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PETS AND HUMAN HEALTH IN GERMANY AND AUSTRALIA:

NATIONAL LONGITUDINAL RESULTS

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PETS AND HUMAN HEALTH IN GERMANY AND AUSTRALIA: NATIONAL LONGITUDINAL RESULTS

Abstract

The German and Australian *longitudinal* surveys analysed here are the first national representative surveys to show that (1) people who continuously own a pet are the healthiest group and (2) people who cease to have a pet or never had one are less healthy. Most previous studies which have claimed that pets confer health benefits were *cross-sectional*. So they were open to the objection that owners may have been healthier in the first place, rather than becoming healthier due to owning a pet. In both countries the data show that pet owners make about 15% fewer annual doctor visits than non-owners. The relationship remains statistically significant after controlling for gender, age, marital status, income and other variables associated with health. The German data come from the German Socio-Economic Panel in which respondents have been interviewed every year since 1984 (N=9,723). Australian data come from the Australian National Social Science Survey 2001 (N=1,246).

PETS AND HUMAN HEALTH IN GERMANY AND AUSTRALIA: NATIONAL LONGITUDINAL RESULTS

The German Socio-Economic Panel Survey (SOEP) and the International Social Science Survey Australia (ISSS-A) provide stronger evidence than previously available about the benefits of pet ownership for human health. So far as we know, these are the first two general population surveys, which – because they are longitudinal – enable us to detect that owning a pet improves medium term health. Many previous studies have claimed that pets produce health benefits, but the claim has been controversial, either because the studies were cross-sectional and so could not establish causal direction, or because they were small scale interventions in which specific groups (mainly older and institutionalised people) were given a pet. In the latter studies, respondents might well have known or suspected that the aim was to improve their health and this could have affected survey responses.

Previous research in the US, Britain, Canada and Australia has shown plausible evidence of a linkage between pet ownership and better human health. But their cross-sectional design made it impossible to know whether owners enjoyed better health as a consequence of having a pet, or whether people who were healthier in the first place tended to acquire pets (Anderson, Reid and Jennings, 1992; Headey, 1999; Garrity and Stallones, 1998). An apparent breakthrough was made by Friedmann, Katcher, Lynch and Thomas (1980) who found that patients who owned pets were much less likely to die in the year following a heart attack than patients with no pet at home. The methods used in this study were criticised by

Wright and Moore (1982) but it has since been replicated on a larger scale and the finding seems fairly well established (Friedmann and Thomas, 1995).

There have been several investigations of physiological responses to the presence of pets in the home. Blood pressure and other autonomic responses to mild mental stress are lowered by the presence of a pet dog (Allen and Blascovich, 1991; Allen, Blascovich and Mendes, 2002; Kingwell, Lomdahl and Anderson, 2001). Watching fish swim peacefully around in an aquarium can have the same effect (De Schriver and Riddick, 1990). Further, one recent study showed that, while ace inhibitor (ACE) therapy lowers resting blood pressure, the presence of a pet is more effective if mild mental stress occurs (Allen and Shykoff, 2001). Finally, 'pet therapy' research has indicated that interaction with pets reduced depressive symptoms and also lowered blood pressure (Stasi et al, 2004).[1]

We now review previous studies which did have a longitudinal design. An important British study by Serpell (1991) showed that people who had not recently owned a dog or cat and then acquired one, or were given one by the researchers, showed improvements over the next ten months in their health, psychological well-being, self-esteem and exercise levels; this compared with a control group who did not get a pet. Results were clearly statistically significant but the study is open to the potential criticism that some subjects may well have guessed that they were given a pet to improve their health and their survey responses could have been affected. This objection cannot be levelled at Siegel's (1990) study of 938 American Medicaid enrollees, some of whom owned pets and some did not. During the follow-up period it was found that pet owners were less distressed by adverse life events and

made fewer doctor visits. Similarly, Raina, Bonnett and Waltner-Toews (1998) found that elderly people who had pets declined less in physical and mental health in a one year period than a matched group without pets. However, in this study the people who had pets were somewhat healthier than non-owners when research began, and this casts some doubt over results.

It should be noted that several studies have found no relationship between pet ownership and health, or have concluded that the sequence might be that people who enjoy good health are more likely to get pets (Beck and Katcher, 1984; Jorm et al., 1997; Ory and Goldberg, 1983; Robb and Stegman, 1983). However, all these studies were limited to small samples and specific population groups rather than applying to the general population.

This issue of causal direction can now be addressed, given that in 2001 the same panel of German respondents, who had previously answered in 1996, were again asked about pet ownership, health and doctor visits, and in the intervening period many had gained and many had lost a pet. In Australia the procedure was different and somewhat less reliable. In 2001 Australian respondents were asked about both their current pet ownership and ownership five years ago; the same time interval as the German survey. They were also asked about their current health and frequency of doctor visits, but not about their previous health, since plainly answers would not have been reliable.

The outcome we seek to explain is survey respondents' reports of the number of doctor visits (general practitioners and all other doctors) they made in the last year. This variable appears

to be as or more strongly affected by pet ownership than other health variables included in the German and Australian surveys. These included self-reported health status and nights spent in hospital in the last year. Annual doctor visits appear to be a good proxy for health, being correlated between -0.3 to -0.4 in both countries with the self-report measure.

METHODS

The German Socio-Economic Panel (SOEP) and the International Social Science Survey Australia (ISSS-A)

SOEP is conducted by the German Institute for Economic Research in Berlin, one of the five economic think tanks charged with forecasting and advising the Federal Government (SOEP Group, 2001). The panel survey began in 1984 in West Germany and, just before reunification, was extended to East Germany in 1990. The initial sample included over 12,000 respondents, with everyone aged 16 and over in sample households being interviewed. In the years 1995, 1998 and 2000 new samples were drawn which approximately doubled the initial sample size. The sample analysed here comprises 9,723 respondents who answered all questions about health and pet ownership in both 1996 and 2001.

The Australian ISSS-A survey was conducted annually by a team headed by Jonathan Kelley of Australian National University and the Melbourne Institute and Mariah Evans of the Melbourne Institute. For the survey in 2001 a national sample of 1,246 was drawn from the Federal electoral rolls. The survey was conducted by mail, and over the years has proved to be statistically representative of the electorate from which it is drawn (Sikora 1997).

Measures: pet ownership and health

In the German panel respondents were first asked whether they owned a pet or not, and if they did, whether they owned a dog, cat, bird, fish, horse or 'other' pet. In the Australian survey respondents were asked just about dogs, cats and 'other' pets. We found in both countries that there was a statistically significant ($p < 0.05$) Pearson correlation between ownership of all types of pet and measures of self-reported health and annual doctor visits. So rather than analyse the effects of each type of pet separately (which would have given small numbers for all but dogs and cats), we relied on a dichotomous (yes-no) measure of pet ownership.[2] We further divided survey respondents into four groups:

- 'PetAlways' – owned a pet now and five years ago
- 'PetNow' – owned a pet now but not 5 years ago
- 'Pet5ago' – owned a pet 5 years ago but not now
- 'PetNever' – did not own now or 5 years ago.

In the regression analyses which follow, the 'PetNever' group was used as a reference group or baseline, and the health of the other groups was compared with them. It was hypothesised that the 'PetAlways' group would score highest on health measures (net of other variables), and also show the largest gains in health in the last five years (or perhaps the smallest losses in health since everyone was five years older). We expected the 'PetNow' group to do next best and to show an improvement in health or a lesser decline than the 'Pet5ago' and 'PetNever' groups. There was no strong reason to expect any difference between the last two groups, although it seemed possible that, if pet ownership had lingering benefits, the Pet5ago group would have better health than PetNever.

The measure of doctor visits in the German panel was: '*Have you gone to a doctor within the last three months? If yes, please state how often.'* We multiplied this measure by four to get an estimate of annual doctor visits. In Australia the same question was posed, except that the period covered was directly the last year rather than the last three months. Measures of self-reported health were also taken in both countries. The question was: '*How would you describe your current health– very good, good, satisfactory, poor, bad?'*[3] This measure is used in many national and international surveys and is known to correlate satisfactorily with medical evaluations (Schwarze, Andersen and Anger, 2000).

Data analysis: negative binomial regressions and propensity score matching

Because the dependent variable, doctor visits, is a 'count' variable (0, 1, 2 etc), rather than being normally distributed, ordinary least squares (OLS) regression was not appropriate. Count data often display overdispersion; i.e. the variable means and variances are not approximately equal. So an appropriate method is negative binomial regression (Winkelmann, 2000).

Another valuable technique for exploring the benefits of pet ownership for human health is the propensity score matching method (Rosenbaum and Rubin, 1983). This method involves specifying a function to measure the proximity of one case to another, based on diverse characteristics. Using nearest-neighbour matching, we then compare individuals who own a pet (the 'treatment group') with those who do not (the 'control group').[4] The underlying idea is that, if it can be shown that the two groups have significantly different outcomes (health

outcomes) after matching on a wide range of variables, then one can have reasonable confidence that the treatment has had a causal impact. Or, putting it more modestly, one might simply claim that the chances of observed differences in outcomes being due to unobserved heterogeneity are much reduced.

It should be noted that propensity score matching requires a large sample in order for cases in the treatment and control groups to be matched successfully. In this paper the method has only been applied to the German panel; the Australian sample was not large enough.[5]

RESULTS

First, some basic information: in 1996 37.7% of Germans owned a pet (mostly a dog or cat or both) and by 2001 this had fallen slightly to 36.3%. Despite the small shift in the aggregate figure – and fortunately for our analysis of the health effects of change – over a thousand people had newly acquired a pet during the five years (11.4% of the sample) and even more no longer had one (12.8%). In 1996 people who owned a pet averaged 11.1 visits a year to the doctor and non-owners averaged 12.0 visits. Everyone had aged five years by 2001, so more medical attention might have been expected, but in the event pet owners now went to the doctor 11.0 times a year on average, whereas non-owners were up to 12.9 visits.

In Australia 64.3% of respondents owned pets in 2001, down from 71.6% in 1996, although still a much higher figure than in Germany. As in Germany the largest numbers owned dogs (25.2%) and cats (19.6%), with cat ownership having fallen by a quarter in the last five years.

On average pet owners had been to the doctor 4.9 times in the last year, compared with 5.6 times for non-owners. Despite Australians making many fewer doctor visits than Germans, the percentage difference between owners and non-owners was about the same.[6]

Before analysing change, we now give some straightforward measures of association between pet ownership and health measures. The Pearson correlation between pet ownership and self-reported health in Germany was 0.06 in 2001, and between pet ownership and annual doctor visits it was –0.05. In Australia the correlation between pet ownership and health was 0.04 and between ownership and doctor visits –0.10. Given the sample sizes, these correlations are statistically significant at the 0.05 level in both countries, but of course the apparent relationships could be wholly or partly due to demographic variables also related to health and doctor visits. Hence the need for multivariate analysis.

Germany: equations for pet ownership and health

What model – what equations – can best enable us to assess whether pet ownership improves health? For Germany we estimated two equations, using negative binomial regressions. The outcome variable is doctor visits in 2001. The explanatory variables of key interest relate to pet ownership. In the first equation we just insert a dichotomous variable (pet owner in 2001=1, non-owner=0), and in the second equation we include the 4-way split discussed above: PetAlways, PetNow, Pet5ago, with PetNever being used as the reference group. Explanatory variables essentially included as ‘controls’, and also measured in 2001, are gender, age, partnership status and disposable income. (Descriptive statistics are given in Appendix 1).

An important inclusion is self-reported health status, but measured in 1996 not 2001. The inclusion of this lagged measure is crucial because it means that, if we find that pet owners made fewer doctor visits in 2001 than non-owners, we can say that this appears true, making a 'fair' comparison between owners and non-owners who had the same standard of health five years before. Or to put it another way, we can say that owning a pet improves health over time, compared with not owning one.[7]

INSERT TABLE 1 ABOUT HERE

Both equations show that owning a pet appears to confer significant health benefits. The first equation shows that in Germany pet owners averaged 7,5% fewer doctor visits in 2001 than non-owners, even if they had the same standard of health in 1996. The second gives more detail. It shows that people who 'always' had a pet (i.e. in 1996 as well as 2001) made significantly ($p<0.01$) fewer doctor visits than people who had ceased to have a pet or had 'never' had one. There were also significant health gains for people who had acquired a pet in the last five years ($p<0.10$).

Germany: propensity score matching

The first step in running the propensity score matching method is to estimate the probability of being in the treatment group; i.e. having a pet in 2001. The aim is to find variables on which the scores of treatment group and control group members differ, in order then to match on these variables and control for their possibly biasing effects. Results from a probit model

showed that the 13 variables considered here (see Table 2) were highly significantly related to pet ownership. In particular, women, older people and German citizens had a higher probability of owning a pet, whereas people who lived in the city and those who did sports regularly were less likely to be owners.

INSERT TABLE 2 ABOUT HERE

The matching method uses derived propensity scores to find the best match for each individual pet owner; that is, the most similar individual who did not own a pet in 2001. It should be noted that the matching procedure was successfully completed for all but one pet owner.[8] After matching, as Table 3 shows, the pet owner and non-owner groups had exactly equal propensity scores and nearly equal scores on all variables.

INSERT TABLE 3 ABOUT HERE

The key issue is whether, after matching, pet owners were still estimated to make fewer doctor visits than non-owners. As Table 3 indicates, the mean difference between the two groups was reduced by matching from 0.44 visits to 0.28 visits, but remained significant at the 0.01 level. Another way of expressing this central result is to calculate a 'treatment effect' (Rosenbaum and Rubin, 1983). This is the difference between the number of doctor visits pet owners actually made and the number they would be predicted to make (the counterfactual in Equation 1 below) on the basis of their scores on the variables included Table 3.

$$\textit{treatment effect} = \{\exp(\textit{doctor visits}_{\textit{treated}}) - \exp(\textit{doctor visits}_{\textit{counterfactual}})\} / \exp(\textit{doctor visits}_{\textit{treated}}) \quad (1)$$

In this instance, the treatment effect or reduction in doctor visits due to owning a pet was estimated at 24%. Plainly, this a substantial difference and gives reasonable confidence that pet ownership confers health benefits.

Australia: equations for pet ownership and health

The Australian equations are somewhat different from the German (see Appendix 1 for descriptive data). Because all information was collected in 2001 we have no lagged measure of health. The first equation in Table 4 comes as near as possible to replicating the first German one, but is purely static. It tells us nothing about change. It assesses whether or not current pet ownership is associated with fewer doctor visits, controlling for gender, age etc. The second equation does address issues of change. It uses the PetAlways, PetNow, Pet5ago and PetNever classification to compare the health of people who owned a pet continuously with those had recently acquired one, ceased to have one, or never had one.

INSERT TABLE 4 ABOUT HERE

The Australian results are broadly, but not completely, in line with the German results. The first equation shows that Australian pet owners made 11% fewer doctor visits than non-owners, controlling for other variables which affect health. Then the second equation confirms that those who owned pets both in 1996 and 2001 were significantly healthier than those who ceased to own a pet during the period, or never owned one. The inconsistency between the two countries is that, whereas in Germany those who had recently acquired a pet

apparently gained just as much as medium term owners, in Australia new owners were no better off than non-owners. Such discrepancies are not unusual in empirical research, and this one might or might not replicate. For the moment, no obvious explanation of the result is available.

DISCUSSION

To summarise: the German and Australian studies reported here are nationally representative and longitudinal. They provide stronger evidence than previous studies that the relationship between pet ownership and better health is probably causal and not just correlational. Most previous research, being cross-sectional, was open to the objection that it was possible that healthy people acquired pets, rather than that people became healthier as a consequence of pet ownership. We have found that the healthiest population group in both Germany and Australia – the group which made the fewest doctor visits – were the medium to long term owners who had a pet at least five years ago and retained it ‘now’. Further analysis of the German data, using the propensity score matching method, provided additional evidence that pet ownership resulted in fewer doctor visits, and that the linkage was ‘causal’ rather than due to unobserved heterogeneity.

In future research it will be desirable to get detailed information about which household members mainly care for pets. One might expect that ‘main carers’ would gain more health benefits than other household members. Indeed, as a result of not being able to differentiate

between main carers and others in the surveys analysed here, it is likely that we have understated benefits to the former and overstated benefits to the latter.

A final point: it is important to understand the mechanisms through which pets benefit health. The issue may be complicated because it seems likely that different groups of pet owners may benefit in quite different ways. Older people, and shy or lonely people, perhaps gain most from companionship. Stressed people may relax and their blood pressure come down. Otherwise sedentary people may be induced to take exercise if they have a dog. Benefits to young people, who grow up with pets, might include both being socialized to care for others and, conceivably, strengthening the immune system. Personality traits, which will be measured in the next wave of the German panel (2005), may be related to the decision to own a pet, the types of pets people choose, and also to health. These are all issues worth continued investigation.

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Table 1
German pet ownership and annual doctor visits[1]: negative binomial regressions (N=9721)

Explanatory variables (2001 unless otherwise shown)	**Dependent variable: Doctor visits** ***b***	
Pet owner (yes=1, no=0)	**-.0774*** **	---
PetAlways2	---	**-.0859*** **
PetNow	---	**-.0717***
Pet5ago	---	**-.0188**
Gender (f=1, m=0)	.2562***	.2562***
Age (years)	-.0088*	-.0088*
Age squared	.0002***	.0002***
Equivalized disposable income (log)	.0314***	.0310***
Partnered (yes=1, no=0)	.1225***	.1208***
Health 1996 (very good)[3]	-1.3074***	-1.3083***
Health 1996 (good)	-1.1226***	-1.1234***
Health 1996 (satisfactory)	-.8361***	-.8367***
Health 1996 (poor)	-.4965***	-.4970***
Constant	1.4770***	1.4858***
LR Chi[2]	1130.19	1130.54
Log likelihood	-20794.25	-20794.08
Pseudo R^2	2.65	2.65

Source: SOEP 1996, 2001, authors calculations.
Note: *** p < 0.01; ** p < 0.05; * p < 0.10
1. Number of doctor visits within the last three months multiplied by four.
2. Reference group: PetNever in equation 2.
3. Reference group: Health status in 1996 (bad).

Table 2
Germany: Results from a probit model estimating the probability of having a pet in 2001

Explanatory variables	**Coeff.**	**Std. Dev.**
Gender (f=1, m=0)	0,137***	0,027
Age (years)	0,035***	0,006
Age squared	0,000***	0,000
Equivalized disposable income (log)	-0,112***	0,015
Having children under the age of 16	0,088**	0,036
Living alone (yes=1, no=0)	0,200**	0,080
Partnered (yes=1, no=0)	0,179***	0,049
German citizen	0,703***	0,039
Smoker	0,156***	0,030
Living in a rural area	0,430***	0,043
Living in a city	-0,209***	0,044
Doing sports at least once a week	-0,124***	0,032
Life satisfaction[1]	-0,032***	0,008
Constant	-0,710***	0,188

Source: SOEP 2001, authors calculations. N=9723, LR-Chi^2= 1074,59, Pseudo R^2=8,29.
Note: *** p < 0.01; ** p < 0.05.
1. Life satisfaction is measured by a 0-10 scale running from 0 ‘totally unhappy’ to 10 ‘totally happy’.

Table 3
Germany: Results of propensity score matching

Explanatory variables	**before matching**		**after matching**	
	pet (treatment)	**no pet (control)**	**pet (treatment)**	**no pet (control**
Gender (f=1, m=0)	0,54	0,51***	0,54	0,53
Age (years)	45,45	49,86***	45,45	44,83
Age squared	2257,59	2765,14***	2257,77	2198,69
Equivalized disposable income (log)	5,78	6,37***	5,78	5,77
Having children under the age of 16	0,40	0,27***	0,40	0,41
Living alone (yes=1, no=0)	0,08	0,17***	0,08	0,09
Partnered (yes=1, no=0)	0,81	0,72***	0,81	0,80
German citizen	0,90	0,78***	0,90	0,90
Smoker	0,36	0,29***	0,36	0,37
Living in a rural area	0,17	0,07***	0,17	0,16
Living in a city	0,08	0,14***	0,08	0,09
Doing sports at least once a week	0,23	0,25**	0,23	0,23
Life satisfaction[1]	6,78	6,95***	6,78	6,79
Propensity Score	**0,45**	**0,34*** **	**0,45**	**0,45**
Doctor visits	**2,57**	**3,01****	**2,57**	**2,85*** **
N	3741	5982	3740	3740

Source: SOEP 2001, authors' calculations. N=9723. T-statistics for H0: effect=0 is -1,9765.
Note: *** $p < 0.01$; ** $p < 0.05$.
1. Life satisfaction is measured on a 0-10 scale running from 0 'totally unhappy' to 10 'totally happy'.

Table 4
Australia: pet ownership and annual doctor visits[1]: negative binomial regressions (N=1246)

Explanatory variables	**Dependent variable: Doctor visits** ***b***	
Pet owner (yes=1, no=0)	**- 0.11*** **	---
PetAlways[2]	---	**- 0.10*** **
PetNow	---	**0.02**
Pet5ago	---	**0.05**
Gender (f=1, m=0)	0.12***	0.12***
Age (years)	0.01***	0.01***
Partnered (yes=1, no=0)	0.10***	0.09***
Disposable income (log)	- 0.13***	- 0.13***
Health (excellent)[3]	-0.84***	- 0.84***
Health (very good)	- 0.57***	- 0.56***
Health (good)	- 0.36***	- 0.36***
Health (fair)	- 0.13***	- 0.13***
	Pseudo R^2 = 9.6%	Pseudo R^2 = 9.5%

Source: ISSS-A 2001, authors' calculations.
Note: *** p < 0.01; ** p < 0.05.
1. Number of doctor visits in the previous year.
2. Reference group: PetNever in equation 2.
3. Reference group: current Health status (poor)

APPENDIX 1

Table A1

Germany: Descriptive statistics for variables in the negative binomial regressions (N=9721)

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Number of doctor visits in last 3 months (2001)	2.849	4.422	0	90
Pet owner (yes=1, no=0)	.363	.486	0	1
PetAlways	.274	.446	0	1
PetNow	.114	.314	0	1
Pet5ago	.128	.347	0	1
PetNever	.484	.500	0	1
Gender (f=1, m=0)	.524	.499	0	1
Age (years)	48.252	15.826	22	98
Age squared	2578.777	1643.975	484	9604
Equivalized disposable income (log)	6.155	1.726	2.10	12.26
Partnered (yes=1, no=0)	.758	.428	0	1
Health 1996 (very good)	.088	.283	0	1
Health 1996 (good)	.384	.486	0	1
Health 1996 (satisfactory)	.352	.478	0	1
Health 1996 (poor)	.143	.350	0	1
Health 1996 (bad)	.030	.171	0	1

Source: SOEP 1996, 2001, authors' calculations.

Table A2

Australia: Descriptive statistics for variables in the negative binomial regressions (N=1246)

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Number of doctor visits in 2001	5.126	3.800	0	16
Pet owner (yes=1, no=0)	.643	.479	0	1
PetAlways	.569	.495	0	1
PetNow	.063	.242	0	1
Pet5ago	.134	.341	0	1
PetNever	.218	.413	0	1
Gender (f=1, m=0)	.550	.498	0	1
Age (years)	49.567	15.541	20	89
Age squared	2698.188	1595.134	400	7921
Partnered (yes=1, no=0)	.764	.425	0	1
Disposable income (log)	10.606	.821	8.52	13.30
Health (excellent)	.169	.375	0	1
Health (very good)	.350	.477	0	1
Health (good)	.315	.464	0	1
Health (fair)	.315	.464	0	1
Health (poor)	.137	.170	0	1

Source: ISSS-A 2001, authors' calculations.

NOTES

[1] For a comprehensive overview of the benefits of pet ownership for human health, see Wood et al. (2005).
[2] This was done only after initial checks showed that owning multiple pets confers no additional health benefits.
[3] The items in the Australian questionnaire deviate somewhat from the German: they are 'excellent, very good, good, fair and bad'.
[4] The key assumption on which the matching estimator rests is that all the variables driving the self-selection process and correlated to the outcome are observable (Rosenbaum and Rubin, 1983). The assignment to the treatment group is fully ignorable, given a set of characteristics x, if conditional on x, the treatment can be thought of as randomly assigned to units. At each value x there has to be a positive probability of being treated: $(Y^T, Y^{NT}) \perp D|x$, $0 < Pr(D = 1|x) < 1$. If this condition holds, we can assume that units were randomly assigned to the treatment group with a probability depending on x; the counterfactual outcome for participants presenting characteristics x can be approximated by the actual outcome for non-participants presenting the same characteristics. Since units presenting x have a common probability of entering enter the program, participants can be matched to non-participants on this probability (the so-called propensity score, see Rosenbaum and Rubin, 1983). Here we make use of the psmatch.ado provided by Barbara Sianesi applying nearest-neighbour matching within calliper.
[5] A general limitation of the propensity score matching method is the need for a very large sample. This is not the case for Australian data used in this study. Furthermore the control group in the Australian data is also small, given that more than 2/3 of the whole population own a pet.
[6] It is possible that one reason Australians appear to go to the doctor so much less than Germans relates to the difference in questions; recall that Australians were asked to report visits for a 12 month period, whereas the German respondents reported only on 3 months of visits, with the researchers then multiplying by four to get an annual figure.
[7] Inspection of the relationship between self-reported health indicated that it was preferable to break the five point scale into dummy variables rather than treat it as a continuous scale. The lowest health rating (health 'very bad') was used as the reference variable.
[8] To determine a successful match we applied a nearest neighbor matching within a calliper of 0.01 of the standard deviation of the propensity score.