J. biosoc. Sci. (2005) **37**, 721–740

doi:10.1017/S0021932004006959

NATIONAL INTELLIGENCE, SUICIDE RATE IN THE ELDERLY, AND A THRESHOLD INTELLIGENCE FOR SUICIDALITY: AN ECOLOGICAL STUDY OF 48 EURASIAN COUNTRIES

MARTIN VORACEK

University of Vienna, Austria

Summary. Across 85 countries around the world, Voracek (2004) found a significant positive relation between estimated national intelligence (IQ) and national male and female suicide rate. The relation was not attenuated when countries' *per capita* Gross Domestic Product (GDP) and type of national IQ estimation were statistically controlled. Independently, investigating the total national suicide rate only, Lester (2003) arrived at the same conclusion. These two findings are consistent with a corollary of de Catanzaro's (1981) evolutionary theory of human suicide, namely that a threshold intelligence is necessary for suicidality and that intelligence and suicide mortality should thus be positively related. Here, further evidence for this hypothesis is bolstered by focusing on suicide rates of the elderly. Across 48 Eurasian countries, estimated national IQ was significantly positively related to national suicide rates of people aged 65 years and over. This new ecological-level finding survived statistical controlling for a set of seven variables (type of national IQ estimation, national GDP, stableness and recency measures for suicide rates, and rates of adult literacy, urbanization and Roman Catholics), which thus are not confounding factors for the relation of intelligence and suicide mortality. Based on ecological data, the threshold IQ for suicidality is predicted to be 70 or slightly over, an estimate that is consistent with various suicidological observations.

Introduction

The question of a possible relation between human cognitive abilities, particularly level of general intelligence, and suicide has been widely neglected in the fields that usually deal with either one or both of these factors, i.e. differential psychology, clinical psychology, suicidology, crisis intervention, psychotherapy, psychiatry and

psychological medicine, and must be considered as an under-researched topic. The present study aimed at providing empirical evidence for a relation between intelligence and suicide mortality at an ecological level. First, the theoretical framework suggestive for a relation between intelligence and suicide is presented; then, the few existing empirical accounts on this research question are reviewed.

To this author's knowledge, the only theory-driven hypothesis that directly bears on the question of a relation between intelligence and suicide can be found in the context of de Catanzaro's (1980, 1981) evolutionary theory of human suicide and self-damaging behaviour. The central argument of this theory is aptly summarized as follows: '[…] suicide will be most likely to occur when an individual has a dramatically reduced ability to contribute to his or her own inclusive fitness' (Buss, 2004, p. 98). One point of de Catanzaro's theory is particularly salient for the present investigation, as it is assumed that a threshold intelligence is necessary for suicidality (de Catanzaro, 1981, pp. 55, 65, 152, 154). This point is derived from the species generality of suicidal behaviour in humans and from cross-species differences in self-damaging behaviour. Stated differently, whereas suicide is a human universal it is not found in non-human animals: '[…] it may take an intelligent animal to know when the situation is hopeless, to realize that purpose for life is removed in those circumstances, and that death can be self-induced' (de Catanzaro, 1981, p. 154).

A corollary of this hypothesis is that intelligence and suicide mortality should be positively related, which specific prediction is testable on an individual level as well as on an aggregate (ecological) level. In the following, a review of existing individual-level and ecological-level evidence for the hypothesized positive relation between intelligence and suicide mortality is presented.

Voracek (2004) re-analysed the suicide mortality within the participant pool of the *Terman Genetic Study of Genius* (Oden, 1968; Holahan *et al.*, 1995) and came to the conclusion that there is evidence of excess suicide prevalence in this sample of the highly gifted, relative to the general population. For this unique study, in fact the longest follow-up study of the social sciences, 1528 highly gifted children (857 boys and 671 girls, with an average Stanford-Binet IQ of 151), who were on average eleven years old, were identified in Californian public schools during 1921/22 and were followed up over their entire life span. As of 1960, fourteen male and eight female suicides were recorded in this sample (Oden, 1968); as of 1970, 20 male and eight female suicides (Shneidman, 1971); and as of 1987, at a median participant age of almost 80 years, a total of 25 male and nine female suicides were known (Lester, 1991b; Holahan *et al.*, 1995, p. 220). Framed differently, i.e. in regard to the overall mortality of this sample, by 1987 one in eleven male deaths and one in nineteen female deaths in the Terman sample were from suicide (Lester, 1991a). The calculated lifetime suicide mortality for the gifted individuals of the Terman study was therefore 2·25%. This figure is roughly four times the lifetime suicide mortality in the general population, which has been estimated as ranging from less than 0·5% (in a meta-analysis of populations not suffering from affective disorders; Bostwick & Pankratz, 2000) to 0·63% (in a 40-year follow-up study of male Norwegians, excluding alcohol abusers; Rossow & Amundsen, 1995). For the Terman sample, Voracek (2004) estimated a mean suicide density rate of 33 per 100,000 person-years over the 66-year observation period (1921/22 to 1987), which is almost three times the

contemporary suicide rate of the enrolment site for the Terman study, California (see US Department of Health and Human Services, 1997), the latter figure, due to the increase in suicide incidence over the 20th century, beyond doubt being an overestimate for the suicide rate that a reasonable control group for the Terman sample, i.e. the early 1910s birth cohort of the Californian general population, must have had. Suicide mortality within the Terman study sample had previously been repeatedly investigated (Oden, 1968; Shneidman, 1971; Tomlinson-Keasey *et al.*, 1986; Warren & Tomlinson-Keasey, 1987; Lester, 1991a, 1991b; Holahan *et al.*, 1995, p. 21), but any appreciation of the fact that suicide mortality was remarkably high in this cohort of highly intelligent individuals is absent in these accounts. Interestingly, this new finding from the Terman study is convergent with lay theories of suicide, i.e. that highly intelligent individuals on average are less adapted to general living contexts and are more prone to suicidality in comparison to other groups in the population (Rook, 1959; Ross, 1969).

Relatedly, above-average university grades for a sample of student suicides have been reported by Seiden (1966). Also pertaining to the issue of excess suicide mortality in the highly gifted is the observation of a high suicide rate in writers. Since this observation is cross-nationally and cross-temporally stable, broad and general factors rather than local and specific factors must be sought for explanation. It is interesting that the literature is still uncertain on whether psychiatric considerations (affective disorders, alcohol and drug abuse) among the highly gifted and creative, such as writers, can satisfactorily explain their high suicide rate (Lester, 1994). By the same token, as detailed in regard to the Terman study, it may well be that the high intelligence of writers is also a co-factor governing their high suicide rate.

Considering ecological-level studies on the relation of intelligence and suicide, Lester (1993) used data from Lynn (1980) to assess the association of regional differences in intelligence and suicide rate within France. Across 87 *Départments* (counties), suicide rate was neither related to average intelligence nor to the population proportion of *Institut de France* members. In a similar fashion, Lester (1995) used data from Lynn (1979) to assess the association of intelligence and suicide within the United Kingdom and the Republic of Ireland. Across twelve regions, it was found that regional intelligence was strongly positively related to the regional suicide rate. However, when this relation was statistically controlled for socioeconomic indicators (infant mortality, *per capita* income, and urbanization), regional intelligence was not a salient predictor of the regional suicide rate and thus Lester (1995) qualified his finding as most likely to be spurious.

Voracek (2004) tested de Catanzaro's hypothesis on a cross-national level, using national IQ data from Lynn & Vanhanen (2002) and accounting for sex. Across 85 countries around the world, national IQ was significantly positively related to the national male and female suicide rate. This relation was not attenuated when countries' *per capita* Gross Domestic Product (GDP) and the type of national IQ estimation were partialled out, and the relation was commensurate for male as well as for female suicide rates. Across world regions, ethnic differences in intelligence corresponded to ethnic differences in suicide rates (Rushton, 2000), such that averaged suicide rates for East Asian countries were highest, were somewhat lower for most European countries, and were lowest for African and Caribbean countries. In

addition, the relation between national IQ and suicide rate, statistically controlled for GDP and type of IQ estimation, remained positive in subgroup analyses (28 American and Oceanian, 22 Asian and African, and 35 European countries), although in these subgroup analyses range restriction inevitably led to an attenuation of the magnitude of the relation and, due to the reduced number of observations, the subgroup analyses were compromised by loss of statistical power. As a consequence, the relation between IQ and male or female suicide rate was statistically reliable only for the numerically largest subgroup of the European countries. However, it is of note that the relation was still positive, although, due to the aforementioned design restrictions, not statistically significantly, when three further indicators, i.e. rates of the divorced, aged and unemployed, salient for suicide rates and available for a subset of 36 countries around the world, were additionally partialled out. Independently, also using the national IQ data of Lynn & Vanhanen (2002), but based on a subset of 72 countries, investigating the total national suicide rate only, and without referring to de Catanzaro's corollary, Lester (2003) arrived at the same conclusion, namely that on a cross-national level IQ and suicide rate are positively related.

The final two research contributions to be reviewed here come from epidemiological investigations. Tomassini *et al.* (2003) presented evidence for a substantially lower suicide rate of twins (across sex, cohorts and zygosity) compared with singletons from the same population. The authors invoked strong family ties of twins as the likely suicide-protective factor for their finding, but did not present any data supporting this claim, which therefore remains weak. Furthermore, their claim is at odds with cumulative evidence from psychological twin research: twins form special relationships among each other and have less strong ties to other kinship than singletons (Segal, 1999). Voracek (2003) noted that the finding of Tomassini *et al.* (2003) added to the convergent strands of evidence supporting de Catanzaro's corollary, on the following grounds. First, it would be expected that population subgroups with a lower intelligence level than the generality would also show lower suicide mortality than the generality. Second, there is in fact evidence for twin–singleton differences in intelligence. It has long been known (Merriman, 1924; Lauterbach, 1925), and has been repeatedly demonstrated (Wingfield, 1930; Byrns & Healy, 1936; Mehrotra & Maxwell, 1949; Sandon, 1957; Husén, 1960; Record *et al.*, 1970), partly in large-scale and population-based investigations, that mean scores in intelligence tests are lower for twins than for singletons, in the order of approximately 0·4 standard deviation units (or 6 IQ points). And third, these twin–singleton differences in intelligence and suicide mortality then are in accord with de Catanzaro's corollary, i.e. that for on average less intelligent subgroups of the general population a reduced suicide risk should be observed.

Agerbo *et al.* (2001) found that, among people with a history of mental illness, those with a high income are at greater risk of committing suicide than those with an average or low income. The authors speculated that shameful feelings about the illness among the rich or undertreatment could be causes for this increased suicide risk, but since they did not present any supporting data, these hypotheses remain weak. On the other hand, it is well known that modern industrialized nations show strong characteristics of social stratification in the sense of meritocracy. High intelligence is the pass-key for entering and completing education at the best schools, and for later

achieving the best jobs, along with high income (Herrnstein & Murray, 1994). It may therefore well be that, among those affected by mental illness, the difference in suicide risk of high-income relative to low-income people is partly due to the difference in intelligence between these groups.

To summarize, there are now several research accounts that either explicitly or implicitly bear on de Catanzaro's corollary and thus provide circumstantial evidence for a relation between intelligence and suicide mortality. Excess suicide mortality has been observed in the highly gifted, in writers, and for high-income groups and reduced suicide mortality in twins, whereas within-country variation in intelligence and suicide rates in the general population has been researched by Lester (1993, 1995) and cross-national variation of this relation in the general population and in consideration of sex by Voracek (2004), and without accounting for sex by Lester (2003).

So far no ecological study has tested de Catanzaro's corollary on a cross-national level by focusing on a subgroup of the general population that is at high risk of suicide. Generally, suicide mortality shows conspicuous age effects, and the increased suicide risk is even more pronounced in older males than in older females (Hawton & van Heeringen, 2000). Therefore, the main aim of the present study was to investigate whether cross-nationally there is a positive relation between national intelligence and suicide rates of the elderly (males, females and total).

In order to test de Catanzaro's corollary in the elderly, archival data sets providing national IQs, suicide rates and socioeconomic indicator variables were used. For reasons of data availability and reliability, and comparability of units of analysis, the analysis was confined to European, Western Asian, and Central Asian countries primarily inhabited by populations of Caucasian descent. Two further subordinated, but also novel research questions were to estimate the predicted national IQ for a hypothetical zero suicide mortality and to assess whether there is a relation between national IQ and the male–female difference in suicide rates. Both of these questions were addressed with the current study's data set and by re-analysis of the Voracek (2004) data.

Methods

Yearly national suicide rates of the elderly (aged 65 years or over), by sex (males, females and total) and for the period 1970 to 2002, were obtained for 48 countries of the Eurasian continent from the European 'health for all' database available from the World Health Organization Regional Office for Europe website (URL http://www.euro.who.int/hfadb). This compilation was comprised of 39 European and nine Asian countries, as follows: the Scandinavian (Northern European) nations of Denmark, Finland, Norway and Sweden, including the North-western island nation of Iceland (historically and demographically, a Scandinavian, mostly Norwegian, offshoot settlement); the Baltic (North-eastern European) nations of Estonia, Latvia and Lithuania; the Western European nations of Belgium, France, Ireland, Luxembourg, the Netherlands and the United Kingdom, including the South-western European nation of Portugal; the Central European nations of Austria, Germany and Switzerland; the Mediterranean (Southern European) nations of Greece, Italy, Malta

and Spain, including the mini-state of San Marino (a landlocked enclave, located in Upper Italy); the Eastern European nations of Belarus, the Czech Republic, Hungary, Moldova, Romania, Russia, Slovakia and the Ukraine; the South-eastern European nations of Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Serbia and Slovenia, including the Near East (and also Mediterranean) nation of Israel; the Caucasus Mountains (Western Asian) nations of Armenia, Azerbaijan and Georgia; and five Central Asian successor nations of the former Soviet Union (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan). The data set was comprised of every contemporary independent European nation, except for the Holy See (Vatican City, an enclave, located in Italy's capital Rome), the mini-nations of Andorra (landlocked, between France and Spain), Liechtenstein (also landlocked, between Austria and Switzerland) and Monaco (on the Mediterranean coast of France), and further the Mediterranean island nation of Cyprus. There were also no data available from Turkey, which, geographically, historically and culturally, is not considered a European nation.

Suicide rates are conventionally expressed as number of suicides per 100,000 inhabitants per year and are thus ratio variables for a given time unit. Generally, the statistical and distributional properties of ratio variables are such that they are more unstable when either the numerator is a rare event (like here, where suicide occurrence is analysed) or when the denominator itself is small (like here, where suicide occurrence of a population subgroup is analysed). These statistical and distributional problems, of course, get worse when the numerator is small and the denominator of the ratio variable under consideration varies greatly (like here, where suicide occurrence of the elderly only is analysed for small and less-populated as well as for large and highly populated countries and further across countries which differ notably in the age composition of their populations). In this situation, reliance on national suicide rates for one given year might produce spurious results, because of the possible unstableness of suicide rates based on single years over time.

Although it has been frequently observed since Durkheim's seminal account on suicidology (Durkheim, 1897/1997), and even since the days of Pre-Durkheimian suicidology (e.g. Morselli, 1881), that suicide rates of the total population cross-regionally and cross-nationally can be surprisingly stable over time, this is less certain for suicide rates of population subgroups. Further, it is also true that external, societal-level phenomena like war, civil war, political upheaval and economic crisis can exert transient, but major impacts on national suicide rates. In the present data set there were several countries that either experienced times of war or civil war or gained independence quite recently. Therefore, an attempt was made not to rely on possibly unreliable suicide rates from a single year, but rather a broad and stable base for estimated suicide rates in the elderly.

For the period 1970 to 2002 and for the 48 countries under study, 1132 single-year suicide rate values were retrieved for each of the male, female and total population subgroups aged 65 years or over. This database amounts to 71·5% of a complete data matrix of this study's observational frame (48 countries times 33 single-year suicide rates yields 1584 observations, for each of the male, female and total population subgroups of the elderly). Across countries, yearly suicide rates of the elderly were retrievable with a range from 6 to 33 years (M=23·6, Md=22, and SD=8·1 years).

The smallest numbers of single-year suicide rates came from Romania (data available for fourteen years), Albania (thirteen years), Germany (twelve years), Macedonia (ten years), Serbia (nine years), Bosnia and Herzegovina (seven years) and San Marino (six years). However, data for all 33 years of the observation frame were available for six countries (Austria, Bulgaria, the Czech Republic, Finland, Hungary and Malta), for 32 years for four further countries (Ireland, Luxembourg, Norway and Sweden), and the modal value (*Mo*) of available single-year suicide rates was 20 (populated by six countries: Armenia, Azerbaijan, Estonia, Kazakhstan, Kyrgyzstan, Lithuania, Moldova and the Ukraine).

For all analyses, the average suicide rate for each country was used and thus subsequent analyses could confidently be based on reasonably stable estimates of national suicide rates in the elderly. Nevertheless, the inevitable incompleteness of retrievable suicide rate data were further accounted for in two ways. First, a stableness measure was used as a statistical control variable, being the number of years for which a country's suicide rate in the elderly was retrievable (ranging from 6 to 33 years, as detailed above). Second, a recency measure was used as a further statistical control variable, calculated as the average year from which a country's average suicide rate in the elderly was computed (ranging from year 1983·5 to year 1997·0; M=year 1989·3, Md=1990·6, and SD=4·1 years). By partialling out both the stableness and the recency measures, all obtained results for the relation between national intelligence and suicide rate in the elderly can be regarded as statistically independent from the cross-national variation in number of years on which the estimated elderly suicide rate was based and also from the cross-national variation in the distribution of years with available data during the period 1970–2002. National male and female suicide rates of the elderly were predicted to be strongly positively correlated and to show a marked sex difference, with males having a higher suicide risk than females (Voracek *et al.*, 2003; Voracek, 2004).

Adult literacy rate and urban population rate (each expressed as a percentage of the total population, as of 1997) were retrieved from the CD-ROM database release of the *Human Development Reports 1990–1999* (United National Development Programme, 2000). These indicators might be of salience for suicide rates, because urban–rural differences in suicide prevalence have been repeatedly demonstrated by past research in suicidology (Hawton & van Heeringen, 2000) and, more recently, a positive relation between literacy rates and suicide rates has been shown in cross-national analysis (Marušič *et al.*, 2002). Adult literacy and urbanization rates were thus predicted to correlate positively with suicide rates in the elderly.

It is noted that, in contrast to the predecessor study (Voracek, 2004) of the present account, further national-level indicators, for example divorce rate, unemployment rate or population proportion of the elderly, were not included. These variables are of known salience for the total population suicide rate, with which they reliably correlate because of the excess suicide mortality among the divorced, unemployed and the aged. However, the reasons for not including these indicators are straightforward. First, divorce rates have most significantly increased as recently as over the second half of the 20th century, but here the older-age suicide rates of birth cohorts from the 1880s to the early 1930s at the latest are analysed, and these have contributed very little to this recent increase and therefore would not be properly

characterized by contemporary divorce rates. Second, people aged 65 years and over are almost always retired and thus this age stratum would not be properly characterized by contemporary unemployment rates. And third, since the standardized suicide prevalence of the population stratum aged 65 years and over was exclusively analysed, there was no need to account for the relative size of this group within the total analysed population.

National IQs for 45 of the 48 countries were obtained from Lynn & Vanhanen (2002; Table 6·5, pp. 73–80). Three countries were not included in this source, and for the first case (San Marino) the national IQ of Italy was ascribed, and for the two other countries (Bosnia and Herzegovina, Serbia) the national IQ of former Yugoslavia (which is identical to the one of Macedonia, as given by Lynn and Vanhanen). The IQs for 26 of the 48 countries were based on direct evidence, i.e. IQs averaged across intelligence test studies, whereas IQs for the remaining 22 countries were estimated by Lynn and Vanhanen or by this author from neighbouring or otherwise comparable countries' IQs. Lynn and Vanhanen's procedures for the calculation or estimation of national IQs are documented in detail in the data source. In the previous study on the relation of national intelligence and suicide rate (Voracek, 2004) the different types of national IQ data used, i.e. directly calculated versus estimated, had no discernible impact on results, which finding can be considered as a validity cue for the procedures employed by Lynn and Vanhanen. However, the ratio of directly calculated versus estimated national IQs in the present study was somewhat lower (26 versus 22 countries, giving a ratio of 1·18) than in the previous study (50 versus 35 countries, giving a ratio of 1·43). Therefore, the type of national IQ estimation was again included as a control variable.

Figures of national Gross Domestic Product (GDP) *per capita* (as of 1998) for 45 of the 48 countries were also gleaned from Lynn & Vanhanen (2002; Table 8·9, pp. 135–141). For the three countries not included in this source, the procedure was as follows: San Marino was ascribed the GDP of Italy, and Bosnia and Herzegovina as well as Serbia were ascribed the averaged GDP of former Yugoslavia and Macedonia (the latter two national values are found in the data source). Western industrialized nations have a higher suicide incidence than developing countries (Schmidtke *et al*., 1999; Voracek, 2004). Therefore, this measure of economic affluence was also predicted to be positively related to suicide rate.

A referee of this article drew attention to the classical suicidological finding (Durkheim, 1897/1997) that religious denomination impacts on suicide prevalence and could thus be a possible confounder for the relation of intelligence and suicide mortality under study. In Durkheim's sociological theory of suicide, the two major societal-level characteristics for the understanding of suicide are social integration and social regulation. Social integration refers to the extent of stable and durable social relationships among the members of a society, including shared beliefs and common goals, whereas social regulation refers to the extent of societal customs, norms and rules. According to Durkheim, some types of religious beliefs, such as Catholicism, lead to higher levels of social integration and may thus be a suicide-protective factor. Some clarifying notes concerning this supposition are indicated.

First, Durkheim was not the first to find that, across Europe, Catholic countries mostly have lower suicide rates than Protestant countries. An extensive analysis

of the impact of religion on suicide was already included in the account of Morselli (1881, pp. 119–130), who, interestingly, also concluded that the Catholic/Protestant difference in suicide mortality exists only cross-nationally, but not within nations.

Second, the cumulative evidence of more than a century of suicide research since the days of Morselli and Durkheim suggests that Durkheim's initial assertion has been seriously challenged since then: support for the assertion that religion impacts on suicide has been generally poor and this line of research has yielded a great many inconsistent findings or replication failures. This conclusion is derived from a review of the world literature on suicide research from 1881 to 1997 in four successive volumes (Lester, 1972, 1983, 1992, 2000b), along with updated reviews on research on religion's impact on suicide, as found in Maris *et al.* (2000) and in Hawton & van Heeringen (2000). Importantly, in a cross-national ecological study, Lester (1996) found that neither the population percentage of Catholics nor of Christians was related to the national suicide rate (based on 61 nations), and further work (Lester, 2000a) showed that the percentage of Islamic adherents was also not related to national suicide rate (based on 72 nations).

Nevertheless, complying with the referee's suggestion, contemporary data on national percentages of population with Roman Catholic denomination were retrieved (URL http://www.nationmaster.com) and were additionally included in the analysis. Following Durkheim's theory, percentage of Catholics was predicted to correlate weakly and negatively with suicide rates in the elderly.

With these archival data, as described and elaborated above and set out in Table 1, the ecological correlation (Lubinski & Humphreys, 1996) of national intelligence and national male, female and total suicide rate in the elderly was assessed, by using the Pearson correlation coefficient (r). For testing the stableness of the obtained relations between intelligence and suicide prevalence, by statistically controlling for the above socioeconomic indicators, for the sake of consistency with the previous report (Voracek, 2004), higher-order partial correlation coefficients (partial r) were used. Partial correlation analysis is equivalent to multiple linear regression analysis and thus yields identical results. For the partial correlation analysis, order of entry for the seven control variables was by assumed decreasing theoretical salience, as follows: first, the obtained correlation of IQ and suicide rates was jointly statistically controlled for type of IQ estimation and the stableness and recency measures for suicide rate estimation; next, the effect of national GDP was partialled out; then, the effect of adult literacy; thereafter, the effect of urbanization; and finally, the effect of Roman Catholic denomination. All zero-order correlations between suicide rate (male, female and total) and the variable set of IQ, GDP, adult literacy and urbanization (except for Catholic denomination) as well as the correlations among the latter variables were predicted to be positive. If not stated otherwise, one-tailed significance testing was employed, since the direction of the key relations under study was predicted and has already been observed previously. The two further research questions were tested by means of linear regression analysis (i.e. the predicted national IQ for a hypothetical zero suicide mortality) and with Pearson's r (i.e. the relation between national IQ and male–female difference in suicide rates). The significance level was set at $p<0{\cdot}05$.

https://doi.org/10.1017/S0021932004006959 Published online by Cambridge University Press

Table 1. National IQ, suicide rates of the elderly, and socioeconomic indicators of 48 Eurasian countries

Country	IQ	SR(t)	SR(m)	SR(f)	Stab	Rec	Lit	Urb	GDP	Cath
Albania	90[e]	6·6	13·2	3·1	13	1994·5	85	37·9	2804	13·32
Armenia	93[e]	5·9	8·5	4·1	20	1992·3	99	69·1	2072	0·00
Austria	102	44·2	78·4	25·8	33	1986·0	99	64·4	23166	72·73
Azerbaijan	87[e]	5·8	9·1	4·0	20	1992·3	96	56·3	2175	0·00
Belarus	96[e]	31·8	65·1	16·6	19	1991·8	99	72·5	6319	10·05
Belgium	100	40·0	67·6	23·4	28	1983·5	99	97·1	23223	76·32
Bosnia-Herzegovina	93[e]	17·9	31·4	9·1	7	1988·0	93	43·0	4127	15·54
Bulgaria	93	47·2	74·2	27·1	33	1986·0	98	69·0	4809	1·00
Croatia	90	53·8	98·1	29·7	18	1993·5	98	56·5	6749	72·14
Czech Republic	97	46·8	81·0	28·1	33	1986·0	99	65·7	12362	38·32
Denmark	98	39·6	56·0	28·5	30	1984·5	99	85·4	24218	0·64
Estonia	97[e]	44·5	85·3	26·8	20	1992·3	99	73·5	7682	0·36
Finland	97	27·7	55·8	12·2	33	1986·0	99	63·9	20847	0·14
France	98	38·7	68·3	21·1	30	1984·5	99	75·0	21175	77·42
Georgia	93[e]	9·3	16·5	5·3	18	1991·7	99	59·3	3353	0·00
Germany	102	27·9	49·4	17·2	12	1995·5	99	86·9	22169	33·05
Greece	92	7·1	11·5	3·8	30	1984·5	97	59·5	13943	0·43
Hungary	99	82·5	131·6	53·2	33	1986·0	99	65·5	10232	56·56
Iceland	98[e]	14·6	22·1	8·4	29	1986·0	99	91·9	25111	1·74
Ireland	93	8·3	13·6	4·0	32	1985·5	99	57·9	21482	76·70
Israel	94	19·6	26·0	14·2	30	1984·5	95	90·9	17301	0·00
Italy	102	17·1	30·4	8·5	31	1985·0	98	66·7	20585	97·31
Kazakhstan	93[e]	37·6	71·4	22·4	20	1992·3	99	60·4	4378	0·66
Kyrgyzstan	87[e]	24·4	42·1	15·2	20	1992·3	97	39·2	2317	0·00
Latvia	97[e]	45·2	83·8	28·1	23	1991·0	99	73·4	5728	17·04
Lithuania	97[e]	44·5	83·9	23·7	20	1992·3	99	73·1	6436	76·45
Luxembourg	101[e]	27·5	49·3	14·5	32	1986·0	99	90·0	33500	86·17
Macedonia	93[e]	24·2	34·3	16·0	10	1995·5	94	60·7	4254	0·64
Malta	95[e]	3·3	6·0	1·4	33	1992·1	91	89·8	16448	95·56
Moldova	95[e]	27·5	48·7	15·3	20	1992·3	98	53·1	1947	0·46
Netherlands	102	19·1	28·2	13·3	31	1985·0	99	89·1	22176	31·27
Norway	98	15·3	25·3	8·0	32	1985·5	99	73·6	26342	1·12
Poland	99	15·2	29·2	6·7	27	1985·1	99	64·4	7619	95·84
Portugal	95	22·6	44·1	9·6	30	1985·0	91	36·5	14701	90·46
Romania	94	17·9	30·4	9·2	14	1995·5	98	56·8	5648	8·06
Russian Federation	96	44·6	94·3	25·8	21	1991·7	99	76·6	6460	0·53
San Marino	102[e]	47·4	76·6	26·6	6	1997·0	96	89·0	20585	97·31
Serbia	93[e]	47·5	69·6	30·8	9	1996·0	93	52·0	4127	4·00
Slovakia	96	21·9	42·5	8·8	16	1993·5	99	59·7	9699	48·83
Slovenia	95	53·3	103·4	26·4	18	1993·5	99	51·8	14293	81·90
Spain	97	15·7	27·7	7·9	31	1985·0	97	76·9	16212	94·03
Sweden	101	25·3	40·9	13·9	32	1985·5	99	83·2	20659	1·62
Switzerland	101	37·1	61·6	21·7	31	1985·0	99	61·6	25512	46·26

https://doi.org/10.1017/S0021932004006959 Published online by Cambridge University Press

Table 1. *Continued*

Country	IQ	SR(t)	SR(m)	SR(f)	Stab	Rec	Lit	Urb	GDP	Cath
Tajikistan	87[e]	8·1	8·6	7·7	18	1991·4	99	32·4	1041	0·00
Turkmenistan	87[e]	13·9	15·9	12·6	16	1990·3	98	45·0	2550	0·00
Ukraine	96[e]	36·5	74·5	20·1	20	1992·3	99	71·1	3194	7·88
United Kingdom	100	11·5	16·6	8·4	31	1985·0	99	89·3	20336	8·45
Uzbekistan	87[e]	12·1	17·0	9·2	19	1991·8	99	41·6	2053	0·01

IQ=national IQs (from Lynn & Vanhanen, 2002; entries marked with [e]=estimates; other IQ values based on direct evidence; IQ for the United Kingdom was set at 100); SR(t), SR(m), SR(f)=average total, male and female suicide rates (1970–2002), rounded to the first digit; Stab=suicide rate stableness measure (number of retrievable yearly suicide rates, 1970–2002); Rec=suicide rate recency measure (average year from which average suicide rates were calculated); Lit=adult literacy rate; Urb=urbanization rate; GDP=*per capita* Gross Domestic Product; Cath=proportion of Roman Catholics. See text (Methods section) for further details.

Correlation coefficients are effect size indexes *per se*, and Cohen (1988) proposed now widely accepted and frequently used conventional benchmarks for their interpretorial evaluation, such that absolute *r* values around 0·10 or lower are considered as small, around 0·30 as medium, and around 0·50 or higher as large effects. However, it has also been noted (see, for instance, Lipsey & Wilson, 2001, pp. 147, 153) that these benchmarks are incongruent with those given by Cohen in the same source for the interpretorial evaluation of another effect size metric, i.e. the standardized mean difference (Cohen's *d*), for which it was suggested to consider absolute values around 0·20 or lower as small, around 0·50 as medium, and around 0·80 or higher as large effects. Corresponding values for *d*s of 0·20, 0·50 and 0·80 would be *r*s of 0·10, 0·24 and 0·37. To correct for this upward bias in Cohen's benchmarks for medium-sized and large-sized effects based on *r* values, absolute *r* values around 0·10 or lower were considered small, around 0·25 as medium, and around 0·40 or higher as large effects, and the magnitudinal evaluation of the obtained relations was based on these latter benchmarks.

Results

Across the 48 countries, suicide rate in the elderly varied greatly. Means (and SD) for countries' average male, female and total suicide rate were 48·3 (30·4), 16·2 (10·2) and 27·8 (16·9), respectively. The averaged male suicide rate varied by a factor of almost 22, ranging from 6·0 (Malta) to 131·6 (Hungary); the averaged female suicide rate varied by a factor of 38, ranging from 1·4 (Malta) to 53·2 (Hungary); and the averaged total suicide rate varied by a factor of 25, ranging from 3·3 (Malta) to 82·5 (Hungary). Further, cross-nationally there was a very strong association between averaged male and female suicide rates ($r=0·93$; $p<0·0001$) as well as a large sex difference in the suicide rate, with the male suicide rate being significantly higher than the female suicide rate ($t=10·47$; $p<0·0001$; paired t test).

https://doi.org/10.1017/S0021932004006959 Published online by Cambridge University Press

Across countries, national IQ was significantly positively related to the national male ($r=0{\cdot}33$; $p=0{\cdot}01$), female ($r=0{\cdot}28$; $p=0{\cdot}03$) and total suicide rate ($r=0{\cdot}33$; $p=0{\cdot}01$) of the elderly. All three relations remained stable when the first three control variables, i.e. type of national IQ estimation and stableness and recency measures for suicide rate estimation, were jointly partialled out: partial rs$=0{\cdot}34$ ($p=0{\cdot}01$), 0·28 ($p=0{\cdot}03$) and 0·33 ($p=0{\cdot}01$) for the associations of national IQ with the male, female and total elderly suicide rate, respectively.

National GDP was strongly positively related to national IQ, $r=0{\cdot}74$ ($p<0{\cdot}0001$), but was not related to the male, female and total suicide rate (rs$=0{\cdot}01$, 0·01 and 0·04, respectively; ns). When national GDP was partialled out as a fourth control variable, the positive relation between national IQ and male, female and total suicide rate slightly increased in magnitude, partial rs being 0·46 ($p=0{\cdot}001$) for the male, 0·38 ($p=0{\cdot}006$) for the female, and 0·42 ($p=0{\cdot}002$) for the total suicide rates.

The national adult literacy rate was significantly positively related to national IQ ($r=0{\cdot}32$; $p=0{\cdot}02$), weakly positively related to national GDP ($r=0{\cdot}22$; $p=0{\cdot}07$) and significantly positively related to the male ($r=0{\cdot}28$; $p=0{\cdot}03$), female ($r=0{\cdot}27$; $p=0{\cdot}03$) and total suicide rate ($r=0{\cdot}27$; $p=0{\cdot}03$). When literacy rate was partialled out as a fifth control variable, the relation between national IQ and suicide rate still remained positively significant, partial rs being 0·41 ($p=0{\cdot}003$), 0·33 ($p=0{\cdot}01$) and 0·38 ($p=0{\cdot}006$) for the male, female and total suicide rates, respectively.

The proportion of urban population was significantly positively associated with the adult literacy rate ($r=0{\cdot}32$; $p=0{\cdot}01$), GDP ($r=0{\cdot}64$; $p<0{\cdot}0001$) and IQ ($r=0{\cdot}71$; $p<0{\cdot}0001$), and weakly positively associated with the male ($r=0{\cdot}13$; $p=0{\cdot}19$), female ($r=0{\cdot}16$; $p=0{\cdot}15$) and total ($r=0{\cdot}15$; $p=0{\cdot}16$) suicide rates. When urbanization was partialled out as a sixth control variable, the positive relation between IQ and suicide rates was unattenuated and positively significant, partial rs being 0·42 ($p=0{\cdot}003$), 0·30 ($p=0{\cdot}03$) and 0·37 ($p=0{\cdot}008$) for the male, female and total suicide rates, respectively.

The population proportion of Roman Catholics was weakly positively associated with the proportion of urban population ($r=0{\cdot}19$; $p=0{\cdot}10$), was not related to the adult literacy rate ($r=-0{\cdot}05$; $p=0{\cdot}37$), was significantly positively associated with GDP ($r=0{\cdot}43$; $p=0{\cdot}001$) and IQ ($r=0{\cdot}44$; $p=0{\cdot}001$), and, contrary to the prediction from Durkheim's theory of suicide, weakly positively related to the male ($r=0{\cdot}22$; $p=0{\cdot}06$), female ($r=0{\cdot}10$; $p=0{\cdot}25$) and total ($r=0{\cdot}20$; $p=0{\cdot}09$) suicide rates. The final partial rs for the relation of national intelligence and suicide rates (controlled for type of IQ estimation, stableness and recency measures for suicide rate estimation, GDP and rates of adult literacy, urbanization and Roman Catholic denomination) were 0·36 ($p=0{\cdot}01$), 0·28 ($p=0{\cdot}04$) and 0·33 ($p=0{\cdot}02$) for the male, female and total suicide rates, respectively.

Furthermore, the author was interested in the predicted national IQ for a hypothetical zero suicide prevalence. Towards this end, a series of linear regression models with the present study's data set was conducted, and, for the sake of comparison, the Voracek (2004) data were also re-analysed accordingly. For the present study, resulting regression equations were suicide rate (SR)$=-171{\cdot}61+2{\cdot}30\times$ IQ (for males), SR$=-46{\cdot}00+0{\cdot}65\times$ IQ (for females) and SR$=-93{\cdot}43+1{\cdot}27\times$ IQ (for the total); for the Voracek (2004) study, equations were SR$=-57{\cdot}70+0{\cdot}84\times$ IQ (for males) and SR$=-18{\cdot}28+0{\cdot}26\times$ IQ (for females).

https://doi.org/10.1017/S0021932004006959 Published online by Cambridge University Press

Based on these regression equations, predicted national IQs for zero suicide prevalence would be, for the present study, 74·6 (male older-age suicides), 70·7 (female older-age suicides) and 73·6 (total older-age suicides), and, for the previous study, 68·7 (all male suicides) and 70·3 (all female suicides). Averaging these five estimates yields an IQ of about 72, or nearly two standard deviation units below the general population mean (an IQ of 100).

Finally, whether there is a relation between national IQ and the male–female difference in suicide rates was tested. Across 48 countries, the signed (male minus female) difference in suicide rates of the elderly was never negative and this difference score was significantly positively related to national IQ ($r=0{\cdot}34$; $p=0{\cdot}02$, two-tailed). For comparison, the Voracek (2004) data were re-analysed accordingly. Across the 85 countries covered in this previous study, the signed male–female difference was negative for only one country, with China reporting a higher female than male suicide rate, and the difference score was commensurately positively related to national IQ ($r=0{\cdot}33$; $p=0{\cdot}002$, two-tailed). The positive relation found here is unlikely to be artifactual, i.e. due to the usage of the male–female difference measure in suicide rates, since the positive relation was also apparent when substitute measures, i.e. the male-to-female ratio of suicide rates or the natural logarithm of this ratio, were used.

Discussion

This study is the first to test the hypothesis that intelligence and suicide mortality are positively related, a corollary derived from de Catanzaro's evolutionary theory of human suicide, cross-nationally by focusing on suicide rates of the elderly. The evidence from this ecological investigation of 48 countries from the Eurasian continent is in favour of the tested hypothesis. Assumed population differences in intelligence may result in varying proportions of the populations ranking beyond a threshold intelligence necessary for suicidal ideation, which in turn may contribute to the marked cross-national differences in the observed suicide incidence (Voracek, 2004). This explanation is possible because the statistical properties of overlapping distributions are such that even seemingly small average group differences yield markedly imbalanced tail ratios (Halpern, 2000, pp. 64–65). In other words, individuals belonging to the group which on average scores higher on a given trait are highly over-represented at the extreme end, i.e. the uppermost percentiles, of the joint distribution (Hedges & Nowell, 1995). This study shows that, on an ecological level, intelligence and suicide mortality are positively related for the population subgroup of the elderly. There are six main points of interest in the results.

First, the cross-continental (European, Asian, African, American, Caribbean and Oceanian) finding of a positive relation between national IQ and suicide rate (Voracek, 2004) was replicable in a combined set of European, Western Asian and Central Asian countries mostly inhabited by people of Caucasian descent and by focusing on the suicide rates of a high-risk group, the elderly. In terms of effect size, the ecological relation found here equals an effect of medium-to-large size (i.e. r values between 0·25 and 0·40). The effect was not attenuated when a set of seven control variables, controlling for possible qualitative differences in the type of national IQ estimates used, stableness and recency of the suicide rate estimates used,

https://doi.org/10.1017/S0021932004006959 Published online by Cambridge University Press

and salient socioeconomic factors (GDP, adult literacy rate, urbanization, and Roman Catholic denomination) were accounted for. This finding disconfirms assumptions that suicide incidence in the elderly cross-nationally is merely a reflection of industrialization and affluence, that both national intelligence and suicide mortality might be spuriously related via affluence, and still other related objections. In particular, notice that national GDP was unrelated to suicide rates in the elderly. However, due to the inherently correlational nature of the study design, it was not feasible to rule out the possibility that both intelligence and suicide mortality are confounded by other factors not accounted for in this study.

Second, again (see Voracek, 2004), the different types of national IQ data used, i.e. calculated ones versus estimated ones, had no impact on the results. This observation can be regarded as a validity cue for the procedures employed by Lynn & Vanhanen (2002).

Third, it is of note that the relation between intelligence and elderly suicide mortality was found for the total as well as for the male and the female suicide rates, with no substantial difference in the magnitude of these relations, paralleling previous findings (Lester, 2003; Voracek, 2004). This evidence is further suggestive of a likely generality of the finding.

Fourth, however, this study was the first to find a positive relation between national IQ and national male–female differences (or ratios) in suicide mortality across countries, meaning that the higher a country's estimated intelligence level, the greater this country's excess in the male elderly suicide rate, relative to the female elderly suicide rate. This new finding was also obvious in the re-analysis of the Voracek (2004) data, but for now interpretation remains difficult. It may well be that the threshold intelligence for suicidality differs between the sexes or that sex differences in general intelligence itself, to which recent reports point (see Lynn, 1994, 1996, 1998, 1999, 2002; Allik *et al.*, 1999; Lynn *et al.*, 2000; Lynn & Irwing, 2004), might be involved in a satisfactory explanation of this finding which must remain unresolved for the time being.

Fifth, the present study replicated the recent finding of a positive association between countries' adult literacy rates and suicide rates (Marušič *et al.*, 2002). However, it appears that literacy is not a decisive factor in this context, since partialling it out from the relation between intelligence and suicide rate did not notably attenuate this relation. The same logic applies to the urbanization rate and the population proportion of Roman Catholics, which were both significantly positively related to national IQ, while weakly positively related to suicide rates in the elderly, but likewise did not notably attenuate the relation between national IQ and suicide rates.

Sixth, on a group level, there might be an adult threshold IQ, somewhere in the range of 70 or slightly over, for which regression models of the various ecological data from the present and the Voracek (2004) study convergently predicted a zero suicide rate. While it is anticipated as not unlikely that this result may well be conceived as mere statistical jugglery, it is also checkable that some countries, in particular some island nations located in the Caribbean Sea (the Bahamas, Jamaica, and Saint Vincent and the Grenadines), which are ascribed very low national IQ estimates by Lynn & Vanhanen (2002), ranging in the area of the estimate above, do indeed report very low suicide rates (in some cases, less than one suicide per 100,000

inhabitants per year; see Schmidtke *et al*., 1999). Conversely, regions which are ascribed high IQ estimates by Lynn & Vanhanen (2002), first of all the Pacific Rim countries Hong Kong (S.A.R.), Japan, Singapore and South Korea, report, by international standards, high suicide rates, and Jewish population groups, which also have been ascribed high intelligence (Lynn, 2004), have higher suicide rates than Arabian population groups (Levav & Aisenberg, 1989; Lubin *et al*., 2001). The likely generalizability of this finding is further demonstrated by the fact that a threshold IQ for suicidality of 70 or slightly over is consistent with various established observations from suicidology and psychiatry: (a) children ascribed a very low IQ when tested with adult-normed intelligence tests, below the ages of 11 or 12 years very rarely and below the ages of 9 or 10 years almost never commit suicide; (b) patients suffering from impulsive–aggressive disorders and with subnormal IQ (70–80) have a very low suicide risk in comparison with other impulsive–aggressive personalities whose IQ is in the normal range (Hall, 2000); (c) one demographical factor associated with reduced suicidality in schizophrenia is low intelligence; and (d) the suicide rate in chronic schizophrenia (formerly termed dementia praecox), which is accompanied by more negative symptoms, structural brain changes and usually low IQ, is lower than the suicide rate in episodical schizophrenia, which in turn is accompanied by fewer negative symptoms, often no brain changes and usually a normal IQ (Siris, 2001). As an aside, it is mentioned that thinking over the implications of a predicted threshold IQ for suicidality of 70 or slightly over one quickly realises that suicide must be of species generality in humans (de Catanzaro, 1981) and that a 'natural' societal suicide rate could never be zero, as has been, in this author's view, rightly concluded by Yang & Lester (1991), because, of course, there is no group or society without a great many individuals ranging beyond that assumed threshold intelligence.

In conclusion, five avenues for future investigation are proposed. First, from recent provisional evidence it appears that postmortem brain weight may be larger in suicide victims, relative to equated control groups of individuals who died of natural causes. Salib & Tadros (2000; see also Salib, 2002), in a sufficiently large sample ($n=292$), found a significant difference (with $d=0{\cdot}98$; this author's calculation, from the report's data) in brain weight between a group of fatal self-harm victims (suicides and open verdicts) and a group of natural deaths. In a similar fashion, in a small sample ($n=21$), Balažic & Marušič (2002) found a significant difference (with $d=0{\cdot}91$; this author's calculation, from the report's data) in brain weight between indoor suicides and a matched control group of natural deaths. However, Hamilton & McMahon (2002), in a large sample ($n=200$), reported a replication failure, with no statistically significant difference in brain weight between suicide victims and a matched control group of natural deaths. Still, from their data a group difference of $d=0{\cdot}16$ is computable, again indicating that brain weight in suicide victims is larger than in people dying of natural causes. Physiological postmortem changes in the brain are deemed as unlikely to fully explain these findings. To what degree the observed effect is attributable to differences in intelligence remains to be tested. Nevertheless, it is emphasized that the finding of a positive relation between size, volume or weight of the brain and psychometric intelligence is securely established. A whole string of magnetic resonance imaging (MRI) studies (for recent accounts, see, for example,

Pennington *et al.*, 2000; Wickett *et al.*, 2000; and also see references therein) on this issue have found a significant positive relation of *in vivo* brain volume and psychometric intelligence, and the combined evidence of these studies suggests an estimate of $r=0{\cdot}44$ for this relation (Rushton & Ankney, 1996). Using this figure as the best estimate for the magnitude of this association, further plugging in the combined evidence for group differences in cranial capacity between suicide victims and people dying of natural causes from the three studies above ($d=0{\cdot}66$; based on $n=513$, which group difference is statistically highly significant), and assuming the usual population standard deviation of 15 IQ points, one arrives at an estimated mean IQ advantage of almost 4·5 points (i.e. $0{\cdot}44 \times 0{\cdot}66 \times 15=4{\cdot}36$) for suicide victims, relative to their controls. The size of this effect might not look impressive, but recall that even small average group differences on a trait lead to pronouncedly imbalanced tail ratios for that trait (see discussion above). Clearly, more data bearing on this issue are needed.

Second, and relatedly, one could also compare the IQ of severe suicide attempters with the IQ of matched controls, either from hospitals or from the general community. Surprisingly, it appears that methodologically adequate studies on this issue have not been undertaken so far. Although higher intelligence in suicidal adolescents relative to control groups has been found by several researchers (Carls, 1986; Warnke *et al.*, 1996), the validity of these accounts is limited insofar as these studies employed retrospective designs throughout, sampled a narrow population, and were based on clinical samples with psychiatric disorders as confounds.

Third, large intelligence test databases are maintained in countries with compulsory military conscription of both sexes (see Flynn, 1998). These extensive sources would be particularly suited for an individually based test of de Catanzaro's hypothesis in the general population, while accounting for sex.

Fourth, and related to the research proposal three above, the participants of large epidemiological intelligence studies could be followed up to ascertain whether there is an increased life-time risk for suicide among the higher intelligence levels. To date, the Scottish Mental Health Survey of 1932 is the only accessible study where intelligence testing has been conducted on almost an entire year-of-birth cohort. Various follow-up studies have been undertaken with the participant pool of this remarkable study (for an overview, see Gottfredson & Deary, 2004), but information on this study cohort's suicide prevalence in relation to intelligence is currently not available (Ian J. Deary, personal communication, Dec. 8 2003). Caution in interpreting ecological findings must always be exercised, especially when large land areas such as countries are used as units of ecological analysis (see Voracek & Fisher, 2002). The ecological-level findings on de Catanzaro's corollary therefore are in need of further individual-level corroboration (King, 1997), as delineated here.

Fifth, more regional-level data in the fashion of the two studies of Lester (1993, 1995), the evidence of which is conflicting, are needed to ascertain whether the positive ecological relation between intelligence and suicide mortality which has been observed cross-nationally (Voracek, 2004, and present study) also holds within nations.

References

Agerbo, E., Mortensen, P. B., Eriksson, T., Quin, P. & Westergaard-Nielsen, N. (2001) Risk of suicide in relation to income level in people admitted to hospital with mental illness: nested case-control study. *British Medical Journal* **322**, 334–335.

Allik, J., Must, O. & Lynn, R. (1999) Sex differences in general intelligence among high school graduates: some results from Estonia. *Personality and Individual Differences* **26**, 1137–1141.

Balažic, J. & Marušič, A. (2002) Apparent higher brain weight in suicide victims: possible reasons. *Psychological Reports* **90**, 236–238.

Bostwick, J. M. & Pankratz, V. S. (2000) Affective disorders and suicide risk: a reexamination. *American Journal of Psychiatry* **157**, 1925–1932.

Buss, D. M. (2004) *Evolutionary Psychology: The New Science of the Mind* (2nd edn). Allyn & Bacon, Boston, MA.

Byrns, R. & Healy, J. (1936) The intelligence of twins. *Journal of Genetic Psychology* **49**, 474–478.

Carls, W. (1986) Intelligenz und Persönlichkeit suizidaler Jugendlicher [Intelligence and personality of suicidal adolescents]. In Specht, F. & Schmidtke, A. (eds) *Selbstmordhandlungen bei Kindern und Jugendlichen: Proceedings der 3. Jahrestagung der Arbeitsgemeinschaft zur Erforschung suizidalen Verhaltens*. Roderer, Regensburg, pp. 108–119.

Cohen, J. (1988) *Statistical Power Analysis for the Behavioral Sciences* (2nd edn). Erlbaum, Hillsdale, NJ.

de Catanzaro, D. (1980) Human suicide: a biological perspective. *Behavioral and Brain Sciences* **3**, 265–290.

de Catanzaro, D. (1981) *Suicide and Self-Damaging Behavior: A Sociobiological Perspective*. Academic Press, New York.

Durkheim, É. (1897/1997) *Suicide: A Study in Sociology* (transl. by J. A. Spaulding & G. Simpson). Free Press, New York.

Flynn, J. R. (1998) Israeli military IQ tests: gender differences small; IQ gains large. *Journal of Biosocial Science* **30**, 541–553.

Gottfredson, L. S. & Deary, I. J. (2004) Intelligence predicts health and longevity, but why? *Current Directions in Psychological Science* **13**, 1–4.

Hall, I. (2000) Young offenders with a learning disability. *Advances in Psychiatric Treatment* **6**, 278–286.

Halpern, D. F. (2000) *Sex Differences in Cognitive Abilities* (3rd edn). Erlbaum, Mahwah, NJ.

Hamilton, S. J. & McMahon, R. F. T. (2002) Sudden death and suicide: a comparison of brain weight. *British Journal of Psychiatry* **181**, 72–75.

Hawton, K. & van Heeringen, K. (eds) (2000) *The International Handbook of Suicide and Attempted Suicide*. John Wiley, Chichester.

Hedges, L. V. & Nowell, A. (1995) Sex differences in mental test scores, variability, and numbers of high-scoring individuals. *Science* **269**, 41–45.

Herrnstein, R. J. & Murray, C. (1994) *The Bell Curve: Intelligence and Class Structure in American Life.* Free Press, New York.

Holahan, C. K., Sears, R. R. & Cronbach, L. J. (1995) *The Gifted Group in Later Maturity*. Stanford University Press, Stanford, CA.

Husén, T. (1960) Abilities of twins. *Scandinavian Journal of Psychology* **1**, 125–135.

King, G. (1997) *A Solution to the Ecological Inference Problem: Reconstructing Individual Behavior from Aggregate Data*. Princeton University Press, Princeton, NJ.

Lauterbach, C. E. (1925) Studies in twin resemblance. *Genetics* **10**, 525–568.

Lester, D. (1972) *Why People Kill Themselves: A Summary of Research Findings on Suicidal Behavior* (1st edn). Charles C. Thomas, Springfield, IL.

Lester, D. (1983) *Why People Kill Themselves: A 1980's Summary of Research Findings on Suicidal Behavior* (2nd edn). Charles C. Thomas, Springfield, IL.

Lester, D. (1991a) Childhood predictors of later suicide: follow-up of a sample of gifted children. *Stress Medicine* **7**, 129–131.

Lester, D. (1991b) Completed suicide in the gifted: a late comment on 'suicide among gifted women'. *Journal of Abnormal Psychology* **100**, 604–606.

Lester, D. (1992) *Why People Kill Themselves: A 1990s Summary of Research Findings on Suicidal Behavior* (3rd edn). Charles C. Thomas, Springfield, IL.

Lester, D. (1993) Intelligence and suicide in France: an ecological study. *Psychological Reports* **73**, 1226.

Lester, D. (1994) Suicide in writers. *Perceptual and Motor Skills* **28**, 698.

Lester, D. (1995) Intelligence and suicide in Ireland and the United Kingdom. *Psychological Reports* **77**, 122.

Lester, D. (1996) *Patterns of Suicide and Homicide in the World.* Nova Science Publishers, New York.

Lester, D. (2000a) Islam and suicide. *Psychological Reports* **87**, 766.

Lester, D. (2000b) *Why People Kill Themselves: A 2000 Summary of Research on Suicide* (4th edn). Charles C. Thomas, Springfield, IL.

Lester, D. (2003) National estimates of IQ and suicide and homicide rates. *Perceptual and Motor Skills* **97**, 206.

Levav, I. & Aisenberg, E. (1989) Suicide in Israel: crossnational comparisons. *Acta Psychiatrica Scandinavica* **79**, 468–473.

Lipsey, M. W. & Wilson, D. B. (2001) *Practical Meta-analysis*. Sage, Thousand Oaks, CA.

Lubin, G., Glasser, S., Boyko, V. & Barell, V. (2001) Epidemiology of suicide in Israel: a nationwide population study. *Social Psychiatry and Psychiatric Epidemiology* **36**, 123–127.

Lubinski, D. & Humphreys, L. G. (1996) Seeing the forest from the trees: when predicting the behavior or status of groups, correlate means. *Psychology, Public Policy, and Law* **2**, 363–376.

Lynn, R. (1979) The social ecology of intelligence in the British Isles. *British Journal of Social and Clinical Psychology* **18**, 1–12.

Lynn, R. (1980) The social ecology of intelligence in France. *British Journal of Social and Clinical Psychology* **19**, 325–331.

Lynn, R. (1994) Sex differences in intelligence and brain size: a paradox resolved. *Personality and Individual Differences* **17**, 257–271.

Lynn, R. (1996) Differences between males and females in mean IQ and university examination performance in Ireland. *Personality and Individual Differences* **20**, 649–652.

Lynn, R. (1998) Sex differences in intelligence: a rejoinder to Mackintosh. *Journal of Biosocial Science* **30**, 529–532.

Lynn, R. (1999) Sex differences in intelligence and brain size: a developmental theory. *Intelligence* **27**, 1–12.

Lynn, R. (2002) Sex differences on the Progressive Matrices among 15–16 year olds: some data from South Africa. *Personality and Individual Differences* **33**, 669–673.

Lynn, R. (2004) The intelligence of American Jews. *Personality and Individual Differences* **36**, 201–206.

Lynn, R., Allik, J. & Must, O. (2000) Sex differences in brain size, stature and intelligence in children and adolescents: some evidence from Estonia. *Personality and Individual Differences* **29**, 555–560.

Lynn, R. & Irwing, P. (2004) Sex differences on the advanced progressive matrices in college students. *Personality and Individual Differences* **37**, 219–223.

Lynn, R. & Vanhanen, T. (2002) *IQ and the Wealth of Nations*. Praeger, Westport, CT.

Maris, R. W., Berman, A. L. & Silverman, M. M. (2000) *Comprehensive Textbook of Suicidology*. Guilford Press, New York.

Marušič, A., Khan, M. & Farmer, A. (2002) Can the interaction of poverty and literacy explain some variability of suicide rates in Europe? *European Journal of Psychiatry* **16**, 103–107.

Mehrotra, S. N. & Maxwell, J. (1949) The intelligence of twins: a comparative study of eleven-year-old twins. *Population Studies* **3**, 295–302.

Merriman, C. (1924) The intellectual resemblance of twins. *Psychological Monographs* **33(5)**.

Morselli, E. (1881) *Suicide: An Essay on Comparative Moral Statistics*. Paul, London.

Oden, M. H. (1968) The fulfillment of promise: 40-year follow-up of the Terman gifted group. *Genetic Psychology Monographs* **77**, 3–93.

Pennington, B. F., Filipek, P. A., Lefly, D., Chhabildas, N., Kennedy, D. N., Simon, J. H., Filley, C. M., Galaburda, A. & DeFries, J. C. (2000) A twin MRI study of size variations in the human brain. *Journal of Cognitive Neuroscience* **12**, 223–232.

Record, R. G., McKeown, T. & Edwards, J. H. (1970) An investigation of the difference in measured intelligence between twins and single births. *Annals of Human Genetics* **34**, 11–20.

Rook, A. (1959) Student suicides. *British Medical Journal* **1**(5122), 599–603.

Ross, M. (1969) Suicide among college students. *American Journal of Psychiatry* **126**, 220–225.

Rossow, I. & Amundsen, A. (1995) Alcohol abuse and suicide: a 40-year prospective study of Norwegian conscripts. *Addiction* **90**, 685–691.

Rushton, J. P. (2000) *Race, Evolution, and Behavior: A Life History Perspective* (3rd edn). Charles Darwin Research Institute, Port Huron, MI.

Rushton, J. P. & Ankney, C. D. (1996) Brain size and cognitive ability: correlations with age, sex, social class, and race. *Psychonomic Bulletin and Review* **3**, 21–36.

Salib, E. (2002) Brain weight in suicide revisited [letter]. *British Journal of Psychiatry* **181**, 441–442.

Salib, E. & Tadros, G. (2000) Brain weight in suicide: an exploratory study. *British Journal of Psychiatry* **177**, 257–261.

Sandon, F. (1957) The relative numbers and abilities of some ten-year-old twins. *Journal of the Royal Statistical Society* **120**, 440–450.

Schmidtke, A., Weinacker, B., Apter, A., Batt, A., Berman, A., Bille-Brahe, U. *et al.* (1999) Suicide rates in the world: update. *Archives of Suicide Research* **5**, 81–89.

Segal, N. L. (1999) *Entwined Lives: Twins and What They Tell Us about Human Behavior*. Dutton, New York.

Seiden, R. H. (1966) Campus tragedy: a story of student suicide. *Journal of Abnormal and Social Psychology* **71**, 389–399.

Shneidman, E. S. (1971) Perturbation and lethality as precursors of suicide in a gifted group. *Life-Threatening Behavior* **1**, 23–45.

Siris, S. G. (2001) Suicide and schizophrenia. *Journal of Psychopharmacology* **15**, 127–135.

Tomassini, C., Juel, K., Holm, N. V., Skytthe, A. & Christensen, K. (2003) Risk of suicide in twins: 51 year follow up study. *British Medical Journal* **327**, 373–374.

Tomlinson-Keasey, C., Warren, L. W. & Elliott, J. E. (1986) Suicide among gifted women: prospective study. *Journal of Abnormal Psychology* **95**, 123–130.

United Nations Development Programme (2000) *Human Development Reports 1990–1999* [CD-ROM database]. Author, New York.

US Department of Health and Human Services (1997) Regional variations in suicide rates: United States, 1990–1994. *Morbidity and Mortality Weekly Report* **46**, 789–793.

Voracek, M. (2003) Risk of suicide in twins: intelligence of twins and singletons may explain risk [letter]. *British Medical Journal* **327**, 1168.

Voracek, M. (2004) National intelligence and suicide rate: an ecological study of 85 countries. *Personality and Individual Differences* **37**, 543–553.

Voracek, M. & Fisher, M. L. (2002) Different sex ratios at birth in Europe and North America: latitude has important role [letter]. *British Medical Journal* **325**, 335.

Voracek, M., Fisher, M. L. & Marušič, A. (2003) The Finno-Ugrian suicide hypothesis: variation in European suicide rates by latitude and longitude. *Perceptual and Motor Skills* **97**, 401–406.

Warnke, A., Friese, H.-J., Trott, G.-E. & Wewetzer, C. (1996) Persönlichkeitsstörungen und suizidales Verhalten bei kinder- und jugendpsychiatrischen Patienten in stationärer Behandlung [Personality disorders and suicidal behavior in child and adolescent psychiatric inpatients]. In Bronisch, T. & Wolfersdorf, M. (eds) *Persönlichkeit: Persönlichkeitsstörungen und suizidales Verhalten*. Roderer, Regensburg, pp. 24–36.

Warren, L. W. & Tomlinson-Keasey, K. C. (1987) The context of suicide. *American Journal of Orthopsychiatry* **57**, 41–48.

Wickett, J. C., Vernon, P. A. & Lee, D. H. (2000) Relationships between factors of intelligence and brain volume. *Personality and Individual Differences* **29**, 1095–1122.

Wingfield, A. H. (1930) The intelligence of twins. *Eugenics Review* **22**, 183–186.

Yang, B. & Lester, D. (1991) Is there a natural suicide rate for a society? *Psychological Reports* **68**, 322.