Birds of a Feather Flock together?: Investigating the role of marriage duration on peer effects and obesity, smoking, and binge drinking outcomes

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Abstract:

There is a growing body of research investigating in couples the role of peer effects on health related behaviour outcomes such as obesity, smoking, and alcohol consumption. The function of relationship duration on peer effects on obesity, smoking, and alcohol consumption has not been explored. This paper uses data from the waves 2-9 of the Household Income and Labour Dynamics of Australia (HILDA) survey to investigate if peer effects on obesity, smoking, and binge drinking vary by relationship duration and gender. The analysis controls for positive assortative mating impacting on outcomes to isolate the influence of peer effects. Results from a dynamic bivariate probit model show evidence of peer effects on smoking, and binge drinking which are stronger for women than men. After controlling for positive assortative mating only marginal peer effects on obesity outcomes was found, with the effect being stronger for women than men. Peer effects vary by relationship duration for obesity and smoking outcomes for women only. The effect of relationship duration is not consistent across different relationship duration categories suggesting the results are not capturing a shared environment effect.

Introduction

The leading causes of death in developed countries are non-communicable diseases such as cardiovascular disease and diabetes. It is estimated that approximately, 80% of deaths from coronary heart disease and cerebrovascular disease are caused by behavioural risk factors such as tobacco consumption, physical inactivity, and an unhealthy diet (World Health Organisation (WHO) 2011). These same behavioural risk factors are potentially influenced by personal relationships; many activities, such as alcohol consumption and eating, are more enjoyable with others than on one's own. Peers also likely influence individual perception regarding social norms associated with health related behaviours. There is a growing body of literature using longitudinal data to investigate peer and social influence on behaviours and outcomes. Peer effects have been found in activities ranging from obesity (Christakis and Fowler 2007) to loneliness (Cacioppo et al. 2009), sleep loss and drug use (Mednick et al. 2010) and even divorce (McDermott et al. N.D).

The literature investigating peer effects has traditionally focused on negative health related behaviours. However, the phenomenon of peer effects may also be used to spread healthy behaviours. Policy and health interventions targeted at changing individual behaviour may have spillover effects on the targeted individual's social network, multiplying the effect of the intervention.

An important point that has been ignored in much of the social interaction and peer effect literature in economics is relationship length on the intensity and duration of peer effects on health related behaviour. Tie dissolution and the factors influencing relationship maintenance have been investigated in the sociology literature. For example, Burt (2000) investigates the deterioration of relationships finds that knowledge about the type of individual one is most compatible with through life experience and duration of the relationship negatively impact on the likelihood of relationship decay. Kandel (1978) finds using longitudinal data on adolescent friendship pairs that friendship maintenance is based on initial characteristics and staying friends with those who are more like you in attitude and behaviour.

Length of relationship may then affect the role of peer effects on health related behaviour. For example, to maintain a relationship tie in the beginning of the relationship, one individual may be more likely to emulate the behaviour of the individual who they want to maintain the social tie with to promote social cohesion. The influence of peer effects may then fade with time as the likelihood of relationship dissolution reduces as found by Burt (2000). Alternatively, longer lasting relationships may be the result of shared behaviours and attitudes as suggested by Kandel (1978). In this case, the duration of the relationship may be conditional on these shared behaviours and/or attitudes, inflating the impact of peer effects in this situation. For both of these alternative scenarios, relationship duration may affect the social multiplier effect of policy interventions.

The aim of this paper is to investigate if peer effects on partner[1] health related behaviour varies by relationship duration. Specifically, I focus on obesity, smoking, and binge drinking using longitudinal data from the Household Income and Labour Dynamics in Australia (HILDA) survey from 2002 to 2009. Understanding how social interactions at the household level are influence by the duration of the relationship will help policy makers and practitioners develop effective health policy and interventions that appropriately address the characteristics and situations of the target group and so reduce the burden of non-communicable disease.

Background

There is extensive evidence suggesting that spouses exhibit similar health related behaviours such as smoking (Clarke and Etile 2006, Christakis and Fowler 2008, and Cutler and Glaeser 2008), alcohol consumption (Leonard and Mudar 2003 and Rosenquist et al. 2010), and obesity (Christakis and Fowler 2007 and Clarke and Etile 2010). Manski (1993) proposed three hypotheses to explain

[1] Partners refer to legally married couples and couples in cohabiting relationships. This term is used to refer to couples throughout this paper.

correlated behaviour in a given social group. Individuals congregate with others that share their interests. Manski called this correlated effects. In the marriage market literature (Becker 1973) this would be referred to as positive assortative mating where partnerships are formed based on the gains to marriage from partners sharing similar characteristics such as smoking participation or interests such as cooking and eating out. The second hypothesis is that a shared environment leads to similar outcomes in a social group which is called either contextual or exogenous factors. For example, if partners live in an obesogenic environment this may result in both of them becoming obese. The third hypothesis which Manski deemed endogenous effects relates to one individual copying the behaviour of another individual in one's social group. This may result from social learning where individuals learn from one another by observation, imitation, and modelling (Bandura 1977). For example, if one partner changed their portion size at meal time to emulate the other partner, leading to correlated BMI outcomes. It is also possible that activities such as alcohol consumption and eating are more enjoyable with others than on one's own leading to correlated health related behaviours or outcomes. Endogenous effects would imply a social contagion effect or peer effect of behaviour.

The literature exploring peer effects on correlated outcomes in obesity, smoking and binge drinking in spouses have found mixed support for this hypothesis. Christakis and Fowler (2007) find a social contagion effect of obesity for spouses. If one spouse becomes obese the likelihood that the other spouse becomes obese increases by 37%. Whereas Clark and Etile (2010) find the social contagion effect of obesity disappears when using an instrumental variable (IV) approach. With the IV method positive assortative mating explains more of the correlation in spousal BMI. There are also a number of studies (Schafer and Keith, 1990, Silventoinen et al. 2003, Speakman et al. 2007, and Oreffice and Quintana-Domeque, 2010) that identify spousal correlations in weight resulting from positive assortative mating in the marriage market.

For smoking, Clark and Etile (2006) used longitudinal data on spouses that did not separate over a nine year period from the British Household Panel Survey and found that positive assortative mating explains the majority of the correlation in spousal smoking. Whereas, Cutler and Glaeser (2008) and Christakis and Fowler (2008) uncover a social contagion effect of spousal smoking. Cutler and Glaeser (2008) use an IV approach finding that men are more influenced by spousal smoking than women. Christakis and Fowler (2008) found that if one spouse quit smoking it increased the likelihood of the other spouse quitting by 67%.

Finally, for alcohol consumption, Leonard and Mudar (2003) investigate spousal drinking patterns in recently married couples. They find evidence of both positive assortative mating and social contagion effect of alcohol consumption. Husband's pre-marital drinking had a significant impact on wife's alcohol consumption after one year of marriage. Rosenquist et al. (2010) use longitudinal data from the Framingham Heart Survey (US) finding that if a wife starts heavy drinking in period *t-1* this increased the likelihood that the husband would become a heavy drinker in period *t* by 196% and if a husband started heavy drinking in period *t-1* this increased the likelihood that the wife would become a heavy drinker in period *t* by 126%.

The majority of the studies identified above investigating social contagion effects use longitudinal data. In theory the use of longitudinal data should provide more flexibility, by observing repeated observations, to separate positive assortative mating resulting from partnership formation from subsequent social contagion effects of behaviour. However, this body of research has limited the sample analysed to spouses that do not separate over the sample period for ease of analysis. For this type of restricted sample, not accounting for relationship duration may distort the impact of peer effects on health related behaviour. Noel and Nyhan (2011) test the impact of friendship dissolution on identifying peer effects by simulating the models testing the social contagion effect of obesity from Christakis and Fowler (2007) allowing for the dissolution of friendship ties. They find that when friendship dissolution is present leading to non-negligible attrition the Christakis and Fowler (2007) models show substantial upward bias and decreased coverage levels as correlated effects in friendship retention increase. This suggests that caution is required in interpreting social contagion effects that rely on maintained ties over time.

To further disentangle how relationship duration may impact on peer effects on obesity, smoking, and binge drinking outcomes, this paper adds to the literature by exploring if there is a joint effect of relationship duration and lagged partner health related behaviour on own health related behaviour. Relationship duration dummies are used to determine if the joint effect of relationship duration and lagged partner health behaviour differs by length of relationship. The analysis controls for positive assortative mating leading to correlated outcomes in an attempt to isolate peer effects.

Data:

The empirical analysis uses data from waves 2 to 9 (2002-2009) of the Household Income and Labour Dynamics of Australia (HILDA) survey. The HILDA is an annual household based panel survey. The panel members are followed over time and each household member over the age of 15

is interviewed. The survey collects multiple year information on financial, labour market, demographic, and health as well as health related behaviour for a general population. The survey was designed to be consistent with the British Household Panel Survey (BHPS) and the German Socio-Economic Panel (GSOEP) Survey. The motivation behind the creation of the HILDA is described in greater detail in Watson and Wooden (2006).

The analysis is limited to respondents between the ages of 25 to 65 whom are observed as married or in a cohabiting partnership with someone of the opposite gender in at least three consecutive years and do not separate over the sample period[2]. Full information for both partners is required. . We observe 2646 couples providing 18,661 observations.

Dependent Variable

The three separate health related behaviours: obesity, smoking participation, and binge drinking are used as dependent variables in the analysis. These behaviours are estimated separately in dynamic bivariate probit models to determine if the influence of relationship duration is different for men or women.

Obesity

Obesity is defined according to the WHO classification system of a BMI of greater than 30 kg/m^2. In the HILDA, BMI is calculated using self-reported height and weight. It is well documented that height and weight which are self-reported are likely to be biased by measurement error (see for example Cawley 2004). Height tends to be overstated and weight tends to be underreported. In the HILDA survey the height and weight responses were inspected via a two stage process. The first stage was a visual scan of the data to ensure that incorrect values had not be entered and the second stage involved changing unrealistic values to missing (Wooden et al. 2008)[3]. The obesity variable is available in waves 6 through 9.

Smoking

Smoking is a binary variable which equals one if the respondent reports smoking less than once a week, at least once a week, or daily and is equal to zero otherwise. The smoking variable is self-reported potentially leading to measurement error or bias. Patrick et al. (1994) conducted a

[2] It is possible that peer effects may be different for same sex couples. The sample size is too small to look at this group.

[3] Unrealistic height values are defined as a height of less than 120cms or greater than 210cms. Unrealistic weight values are defined as a weight less than 40kgs or greater than 200kgs. Unrealistic height and weight combination were defined as a BMI of less than $15kg/m^2$ or greater than $60kg/m^2$.

systematic review of the literature using self-reported smoking variables finding that they are accurate in most studies when compared with biochemical markers such as cotinine in the salvia. The smoking variable used in the analysis is available in waves 2 through 9.

Binge Drinking

The National Health and Medical Research Council (NHMRC) of Australia state that drinking more than four standard drinks on a single occasion increases the risk of alcohol related injury[4] (NHMRC 2009). I use this definition for harmful drinking to classify binge drinking as equal to one if individuals drink more than four standard drinks on a day when they consume alcohol and is equal to zero otherwise. Alcohol consumption is also self-reported potentially leading to measurement error and bias. Del Boka and Darkes (2003) reviewed the literature using self-reported alcohol consumption finding that such measures are generally reliable and valid. The binge drinking variable is available in waves 2 through 9.

Covariates

I assume that the three health behaviours of obesity, smoking, and binge drinking are a function of marriage duration, individual characteristics, household characteristics, and relationship characteristics.

$$Obesity, Smoking, Binge\ Drinking = f(D, X, H, M)$$

Individual characteristics, household characteristics, and relationship characteristics are expected to significantly impact on obesity, smoking, and binge drinking. However the covariates are allowed to affect each health related behaviour differently. All explanatory variables may also impact differently on men and womens outcomes. It is not expected that relationship duration as an independent explanatory variable will significantly impact on obesity, smoking and binge drinking. The focus is on the interaction of relationship duration with lagged partner health related behaviour.

Relationship duration is calculated for married individuals using the derived variable *mrcdur*. In period *t=1*, *mrcdur* is calculated from the month and year of current marriage to date of current interview. *Mrcdur* is updated each year of the survey that partners remain together. The HILDA contains information for the amount of time that couples cohabited before marriage. For couples that cohabited before marriage this time is added to the relationship duration variable to control for the amount of time spent in the shared environment and true duration of the co-residential relationship impacting on the role of social interactions on health related behaviour outcomes. For

[4] An Australian standard drink contains 10g of alcohol which is equivalent to 12.5ml of pure alcohol (NHMRC 2009).

cohabiting individuals, there is a separate relationship duration variable, the derived variable *orcdur* which is calculated from month and year started living with current partner to date of interview. Similar, to the marital duration variable, cohabitation duration variable is updated each year the couple remains together. Four dummy variable for length of relationship: 1) 0 to 5 years; 2) 5 to 10 years; 3) 10 to 20 years; and 4) 20 or more years are created. The relationship duration dummies do not distinguish between married and cohabiting couples.

The individual characteristics included in the model control for demographic and economic factors. To control for cultural orientation and social norms impacting on health related behaviour a dummy variable for if the respondent was born in Australia and an indicator variable if they had emigrated from a country where English was the dominant language and there are cultural similarities to Australia[5] are included in all models. Age and age squared are included in all models to control for cohort effects on health related behaviour. Including age and age squared should mean that relationship duration is not a proxy for age effects on partner influence on health related behaviour. Six dummy variables for highest educational qualification are included in the analysis. The economic variables included in the models are a dummy for if the respondent is currently employed in either full time or part time employment, an indicator variable for if the respondent is currently unemployed, and labour income which is defined as zero if the respondent is not working and is a positive number if the respondent is currently employed.

The household characteristics included in the model are log of household income, an indicator variable for if the household is located in the three most deprived deciles, an indicator variable for if the household is located in the middle three deprived deciles, a dummy variable for if the household is located in a rural area, number of children, and a dummy variable controlling for if there are children under the age of 5 in the household.

In addition to the relationship duration dummies, there are other relationship characteristics included in the analysis. Age married[6] and dummies for the age difference between partners are included in all equations. There is also an indicator variable for if it is a cohabiting partnership. Finally, two dummy variables are included for if partners have different educational qualifications and partners were born in the same country.

Descriptive Statistics

[5] This group of countries includes the USA, New Zealand, Canada, Ireland, and the UK.
[6] In cohabiting relationships this age began cohabitation spell.

The descriptive statistics are presented in Table 1. Approximately 25% of the total sample across waves 6 through 9 are classified as obese. The National Health Survey (NHS) for Australia from 2004-2005 report lower levels of obesity in adult men and women (19.1% for men and 21.8% for women). However, the data from the NHS is also self-reported and there is a higher percentage of non-response compared with the HILDA which may lead to measurement error and reporting bias (Wooden et al. 2008). It is also possible that the sample of married respondents may have a higher BMI than the average population. Approximately, 21% of men and 15% of women of the total sample are current smokers. Data from the 2004-05 NHS indicates that 26% of men and 20% of women were current smokers. In Table 1, we can see that 21% of men in the sample report binge drinking and 7% of women report binge drinking. A higher percentage of men included in the sample from HILDA report binge drinking compared to the 18% of adult men reported in the 2004-2005 NHS. Fewer women report binge drinking than the 13% of adult women from the 2004-2005 NHS. Differences in smoking and binge drinking outcomes for the coupled sample compared to the NHS sample may reflect differences in sample composition. As a higher percentage of men report smoking and binge drinking, in our sample, if there is a social interaction effect leading to both partners engaging in unhealthy behaviour it would likely work in the direction of men to women than vice versa. For obesity, as there are approximately equal percentages of obese men and women, it is more likely that there could be a bi-directional effect of social interactions on obesity outcomes.

Econometric Model

To investigate peer effects on obesity, smoking, and binge drinking outcomes, I use a dynamic bivariate probit framework. Dynamics are introduced to the models by including a lagged term for own and partner health related behaviour. Individual heterogeneity and endogeneity introduced from adding the lagged terms to the model are accounted for by controlling for initial conditions (health outcome in period $t=1$) following the method proposed by Wooldridge (2005). The distribution of the unobserved heterogeneity, conditional on the initial conditions and any exogenous covariates is specified. If spouses match on time constant factors related to the propensity to be obese, or participate in smoking and binge drinking, the Wooldridge method will remove the effect of positive assortative mating from the model.

In addition, the dynamic bivariate probit model allows for correlation between partner's outcomes recognising that there are shared unobservable characteristics of couples that influence both of their health related behaviour outcomes. I estimate three sets of equations for obesity, smoking, and binge drinking:

$$Obese_{h,t} = \begin{cases} 1 if\ Obese^{*}_{h,t} = \alpha_1 Obese_{h,t-1} + \beta_1 Obese_{w,t-1} + \zeta_1 D_{h,t} + \gamma_1 X_{h,t} + \delta_1 H_{h,t} + \xi_1 M_{h,t} + c_h + \varepsilon_{h,t} \\ 0 Otherwise \end{cases}$$

$$Obese_{w,t} = \begin{cases} 1 if\ Obese^{*}_{w,t} = \alpha_2 Obese_{w,t-1} + \beta_2 Obese_{h,t-1} + \zeta_2 D_{w,t} + \gamma_2 X_{w,t} + \delta_2 H_{w,t} + \xi_2 M_{w,t} + c_w + \varepsilon_{w,t} \\ 0 Otherwise \end{cases} \quad (1)$$

Where $c_h = \eta_0 + \eta_1 Obese_{h,1} + \mu_h$ and $c_w = \eta_0 + \eta_1 Obese_{w,1} + \mu_w$ and $t=1,...,T$

The subscript *h* denotes males (husbands) and the subscript *w* denoted women (wives).

Let *Obese* be a binary variable for obesity in period *t*. The individual is obese in period *t* if $Obese^{*}_{h(w),t} = 1$. The vector ***D*** includes the dummy variables for relationship duration, the vector X includes exogenous individual characteristics, the vector ***H*** includes exogenous household characteristics, and the vector ***M*** includes other exogenous characteristics related to the relationship. The associated coefficients of parameters to be estimated are, $\gamma, \delta, \xi,$ and ζ. Own and partner lagged obesity are estimated by the parameter of coefficients in $\alpha_1, \beta_1, \alpha_2,$ and β_2. Dynamics are assumed to be first order, implying that state dependence can be collapsed into a single parameter for own and partner lagged obesity[7]. c_h and c_w represent the unobserved heterogeneity for husbands and wives respectively; which following the Wooldridge (2005) method is specified as conditional on obesity in period *t=1* (initial conditions) ($Obese_{h,1}$ and $Obese_{w,1}$) and a normally distributed error term (μ_h and μ_w). $\varepsilon_{h,(w),t}$ is a random error component. The error terms are assumed to have a bivariate normal distribution.

$$Smoke_{h,t} = \begin{cases} 1 if\ Smoke^{*}_{h,t} = \alpha_1 Smoke_{h,t-1} + \beta_1 Smoke_{w,t-1} + \zeta_1 D_{h,t} + \gamma_1 X_{h,t} + \delta_1 H_{h,t} + \xi_1 M_{h,t} + c_h + \varepsilon_{h,t} \\ 0 Otherwise \end{cases}$$

$$Smoke_{w,t} = \begin{cases} 1 if\ Smoke^{*}_{w,t} = \alpha_2 Smoke_{w,t-1} + \beta_2 Smoke_{h,t-1} + \zeta_2 D_{w,t} + \gamma_2 X_{w,t} + \delta_2 H_{w,t} + \xi_2 M_{w,t} + c_w + \varepsilon_{w,t} \\ 0 Otherwise \end{cases} \quad (2)$$

Where $c_h = \eta_0 + \eta_1 Smoke_{h,1} + \mu_h$ and $c_w = \eta_0 + \eta_1 Smoke_{w,1} + \mu_w$ and $t=1,...,T$

[7] Higher order dynamics are permitted (Heckman 1981), however this requires simultaneous estimation of multiple equations as there will be multiple initial conditions which is computationally intensive. First order dynamics are also assumed for smoking and binge drinking.

Let *Smoke* be a binary variable for smoking participation in period *t*. The individual smokes in period *t* if $Smoke^{*}_{h,(w),t} = 1$. The vectors ***D*** **,*X***, ***H***, and ***M*** and their associated parameters of coefficients to be estimated have been described above. In equation (2), own and partner lagged smoking participation are estimated by the coefficients in $\alpha_1, \beta_1, \alpha_2,$ and β_2. In equation (2), c_h and c_w the unobserved heterogeneity for husbands and wives respectively, are conditional on smoking in period *t=1* and an unobserved error component.

$$BD_{h,t} = \begin{cases} 1 if\ BD^{*}_{h,t} = \alpha_1 BD_{h,t-1} + \beta_1 BD_{w,t-1} + \zeta_1 D_{h,t} + \gamma_1 X_{h,t} + \delta_1 H_{h,t} + \xi_1 M_{h,t} + c_h + \varepsilon_{h,t} \\ 0 Otherwise \end{cases}$$

$$BD_{w,t} = \begin{cases} 1 if\ BD^{*}_{w,t} = \alpha_2 BD_{w,t-1} + \beta_2 BD_{h,t-1} + \zeta_2 D_{w,t} + \gamma_2 X_{w,t} + \delta_2 H_{w,t} + \xi_2 M_{w,t} + c_w + \varepsilon_{w,t} \\ 0 Otherwise \end{cases} \quad (3)$$

Where $c_h = \eta_0 + \eta_1 BD_{h,1} + \mu_h$ and $c_w = \eta_0 + \eta_1 BD_{w,1} + \mu_w$ and *t=1,...,T*

Let *BD* be a binary variable for binge drinking in period *t*. The individual binge drinks in period *t* if $BD^{*}_{h,(w),t} = 1$. The vectors ***D*** **,*X***, ***H***, and ***M*** and the associated coefficients to be estimated have been defined in equation (1). Own and partner lagged binge drinking are estimated by the parameter of coefficients, $\alpha_1, \beta_1, \alpha_2,$ and β_2. In equation (3), c_h and c_w, the unobserved heterogeneity for men and women respectively are conditional on binge drinking in period *t=1* and an unobserved error component.

The parameters of interest in equations (1), (2), and (3) are estimated by maximum likelihood.

The next step of the estimation procedure is to test the combined role of relationship duration and lagged partner behaviour on own health related behaviour. For illustrative purposes, only the obesity equations will be shown. Smoking and binge drinking follow the same pattern.

$$Obese_{h,t} = \begin{cases} 1 if\ Obese^{*}_{h,t} = \alpha_1 Obese_{h,t-1} + \beta_1 Obese_{w,t-1} + \zeta_1 D_{h,t} + \beta_1 \zeta_1 Obese_{w,t-1} D_{h,t} + \gamma_1 X_{h,t} + \delta_1 H_{h,t} \\ + \xi_1 M_{h,t} + c_h + \varepsilon_{h,t} \\ 0 Otherwise \end{cases}$$

$$Obese_{w,t} = \begin{cases} 1 if\ Obese^{*}_{w,t} = \alpha_1 Obese_{w,t-1} + \beta_1 Obese_{h,t-1} + \zeta_1 D_{w,t} + \beta_1 \zeta_1 Obese_{h,t-1} D_{w,t} + \gamma_1 X_{w,t} + \delta_1 H_{w,t} \\ + \xi_1 M_{w,t} + c_w + \varepsilon_{w,t} \\ 0 Otherwise \end{cases} \quad (4)$$

The vector ***D*** is decomposed to contain only one relationship duration dummy, because of this equation (4) is estimated four times with each of the relationship duration dummies separately. This is done to isolate the affects of different periods of relationship duration from early relationship to a longer partnership on the influence of partner health related behaviour on own outcomes.

Five different model specifications are estimated:

- Model (1) is a dynamic bivariate probit model estimated using equations (1), (2), and (3) for obesity, smoking, and binge drinking respectively. The base category for the relationship duration dummy is being in a relationship twenty or more years.
- Model (2) includes an interaction term of the dummy variable for being in a relationship between 0 to 5 years and the lagged partner health related behaviour in question.
- Model (3) includes an interaction term of the dummy variable for being in a relationship between 5 and 10 years and the lagged partner health related behaviour in question.
- Model (4) includes an interaction term of the dummy variable for being in a relationship between 10 to 20 years and the relevant lagged partner health related behaviour.
- Model (5) includes the interaction term of the dummy variable for being in a relationship twenty or more years and the lagged partner health related behaviour in question.

In Models 2-5 only the relationship duration dummy term that is being interacted with lagged partner health related behaviour is included in the model, the other dummies for relationship duration are excluded.

Results

The results from the dynamic bivariate probit models for obesity, smoking, and binge drinking are presented in Tables 2, 3, and 4 respectively. Average partial effects are calculated for the probability of a positive outcome on the health related behaviour in question for both partners. The key variables of interest are partner's lagged behaviour and the interaction between lagged partner behaviour and the relationship duration dummies. Our key variables of interest are all binary implying that the average partial effect can be interpreted as the difference of the predicted value at 1 and the predicted value at 0 averaged across the sample population. The average partial effect on the interaction term is the double difference of the interacted covariates. The built in programme (*margins*) available starting with *STATA v.11*, for computing partial effects and their standard errors, has removed the stumbling block in correctly interpreting interaction terms in nonlinear models (Greene 2010 and Norton et al. 2004). The partial effects on the interaction terms show if the interaction effect of the relationship duration dummy and lagged partner behaviour are significantly different from zero for the average individual in the sample.

All models estimated also control for individual characteristics, household characteristics, and relationship characteristics that impact on obesity, smoking, and binge drinking outcomes[8]. All models also control for initial conditions.

Looking at the obesity equations in Table 2, Model (1), being obese in the previous period increases the likelihood of being obese in the current period by approximately 6% for both men and women. Controlling for state dependence significantly reduces the magnitude of the coefficient on lagged obesity[9]. The effect on own obesity is consistent across all five models for men and women. For both men and women, lagged partner's obesity increases the likelihood of being obese in the current period by approximately 1%. The significance of lagged obesity participation varies by model specification. These findings suggest that after controlling for initial conditions, there is not a large peer effect on obesity outcomes. This result is similar to Clark and Etile (2010). In Model (1) for both men and women none of the relationship duration dummies significantly impact on obesity. However, I am interested in investigating the relationship between partner behaviour and relationship duration, rather than marriage duration per se on health related outcomes. Rho is positive and significant at the 10% level suggesting a bivariate probit model is the appropriate model specification.

Moving on to the interaction models in Table 2 (Models 2-5), there is no significant interaction effect in Model (2) in column (II) for men and column (VII) for women between being in a relationship between 0 and 5 years and lagged partner obesity on own obesity. For women in Models (3) and (4) in columns (VIII) and (IX) the interaction term is significantly different from zero. The interaction term is not significant in Model (6) in Table 2 for women suggesting that the significant interaction between relationship duration of 5 to 10 years and 10 to 20 years with lagged partner obesity is not caused by environmental factors. For men in Model 3-6 there is no significant effect of the interaction term, but this is to be expected as wife's lagged obesity only marginally impacts own obesity in Models (1) and (3).

Next, we will look at the results from the smoking models in Table 3. As is expected, lagged own smoking significantly increases the likelihood of own smoking in the current period by 4% for men and 5% for women after using initial conditions to control for state dependence in smoking. This result is consistent across the different model specifications. For both men and women, partner's lagged smoking has a significant and positive effect on own smoking in the current period. The

[8] Because of space limitations, only the key variables impact on obesity, smoking, and binge drinking are shown in Tables 3,4, and 5.

[9] Because of space constraints, models that do not control for initial conditions are not shown but are available upon request.

partner effect on lagged smoking is significant at the 1% level for both men and women in all models suggesting social influence works in both directions between spouses. In Model (1) for both men and women none of the duration dummies significantly impact on smoking. Rho is positive and significant at the 1% level (0.25) suggesting that there are shared unobserved characteristics impacting the likelihood of both spouses smoking.

Models 2-5 in Table 3, show the interaction terms for the relationship duration dummies and lagged partner smoking. For women in Model (2) (column VI) which includes the interaction term for the being in a relationship between 0 to 5 year dummy and lagged partner smoking and in Model (4) (column VIII) with the interaction term for being in a relationship between 10 to 20 years and lagged partner smoking, the partial effect on the interaction terms are significantly different from zero. As this effect is not consistent across the different model specifications for women it is likely not caused by partners sharing the same environment. None of the interaction terms are significant for men.

Finally, we look at the models for binge drinking in Table 4. Lagged own binge drinking significantly increases the likelihood of binge drinking in the current period by 2% for men and 5.3% for women after controlling for state dependence. This effect is consistent across all model specifications. Partner lagged binge drinking has a positive and significant impact on own drinking in all models for both men and women. Having a husband who engaged in binge drinking in the previous period increases the likelihood of a wife binge drinking in the current period by 1.5% whereas a wife binge drinking in the previous period only increases the likelihood of her partner binge drinking in the current period by 0.5%. These findings suggest that the social influence favours husband's influencing their wives behaviour. The social interaction effect is much smaller than that found in Rosenquist et al. (2010). In their lagged logistic model they do not control for state dependence in drinking and marriage duration which may partially explain the smaller effect of social interactions on binge drinking found in this paper. Rho is positive and significant at the 1% level suggesting that there are shared unobserved factors impacting on spouses' likelihood of binge drinking.

In Models 2-5 in Table 4, none of the interaction terms are significantly different from zero for either men or women. This suggests that partner influence on binge drinking does not significantly vary by marital duration.

Discussion and Conclusion

The results add to the literature exploring peer effects on couples' obesity, smoking, and binge drinking outcomes.

Obesity:

- Similar, to Clark and Etile (2010) after controlling for positive assortative mating, there was only a small peer effect for women and a marginal peer effect for men.
- The interaction term for obesity and peer effects was significant for women in two model specifications. The interaction terms were not consistent across model specifications implying that it is not capturing the influence of the shared environment.

Smoking:

- After controlling for positive assortative mating, significant peer effects were found for both men and women. A stronger effect was found for women. These findings are consistent with Cutler and Glaeser (2008) and Christakis and Fowler (2008).
- The interaction term for smoking and peer effects was significant in two model specifications. The interaction terms were not consistent across model specifications implying that it is not capturing the influence of the shared environment.

Binge Drinking:

- Significant peer effects were found for both genders after controlling for positive assortative mating.
- None of the interaction terms were significant for either gender.

Implications:

- Peer effects of one's partner are a more important factor in influencing women's health related behaviour outcomes.
- Social influence appears to vary significantly by relationship duration for obesity and smoking participation for women adding support to the hypothesis that relationship duration may affect the observed peer effect of behaviour.
- Maintaining social cohesion by emulating partner behaviour may be more important at different stages of the relationship. Alternatively, social learning may occur at different rates and at different times during a relationship impacting on peer effects.

Policy:

- Health interventions that impact on individual behaviour, especially that of men in a co-residential relationship may have both direct and indirect effect on the health related behaviour of their partner.
- For weight and smoking interventions, the spillover effects of the individual intervention may be affected by relationship duration.

Future Work:

- Investigate peer effects in couples that separate over the sample period.

- Significance differences in the impact of peer effects on couple outcomes by relationship continuation would add empirical evidence to the hypothesis that relationship duration should not be ignored when investigating social contagion effects

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Table 1: *Descriptive Statistics*

	Males	n	Females	n
Obese	0.25 (0.43)	7330	0.24 (0.43)	7627
Smokes	0.21 (0.40)	15861	0.15 (0.36)	15830
Binge Drinking	0.21 (0.41)	14196	0.07 (0.25)	13213
Age	45.47 (10.33)	18661	43.11 (10.09)	18661
Australian	0.76 (0.43)	18655	0.77 (0.42)	18653
Anglo-Saxon	0.11 (0.32)	18655	0.09 (0.29)	18653
Employed	0.87 (0.34)	18661	0.69 (0.46)	18661
Unemployed	0.02 (0.13)	18661	0.02 (0.13)	18661
Labour Income	46397.94(44027.55)	18661	23904.80 (26534.20)	18661
Highschool	0.09 (0.29)	18617	0.14 (0.35)	18535
Certificate 1 &2	0.01 (0.10)	18617	0.01 (0.12)	18535
Certificate 3 &4	0.31 (0.46)	18617	0.13 (0.34)	18535
Diploma	0.10 (0.30)	18617	0.10 (0.31)	18535
Degree	0.15 (0.35)	18617	0.16 (0.37)	18535
Postgrad	0.12 (0.32)	18617	0.12 (0.32)	18535
Household Characteristics				
Loghhincome	10.14 (0.70)	18583	10.14 (0.70)	18583
Disadvantaged	0.24 (0.43)	18660	0.24 (0.43)	18660
Medium_disadvantaged	0.28 (0.45)	18660	0.28 (0.45)	18660
Kids_under5	0.22 (0.42)	18661	0.22 (0.42)	18661
Nkids	1.33 (1.26)	18661	1.33 (1.26)	18661
Rural	0.20 (0.40)	18661	0.20 (0.40)	18661
Relationship Characteristics				
0 to 5 years	0.14 (0.35)	18661	0.14 (0.35)	18661
5 to 10 years	0.17 (0.37)	18661	0.17 (0.37)	18661
10 to 20 years	0.30 (0.46)	18661	0.30 (0.46)	18661
20 or more years	0.39 (0.49)	18661	0.39 (0.49)	18661
Age_married	28.86 (8.06)	18661	26.48 (7.39)	18661
Wife_5yrs_older	0.04 (0.20)	18661	0.04 (0.20)	18661
Wife_3to5_yrs_older	0.04 (0.20)	18661	0.04 (0.20)	18661
Wife_0to3_yrs_older	0.22 (0.42)	18661	0.22 (0.42)	18661
Husband_2to4_yrs_older	0.25 (0.44)	18661	0.25 (0.44)	18661
Husband_5plus_yrs_older	0.29 (0.45)	18661	0.29 (0.45)	18661
Cohabit	0.13 (0.34)	18647	0.13 (0.34)	18647
Partners_same_edu	0.72 (0.45)	18656	0.72 (0.45)	18656
Partners_samecountry	0.75 (0.43)	18647	0.75 (0.43)	18647

Notes: The descriptive statistics are the mean across all waves that the variable is asked. Labour income and log of household income are in Australian dollars. Age_married is age at which relationship started, it includes cohabiting couples. n is number of observations. Standard errors are in parenthesis.

Table 2: *Obesity Equations*

	Males					Females				
Obesity	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	(I)	(II)	(III)	(IV)	(VI)	(VI)	(VII)	(VIII)	(VI)	(X)
Lag own obesity	0.064***	0.064***	0.064***	0.064***	0.064***	0.061***	0.061***	0.062***	0.062***	0.061***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Lag partner obesity	0.005*	0.005	0.006*	0.005	0.004	0.005**	0.005*	0.003	0.008***	0.006*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
0 to 5 years	0.001	0.000				-0.004	-0.007			
	(0.008)	(0.006)				(0.007)	(0.006)			
5 to 10 years	0.001		0.001			0.004		0.002		
	(0.007)		(0.004)			(0.006)		(0.004)		
10 to 20 years	0.001			0.000		-0.002			0.000	
	(0.005)			(0.003)		(0.004)			(0.003)	
20 plus years					-0.001					0.002
					(0.005)					(0.004)
Lag partner obesity * 0 to 5 years		0.001					0.004			
		(0.012)					(0.008)			
Lag partner obesity * 5 to 10 years			-0.004					0.016**		
			(0.007)					(0.007)		
Lag partner obesity * 10 to 20 years				0.000					-0.011*	
				(0.006)					(0.006)	
Lag partner obesity * 20 + years					0.001					-0.001
					(0.006)					(0.005)
Includes initial conditions	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
rho	0.10* (0.05)	0.10*	0.10* (0.05)	0.10* (0.05)	0.10*	0.10* (0.05)	0.10* (0.05)	0.10*	0.10*	0.10*
		(0.05)			(0.05)			(0.05)	(0.05)	(0.05)
n	4195	4195	4195	4195	4195	4195	4195	4195	4195	4195

Notes: Being in a relationship 20+ years is the base category in Model (1). The interaction terms are estimated separately in Models 2-5. The other dummy variables for relationship duration are not included in the interaction models. Average marginal effects are shown. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: *Smoking Equations*

	Males					Females				
Smoking	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	(I)	(II)	(III)	(IV)	(VI)	(VI)	(VII)	(VIII)	(VI)	(X)
Lag own smoking	0.040***	0.040***	0.040***	0.040***	0.040***	0.051***	0.050***	0.051***	0.051***	0.051***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Lag partner smoking	0.005***	0.004***	0.004***	0.005***	0.005***	0.009***	0.007***	0.008***	0.010***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
0 to 5 years	0.005	0.002				0.004	-0.004			
	(0.003)	(0.002)				(0.004)	(0.003)			
5 to 10 years	0.001		-0.002			0.005		0.002		
	(0.002)		(0.002)			(0.004)		(0.002)		
10 to 20 years	0.001			0.000		0.002			0.001	
	(0.002)			(0.001)		(0.002)			(0.002)	
20 plus years					0.000					-0.001
					(0.002)					(0.002)
Lag partner smoking * 0 to 5 years		0.004					0.008**			
		(0.003)					(0.004)			
Lag partner smoking * 5 to 10years			0.001					0.001		
			(0.002)					(0.003)		
Lag partner smoking* 10 to 20 years				-0.002					-0.006**	
				(0.002)					(0.003)	
Lag partner smoking * 20 + years					-0.002					0.001
					(0.002)					(0.003)
Includes initial conditions	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
rho	0.49***	0.49***	0.49***	0.49***	0.49***	0.49***	0.49***	0.49***	0.49***	0.49***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
n	11757	11757	11757	11757	11757	11757	11757	11757	11757	11757

See Notes on Table 2

Table 4: *Binge Drinking Equations*

	Males					Females				
Binge Drinking (bd)	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	(I)	(II)	(III)	(IV)	(VI)	(VI)	(VII)	(VIII)	(VI)	(X)
Lag own bd	0.022***	0.022***	0.022***	0.022***	0.022***	0.053***	0.053***	0.053***	0.053***	0.053***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Lag partner bd	0.005***	0.005***	0.005***	0.005***	0.005***	0.015***	0.015***	0.016***	0.015***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
0 to 5 years	-0.001	0.001				0.000	-0.002			
	(0.002)	(0.001)				(0.007)	(0.004)			
5 to 10 years	-0.001		0.000			0.003		0.003		
	(0.002)		(0.001)			(0.006)		(0.003)		
10 to 20 years	-0.001			-0.001		0.000			-0.002	
	(0.001)			(0.001)		(0.004)			(0.003)	
20 plus years					0.001					0.000
					(0.001)					(0.004)
Lag partner bd* 0 to 5 years		-0.001					0.000			
		(0.003)					(0.006)			
Lag partner bd * 5 to 10years			0.001					-0.002		
			(0.003)					(0.005)		
Lag partner bd* 10 to 20 years				0.000					0.002	
				(0.002)					(0.004)	
Lag partner bd* 20 +years					0.000					
					(0.003)					
Includes initial conditions	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
rho	0.25***	0.25***	0.25***	0.25***	0.25***	0.25***	0.25***	0.25***	0.25***	0.25***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
n	8620	8620	8620	8620	8620	8620	8620	8620	8620	8620

See notes on Table 2