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Negative life events and symptoms of depression and anxiety: Stress causation and/or stress generation

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Running head: Life events and depression

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Abstract

Background and Objectives: Stressful life events are known to contribute to development of depression, however, it is possible this link is bi-directional. The present study examined whether such stress generation effects are greater than the effects of stressful life events on depression, and whether stress generation is also evident with anxiety. Design: Participants were two large age cohorts (N = 732 aged 44 years; N = 705 aged 63 years) from the West of Scotland Twenty-07 study. Methods: Stressful life events, depression and anxiety symptoms were measured twice five years apart. Cross-lagged panel analysis examined the mutual influences of stressful life events on depression and on anxiety over time. Results: Life events predicted later depressive symptomatology (p = .01), but the depression predicting life events relationship was less strong (p = .06), whereas earlier anxiety predicted life events five years later (p = .001). There was evidence of sex differences in the extent to which life events predicted later anxiety. Conclusions: This study provides evidence of stress causation for depression and weaker evidence for stress generation. In contrast, there was strong evidence of stress generation for anxiety but weaker evidence for stress causation, and that differed for men and women.

Keywords: anxiety; depression; stressful life events; stress causation; stress generation

Consequent on the pioneering research of Brown and Harris (Brown & Harris, 1978; Brown, Harris, & Peto, 1973), it is now widely accepted that stressful life events play a formative role in the development of depressive symptomatology and clinical depression, i.e., psychosocial factors contribute to depression. This concept can be termed social causation or stress causation. More recently, it has been contended that the link between stress and depression is bi-directional and that individuals with depression precipitate stressful life events (Hammen, 2006). The concept of stress generation holds that individuals with depressive symptomatology and depressive disorders actively generate stressful life events as a result of their behaviour and characteristics (Hammen, 2006). In the first empirical demonstration of the phenomenon, a small group of women with unipolar depression were observed to experience more stressful life events over one year of follow-up than demographically-matched groups of women with bipolar disorder, chronic physical illness, or no disorder/disease (Hammen, 1991). Since then, this prospective association between depression and life events has been observed in several samples of clinically depressed adults (Chun, Cronkite, & Moos, 2004; Hammen, 1992; Harkness, Monroe, Simons, & Thase, 1999) as well as in non-clinical populations with elevated levels of depressive symptomatology (Hankin, Kassel, & Abela, 2005; Joiner, Wingate, Gencoz, & Gencoz, 2005; Liu & Alloy, 2010; Potthoff, Holahan, & Joiner, 1995), for a review see (Liu & Alloy, 2010).

However, several not fully answered questions remain. First, are these effects greater than the social causation effects of stressful life events on depression? Second, to what extent is stress generation also evident with related disorders such as anxiety? In a study of undergraduate students, symptoms of depression predicted the change in stressful life events over a five week period whereas symptoms of anxiety did not (Joiner, et al., 2005). Further, in a study following 627 adolescents with depression or anxiety disorders one year after initial assessment, stress

generation effects were also evident for those with anxiety, particularly driven by high neuroticism scores (Uliaszek et al., 2012). Undergraduate students (78% female) high in cognitive personality factors associated with anxiety have also been shown to exhibit stress generation over a four months interval (Riskind, Black, & Shahar, 2010). A follow-up study in 99 female undergraduates replicated this finding (Riskind, Kleiman, Weingarden, & Danvers, 2013). However, further enquiry is merited over a longer follow-up to see whether this direction of effect is maintained in the longer term, especially given the frequent co-morbidity of depression and anxiety (Phillips et al., 2009a), and their symptoms (Carroll, Phillips, Hunt, & Der, 2007) and the short timescales in the previous studies. Studies have observed greater stress generation in individuals with comorbid anxiety than depression alone (Harkness & Luther, 2001), although depressive symptoms appear to strongly drive this effect (Connolly, Eberhart, Hammen, & Brennan, 2010). Finally, in a recent study of 290 female undergraduates with an eating disorder, depression and/or anxiety symptoms, each disorder independently predicted stress generation over an 8-week time period, but when analysed together, only depression remained a significant predictor (Bodell et al., 2012). Third, it might be that women are more likely than men to experience stress; indeed, it was first thought that stress generation was unique to women (Hammen, 2006) and many studies of stress generation have focused solely on females. However, there are exceptions, although these have often shown effects to be stronger among females (Rudolph & Hammen, 1999; Shih, 2006); thus, it is also important to examine sex differences in a large diverse sample, particularly as several previous studies have focused mainly on females and or undergraduates/adolescents.

With data from a sizeable community sample, in which stressful life events and symptoms of depression and anxiety were measured on two occasions five years apart, it is possible to attempt

to answer these questions. Based on previous research (Hammen, 2006), it was hypothesised that a stress generation effect would be observed and it would be of at least equal magnitude to the stress causation effect on symptomatology of stressful life events. Given their co-occurrence, it was further hypothesised that a stress generation effect would also be evident for those with elevated levels of anxiety symptoms.

Method

Participants

Participants were resident in Glasgow and the surrounding area in Scotland. As part of the West of Scotland Twenty-07 Study, they have been followed up at regular intervals since the baseline survey in 1987 (Benzeval et al., 2009). The present analyses were confined to the middle-aged and older cohorts. At wave 3 of data collection in 1995, participants were aged 44 years in the middle cohort and 63 years in the older cohort. 1437 participants had complete data for depression, anxiety, and stressful life event measures at this time. Of these, 732 (51%) were from the middle aged cohort and 705 from the older cohort. At wave 4 of data collection in 2000/01, participants were aged 49 and 68 years. Of these, 1114 completed both depression and anxiety and life events measures, with 592 (53%) of these participants being in the middle aged cohort and 522 in the older cohort. This study was approved by the appropriate Ethics committees.

As depression or ‘nerves’ was one of the life events measured at each time point, individuals who had endorsed this item (N = 71) were removed from all analyses, although inclusion of these individuals had little impact on the present findings, see below. The resultant effective sample size with both depression and anxiety scores and life events scores at both sampling occasions was 1008. Those who had not endorsed these items or did not have full data at wave 4, had

significantly higher anxiety, depression, and life events number at wave 3 measurement (p <.001 in each case). This final sample consisted of 525 (52%) in the middle-aged cohort and 483 in the older cohort, 445 (44%) males and 563 females. Household occupational status, an accepted index of socio-economic position, was classified as manual or non-manual from the occupational status of the head of household, using the Registrar General's (1980) classification of occupations. The head of household was usually the man. The middle cohort was 44% male with 42% from manual occupational households. The older cohort was 44% male and 53% were from manual occupational households; meaning that this group had a significantly higher number of individuals from manual households, $\chi^2(1) = 12.05$, $p = .001$, reflecting the distribution in the general population of that age. A comparison of the cohorts with equivalent samples drawn from the 1991 UK census revealed equivalence in terms of sex, occupational group, and home ownership (Der, 1998). The sample was almost entirely Caucasian, reflecting the West-of-Scotland population from which it was drawn.

Procedure and measurements

Depression and anxiety

Symptoms of depression and anxiety were measured at both wave 3 and wave 4 using the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). The mean (SD) temporal lag between the two follow-ups was 5.5 (SD = 1.00) years. The HADS is a well-recognised assessment instrument that comprises 14 items, seven measuring depression and seven measuring anxiety. The depression subscale emphasises anhedonia and excludes somatic items. Items are scored on a 4-point scale, 0 to 3; the higher the score, the greater the depression and anxiety. The HADS has good concurrent validity (Bramley, Easton, Morley, & Snaith, 1988; Herrmann, 1997), performs well as a psychiatric screening device (Bjelland, Dahl, Haug, &

Neckelmann, 2002; Herrmann, 1997), and boasts acceptable psychometric properties; for example, a Cronbach's α of .90 for the depression items and .93 for the anxiety items has been reported (Moorey et al., 1991) and test-retest reliability coefficients as high as .85 for depression and .84 for anxiety have been found (Herrmann, 1997).

Stressful life events

On each of the occasions, participants completed questionnaires and were interviewed in their own homes by trained nurses. Major life events over the two years prior to interview and their psychological impact were assessed by presenting participants with eight cards each of which listed a number of major life events in one particular domain. The domains were as follows: health, marriage, relationships, bereavement, work, housing, finance, and general. Participants were asked to indicate up to six events which had happened either to them or to someone they cared about. In addition, participants could endorse a final item in each domain if they had experienced an event not listed on the cards without specifying the nature of the event. This was rarely used. The present analyses focused on those events that had happened directly to the participant, (e.g., suffered bereavement, burglary or theft, loss of job etc.) in order to try to focus on events most stressful to themselves, and potentially including those that might have been dependent upon them. Following identification of the events, participants were asked to specify, for each event, how stressful it was at the time of occurrence and now, how disruptive it was at the time and now, and its seriousness. Disruption and stressfulness were rated on a 5-point scale, and seriousness on a 10-point scale. In order to generate a measure that more reflected total perceived allostatic load or life events burden, the ratings at the time were summed across events for each participant; thus, this measure encompasses both the number of life events experienced and their subjective impact. The life events burden measure at each wave was negatively

skewed, but this reflects the occurrence of zero stressful events in many instances. The rest of the distribution is relatively normal. The occurrence of events and these ratings was used to generate the latent variables for structural equation modelling (see Appendix A). The present life events assessment method is based on the well-established Life Events and Difficulties Schedule (Brown & Harris, 1989) and included the same domains of personal experience. It has been argued that the interview method adopted here produces better reliability than self-administration of life events checklists (Raphael, Cloitre, & Dohrenwend, 1991).

Data reduction and statistical analyses

Changes in depression, anxiety, and life events number and burden between waves 3 and 4 were examined using repeated-measures within-subjects ANOVA. Differences in depression, anxiety, and life events at each follow-up between age cohorts, sexes, and household occupational groups were explored using univariate ANOVAs. For comparability with the existing literature, a number of regression models were fitted. Depression score at wave 4 was regressed on the number of stressful life events at wave 3, after controlling for depression score at wave 3. This model was then reversed, with the number stressful life events at wave 4 regressed on the wave 3 depression score, controlling for the number of stressful life events at wave 3. These analyses were repeated substituting anxiety scores for depression in both cases. All the above models were then repeated using the summed life events burden in place of the number of stressful events. All of these models also included adjustment for age cohort, sex, and household occupational group. Further analyses were run predicting the number of life events at wave 4, with both depression and anxiety at wave 3 entered into the model. To investigate causal direction cross lagged panel models were fitted. In this form of structural equation model depression and life event burden at wave 4 are simultaneously regressed both on their own wave

3 values and on the wave 3 values of each other. To decide whether stressful life event burden appears to cause depressive symptomatology or vice versa the strength and significance of the effect of past life event burden on later depression was compared with that of past depression on later life event burden. The same model was also fitted for life event burden and anxiety symptoms.

Results

Depression, anxiety, and life events scores

The descriptive statistics for the HADS and the life events number and burden are displayed in Table 1. As can clearly be seen, depression scores appeared to increase over time while anxiety scores declined, although this temporal change was only significant for anxiety, $F(1, 1007) = 13.83$, $p < .001$, $\eta^2 = .014$. The number of life events reported was roughly stable over time. The older cohort had lower anxiety scores and fewer life events at wave 3, $F(1, 1006) = 8.57$, $p = .003$, $\eta^2 = .008$ and $F(1, 1006) = 14.40$, $p < .001$, $\eta^2 = .014$, respectively, and at wave 4, $F(1, 1006) = 14.68$, $p < .001$, $\eta^2 = .014$ and $F(1, 1006) = 26.52$, $p < .001$, $\eta^2 = .026$, respectively. Men had significantly lower anxiety scores than women at both wave 3 and wave 4, $F(1, 1006) = 22.46$, $p < .001$, $\eta^2 = .022$ and $F(1, 1006) = 35.05$, $p < .001$, $\eta^2 = .034$, respectively. Finally, those from the manual occupational group had higher depression and anxiety symptom levels at wave 3, $F(1, 998) = 11.34$, $p = .001$, $\eta^2 = .011$ and $F(1, 998) = 5.92$, $p = .015$, $\eta^2 = .006$, respectively, as well as at wave 4, $F(1, 998) = 14.71$, $p < .001$, $\eta^2 = .015$ and $F(1, 998) = 7.37$, $p = .007$, $\eta^2 = .007$, respectively. The same differences between age cohort emerged for the life events burden as are reported above for the life events numbers, but there were no sex or occupational group differences. Depression and anxiety scores were correlated at both time points, $r(1006) = .58$, $p < .001$, $r(1006) = .62$, $p < .001$, respectively. As expected, the number of stressful life events

significantly positively correlated with depression scores five years later, and *vice versa*. Similar associations emerged for anxiety; those with a greater number of life events at wave 3 experienced more anxiety symptoms at wave 4, and *vice versa* (see Table 2).

[Insert Table 2 about here]

Main Analyses

Controlling for life events and HADS scores at wave 3 and other covariates

With adjustment for HADS score at wave 3, and age cohort, sex, and household occupational group, the number of stressful events at wave 3 significantly predicted later depressive symptoms at wave 4, $\beta = .07$, $p = .01$, $R^2 = .004$. Depressive symptoms did not significantly predict later life events occurrence, although the association was close to significance ($p = .06$). Analogous analyses for anxiety revealed that life events were not related to anxiety scores five years later. However, higher anxiety at wave 3 predicted an increased number of subsequent life events, $\beta = .10$, $p = .001$, $R^2 = .010$. These associations are summarised in Figure 1.

[Insert Figure 1 about here]

Associations between depression, anxiety, and life events burden experienced.

With adjustment for HADS score at wave 3 (as well as age cohort, sex, and occupational group), stressfulness burden at wave 3 was positively associated with depression, but not anxiety, score at wave 4, $\beta = .07$, $p = .01$, $R^2 = .004$. Fully-adjusted analyses controlling for life events burden at wave 3, showed that both depression and anxiety scores at wave 3 were positively associated with the life events burden five years later, $\beta = .08$, $p = .02$, $R^2 = .005$, and $\beta = .12$, $p < .001$, $R^2 = .014$, respectively.

Adjusting for mutual confounding

Given the strong correlations between depression and anxiety, further analyses were run predicting the number of life events at wave 4, with both depression and anxiety, and age cohort, sex, and occupational group, at wave 3 entered into the model. For the number of events, anxiety significantly predicted a greater number of future stressful life events, $\beta = .10$, $p = .01$, $R^2 = .006$, but depression did not ($p = .93$). In mutually adjusted analyses predicting stressful life events burden, depression did not predict future life events stressfulness ratings when controlling for anxiety ($p = .77$), whereas anxiety adjusting for depressive symptoms did predict future stressful events burden, $\beta = .12$, $p = .002$, $R^2 = .008$. The correlations between all of these variables and age cohort, sex, and occupational group are shown in Table 2.

Inclusion of individuals with higher psychopathology

Inclusion of the 71 individuals who endorse the life events item ‘depression or ‘nerves’’ did not change the present findings, with two exceptions. The trend for depressive symptoms to predict subsequent life events in fully adjusted analyses became significant, $\beta = .10$, $p = .002$, $R^2 = .009$. However, in the mutually adjusted analyses, controlling for anxiety symptoms, depression no longer predicted a greater number of stressful life events at follow-up ($p = .36$).

Structural equation models

The structural models from the cross lagged panel analyses for symptoms of depression and anxiety and life event burden are presented in Figure 2. The measurement models for the same analyses and some further technical details are described in Appendix A. The models shown in Figure 2 are both good fits to the data: RMSEA=.033 and CFI=.990 for depression, and

RMSEA=.048 and CFI=.979 for anxiety. Significant paths are shown as arrows with solid lines and non-significant paths with dashed lines. The standardised coefficient values for each path are also presented. Taking the model for depression first, it is clear that depression has high temporal stability. Life event burden is also stable but more modestly so. The principal interest lies in the cross-lagged paths. These are of similar magnitude, but the impact of life event burden on later depression is statistically significant (p =.03), whereas the impact of depression on later life event burden is marginal (p =.06); nevertheless, the two cross-lagged coefficients are not significantly different from each other (p =.39). To test for sex differences, the model was reformulated as a multi-group model with men and women comprising the groups; then the cross-lagged paths were tested for equality. In neither case was there a significant difference (p=.37 for the path from depression to later life event burden and p=.95 for that from burden to later depression).

The model for symptoms of anxiety shows a similar pattern for construct temporal stability as that found for symptoms of depression. In this model the cross-lagged paths are significantly different (p <.001). The impact of anxiety on later life event burden is large and statistically significant whereas the impact of life event burden on subsequent anxiety appears to be virtually zero (p <.001 and p = .97, respectively). However, the multi-group model showed a significant sex difference for this path (p=.04) with coefficients -.057 for men and .053 for women. These contrasting effects cancel each other out in the model with men and women combined. The path from anxiety to later life event burden did not differ for men and women (p=.47).

[Insert Figure 2 about here]

Given the gender influence on the effects of stress on later anxiety in the SEM, the regression model above predicting anxiety from stressful life events was revisited to examine this effect, entering the covariates as above and a sex x stress interaction term. The stressful life events x sex interaction term was significant, $\beta = .17$, $p = .03$, such that there was a strong positive relationship between stressful events and anxiety for females.

Discussion

The present analyses provide some evidence for both stress causation and stress generation. Stressful life events, whether measured in terms of frequency or subjective impact, predicted depressive symptomatology five years later, even allowing for earlier symptoms of depression. Evidence for an effect of depression on later life events was somewhat weaker. In contrast, anxiety reliably predicted subsequent stressful life events occurrence and impact.

That stressful life events contribute to the development of depressive symptomatology is hardly a novel finding (Brown & Harris, 1978; Brown, et al., 1973). However, this stress causation effect would appear to be specific to depression. Despite the strong correlation between depression and anxiety symptoms at both time points, we could find no evidence in the present study that life events predicted an increase in anxiety levels over time. Others have found evidence of an association between life events and anxiety symptomatology (Hadley et al., 2008), and the onset of anxiety disorders (Blazer, Hughes, & George, 1987). However, no studies that we know of have examined the relationship with life events and the change in anxiety symptoms over time. In line with some previous studies, depressive symptoms predicted subsequent stressful events (Joiner, et al., 2005; Potthoff, et al., 1995), but not reliably so and not in the competitive analyses with anxiety. It has been argued that depressive symptoms generate the perception but not the

occurrence of stress (Joiner, et al., 2005). However, the present findings do not confirm this, as there were no significant associations between depressive symptoms and future life events burden, although for the number of life events, analyses including those with self-reported 'depression or 'nerves'' did significantly predict the number of life events. These less consistent associations for depression may reflect the stressful life events measurement employed by the present study, which focused only on major stressful events. The concept of stress generation holds that individuals with depressive symptomatology actively generate stressful life events, but these are not only major life events but also many minor stressful events, including daily hassles, that may accumulate over a period of time. Consequently, the present study may have failed to observe the full effect of depression on stress generation by focusing on the measurement of major life events only.

In the present study, reliable stress generation effects appeared mainly for symptoms of anxiety. This result contrasts with those of previous studies in which depressive symptoms but not anxiety predicted change in stressful life events (Joiner, et al., 2005) or comorbidity predicted stress generation (Harkness & Luther, 2001) but was more strongly driven by depressive symptoms than anxiety (Bodell, et al., 2012; Connolly, et al., 2010). However, direct comparison is difficult as the present study differs from previous ones in several ways; most noticeably, our participants were middle-aged and older adults, only major stressful events were measured, , and there was a five year follow-up as opposed to undergraduates tested on two occasions weeks apart or retrospective observational studies of individuals with diagnosed depression and anxiety (Connolly, et al., 2010; Harkness & Luther, 2001). However, what the present study might be illustrating is that, at least for depression, stress generation effects are time limited and do not persist beyond the year or less follow-up used in most previous studies. Alternative explanations

are that stress generation associated with depressive symptoms is more evident in those with more severe pathology, as observed here, or that the capacity of depressive symptoms to generate stress is more evident with less burdensome events.

It has been argued that stress generation may reflect an underlying personality characteristic, such as neuroticism, common to a variety of psychological disorders (Hammen, 2006). The present findings would certainly support this contention. That the association between anxiety and stressful life events five years later was evident for both event frequency and burden further reinforces the contention above, that psychological symptoms or disorders can essentially generate stressful life events. How might symptoms of anxiety create life events? The term 'active vulnerability' has been coined to describe models in which individuals generate, rather than simply react to, stressful life events (Shahar & Priel, 2003). Among the components of active vulnerability are maladaptive characteristics such as self-criticism, neuroticism, and perfectionism which are considered antecedents of anxiety (Zuroff, Mongrain, & Santor, 2004). Individuals with such characteristics have been shown to have more daily hassles and life events (Dunkley, Blankstein, Holsall, Williams, & Winkworth, 2000; Priel & Shahar, 2000). However, these characteristics are also heavily over-represented among individuals with symptoms of depression (Sherry, Mackinnon, Macneil, & Fitzpatrick, 2013) as well as anxiety and it is likely that they are common antecedents of both stressful events and anxiety and depression. Unfortunately, in the present study we do not have the data to examine these putative pathways. That we observed weaker stress generation for depression than anxiety in the current study does not militate against an underlying personality mechanism. Differences in the capacity for stress generation might alternatively reflect a lower incidence of depressive than anxiety symptoms in this particular sample, or differences in methodology between this and previous studies, as

discussed above and in the limitations section. Alternatively given the stronger findings for anxiety in the analyses where concurrent depression symptoms were adjusted for, it is possible it is that in some populations, anxiety is a stronger determinant of future events than depression. Support for this contention can be found in the epidemiological literature where those with anxiety, or comorbid and anxiety and depression had poorer health outcomes than those with depression alone (Carroll, Phillips, Gale, & Batty, 2010; Carroll et al., 2009; Phillips et al., 2009b). As some previous studies focused only on depression and stress generation, e.g., (Chun, et al., 2004), it is difficult to know whether they might similarly have observed effects for anxiety too. Further, the previous studies assessing both anxiety and depression and finding either no effects for anxiety (Joiner, et al., 2005) or stronger effects for depression (Bodell, et al., 2012; Connolly, et al., 2010; Riskind, et al., 2010; Riskind, et al., 2013; Uliaszek, et al., 2012) also tended to focus on adolescents or young adults. In the present sample, we have observed lower depression but higher anxiety among the older cohort than the youngest cohort (Carroll, et al., 2007), which might explain why anxiety was a stronger predictor of stress generation in the present analyses. Indeed, in the epidemiological studies above (Carroll, et al., 2010; Carroll, et al., 2009; Phillips, et al., 2009b), the average age of the sample was greater than that in most studies of stress generation, where adolescents or university undergraduates have been studied (Bodell, et al., 2012; Connolly, et al., 2010; Joiner, et al., 2005; Potthoff, et al., 1995; Riskind, et al., 2010; Riskind, et al., 2013; Uliaszek, et al., 2012).

In our analyses we were able to examine the effects of age, sex, and occupational group on these associations. A sex difference emerged for the prediction of later anxiety from stressful life events, such that this was evident in women not men; this effect was also evident as a significant effect of the sex x stressful life events interaction term in the regression model. It is possible that

this prediction of future anxiety emerges for women rather than men as the characteristics considered antecedents of anxiety mentioned above are more common among women (Costa, Terracciano, & McCrae, 2001; Elgin & Pritchard, 2006).

The present study has a number of limitations. First, the effect sizes are on the small side. However, this is what would be expected given the complex and varied determinants of depression, anxiety, and life events experience. Second, only middle-aged and older participants are included in this analysis as these were the two cohorts with the same life events measure in this study, which might explain our stronger findings for anxiety, as discussed above. However, a future study could consider the associations between depression, anxiety, and life events in the youngest cohort which more is comparable in age to previous study samples. The issue of generalization is also called into question by our finding that the final sample had lower anxiety, depression, and stressful life event frequency and burden than those without full data. However, it might be contended this makes the present results more impressive given that those with the highest symptomatology and stress were not in the analytic sample. Third, the life events measure used here was one in which participants were permitted to select up to six life events only, rather than being free to nominate as many events as had occurred. However, in reality, participants on average selected only a small number of events and only nine (1%) reported having experienced six events, whereas 286 (28%) reported just one event, which suggests that the methodology was not unduly constraining. Fourth, given that stress generation is more likely with contingent life events (Hammen, 2006), it is unfortunate that our life events measure does not readily differentiate between contingent and non-contingent stressful events. However, this is also the case for other studies (see e.g., (Joiner, et al., 2005) impeded by traditional life events measures where it is not possible to distinguish between events dependent or independent from

the participant. The difficulty here is that although we can hypothesise that anxiety might bring about stress generation in the present assessment, a stronger test would be to show an association with events contingent on the individual whereas no association or a weaker one where events are independent of the individual. This suggests that a fruitful line of enquiry would be to examine these associations using a more sensitive measure that differentiates between dependent and independent life events. Finally, we acknowledge that the present study did not directly assess major depression disorder or generalised anxiety disorder. However, previous studies have also observed stress generation effects in non-clinical populations with elevated levels of symptomatology, e.g., (Hankin et al., 2005; Joiner et al., 2005; Potthoff et al., 1995;(Uliaszek, et al., 2012).

In conclusion, the present study provides further evidence of stress causation for symptoms of depression, and some, but very modest indications of stress generation. In contrast, although life events stress was not related to an increase in anxiety over five years, individuals with high levels of anxiety symptoms were more likely to generate future stressful life events. Whether these findings extend to the youngest cohort in this study, where the different measure of life events will also allow differentiation of non-contingent and contingent events, remains to be determined.

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Table 1: Descriptive statistics for HADS and life events scores at each time point.

			Sex		Household occupational group	
		All	Men	Women	Manual	Non-manual
Wave	Measure	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
3	HADS depression	3.75 (2.90)	3.58 (2.76)*	3.88 (3.01)	4.07 (2.99)*	3.45 (2.80)
	HADS anxiety	6.88 (3.66)	6.28 (3.60)*	7.37 (3.64)	7.17 (3.88)*	6.61 (3.42)
	Stressful life events	0.97 (1.25)	1.00 (1.29)	0.95 (1.21)	0.92 (1.16)	1.02 (1.33)
	Stressfulness rating	3.76 (5.07)	3.60 (5.00)	3.88 (5.12)	3.58 (4.85)	3.94 (5.27)
4	HADS depression	3.86 (3.19)	3.71 (3.12)	3.97 (3.25)	4.26 (3.37)*	3.49 (2.98)
	HADS anxiety	6.52 (3.73)*	5.75 (3.60)*	7.13 (3.72)	6.84 (3.89)*	6.21 (3.53)
	Stressful life events	0.92 (1.19)	0.94 (1.26)	0.91 (1.13)	0.92 (1.13)	0.93 (1.25)
	Stressfulness rating	3.45 (4.73)	3.40 (4.84)	3.50 (4.65)	3.57 (4.60)	3.37 (4.85)

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Table 2: Correlations between anxiety, depression, number of events, life events burden, age, sex, and household occupational group.

	Anxiety wave 3	Depression wave 3	Anxiety wave 4	Depression wave 4	N of events wave 3	Burden wave 3	N of events wave 4	Burden wave 3	Age cohort	Sex
Anxiety wave 3										
Depression wave 3	.584**									
Anxiety wave 4	.644**	.430**								
Depression wave 4	.398**	.604**	.617**							
N of events wave 3	.202**	.173**	.138**	.166**						
Burden wave 3	.228**	.183**	.176**	.179**	.969**					
N of events wave 4	.150**	.095**	.223**	.197**	.220**	.234**				
Burden wave 4	.170**	.108**	.231**	.204**	.205**	.225**	.938**			
Age cohort	-.092**	.006	-.120**	-.020	-.119**	-.112**	-.160**	-.153**		
Sex	.148**	.052	.183**	.040	-.017	.027	-.015	-.007	-.003	
Occupational group	.077*	.106**	.086**	.121**	-.041	-.035	-.002	.009	.110**	.017

*p <.05, **p < .01

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Figure 1: Associations between HADS scores and the number of life events. * $p < .05$, # $p = .06$, ns = not significant

Figure 2: Cross lagged models for life events and depression and anxiety scores. * -.057 for men; .053 for women.

Figure A1 and A2: Measurement model for depression over time

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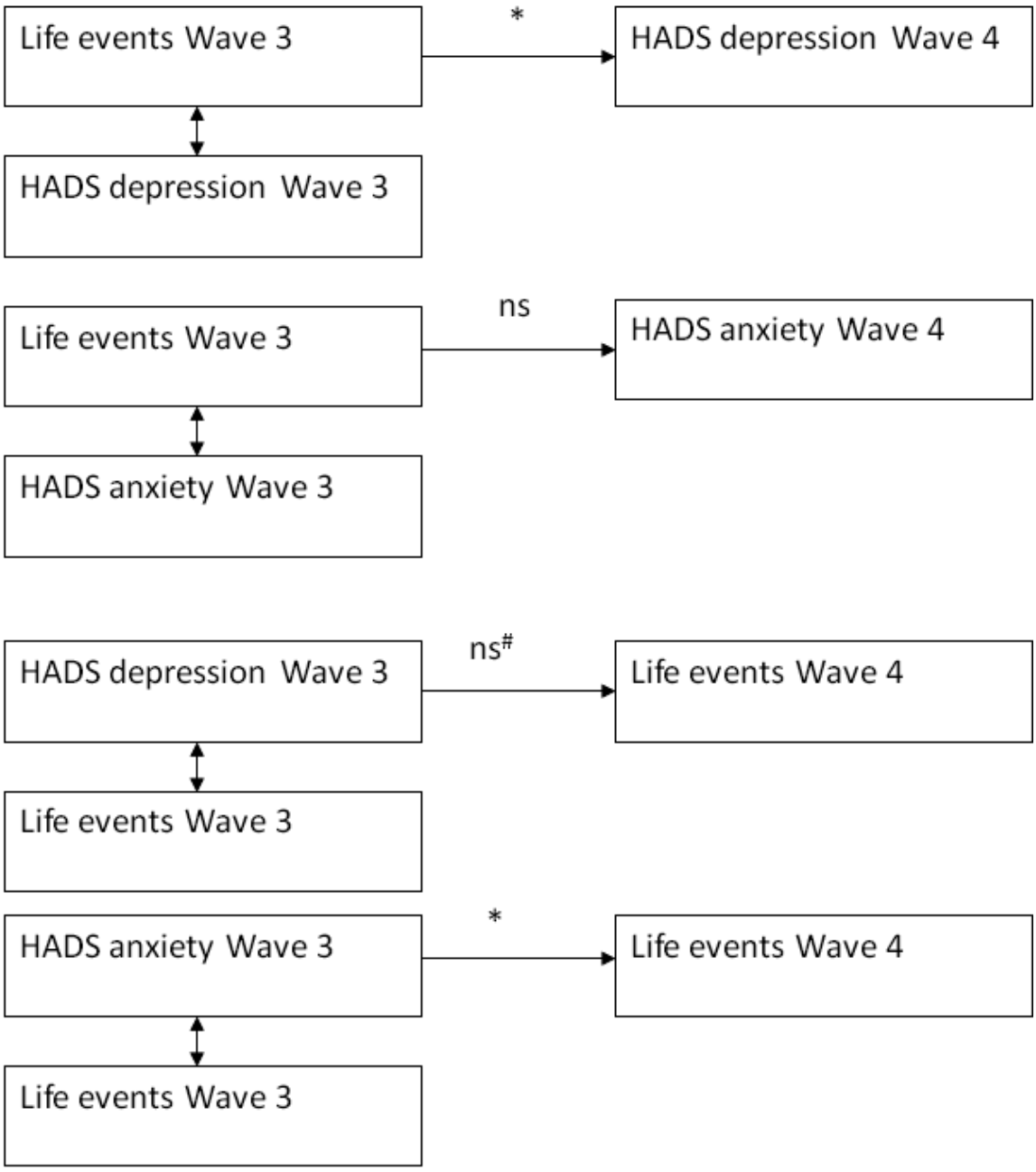

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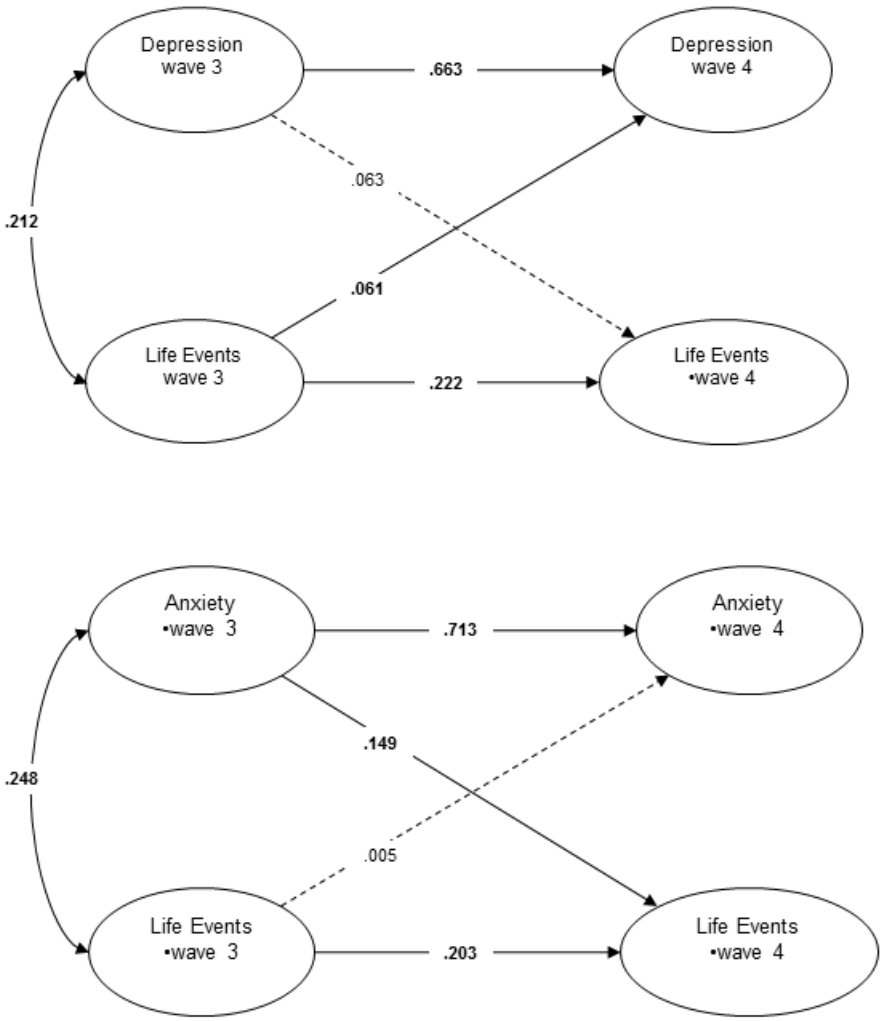

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Appendix A:

Measurement models

The three measurement models for depression and anxiety scores and life event burden were developed separately incorporating the two time points. The measurement model for depression is shown in Figure A1. Depression at the two time points is represented as two latent variables (in ellipses) with the even numbered HADS items as indicators of the latent variable. In the conventions of SEM, measured variables such as the HADS items are shown in boxes. Error terms are represented as numbered letters (e1 to e14 in Figure A1). In this type of longitudinal model it is common for correlations between individual items over time to be necessary to achieve adequate model fit. These correlations are in addition to that implied by the effect of one latent variable on the other and are specified by allowing a non-zero correlation between the error terms of the items and represented graphically as a double headed arrow connecting the correlated terms. In the case of depression all the correlations shown in Figure A1 were needed. The measurement model for anxiety was essentially the same with anxiety indicated by the odd numbered items of the HADS. In the measurement model for life events, event burden was indicated by six variables, which included the number of life events and five scores derived from summing the ratings for those events of: disruption caused by the event at the time; disruption currently caused by it; stressfulness of the event at the time; stressfulness currently; and an overall rating of the seriousness of the event. The measurement model included three correlations between the event scores at each time point but none over time. Figure A2 shows the measurement model for one time point. In principal components analyses of these six event scores the first component explained over 93% of

the variance both at wave 3 and wave 4 clearly indicating that they represented a single dimension of life event burden.

A sensitivity analysis was also carried out in which the main analyses were repeated with life event burden indicated only by the number of events and their summed severity ratings. The results were essentially the same.

Factorial Invariance

Factorial invariance was tested by constraining the corresponding factor loadings in the measurement models to be the same at the two time points: the loading HADS of item 2 on depression was forced to take the same value at wave 3 and wave 4 and likewise for all the other items and event scores. Introducing these constraints decreases the fit of the model, increasing its X^2 value, and the significance of this change can be against a X^2 distribution with degrees of freedom equal to the number of constraints. For depression and anxiety this led to increases in the X^2 value of 10.05 and 2.2, respectively, and corresponding *p* values (for 6 df) of 0.123 and 0.895. For life event burden the values were $X^2 = 5.28$, df=5, $p = 0.383$. Thus there is no evidence of departure from factorial invariance.

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