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The 2005 London terror attacks: An investigation of changes in psychological wellbeing and social capital pre- and post-attacks (2003–07)–A UK panel study

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ABSTRACT

The London public transport suicide bombings, which occurred on 7th July 2005, were described as the worst single terrorist atrocity on British soil to date. Past acts of terrorism have been associated with deterioration in population mental health. They may also negatively impact levels of social capital, which is considered a buffer against poor mental health outcomes. By employing panel data from the British Household Panel Survey and following the *same* individuals ($N_T=9287$) three times over a five-year period (2003, 2005 and 2007), the aim of this longitudinal multilevel study was to investigate: (i) the impact of terrorism on individual-level social capital (generalised trust and social participation) across the UK; and (ii) the buffering effects of social capital on psychological wellbeing (GHQ-12). By comparing 2005 and 2007 covariate values (including the two social capital proxies) against their pre-terror baseline (2003) measurements in two separate multilevel logistic regression models, we examined the immediate and longer-term effects of the 2005 attacks on our GHQ-12 outcome. Compared to baseline, generalised trust dropped from 44% to 36% immediately post-terror attacks in 2005, while local participation increased from 45.8% to 47.5%. Social capital levels started to return to baseline levels by 2007, yet both proxies maintained independent buffering effects against poor GHQ-12 scores in years 2005 and 2007. From this empirical evidence, it seems that though generalised trust levels are negatively affected by acts of terrorism, the accompanying increase in local active participation may aid in the re-establishment of societal norms and beliefs in later years. Decision makers should be aware that such atrocities may negatively impact on populations' generalised trust in the shorter-term. To safeguard against losing this buffer against poor mental health outcomes, local active participation should be encouraged.

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Introduction

On Thursday, July 7th 2005, the city of London (United Kingdom (UK)) was subjected to "...the worst single terrorist atrocity on British soil." (Rodgers, Qurashi & Connor, 2015). At around 08.50, towards the end of the capital's morning rush-hour, three suicide bombers detonated explosive devices whilst travelling on separate London Underground trains approaching Aldgate, Edgware Road and Russell Square stations. A fourth triggered their device an hour later on a double decker bus in Tavistock Square. These four explosions resulted in a total of 52 people being killed and many hundreds being severely injured (British Broadcasting

Corporation, 2007). What emerged within days following this atrocity was the fact that all four suicide bombers were middle-class British citizens, three of whom were British-born. Furthermore, all four individuals were unknown to authorities prior to the 7th July attacks (House of Commons Report, 2006).

An eerily similar attack (also involving three bombs on the London Underground and one on a London bus) was attempted a fortnight later, on 21st July. However, none of the devices detonated and no one was physically injured. The following day at around 10.00, Jean Charles de Menezes, a Brazilian electrician living in London, was fatally shot at Stockwell tube station by armed Metropolitan police officers under a new shoot-to-kill remit. He had been mistaken for one of the failed terror plot suspects from the previous day (British Broadcasting Corporation, 2005a). By early August 2005, the current British Prime Minister Tony Blair announced in a press conference that "...the rules of the game are changing" (Jeffery, 2005). Soon after, the Terrorism Act was introduced to Parliament, which aimed to increase collective

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security throughout the UK, though seemingly at the expense of individual and group liberties (Cobain, 2010).

Aside from the obvious physical damage the attacks incurred, acts of terrorism have been shown to have an immediate and longer-term negative effect on population mental health (Silver, Holman, McIntosh, Poulin & Gil-Rivas, 2002; Whalley & Brewin, 2007). This may be the result of two mechanisms: (i) the indiscriminate nature of acts of terrorism themselves and the subsequent collective climate of fear (O'Driscoll, 2008), and (ii) by negatively impacting on levels of social capital (Blomberg, Hess & Tan, 2011), a resource which has been empirically shown to act as a buffer against poor mental health outcomes (Ehsan & De Silva, 2015; Lindström & Giordano, 2016; McPherson et al., 2014; Whitley & McKenzie, 2005).

To expand and clarify, past research shows that whole populations, not just those individuals in the immediate vicinity of such events, suffer from worse mental health outcomes after such traumatic events (Silver et al., 2002; Whalley & Brewin, 2007). Though the former are more likely to recover faster (Knudsen, Roman, Johnson & Ducharme, 2005), there appears to be a minority who continue to display negative mental health symptoms, despite not having been in close geographic proximity to the terror incident (Whalley & Brewin, 2007).

The relationship between social capital and terrorism appears more complex. Social capital is considered both an individual and collective resource (Berkman & Kawachi, 2000; Bourdieu, 1986; Coleman, 1988; Portes, 1998; Putnam, 2000). It is often defined in terms of social networks, norms of reciprocity and trust (Putnam, 2004), and has been considered a public good, providing positive externalities (unintended benefits) for all (Putnam, 2000). This rather simplistic idea is open to critique, however, one pertinent example being how the role of social capital (in understanding the potential for acts of terrorism) can be succinctly argued as both a restraint and a catalyst (Helfstein, 2014).

It is of greater interest to us, however, to investigate if such terror atrocities may have impacted on levels of social capital, measured by *generalised trust* and *active participation* in this study. The presence of social capital has been hypothesised to buffer against poor mental health by reducing levels of perceived psychological stress (Kawachi, Kennedy & Glass, 1999). High levels of stress have been shown to increase blood cortisol levels, which in turn, have been linked to deleterious health outcomes, including worse mental health (Roy & Campbell, 2013; Watson & Mackin, 2006). Any reduction in social capital after the terror attacks in 2005, therefore, may further compound the effects of terrorism on mental health outcomes.

Of the two social capital proxies utilised in this study, *generalised trust* levels (trust in strangers) may be negatively impacted by a collective climate of fear after the 2005 terror attacks (O'Driscoll, 2008), compounded possibly by the breaking news that the four suicide bombers were 'home-grown' middle-class British citizens (British Broadcasting Corporation, 2005b). Another theory suggests that specific political responses to terrorism that include increased vigilance, security and control could further erode both *generalised* and *institutional* trust (Barker, 2005; Furedi, 2005; Hobbes, 1996). In the case of the UK in 2005, the immediate shoot-to-kill remit of the Metropolitan police force and the rapid draughting of the Terrorism Act are two such policy examples that may negatively affect trust.

Levels of local *active social participation* (our second social capital proxy) could be negatively affected by terrorism, any climate of fear translating into individuals feeling too concerned or even intimidated to venture out more than deemed essential (British Broadcasting Corporation, 2005c). Conversely, local active participation (in the form of peaceful anti-terrorism demonstration, for example) may increase, as a way to express shared emotions and

to reinforce positive social norms and beliefs (Paez, Basabe, Ubillos & Gonzalez-Castro, 2007). Social participation in this study is captured by individuals' *active* (not passive) membership in local groups, organisations or leisure activities (see appendix for a full list). Increased active participation, as defined here, may help reverse any downward trend in trust (Putnam, 2000) and could also have positive effects on psychological wellbeing through increasing social ties and (re-establishing) community integration (Kawachi & Berkman, 2001).

To date, there is no empirical research published that investigates individuals' mental health outcomes surrounding the 2005 London terror attacks, whilst considering the role of social capital. This study attempts to fill this lacuna. By employing panel data and following the *same individuals* ($N_T=9156$) from 2003–2007, the aim of this study was to investigate: (i) any short- and longer-term fluctuations in individual-level social capital (as measured by generalised trust and social participation); and (ii) if the presence of social capital buffered against worse psychological wellbeing immediately post-attacks in 2005 and also longer term (2007). We hypothesise that there will be a significant drop in trust and social participation immediately post-terror attacks; despite this, we further hypothesise that the buffering effects of social capital will remain evident across the timeframe of this study.

Methods

Data collection

Since 1991, the UK's Economic and Social Research Centre have annually conducted the British Household Panel Survey (BHPS), a longitudinal survey of randomly selected private households. The first (1991) cohort sample was randomly selected by using a two-stage cluster design, with a total of 8,166 private postal addresses around the UK being originally selected. Those aged 16 years or older were invited to participate, with a total of 10,264 individual face-to-face interviews being completed in the first BHPS Wave (participation rate 95%). Until the final Wave (18) in 2008–9, individuals from this nationally representative sample of selected households had been interviewed annually with a view to identifying social and economic changes within the British population. All data were weighted after collection by the Research Centre to adjust for non-response in the standard fashion (Elliot, 1991); further weighting for longitudinal analyses is not recommended (Taylor, Brice, Buck & Prentice-Lane, 2010).

For each annual Wave, face-to-face interviews took place between September and May. In all eighteen Waves of the BHPS, approximately half of all anticipated interviews for that year were completed by the end of October. This is particularly relevant for the purposes of this study, as *all* measures in Wave 15 (2005) were taken post-terror attack, with over 50% of 2005 values being collected within 3–4 months of the terror atrocities. Greater details of the selection process, weighting and participation rates can be found on-line (Taylor et al., 2010).

The raw data for this panel study come from the BHPS *individual-level* responses ('INDRESP') from Waves 13 (2003), 15 (2005) and 17 (2007). Unique cross-wave identifiers meant that individuals, who responded to all considered variables in this study, could be followed across this timeframe ($N=9153$). Full interview participation rates for year 2003 (as compared to year 2002) were 93.1%, with 55.3% being from the original 1991 cohort sample.

The Research Centre fully adopted the Ethical Guidelines of the Social Research Association; informed consent was obtained from all participants and strict confidentiality protocols were adhered to

throughout data collection, processing procedures and subsequent analyses for this study by the authors.

Measures

The outcome in this study was psychological wellbeing, obtained using the 12-item General Health Questionnaire (GHQ-12) (Goldberg & Williams, 1988). We utilised the 'standard scoring' approach (Goldberg & Williams, 1988) to dichotomise each of the twelve items (see appendix for more details). We then employed a cut-off threshold of three (or more) out of twelve to enable optimal discrimination between cases and non-cases (Goldberg & Williams, 1988). In other words, depending on the answers obtained, if three or more of the twelve items considered to reflect poor psychological wellbeing were selected, then respondents were categorised as having 'worse' psychological wellbeing (1); all others were labelled 'better' psychological health (0) for our dichotomous outcome (Goldberg & Williams, 1988). The GHQ-12 item has been shown to have high sensitivity and specificity (83.4% and 76.3%, respectively) when compared with the GHQ-28 item, suggesting that the twelve-item tool is comparable to more complex assessment instruments (Goldberg et al., 1997).

Social capital proxies

Generalised trust was assessed by asking people: 'Would you say that most people can be trusted, or that you can't be too careful?' Possible answers were 'Most people can be trusted', 'You can't be too careful' and 'It depends'. This variable was dichotomised, with only those respondents stating that most people could be trusted being labelled 'Can trust' (0); all negative responses (including 'it depends') were labelled 'Can't trust' (1) (Uslaner, 2002).

Social participation was measured by asking respondents questions about being *active* (not passive) members of voluntary community groups or any sports, hobby or leisure group activity found *locally* – see appendix for the full list. Only those who answered positively to any of these were judged to participate (0), with all others being labelled 'No participation' (1). This dichotomisation of social participation was performed at data source by the collection agency and not by the authors.

Marital status

Respondents were asked if they were: 'married (0), cohabiting (1), widowed (2), divorced (3), separated (4) or never married (5)'. These categories were maintained in all analyses, with 'married' being the reference group.

Socio-economic variables

Annual household income was weighted according to size by summing the total income of all household members (net of taxation) and dividing this sum by the square root of the household size (Burkhauser, Smeeding & Merz, 1996). The *log* of this income measure was kept as a continuous variable (per £1000 increase) for all analyses. Social class was determined by respondents' most recent occupation, derived from the Registrar General's Social Classification of occupations. The usual six categories (see appendix) were dichotomised into high (0) and low social class (1), with those yet to be employed being labelled 'never worked' (2). To compliment this, a further current employment status variable was categorized as 'Employed'(0), 'Retired'(1), 'Fulltime student'(2) or 'Unemployed' (3). Highest achieved education was categorised as 'Undergraduate or higher'(0), 'Year 13'(1), 'Year 11' (2) or 'No formal qualifications' (3).

Confounders

Self-rated health (SRH) was assessed by the question: 'Compared to people your own age, would you say that your health has on the whole been: excellent, good, fair, poor or very poor?' As standard, this five-point scale was recoded into the dichotomous variable 'good' (0) (excellent, good) and 'poor' (1) (fair, poor, very poor) health (Manor, Matthews & Power, 2000).

Age and gender (men (0), women (1)) were also considered confounders in this study, with age being stratified into quintiles for descriptive purposes only (see Table 1) and treated as a continuous variable (per 10 year increase) in all analyses.

Values for *all* variables were obtained from the *same* individuals (N=9023) in years 2003, 2005 and 2007 (BHPS Waves 13, 15 and 17). The three data panels were subsequently merged to form a single multilevel, longitudinal dataset (occasions (time - level 1) clustered on individuals (level 2)).

In order to assess short- and longer-term effects of the 2005 terror attacks on the outcome GHQ-12, these data were further stratified into timeframes; *timeframe 1* compared associations between GHQ-12 and all considered covariates immediately after the attacks in 2005 with baseline (2003) values. Longer-term trends were investigated in *timeframe 2*, which compared associations between GHQ-12 and all considered covariates in 2007 compared to baseline (2003) measures.

Statistical analysis

Analyses 1 and 2 tested if the differences in social capital levels reported in 2005 and 2007 (Table 1b) were statistically significant from baseline (2003) measurements. To this effect, we performed logistic regression pairwise tests using the multilevel, longitudinal data previously described and included respondents who answered the social capital questions in *all three* Waves (N=9287). In Analysis 1 for trust, 'can trust' – (0) 'cannot trust' – (1) was the dichotomous outcome, with time (2003 – (0) and 2005 (1)) as the sole covariate. Odds ratios (OR) derived here described the same individuals' risk of not trusting in 2005 compared to trusting others in 2003, alongside a 95% confidence interval (See Table 1c (i)).

A similar procedure was conducted for active local social participation (participation – (0); no participation – (1)), with time (2003 – (0) and 2005 (1)) as the sole covariate.

In analysis 2, we performed the same pairwise tests described above but now using *timeframe 2* datasets, to assess if changes in individuals' social capital levels in 2007 were significantly different from their 2003 baseline measurements (see Table 1c (ii)).

Analysis 3 (Table 2, Model 1) was the first of our main analyses to employ the full multilevel, longitudinal datasets previously described (N=9023). As this analysis aimed to capture changes in GHQ-12 scores immediately post-terror attacks, the outcome of interest was 'worse psychological wellbeing' in 2005 (1) when considering the same individuals' GHQ-12 score in 2003 (0) - *timeframe 1*; odd ratios derived from Analysis 3 (the *fixed* effects from the mixed model) reflected an individuals' risk of worse GHQ-12 in 2005 according to *changes* in *all* considered covariates from 2003 to 2005. The multilevel, longitudinal logistic regression model (time clustered on individuals) allowed a random intercept for each individual, which provided standard errors adjusted for the temporal correlation of GHQ-12 scores *within* the same individual across the timeframe of this study, whilst allowing between-Wave comparisons.

Analysis 4 (Table 2, Model 2) followed a near-identical procedure to Analysis 3, the sole exception being that ORs derived from Analysis 4 reflected an individuals' risk of worse GHQ-12 in 2007 according to *changes* in GHQ-12 scores and *all* considered

covariates from baseline (2003) measurements – *timeframe 2*. This was done to investigate longer-term trends in changes GHQ-12 scores (i.e. 2 years post-terror attacks).

Analysis 5 (Table 3) was conducted as a series of sensitivity tests. It is recommended having a cut-off of three (or more) out of twelve when employing the GHQ-12 item (Golderberg & Williams, 1988). For our sensitivity tests, we employed cut-off values of 1, 2, 3 and 4 to create different grades of 'caseness' within the GHQ-12 item. Continuing the methodology from the main analyses, we performed a total of eight univariate sensitivity analyses (Table 3). These utilised (a) trust (dichotomous), and (b) trust (categorical) as separate independent variables; from Table 3, Models 1a & 1b employed a GHQ-12 outcome with a cut-off value of 1; Model 1a presents the odds ratios (OR) of having poor psychological wellbeing in 2005 whilst not trusting in 2005, compared with 2003 values; Model 1b compares these same individuals again in 2007 against their 2003 values, also with the GHQ-12 cut off of 1; the same logic follows for Models 2a/b (GHQ cut-off=2), 3a/b (GHQ-12 cut-off=3), and 4/a/b (GHQ cut-off=4).

All analyses were conducted using GLLAMM version 2.3.15 (Rabe-Hesketh, Skrondal & Pickles, 2005), within the statistical software package STATA 11.2. (StataCorp, 2009).

Results

Table 1a shows frequencies and total percentages (N=9156) of all considered explanatory variables, stratified by baseline psychological wellbeing (2003).

Table 1b compares the levels of generalised trust and social participation from the *same* respondents in 2003, 2005 and 2007 (N=9287). There was a *decrease* in generalised trust from 45.4% in 2003 to 36.8% immediately post-terror attacks in 2005. Trust levels had increased again (to 41.3%) by 2007. Conversely, there was an *increase* in participation, from 45.8% in 2003 to 47.5% in 2005. Levels had dropped to 44.5% by 2007.

Table 1c presents pairwise odds ratios (OR) with 95% confidence intervals (95%CI) for trust and participation across the three Waves. For trust, interpretation of the 2005/2003 comparison (i) (OR=2.10, (95%CI) 1.92–2.29) implies that for each individual, the odds for not trusting was 2.10 times higher in 2005 than in 2003, i.e. reduced trust levels seen in 2005 compared to 2003 (Table 1b) were statistically significant and unlikely to be due to chance. For the 2007/2003 comparison (ii), the odds for not trusting were 1.39 times higher in 2007 than in 2003.

Regarding active social participation, odds for not participating in 2005 were 0.88 lower compared to 2003 and, in 2007 they were 1.09 times higher than in 2003. These patterns reflected the Wave-on-Wave comparison of social capital levels shown in Table 1b.

Table 2 (Model 1) presents the risk of having poor psychological wellbeing in 2005 (immediately post-terror attacks) having adjusting for *changes* in GHQ-12 scores and *all* considered covariates from 2003 to 2005 (N=9023). Individuals with low levels of trust in 2005 had an increased risk of worse psychological wellbeing in 2005 compared to 2003 (OR=1.31, (95%CI) 1.17–1.46). This pattern of negative association was also seen for those with no social participation (OR=1.24, (95%CI) 1.11–1.38), for women, in those who were now widowed, divorced or separated, those with poor SRH in 2005, the unemployed and full-time students. Covariates that protected against worse psychological wellbeing in 2005 (compared with 2003 values) included all education categories. Every ten-year increase in age also protected against worse psychological wellbeing.

Table 2 (Model 2) presents the risk of having poor psychological wellbeing in 2007 having adjusted for *changes* in GHQ-12 scores and *all* considered covariates from baseline (2003)

Table 1a

Baseline (year 2003) frequencies of all considered variables expressed as integers and percentages (%) of N_T (9,156), stratified by psychological wellbeing (GHQ-12). Source: The British Household Panel Survey Wave 13, 2003

		Psychological wellbeing (GHQ-12)		
		Better	Worse	Total (N _T)
Age	16–24	825 9.0%	262 2.9%	1087 11.9%
	25–34	1148 12.5%	377 4.1%	1525 16.7%
	35–44	1465 16.0%	477 5.2%	1942 21.2%
	45–54	1163 12.7%	421 4.6%	1587 17.3%
	55–64	1119 12.2%	302 3.3%	1421 15.5%
	65+	1243 13.6%	354 3.9%	1597 17.4%
	Total	6963 76.0%	2193 24.0%	9156 100.0%
Gender	Male	3328 36.3%	749 8.7%	4122 45.0%
	Female	3635 39.7%	1399 15.3%	5034 55.0%
Total	6963 76.0%	2193 24.0%	9156 100.0%	
Generalised trust	Trusts others	3339 36.5%	831 9.1%	4170 45.5%
	Cannot trust	3624 39.6%	1362 14.9%	4986 54.5%
	Total	6963 76.0%	2193 24.0%	9156 100.0%
Active participation in local groups	Participates	3300 36.0%	895 9.8%	4195 45.8%
	No participation	3663 40.0%	1298 14.2%	4961 54.2%
	Total	6963 76.0%	2193 24.0%	9156 100.0%
Self - rated health ^a	Good health	5368 58.6%	1096 12.0%	6464 70.6%
	Poor health	1593 17.4%	1096 12.0%	2689 29.4%
Total	6961 76.1%	2192 23.9%	9153 100.0%	
Marital status ^b	Married	4043 44.3%	1155 12.6%	5198 56.9%
	Cohabiting	849 9.3%	259 2.8%	1108 12.1%
	Widowed	427 4.7%	153 1.7%	580 6.4%
	Divorced	350 3.8%	182 2.0%	532 5.8%
	Separated	80 0.9%	68 0.7%	148 1.6%
	Never married	1198 13.1%	369 4.0%	1567 17.2%
Total	6947 76.1%	2186 23.9%	9133 100.0%	

Table 1a (continued)

		Psychological wellbeing (GHQ-12)		
		Better	Worse	Total (N _T)
Social class: based on latest (RGSC) occupation ^c	High social class	3945 44.5%	1186 13.4%	5131 57.8%
	Low social class	2690 30.3%	885 10.0%	3575 40.3%
	Never worked	119 1.3%	45 0.5%	164 1.8%
	Total	6754 75.3%	2116 24.7%	8870 100.0%
Employment status	Employed	4380 47.8%	1178 12.9%	5558 60.7%
	Unemployed	820 9.0%	491 5.4%	1311 14.3%
	Retired	1459 15.9%	413 4.5%	1872 20.4%
	Full-time student	304 3.3%	111 1.2%	415 4.5%
	Total	6963 76.0%	2193 24.0%	9156 100.0%
Education achieved ^d	University or higher	1498 16.5%	452 5.0%	1950 21.5%
	Year 13	1339 14.8%	425 4.7%	1764 19.5%
	Year 11	2189 24.2%	635 7.0%	2824 31.2%
	No formal qualifications	1866 20.6%	651 7.2%	2517 27.8%
Total	6892 76.1%	2163 23.9%	9055 100.0%	
Household income, (annual) - size weighted	< £5903	1697 18.5%	579 6.3%	2276 24.9%
	£5904-£11,375	1653 18.1%	626 6.8%	2279 24.9%
	£11,376-£19,102	1800 19.7%	499 5.4%	2299 25.1%
	£19,103 +	1813 18.1%	489 5.4%	2302 25.1%
Total	6963 76.0%	2193 24.0%	9156 100.0%	

^a Missing N=3^b Missing N=23^c Missing N=286^d Missing N=101

measurements (N=9023). Similar patterns of association were seen here as in Model 1; women, those who were widowed, divorced or separated between 2003 and 2007, individuals with poor SRH in 2007, the unemployed and fulltime students all had an increased risk of worse psychological wellbeing in 2007 compared with baseline (2003) GHQ-12 scores. Of the social capital variables, those who could not trust in 2007 compared to 2003 had a greater risk of worse psychological wellbeing in 2007 (OR=1.45, (95%CI) 1.27-1.57); conversely, the risk of worse psychological wellbeing in 2007 in those who now did not participate compared to 2003 was half that seen in 2005.

Table 1b

Frequencies of social capital levels (as measured by generalised trust and social participation) from the same respondents in years 2003, 2005 & 2007, expressed as integers and percentages (%) N=9287.

Source: The British Household Panel Survey, Waves 13, 15 & 17 (2003, 05 & 07)

Social Capital		BHPS Waves		
		Wave 13 (2003)	Wave 15 (2005)	Wave 17 (2007)
Generalised trust	Trusts others	4216 45.4%	3418 36.8%	3835 41.3%
	Cannot trust	5071 54.6%	5869 63.2%	5452 58.7%
	Total	9287 100.0%	9287 100.0%	9287 100.0%
Local social participation	Active participation	4253 45.8%	4408 47.5%	4136 44.5%
	No participation	5034 54.2%	4879 52.5%	5151 55.5%
	Total	9287 100.0%	9287 100.0%	9287 100.0%

Table 1c

Pairwise odds ratios (ORs) with 95% confidence intervals (95% CI) describing changes in social capital within the same individuals (as measured by trust and participation) in: (i) 2005 compared to 2003, and (ii) 2007 compared to 2003, derived from multilevel, longitudinal analysis (N = 9287).

Source: BHPS, Waves 13, 15 & 17

Timeframe	Social capital	Pairwise OR (95% CI)
(i) Social capital in 2005 vs. 2003 (N _T = 9287)	Trusts others	1.0
	Cannot trust in 2005 but trusted in 2003	2.10 (1.92-2.29) ***
	Participates	1.0
(ii) Social capital in 2007 vs. 2003 (N _T = 9287)	No participation in 2005 but participated in 2003	0.88 (0.82-0.96) **
	Trusts others	1.0
	Cannot trust in 2007 but trusted in 2003	1.39 (1.29-1.50) ***
	Participates	1.0
	No participation in 2007 but participated in 2003	1.09 (1.01-1.17) *

Reference group=1.0

* p < 0.05

** p < 0.01

*** p < 0.001

Table 3 presents the sensitivity analyses described previously in the statistical analyses section. The patterns of risk of having poor psychological wellbeing in 2005 and 2007 (compared to 2003 baseline measures) and not trusting were as expected, increasing as the 'caseness' GHQ-12 cut-off score increased from 1 to 4. Unsurprisingly, 'Categorical trust' did not contribute anything further, as only 1.7% of the sample population are in the 'It depends' category in these BHPS data.

Table 2
Comparison of odd ratios (ORs) with 95% confidence intervals (95% CI) of the same individuals having worse psychological health in (i) 2005 compared to 2003 (Model 1) and (ii) in 2007 compared to 2005 (Model 2) according to multiple variable, multilevel analysis of all considered explanatory variables and potential confounders ($N_t=9023$).
Source: The British Household Panel Survey, Waves 13, 15 & 17 (2003–07)

Explanatory variables		Model 1 Timeframe 1 N = 9023 Worse psychological health in 2005 compared to 2003 ORs (95% CI)	Model 2 Timeframe 2 N = 9023 Worse psychological health in 2007 compared to 2003 ORs (95% CI)
Time	Continuous	1.11 (1.01–1.21)*	1.05 (0.96–1.14)
Age	Continuous (per10 years)	0.90 (0.85–0.96) ***	0.94 (0.89–0.99) *
Gender	Male	1.0	1.0
	Female	1.63 (1.44–1.85) ***	1.66 (1.48–1.86) ***
Household income - size weighted (log)	Continuous (per £1000 years)	1.00 (0.99–1.00)	1.00 (0.99–1.00)
Social class: derived from most recent occupation-based RGSC schema	High SC	1.0	1.0
	Low SC	0.93 (0.82–1.06)	0.86 (0.76–0.96) *
	Not applicable	0.97 (0.64–1.49)	0.86 (0.58–1.27)
Generalised trust	Trusts others	1.0	1.0
	Cannot trust	1.31 (1.17–1.46) ***	1.45 (1.27–1.57) ***
Social participation	Active participation	1.0	1.0
	No participation	1.24 (1.11–1.38) ***	1.12 (1.01–1.23) *
Marital status	Married	1.0	1.0
	Cohabiting	0.97 (0.81–1.16)	0.91 (0.77–1.08)
	Widowed	1.61 (1.26–2.05) ***	1.54 (1.24–1.91) ***
	Divorced	1.73 (1.38–2.17) ***	1.64 (1.33–2.00) ***
	Separated	4.33 (2.99–6.27) ***	3.29 (2.30–4.71) ***
	Never married	1.01 (0.84–1.22)	1.13 (0.96–1.33)
Self-rated health	Good health	1.0	1.0
	Poor health	5.16 (4.57–5.82) ***	4.52 (4.05–5.04) ***
Education	Undergraduate +	1.0	1.0
	Year 13	0.83 (0.70–0.99) *	0.83 (0.71–0.96)*
	Year 11	0.67 (0.57–0.79) ***	0.67 (0.58–0.78) ***
	No Qualifications	0.68 (0.56–0.83) ***	0.66 (0.55–0.79) ***
Employment status	Employed	1.0	1.0
	Unemployed	2.11 (1.79–2.47) ***	1.72 (1.48–2.00) ***
	Retired	0.98 (0.80–1.21)	0.90 (0.75–1.08)
	FT student	1.48 (1.07–2.04) *	1.36 (1.01–1.87)*

Reference group=1.0

**p < 0.01

* p < 0.05

*** p < 0.001

Discussion

The aim of this longitudinal UK panel study was twofold: (i) to investigate changes in individual-level social capital (generalised trust and social participation) across the UK from 2003–07; and (ii) to quantify the buffering effect of social capital against worse psychological wellbeing (GHQ-12) in the months and years after the 2005 London terror attacks.

Regarding levels of social capital (i), results demonstrated a substantial and statistically significant drop in generalised trust levels from 45.4% in 2003 to 36.8% in 2005 across the UK (Table 1b); trust levels rebounded to 41.3%, however, by year 2007. Conversely, active local social participation seemed to increase significantly in 2005 to 47.5% before declining in 2007 to 44.5% (Table 1b). Regarding buffering effects (ii), when viewed together, the two social capital 'dimensions' (Harpham, Grant & Thomas, 2002) provided a

stable buffer against worse psychological wellbeing immediately after the 2005 terror attacks and in 2007 (Table 2).

Looking more closely at generalised trust, the fluctuations reported in Table 1b support the theories presented in the Introduction that generalised trust may be eroded by a collective climate of fear (O'Driscoll, 2008) or by the extreme political responses to terrorism, as witnessed in the UK (Furedi, 2005). Such fluctuations also lend weight to the 'economic premise' that trust is indeed a summary measure of individual experiences (Glaeser, Laibson, Scheinkman & Soutter, 2000) and not the stable trait once thought (Putnam, 2000; Uslaner, 2002). That similarly low UK trust levels are also reported by the World Values Survey in 2005 (30% can trust, N=1041) (World Values Survey, 2005) and that a similar decline in trust was reported immediately post-2008 financial crisis, lends further weight to the 'economic premise' of generalised trust (Lindström & Giordano, 2016).

Table 3

Sensitivity testing: Comparison of odd ratios (ORs) with 95% confidence intervals (95% CI) of the same individuals having worse psychological health in (i) 2005 compared to 2003 (timeframe 1), and (ii) in 2007 compared to 2005 (timeframe 2) according to univariate analysis of: (a) Dichotomous trust and (b) Categorical trust; each univariate Model (1-4) considers both trust measures separately in each of the two timeframes, whilst using a GHQ-12 outcome derived from different cut-off values ($N_t=9263$).
Source: The British Household Panel Survey, Waves 13, 15 & 17 (2003-07)

Explanatory variables		Model 1a GHQ cut-off value 1 (i) Timeframe 1 N=9263 Worse psychological health in 2005 compared to 2003 ORs (95% CI)	Model 1b GHQ cut-off value 1 (ii) Timeframe 2 N=9263 Worse psychological health in 2007 compared to 2005 ORs (95% CI)	Model 2a GHQ cut-off value 2 (i) Timeframe 1 N=9263 Worse psychological health in 2005 compared to 2003 ORs (95% CI)	Model 2b GHQ cut-off value 2 (ii) Timeframe 2 N=9263 Worse psychological health in 2007 compared to 2005 ORs (95% CI)
(a) Generalised trust (dichotomous)	Time	Continuous 1.05 (0.97-1.13)	0.97 (0.90-1.05)	1.03 (0.95-1.12)	0.99 (0.92-1.07)
	Trusts others	1.0	1.0	1.0	1.0
	Cannot trust	1.56 (1.42-1.72) ***	1.59 (1.44-1.76) ***	1.62 (1.46-1.79) ***	1.60 (1.44-1.78) ***
(b) Generalised trust (Original three categories maintained)	Trusts others	1.0	1.0	1.0	1.0
	Cannot trust	1.59 (1.44-1.75) ***	1.61 (1.46-1.78) ***	1.63 (1.47-1.81) ***	1.62 (1.46-1.80) ***
	It depends	0.91 (0.65-1.30)	1.06 (0.73-1.53)	1.24 (0.86-1.78)	1.17 (0.80-1.72)
Explanatory variables		Model 3a GHQ cut-off value 3 (i) Timeframe 1 N = 9263 Worse psychological health in 2005 compared to 2003 ORs (95% CI)	Model 3b GHQ cut-off value 3 (ii) Timeframe 2 N=9263 Worse psychological health in 2007 compared to 2005 ORs (95% CI)	Model 4a GHQ cut-off value 4 (i) Timeframe 1 N=9263 Worse psychological health in 2005 compared to 2003 ORs (95% CI)	Model 4b GHQ cut-off value 4 (ii) Timeframe 2 N=9263 Worse psychological health in 2007 compared to 2005 ORs (95% CI)
(a) Generalised trust (dichotomous)	Time	Continuous 1.10 (1.01-1.21) *	0.97 (0.90-1.06)	1.11 (1.02-1.22) *	1.00 (0.91-1.09)
	Trusts others	1.0	1.0	1.0	1.0
	Cannot trust	1.62 (1.46-1.81) ***	1.65 (1.47-1.84) ***	1.63 (1.45-1.83) ***	1.66 (1.48-1.87) ***
(b) Generalised trust (Original three categories maintained)	Trusts others	1.0	1.0	1.0	1.0
	Cannot trust	1.64 (1.47-1.83) ***	1.67 (1.49-1.88) ***	1.65 (1.47-1.86) ***	1.69 (1.50-1.91) ***
	It depends	1.12 (0.76-1.66)	0.93 (0.61-1.43)	1.03 (0.67-1.59)	0.88 (0.55-1.39)

Reference group=1.0

** p < 0.01

* p < 0.05

The buffering effect of trust on worse psychological wellbeing appeared to increase over the timeframe of this study (Table 2). As specified by design, results for trust in Models 1 & 2 (Table 2) expressed the risk of worse psychological wellbeing in 2005 and 2007, respectively, for those individuals who had both: (a) previously trusted and (b) had better psychological wellbeing at baseline (year 2003). If a trusting attitude buffers against poor mental health outcomes, then the somewhat higher OR for lack of trust in Model 2, may possibly reflect a trait of that particular subgroup of the population, as described by (Whalley & Brewin, 2007), who continue to display negative mental health symptoms for longer periods after a terror event, irrespective of geographic proximity to such atrocities. Future multilevel mental health research (clustering on postal areas/cities/regions of the UK) could empirically test this with these UK data.

When regarding the buffering effects of social participation, associations were strongest in 2005 compared to baseline (2003) levels. That levels of participation increased in 2005 (immediately post-terror attacks) may reflect the resolve of those individuals determined not to let such events affect their everyday routines; active local participation for these individuals may reflect a conscious effort to regain 'control' over their lives (Herzenstein, Horsky & Posavac, 2015). Those who did not participate in 2005 (British Broadcasting Corporation, 2005c) may have been more

sensitive to the collective climate of fear after the terror atrocities (O'Driscoll, 2008). The greater risk of worse psychological wellbeing in 2005 seen in these individuals (Table 2) may be the result of missed opportunities for increased local social interactions, which may have aided in reinforcing positive social norms and beliefs (Paez et al., 2007).

Alternatively, increased local participation in 2005 may reflect the theory of 'miniaturization of community' proposed by Fukuyama (1999). To clarify, he postulates that individuals' radii of trust have been slowly decreasing over the past few decades. A terror event such as that experienced in London, could temporarily mimic this process, i.e. immediately after the London attacks, individuals may lose the ability to trust strangers (generalised trust) yet still retain high levels of particularised trust (trust in known/local individuals or groups). Such a tighter 'local' focus of trust could readily translate to an increase in active local participation, as shown in our 2005 data. That the social participation variable specifically detailed 'local' activity (i.e. a defined narrow radius of participation), coupled with the decrease in generalised trust levels seen in 2005 adds weight to Fukuyama's (1999) theory.

Patterns of association between changes from baseline (2003) values in GHQ-12 scores and our other covariates in 2005 and 2007 were as expected (e.g. SRH - (Tessler & Mechanic, 1978), marital status - (Umberson, 1992), and employment status (Paul &

Moser, 2009)). That the negative effects of marital separation, being unemployed and poor SRH on worse psychological wellbeing seemed stronger in 2005 than in 2007 (when compared to their respective 2003 baseline measures) may be due to psychological health being further compounded by the recent terror attacks in 2005, with the negative effects of terrorism diminishing over time (Whalley & Brewin, 2007).

That the effects of age (Hankin et al., 1998) and gender (Piccinelli & Wilkinson, 2000) on worse psychological wellbeing remained stable over the five-year timeframe of this study adds further credibility to our other results.

That lower levels of education seem to protect against worse psychological wellbeing in this study may be an artefact, as some doubts have been raised regarding the validity of the GHQ-12 item when assessing lower educated individuals (Araya, Wynn & Lewis, 1992; Mari & Williams, 1986). However, compared to the well-known SES gradients seen with other health outcomes (such as SRH, cardiovascular disease and poor health behaviours), a less-defined health gradient is often seen with the outcome GHQ-12 and individuals' level of education (Lindström, 2004; Lindström, Ali & Rosvall, 2012).

Strengths and weaknesses

A major strength of this panel study is that it is longitudinal, comparing the *same individuals* pre- and post-London terror attacks, with a high number of individual respondents ($N=9156$). That these panel data span the timeframe 2003–07 allowed us to investigate the terror attacks in London and draw inference from any immediate and longer-term *changes* in associations from pre-attack (2003 baseline) measures. To our knowledge, this is the first empirical research paper to investigate the buffering effects of social capital on psychological wellbeing against such a backdrop. The data were obtained via interview rather than relying on postal questionnaires, which contributed to the very high participation rate of around 95%, year on year (Taylor et al., 2010). Unfortunately, there is no 'gold standard' with which to validate our social capital proxies (generalised trust and social participation); however, they have been considered acceptable proxies for two decades (Islam, Merlo, Kawachi, Lindström & Gerdtham, 2006; Kawachi et al., 1999; Putnam, 2001). Our sensitivity tests (Table 3) further confirmed the robustness of dichotomous trust compared with the three original trust categories. To reduce the risk of potential confounding, we further included numerous well-known mental health determinants in our full model analyses.

One major limitation is that the BHPS sample was originally selected to reflect the UK population as a whole, and as such avoided oversampling of smaller-sized communities. Although there are more complex GHQ instruments to measure psychological wellbeing, there seems little difference in validity between these and the GHQ-12 item used in this study (Goldberg et al., 1997). The sensitivity analyses (Table 3) demonstrated the robustness of the GHQ-12 item when employing different cut-off values. Further, values obtained for GHQ-12 and SRH must be considered relative, i.e. responses given were dependent on respondents' usual levels; as such, some self-report bias may have been introduced, though the validity of GHQ-12 and SRH are quite high (see Methods). By year 2003, only 55.3% of the original (1991) cohort members were able to answer the questions posed (Taylor et al., 2010). This would have introduced further selection bias into this study.

Conclusion

It appears that the July 7th terror attacks that took place in London in 2005 had an immediate and negative impact on the UK

populations' ability to trust strangers (generalised trust). Conversely, there was significant rise in active local participation post-terror attacks. By 2007, however, trust and participation levels had started to return to pre-attacks (2003) levels (Table 1b). Interestingly, the two dimensions of social capital investigated here exhibited independent buffering effects against worse psychological wellbeing in 2005 and 2007 compared to 2003 baseline measurements. When considered together, however, the overall buffering effect of social capital remained fairly consistent across the timeframe of this study. Though Putnam had originally postulated that trust and participation were strongly correlated (2000), empirical research (including the results of this study) has cast doubt on this assumption (Giordano & Lindström, 2010; Stolle, 2001). However, the increase in active local participation in 2005 appeared to counter the 25% drop (in real terms) in generalised trust when considering the overall buffering effects of social capital on psychological wellbeing. This reflects the notion that local participation, in the context of this study, may well become "the cornerstone of social capital" (Putnam, 2000) when the resource of generalised trust is diminished.

In light of the immediate depletion of generalised trust seen in 2005 across the UK, policy makers should consider not just how terror events directly impact on individual trust attitudes, but also how policy responses to such calamitous events may also contribute to a further reduction in this apparently fragile dimension of social capital (Lindström & Giordano, 2016). In such instances, active local participation should be openly encouraged, not only to aid in the (re)establishment of societal norms, such as generalised trust, but to also help buffer against the effects of worse psychological wellbeing.

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Appendix

GHQ-12

The items included in the GHQ-12 are 'Have you felt tense during the past weeks?', 'Have you had problems with your sleep during the past weeks?', 'Have you been able to concentrate on what you have been doing during the past weeks?', 'Do you feel that you have been useful during the past weeks?', 'Have you been able to make decisions in different areas during the past weeks?', 'Have you during the past weeks been able to appreciate what you have been doing during the days?', 'Have you been able to deal with your problems during the past weeks?', 'Generally speaking, have you felt happy during the past weeks?', These eight items had four alternative answers: 'More than usual', 'As usual', 'Less than usual' and 'Much less than usual'. The items were dichotomized

with two alternatives denoting 'good' psychological health and two alternatives denoting 'poor' psychological health, i.e. for the two first questions 'More than usual' and 'As usual' denoted 'poor' psychological health and for the following six questions they denoted 'good' psychological health. Four other items had somewhat different alternative answers: 'Have you felt unable to deal with your own personal problems during the past weeks?', 'Have you felt unhappy and depressed during the past weeks?', 'Have you lost faith in yourself during the past weeks?' and 'Have you felt worthless during the past weeks?'. The four alternative answers to these four items were: 'Not at all', 'No more than usual', 'More than usual' and 'Much more than usual'. The answers to these items were also dichotomised to denote either 'poor' psychological health ('more than usual' and 'much more than usual') or 'good' psychological health ('not at all' and 'no more than usual'). If three or more of the 12 items above denoted 'poor' psychological health, then psychological wellbeing (GHQ-12) was denoted as 'worse'.

Social class

The six occupation categories, as per the Registrar General's Social Classification of occupations are: (I) Professional, (II) Managerial/Technical, (IIIa) Skilled (non-manual), (IIIb) Skilled (manual), (IV) Partly Skilled and (V) Unskilled.

Active participation

To determine social participation levels respondents were asked if they were *active* (not passive) members of any local group or organisation listed below: Political party, trade union, environmental group, parents'/school association, tenants'/residents' group or neighbourhood watch, church organisation, voluntary service group, pensioners group/organisation, social club/working men's club, sports club or Women's Institute.

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