries other than Germany, a significant increase of railway suicides in the two-year period after Enke's suicide compared to the two-year period before this event has occurred (16.7%, $p=0.003$).

On the level of the individual countries, besides Germany, significant long-term effects of Enke's suicide on railway suicides were present in Hungary (+31.1%, $p=0.004$) and the Netherlands (+21.3%, $p=0.009$, see Table 2).

3. Are increased railway suicide numbers associated with changes in kilometres driven by trains in the study countries?

Regarding the period 2006–2011, there was a slight and non-significant negative association between the yearly numbers of railway suicides and the yearly total numbers of train kilometres in Germany ($\rho=-0.14$; $p=0.79$), the four countries other than Germany combined ($\rho=-0.03$; $p=0.96$), Austria ($\rho=-0.09$; $p=0.86$) as well as Hungary ($\rho=-0.23$; $p=0.66$). A marked, albeit non-significant positive correlation regarding these two variables was found for the Netherlands ($\rho=0.60$; $p=0.21$) and statistically significant association for Slovenia ($\rho=0.93$; $p=0.008$). Due to the small sample size, however, this should be interpreted with caution.

4. Are potential long-term changes of railway suicide numbers following Enke's suicide different from the overall changes of suicide numbers?

In Germany and the other four countries altogether, for the investigated two-year periods (2008–2009 vs. 2010–2011), an increase of the number of suicides (5.76% and 2.38%, respectively) went along with increased numbers of railway suicides (Germany: 10.2%; the other four countries altogether: 7.73%). The increase in overall suicide numbers, however, was lower than that of the railway suicides. The differences are statistically significant ($p=0.007$ (Germany) and 0.011 (the other four countries); see Table 3). The same is true for the Netherlands (9.7% overall suicides increase vs. 15.5% increase of railway suicides; $p=0.022$). In Hungary, the increase is even more pronounced. While railway suicide frequencies increased by 11.30%, the overall occurrence of suicides diminished by 0.49% ($p=0.016$). For Austria, a decrease of railway suicides of –13.7% went along with an increase of overall suicides of 0.35% ($p=0.015$).

Does this impression remain after changes in train kilometres are taken into account?

As can be seen in Table 4, the increase for the means of two 2-year time-periods (2008–2009 and 2010–2011) in railroad kilometres in Germany was of 1.96%, whereas the increase of 10.2% of railroad suicides for the same periods was much higher. There was a statistical tendency ($\chi^2=2.47$; $df=1$; $p=0.06$) that the long-term increase in the frequency of railway suicides after Enke's suicide in Germany was more pronounced than would be expected if this change would have been only due to a corresponding increase in the total number of driven train kilometres (tk). In the period 2010–2011 131 more railway suicides occurred in Germany than would have been expected due to a mere increase in the tk.

Table 3
Number of railway suicides and national suicides in the period 2008–2011 in the five study countries (Germany, Austria, Hungary, Netherlands, Slovenia).

Country	M1 (2008–2009)	M2 (2010–2011)	Percentage change (M2–M1) (%)	p^1
Germany				
Number of railway suicides	794	875	10.20	0.007
Total number of suicides	9533.5	10,082.5	5.76	–
Railway suicides/total suicides (in %)	8.32	8.68	4.33	–
All 4 countries except Germany				
Number of railway suicides	414	446	7.73	0.011
Total number of suicides	5646	5780.5	2.38	–
Railway suicides/total suicides (in %)	7.33	7.71	5.30	–
Austria				
Number of railway suicides	98.5	85	–13.71	0.015
Total number of suicides	1269	1273.5	0.35	–
Railway suicides/total suicides (in %)	7.76	6.675	–13.98	–
Hungary				
Number of railway suicides	119.5	133	11.30	0.016
Total number of suicides	2469	2457	–0.49	–
Railway suicides/total suicides (in %)	4.845	5.425	11.97	–
Netherlands				
Number of railway suicides	180.5	208.5	15.51	0.022
Total number of suicides	1480	1623.5	9.70	–
Railway suicides/total suicides (in %)	12.175	12.835	5.42	–
Slovenia				
Number of railway suicides	15.5	19.5	25.81	0.060
Total number of suicides	428	426.5	–0.35	–
Railway suicides/total suicides (in %)	3.69	4.545	23.17	–

Notes: M=means.

¹ In order to answer the question whether the percentage of railway suicides in the period 2010–2011 (after Enke's suicide) related to the total period 2008–2011 was significantly different from the corresponding probability derived from national suicide data, binomial tests were computed by using an online calculator (<http://stattrek.com/online-calculator/binomial.aspx>).

Table 4

Number of railway suicides (RS) in the period 2008–2011 in the five study countries for raw data and hypothetical numbers of railway suicides (HRS) considering train kilometres (tk).

Country	2008–2009	2010–2011	Percentage change (M2–M1) (%)	RS-HRS (2010–2011)
Germany				
Number of RS (sum)	1588	1750	10.20	131
HRS considering changes of tk (sum)	1588	1619	1.96	–
Total number of tk (in million, yearly mean)	1022.5	1042.5	1.96	–
All 4 countries except Germany				
Number of RS (sum)	828	892	7.73	34
HRS considering changes of tk (sum)	828	858	3.60	–
Total number of tk (in million, yearly mean)	417	432	3.60	–
Austria				
Number of RS (sum)	197	170	–13.71	–26
HRS considering changes of tk (sum)	197	196	–0.65	–
Total number of tk (in million, yearly mean)	155	154	–0.65	–
Hungary				
Number of RS (sum)	239	266	11.30	30
HRS considering changes of tk (sum)	239	236	–1.40	–
Total number of tk (in million, yearly mean)	107.5	106	–1.40	–
Netherlands				
Number of RS (sum)	361	417	15.51	9
HRS considering changes of tk (sum)	361	408	12.92	–
Total number of tk (in million, yearly mean)	135.5	153	12.92	–
Slovenia				
Number of RS (sum)	31	39	25.81	8
HRS considering changes of tk (sum)	31	31	0	–
Total number of tk (in million, yearly mean)	19	19	0	–

Notes: According to chi-square tests for two-by-two tables with “Number of railway suicides” (with versus without considering changes of the number of train kilometres) being the row variable and period (2008–2009 versus 2010–2011) being the column variable, changes in the frequency of railway suicides after Enke's suicide were in all six cases (Germany, Austria, Hungary, Netherlands, Slovenia, all four countries except Germany) not significantly different from changes in the frequency of railway suicides which would be expected if these changes would be a mere epiphenomenon of changes in the total number of driven train kilometres.

The other countries taken together showed a mean increase in railroad kilometres of 3.6%. The mean increase in railroad suicides of 7.73% was lower than in Germany, but still elevated. 858 railway suicides would have been expected in the period 2010–2011 due to equal increases in the tk. In fact, 892 railway suicides occurred, with the difference of 34 cases being clinically meaningful, but failing to be statistically significant ($\chi^2=0.32$; $df=1$; $p=0.29$).

On the level of the individual countries, the results differed in terms of railway kilometres. They decreased slightly in Austria and Hungary. However, the number of railway suicides decreased substantially and significantly in Austria, but increased in Hungary, even more than in Germany. In the Netherlands, the number of railway kilometres increased most (12.92%), but still less if compared to the number of railroad suicides (15.51%).

Slovenia did not show a change in railway kilometres for the means of the two compared periods.

These results suggest that the long-term increases in railroad suicides cannot exclusively be attributed to increases in railway kilometres. This seems to apply even for Slovenia and the Netherlands, for which general associations of railway suicides to train kilometres were found if analysed for a time span of 6 years (2006–2011, see above).

5. Is there a relationship between an increase in railway suicides and Google Trends data for defined search terms related to the case?

Comparing the five study countries, the search term “Enke” became salient in four out of five study countries only in November 2009 (see Fig. 1). While among the five countries most searches for the term were conducted in Germany (which is normalised by Google Trends and assigned the number 100), people in Austria were about 1/3 and in the Netherlands as well as Hungary about 1/10 as likely to search for the term. In Slovenia the search volume was too low for results to be displayed.

The outstanding frequency of Google searches for the term “Enke” in Germany was significantly associated with the frequency of railway suicides in the last ten weeks of the year 2009 (including the day of Enke's suicide (10/11/2009); $\rho=0.78$; $p=0.007$). For the other countries, these correlations were not significant ($\rho=0.26$ – 0.56 ; see Table 5). The country-specific associations between the frequencies of railway suicides in the last ten weeks of the year 2009 and the web search interest regarding “suicide” in the same period were mainly insignificant, with the exception of the Netherlands, where the increase in railway suicides corresponded to an increase of Google searches on ‘suicide’ ($\rho=0.75$; $p=0.012$; see Table 5).

4. Discussion

This paper aimed at examining whether there are international effects on the frequency of railway suicides following the media reporting about the celebrity suicide case of Robert Enke, the former German national football goalkeeper, who died by suicide on a German railway track in November 2009. The main finding of our study is that there are indications pointing in this direction. Combining data from four different countries (Austria, Hungary, the Netherlands and Slovenia), a significant increase of railway suicide numbers during the two weeks after his death compared to the control interval before it was found (increase of 93.9%). Furthermore, the analysis of long-term changes (2 year post-interval) revealed a significant increase (16.7%) as compared to the control interval prior to it.

At the same time an overall 6% increase of railway suicide numbers per annum has been reported for the European Union by the European Railway Agency (ERA, 2014) starting prior to Enke's suicide in 2006. Consequently, imitation effects likely are only one factor among others when trying to find an explanation for this overall trend. Our findings, suggesting that increases in railway

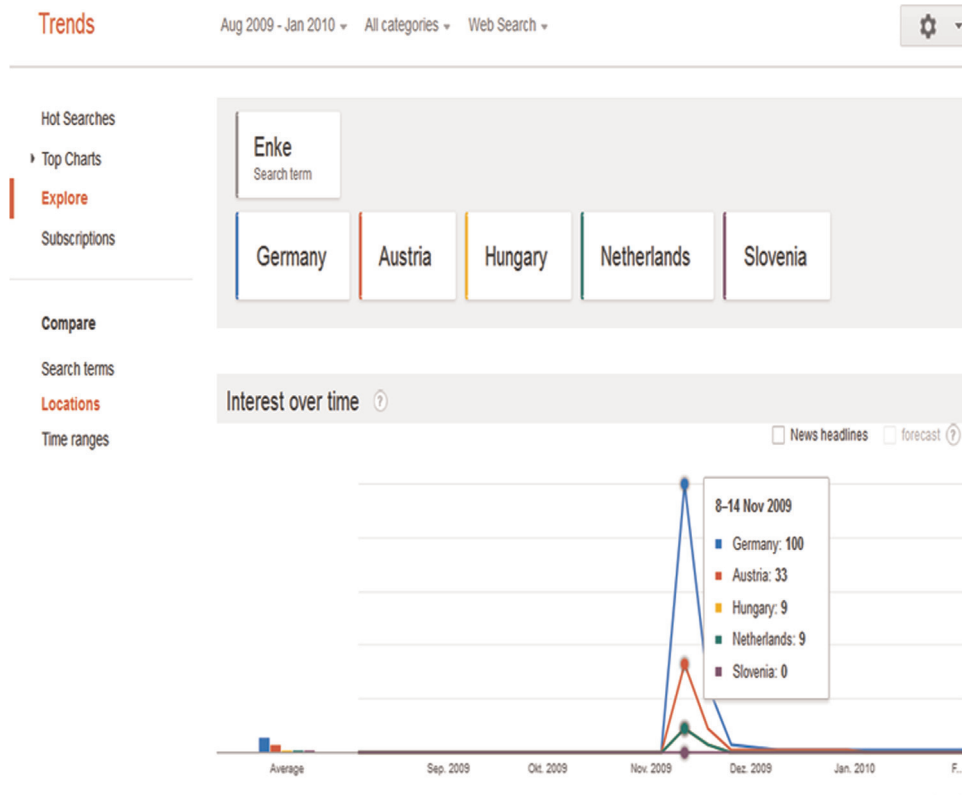


Fig. 1. Google Trends result graphic for the search term “Enke” and time span of August 2009 – January 2010 compared in between Germany, Austria, Hungary, the Netherlands and Slovenia. Data retrieved: August 5, 2014; Source: Google Trends (www.google.com/trends).

Table 5
Association between the frequency of railway suicides and Google Trend data.

Country	Correlation between railway suicides and web search interest ^a regarding	
	“Enke”	“Suicide”
All 3 foreign countries except Germany and Slovenia	0.29 ($p=0.12$)	0.29 ($p=0.13$)
Germany	0.78 ($p=0.007$)	0.39 ($p=0.27$)
Austria	0.26 ($p=0.47$)	-0.11 ($p=0.77$)
Hungary	0.28 ($p=0.43$)	0.25 ($p=0.49$)
Netherlands	0.56 ($p=0.10$)	0.75 ($p=0.012$)
Slovenia	NA	NA

Notes: Spearman–Brown correlation coefficients with the corresponding p values (for two-tailed testing) ($n=10$) are given.
NA=not applicable (for Slovenia, weekly Google Trend data were not available for the selected period).

^a Computed for the last ten weeks of the year 2009 including the day of Enke’s suicide (10/11/2009) (25/10/2009–02/01/2010).

suicide numbers in Europe after 2009 may be associated with the death of Robert Enke, seem probable due to several reasons.

Firstly, for the combined data of the four European countries other than Germany, changed railway suicide numbers do not simply reflect the overall increases of suicides as the change in railway suicide numbers was significantly higher than the corresponding changes of the overall suicide numbers.

Secondly, for the overall data of the four countries other than Germany there is no positive correlation between kilometres driven by trains in the study countries and railway suicide frequency, meaning that the rise in train suicides is not attributable to an increase in traffic intensity and, consequently, not only an effect of an increased availability of trains. This result is underlined when

the long-term increase in railway suicides of 7.73% is compared to the hypothetical increase of 3.6% which would have occurred if only increases in train kilometres were responsible for increased railway suicide numbers: 858 railway suicides would have been expected in the two-year period following Enke’s suicide (2010–2011) due to equal increases in the train kilometres. In fact, 892 railway suicides occurred.

Thirdly, media coverage and public attention to the case of Robert Enke was also present outside of Germany. This is supported by our analysis of Google Trends data showing that the search terms “Enke” and “suicide” were subject of internet searches in November and December 2009 in four out of five participating study countries. Also in Slovenia, even though the Google search volume was too limited to reveal results, the case was reported at the time (personal communication by Saska Roskar). For the term “Enke”, which was almost not searched at all prior to his suicide, this was mostly visible immediately after it. In Germany, the internet search volume for this term showed a significant correlation to the increase in railway suicide cases for the last 10 weeks in 2009. It can also be assumed from previous research that media coverage contributes to copycat effects (for review see e.g. [Sisask and Värnik \(2012\)](#); [Too et al. \(2014\)](#)).

Fourthly, it was considered whether there were other celebrity railway suicide cases or fictional stories portraying a railway suicide in the countries participating in this study, which could have been a possible alternative explanation for the observed changes in railway suicides as reported by other studies before ([Stack, 2005](#); [Schmidtke and Häfner, 1988](#)). All co-authors stemming from the respective study countries confirmed that this was not the case.

Of the individual countries investigated, the interpretation that a Werther effect occurred seems most likely for Hungary, where the increase of railway suicides was especially pronounced, showing significant short and long-term effects. In addition,

significant changes during the two-year interval after the incident were found for the Netherlands. Why there is a significant short-term increase of railway suicides in Hungary, but not in the Netherlands, cannot fully be answered by our data. The quality of media reporting in the two countries might be one determining factor. Whereas in the Netherlands media guidelines are implemented and mostly followed (personal communication by Christina van der Feltz-Cornelis), in Hungary, they were only issued in 2012, after Enke's suicide. Accordingly, at the time of Enke's suicide, cultural factors associated with media reporting might still have influenced subsequent behaviour in Hungary. For instance, it was found earlier that Hungarian media tend to portray suicide in a heroising way (Fekete et al., 2001), a factor contributing to identification and, subsequently inducing the Werther effect. This might be especially true for a railway suicide, as the reputed Hungarian poet Attila József and the "actor of the nation" Zoltán Latinovits took their life in the same way. Although this was long ago (1937 and 1962), it is well known in Hungary that they died by collisions with trains, potentially leading to an image of this method as an "iconic" one (personal communication by Mónika Ditta Toth). Another important factor of influence, especially for the Netherlands, appears to be the availability of trains passing. If a hypothetical number of increases in railway suicides is calculated based on increases in kilometres driven by trains in the country, the percentage change (12.92%) is close to the real increase of 15.51% in the two years after the Enke suicide (2010–2011) compared to 2008–2009. This apparent influence of train traffic intensity is in line with recent study results from the Netherlands of a significant influence of train traffic intensity in terms of the frequency of trains passing (van Houwelingen et al., 2013).

For the German-speaking Austria, where the media reporting about Enke's suicide was elaborate and long-lasting, there were no indications for a Werther effect. Its absence might be due to more sensitive media coverage in Austria. In this country, after a pronounced increase of subway suicides and non-beneficial reporting about them in the 1980s, media guidelines were introduced in 1987. Subsequently, in the second half of 1987, there was a decrease of 75% which could be sustained for five years (Sonneck and Etzersdorfer, 1994) and corresponds to significant changes in the quality and quantity of media reporting (Niederkrotenthaler and Sonneck, 2007). In line with this, the suicide of Robert Enke was reported in a sensitive way as a consequence of a depressive disorder and fear of stigma by at least some newspapers (personal communication by Ullrich Meise). From a different perspective, the stuttering historical relationship of Austria and Germany (Pape, 2000) might play a role as well. It could lead to less identification with the German national "hero" Robert Enke. Most likely he did not have the same celebrity status in countries outside of Germany. In the original concept of the Werther effect (Phillips, 1974), however, identification with the role model is a crucial factor in triggering imitational suicidal behaviour. Corresponding to this, previous studies have shown that copycat behaviour was more elaborate in individuals similar to the celebrity in terms of gender and age (Niederkrotenthaler et al., 2009; Fu and Yip, 2009).

It seems plausible that there is no indication for a Werther effect in Slovenia mainly due to the geographically more distant location of this country from Germany. Far reaching conclusions, however, are prevented by the small sample size.

Considering the above and assuming that celebrity suicides like that of Robert Enke and related media coverage influence subsequent suicide numbers beyond country borders, seemingly several mechanisms apply in such an international setting. It appears that there are factors directly related to the model (a Werther effect in the original sense by imitating an exact model) and

others that lead to copycat behaviour with the same method without having personal links to the model. Likely, in the examined international setting, the reporting about such a case increases the awareness and 'cognitive availability' (Florentine and Crane, 2010) of railway suicide as one potential and lethal suicide method. This would also be supported by the findings of a German study (Kunrath et al., 2011) where media coverage of a fatal railway accident not being a suicide, led to a significant increase of railway suicides in an index period.

There are five main limitations of the present research. (1) Some countries possessed many missing values on data for age and gender. Consequently, subgroup analyses could not be conducted. (2) We could not obtain sufficient information about mass media reports regarding Enke's suicide in order to be able to answer the question whether differences in the quantity or quality of these reports might explain the different effects of this event on railway suicides in different countries. (3) The analyses were limited to a small sample of European countries due to practical reasons and available data, as explained in Section 2. (4) Although the biggest train company regarding track coverage was approached in each country, it is likely that a small percentage of railway suicides has not been covered by this study. Some countries possess more than one train company. For example in the Netherlands, NS/ProRail, which is the company we obtained data from, covers approximately 85% of the complete train system, but in total there are 29 transporters active on the railway system in the Netherlands. (5) Data from Google Trends do not seem to be a 100 per cent reliable source of data. To validate the data used in this study, they were accessed from Google Trends twice (in August and November 2014). Even though the exact same search criteria were applied, the two searches revealed slightly different numbers. Since this did not have major effects on the calculations presented, the results were still included for illustrative purposes. Queries addressed to Google Inc. in relation to the differing numbers could not be clarified. Consequently, the data have to be interpreted with caution.

In addition, there is the methodological limitation of rather small sample sizes for the correlation analyses for both, the Google Trends data and train kilometres. Finally, other events than the railway suicide of Robert Enke in the same time span might have influenced the corresponding numbers. Although known factors were addressed, a risk remains that others were overlooked.

In spite of these limitations and heterogeneous results, our study is among the first to analyse and show indices for an imitational effect following a celebrity's suicide in an international context. This has several implications. Firstly, media guidelines should not only be continuously used, but also updated to account for modern and global media at the same time as traditional media channels. Maloney et al. (2014) recently found that only 15% of all media recommendations include a paragraph on reporting suicidal behaviour on the internet. Consequently, the authors suggest potential improvements for existing guidelines. Especially dealing with celebrity suicide cases, such as Robert Enke, or more recently Robin Williams, guidelines should be adapted to a world of global news reporting and rapidly increasing social networks not limited by country borders. Secondly, the research focus about copycat suicides should be widened in the future. This should, on the one hand, include further epidemiological studies investigating changed international patterns of a suicide method used in a celebrity suicide to replicate this finding. On the other hand, studies investigating the primary source of (online) media reports are needed to draw more reliable conclusions about the exact relationship between news channels perceived internationally and increased cross-country suicide figures.

Role of funding source

The research leading to this paper received funding within the OSPI-Europe project, funded by the European Commission's Seventh Framework Program (FP7/2007–2013) under Grant Agreement no. 223138. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Contributors

Nicole Koburger, Roland Mergl, Christine Rummel-Kluge and Ulrich Hegerl developed the study questions and plan for statistical analyses. Nicole Koburger and Roland Mergl wrote together the first draft of the manuscript and managed the literature searches. Nicole Koburger obtained Google Trends data. Roland Mergl performed the statistical analysis of the data. Angela Ibelshäuser, Vita Postuvan, Saska Roskar, András Székely and Christina van der Feltz-Cornelis obtained data from their national railway companies. All authors were included in the conception and design of the study, interpreting the data and revising the manuscript critically for important intellectual content. They all gave final approval to the submitted version of the manuscript.

Conflict of interest

Professor Ulrich Hegerl has served as an advisory board member for Eli Lilly, Lundbeck, Otsuka, Takeda, and Servier, as a consultant for Nycomed, a Takeda company, and as a speaker for Bristol-Myers Squibb, Medice Arzneimittel, Novartis, and Roche Pharma. Roland Mergl has served as a consultant for Nycomed, a Takeda company.

Acknowledgements

We gratefully thank our partners at the national railway institutions for granting access to the data: Dr. Christian Gravert for the Deutsche Bahn AG, Andreas Hahl for the ÖBB Infrastruktur AG, Ottó Kertész for Magyar Államvasutak, Bart Hoogcarspel & Angela van der Veer from Prorail and Iztok Prtnemer from Slovene Railways.

We also thank our colleague Stephanie Schmit for proof-reading the final version of the manuscript.

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