Title: Gluten free diet adherence in coeliac disease: The role of psychological symptoms in bridging the intention-behaviour gap

Short title: Gluten free diet adherence

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Abstract

This study examined the potential role of psychological symptoms in limiting the translation of positive intention into strict gluten free diet (GFD) adherence in coeliac disease (CD) within a theory of planned behaviour (TPB) framework. It was hypothesised that participants with more symptomatic psychological profiles would exhibit poorer adherence, primarily in the context of positive intentions. Coeliac disease participants (N = 390) completed online measures of gluten free diet adherence, psychological symptoms, coping behavior, and TPB items. Intention and behaviour were moderately correlated, confirming the existence of the intention-behaviour gap. Psychological symptoms accounted for additional variance over and above TPB variables in GFD adherence but not intention. Participants who failed to act on their positive intentions displayed more psychological symptoms and greater reliance on maladaptive coping strategies than those with consistent intention-behaviour relationships ($p < .01$). The heightened incidence of psychological symptoms in CD has a small but significant negative impact on the ability to translate positive intentions into strict adherence. Directions for future research including interventions to improve GFD adherence are discussed.

Key words: coeliac disease, gluten free diet, theory of planned behaviour, intention-behaviour gap, psychological symptoms

Abbreviations: CD = coeliac disease; GFD = gluten free diet; ANOVA = analysis of variance

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Introduction

Coeliac disease (CD) is a chronic autoimmune disorder involving intolerance for dietary gluten and affecting approximately 1% of the population (Green & Jabri, 2006; West et al., 2003). Gluten consumption in affected individuals causes atrophy of the small intestine and is associated with both gastrointestinal symptoms and the malabsorption of nutrients (Green & Cellier, 2007). Left untreated coeliac disease can lead to serious and potentially life-threatening long-term health complications including intestinal and bowel cancers, osteoporosis, and infertility (Green & Jabri, 2003; Rubio-Tapia & Murray, 2010). Importantly, with strict adherence to a gluten free diet (the only effective treatment for coeliac disease) reduction of symptoms and the risk of complications can be achieved (Anderson, 2008; Bai et al., 1997; Kemppainen et al., 1999; West, Logan, Smith, Hubbard, & Card, 2004). Thus, the ability to maintain strict adherence to a gluten free diet is of utmost importance in this population.

A systematic review of 38 gluten free diet adherence studies (Hall, Rubin, & Charnock, 2009) found that strict adherence estimates ranged considerably (range = 36 – 90%; median = 70%), although comparisons were limited due to variability in the method of assessment and definitions of strict adherence, and the lack of replication of most study designs. The review found no consistent relationship between adherence and demographic or disease factors (Hall et al., 2009), and concluded that there was a need for more rigorous empirical and theory-based research into the demographic, cognitive, emotional and disease characteristics that influence adherence in coeliac disease, as well as calling for a more reliable means of assessing dietary adherence.

The theory of planned behaviour is a commonly used model in the psychological and behavioural health research which posits that the most proximal predictor of behaviour is intention to perform that behaviour (Ajzen, 1991). Intention is in turn influenced by three factors: attitudes – beliefs about the likely outcome of the behaviour; subjective norms – perceptions of the expectation of others to perform the behaviour; and perceived behavioural control – perceived level of control over performance of the behaviour, which also has a direct effect on behaviour (Ajzen, 1991). The theory of planned behaviour has been successfully applied to the prediction of a number of health intentions and behaviours including fruit and vegetable consumption (Kothe, Mullan, & Butow, 2012; Povey, Conner, Sparks, James, & Shepherd, 2000), breakfast consumption (Wong & Mullan, 2009), intention to consume foods with a low glycemic index (Goodwin & Mullan, 2009), and dietary and exercise behaviours in type 2 diabetes patients (White, Terry, Troup, Rempel, & Norman, 2010). In the only reported theory-based study in coeliac disease the theory of planned behaviour was also applied to the prediction of gluten free diet adherence, and accounted for 37% of the variance in intention to maintain a strict gluten free diet and 22% of actual adherence (Sainsbury & Mullan, 2011). These results were consistent with a meta-analytic review (Armitage & Conner, 2001) which found that the theory accounted for 39% and 27% of the variance in intention and behaviour.

The theory of planned behaviour has been criticised for its failure to explicitly consider the non-rational components of decision-making (Conner & Sparks, 2005; Sharpe & Curran, 2006). That is, behaviour is assumed to be logical and goal-directed, while the unconscious, irrational determinants of behaviour including emotional states, psychological problems, and coping skills are considered only to the extent that they inform the development of beliefs (Ajzen, 2011). Further it has been suggested that while the theory reliably accounts for significant

variance in both intentions and behaviour, there is not a perfect relationship ($r = 1$) between them; a phenomenon known as the intention-behaviour gap (Sheeran, 2002). That is, a significant proportion of people do not act in line with their intentions: those who fail to act on their positive intentions (inclined abstainers) and those who act despite negative intentions to do so (disinclined actors). Research suggests that it is the first group of people who are primarily responsible for the intention-behaviour gap (Sheeran, 2002). In contrast, inclined actors and disinclined abstainers represent intention-behaviour consistency for people with positive and negative intentions respectively. Previous research has attempted to improve the predictive ability of the theory of planned behaviour and narrow this gap by considering post-intentional factors such as planning and self-regulation abilities (Mullan, Wong, Allom, & Pack, 2011; Norman & Conner, 2005; White et al., 2010). The heightened incidence of psychological symptoms in coeliac disease (Addolorato et al., 2008) is proposed here as a potential candidate for addressing both these criticisms.

Numerous researchers have reported an increase in the incidence of psychological symptoms within coeliac disease (Addolorato et al., 2008), including depression (Addolorato et al., 2001; Addolorato et al., 1996; Ciacci, Iavarone, Mazzacacca, & De Rosa, 1998; Siniscalchi et al., 2005), anxiety (Addolorato et al., 2001; Fera, Cascio, Angelini, Martini, & Guidetti, 2003), and eating disorders (Karwautz et al., 2008), with a relationship between psychological symptoms and increased gastrointestinal symptoms also being evidenced (Hauser, Musial, Caspary, Stein, & Stallmach, 2007). Attempts to explicitly link psychological symptoms to adherence have, however, been limited. Specifically, higher depression and anxiety symptoms have been correlated with poorer gluten free diet adherence, although failed to account for unique variance in adherence (Edwards-George et al., 2009). The self-reported ability to follow a gluten

free diet despite changes in mood and stress, but not the presence of self-reported comorbid psychological disorders per se, was also associated with improved adherence (Leffler et al., 2008). Finally, a relationship between the presence of eating disorders and gluten free diet adherence, as assessed by self-reported transgressions and serological analysis, has been reported (Karwautz et al., 2008). No study to date has explicitly assessed coping behaviour in coeliac disease, although qualitative evidence suggests that coping may impact on adherence (Hallert, Sandlund, & Broqvist, 2003; Olsson, Hornell, Ivarsson, & Sydner, 2008). These preliminary findings, combined with the observation that patients suffering from depression are three times more likely to be non-compliant with medical treatment recommendations (DiMatteo, Lepper, & Croghan, 2000), suggest that assessing the impact of psychological symptoms and coping on gluten free diet adherence is warranted.

A major limitation in the literature is that although there have been attempts at linking disease, demographic, and psychological factors to gluten free diet adherence, individual relationships have largely been assessed in isolation. Research elsewhere has demonstrated the negative impact of depression on compliance (DiMatteo et al., 2000), particularly in chronic illness populations (Safren, Gonzalez, & Soroudi, 2008). Maladaptive coping is also linked to increased psychopathology (Wingenfeld et al., 2009), with evidence from varying medical conditions that coping styles, specifically an active and internally focused coping style, are related to improved treatment adherence (Christensen & Johnson, 2002). Further limitations include the lack of a theoretical base for understanding gluten free diet adherence and the lack of a consistent and validated measure of gluten free diet adherence.

This study was therefore designed to address these limitations by firstly applying a social-cognitive model (the theory of planned behaviour) to the prediction of gluten free diet adherence,

measured using a validated questionnaire. The second aim was to improve the predictive ability of the theory of planned behaviour and narrow the intention-behaviour gap by adding measures of psychological symptoms and coping behaviour. It was hypothesised that the theory components would account for significant variance in intentions and gluten free diet adherence, and that psychological symptoms and coping behaviour would add to the prediction of adherence over and above intention and perceived behavioural control, such that individuals with higher levels of psychological symptoms and greater reliance on maladaptive coping strategies would exhibit poorer adherence. Finally, it was predicted that the intention-behaviour gap would be primarily attributable to the failure to translate positive intentions into strict adherence, and that this group would exhibit a more symptomatic psychological profile and higher reliance on maladaptive coping strategies than the inclined actors.

Method

The participants were 390 individuals (mean age = 44.2; *SD* = 12.7) who responded to a recruitment email sent to a randomly selected sample of 2989 members of the NSW Coeliac Society, screened as meeting inclusion criteria (biopsy-confirmed coeliac disease, gluten free diet duration >3 months, >18 years). Data was submitted anonymously via a link to the online survey, which took approximately 20-30 minutes to complete. The majority of the sample was female (82.8%), which is consistent with the gender distribution of coeliac disease (2-3:1) (Green & Cellier, 2007), and the gender split within the Coeliac Society database (80% female) (Coeliac Society of NSW, 2010). The mean age at diagnosis was 37.4 years (*SD* = 12.8) and participants had been on a gluten free diet for a mean of 6.8 years (*SD* = 7.2). The mean duration of symptoms prior to diagnosis was 9.9 years (*SD* = 12.5; range 0 – 60 years) with most participants

reporting some symptom recurrence when consuming gluten since diagnosis (15.9% mild; 28.2% moderate; 30.3% severe; 20.5% unsure; 5.1% none).

Participants completed measures of demographic (e.g., age, gender, education); and disease factors (e.g., age of diagnosis, duration of gluten free diet, symptoms); as well as the following:

The Coeliac Dietary Adherence Test (Leffler et al., 2009) is a newly validated seven-item questionnaire designed to assess gluten free diet adherence in coeliac disease. It has demonstrated good psychometric properties and correlates highly with dietitian rated estimates of adherence (Leffler et al., 2009). Higher scores indicate poorer adherence. As per recommendations participants were also classified as having excellent or very good adherence (score 7-12); moderate adherence (13-16); or fair to poor adherence (17-35) (Leffler et al., 2009).

The Coeliac Disease Theory of Planned Behaviour Questionnaire (Sainsbury & Mullan, 2011) is a 17-item direct measure of the components of the theory of planned behaviour in relation to gluten free diet adherence. As suggested (Ajzen, 2006; Francis et al., 2004), a longer interview-derived questionnaire was previously administered and adequate content validity of the direct items demonstrated (Sainsbury & Mullan, 2011), therefore allowing for the sole administration of the direct items here. The intention ($\alpha = 0.68$), attitude ($\alpha = .68$), and PBC ($\alpha = 0.81$) composites are internally consistent; subjective norm is less so ($\alpha = 0.43$), although this was congruent with interview data, whereby respondents felt their decision to maintain a strict gluten free diet was not influenced by other people (Sainsbury & Mullan, 2011). All items are rated on a 7-point Likert scale, with composite scores reflecting the weighted sum of the relevant items. Higher scores indicate more positive intentions and attitudes, and higher perceptions of normative pressure and perceived control.

The Depression Anxiety Stress Scale (Lovibond & Lovibond, 1995) is a 21-item questionnaire designed to measure the negative emotional states of depression, anxiety and stress. Each question is rated on a four-point scale from "did not apply to me at all" to "applied to me very much or most of the time," with subscale scores representing the sum of the relevant items, and higher scores indicating more severe or frequent symptoms. Clinical cut-off scores denoting normal, mild, moderate, severe, and extremely severe symptomatology are also provided. The questionnaire has good reliability and validity, and distinguishes well between clinical and community samples (Antony, Bieling, Cox, Enns, & Swinson, 1998).

The Eating Disorder Inventory-3 Eating Disorder Risk Scale (Garner, 2004) is a 25-item scale designed to measure the risk of an individual developing an eating disorder based on excessive concerns about dieting, body weight, and problematic eating behaviours. It has excellent psychometric characteristics (Garner, 2004). Normative data and instructions for transforming raw scores are provided for females aged 13-53 years with eating disorders in both inpatient and outpatient settings. Due to the difficulty of performing this transformation on a diverse sample (female *and* male, non-clinical, 18-65 years), raw scores were summed to provide a total score, which was used in subsequent analyses. Comparisons to population norms are thus not possible; however, the measurement was deemed valid in this context as higher scores still indicate greater risk and the analysis was not concerned with identifying eating disorders per se.

The Coping Inventory for Stressful Situations (Endler & Parker, 1999) is a 21-item questionnaire designed to assess three distinct coping styles: task-oriented coping (e.g., problem solving or planning a course of action), emotion-oriented coping (e.g., feeling anxious or blaming oneself), and avoidance coping (e.g., removing oneself from the situation). Each question asks the individual to rate how much they engage in the particular coping behaviour when faced with a

difficult, upsetting or stressful situation, with higher scores indicating more frequent use of the coping strategy. Cut-off scores allow for interpretation of scores as very much below/above average, much below/above average, below/above average, slightly below/above average, and average. Increased task-oriented coping combined with decreased emotion-oriented coping is generally considered to constitute an adaptive coping style, whereas the reverse is considered maladaptive (Endler & Parker, 1999). It has demonstrated reliability and validity (Cohan, Jang, & Stein, 2006; Endler & Parker, 1999).

The gluten free diet knowledge test consisted of 14 ingredient lists adapted from educational materials used by the Coeliac Society of NSW. The test required participants to draw on their label reading skills and knowledge of ingredients to state whether each product was gluten free or not.

Bivariate correlations and independent samples t-tests were conducted to examine the associations between adherence and the continuous and categorical variables respectively. Hierarchical regression analyses were used to determine the significant predictors of intention and gluten free diet adherence. The order of entry of the psychological variables was based on the strength of evidence linking each to gluten free diet adherence in the literature. Cases were additionally classified into a 2 (adherence: good vs. inadequate) x 2 (intentions: positive vs. negative) design to examine the distribution of cases contributing to the intention-behaviour gap (Sheeran, 2002). Subsequently, a series of one-way analyses of variance (ANOVA) with planned contrasts were conducted to examine the relationships between intention-behaviour consistency and psychological symptoms. Adopting a conservative approach due to the lack of similar guiding research, an a priori power analysis (alpha = 0.05; power = 95%) indicated that a sample size of 132 people would be needed to detect a small effect size (0.2), although due to the relative

ease of online recruitment significantly more people responded. An identical pattern of results was found in a randomly selected sample of 132 participants, therefore reported analyses are based on the full sample.

Results

Descriptive Statistics. The mean and modal gluten free diet adherence scores fell in the excellent or very good range (56.7% excellent/very good; 37.2% moderate; 6.2% reporting fair/poor) (Leffler et al., 2009). The mean theory of planned behaviour questionnaire scores were consistently high (>85% within 1 SD), although the lower ranges indicated that a proportion of the sample held less than positive beliefs. The mean scores on the depression, anxiety, and stress measure fell in the normal range; scores were higher than a sample of healthy control volunteers (Depression: + 1.12 *SD*; Anxiety: + 2.12 *SD*; Stress: + 1.97 *SD*), but not to the levels observed in clinical samples (Antony et al., 1998). Coping scores were normally distributed, with the mean scores falling in the average range. Males and females here scored equivalently to the normative samples on task-oriented and emotion-oriented coping (Cohan et al., 2006). Eating disorder risk scores were consistent with a female, adult, non-eating disorder control sample. The mean percent correct on the gluten free diet knowledge test was 82.77%. Of the incorrect responses 32% represented a risk of consuming gluten, while the remaining 68% suggested unnecessary restriction and avoidance of products that were in fact safe.

Relationships with Adherence. Tables 1 and 2 show the relationships between adherence and the demographic/disease characteristics and psychological measures respectively. The moderate correlation between adherence and intention confirmed the existence of an intention-behaviour gap. The theoretical variables were all significantly correlated, as were the psychological symptoms and coping behaviour. There were no gender differences on depression,

anxiety or stress ($p > .05$); females scored higher on eating disorder risk and emotion-oriented coping, and lower on task-oriented coping, than males ($p < .01$)

Table 1 here

Table 2 here

Predicting Intention. Based on the significant relationships with adherence, step 1 of the hierarchical regression analysis controlled for gender, symptom severity and knowledge. The theory of planned behaviour variables were entered at step 2, followed by depression and anxiety (step 3), eating disorder risk (step 4), and task- and emotion-oriented coping (step 5). Stress was not included in the model due to the high correlations with depression and anxiety, and the lack of evidence linking stress to adherence in the literature. Depression and anxiety were also highly correlated ($r = .63$, $p < .01$), although the tolerance statistic (.998) suggested no multicollinearity so both measures were included. Avoidance coping was not included in the model due to the lack of significant correlations with intentions or adherence.

At step 1, gender, symptom severity, and knowledge together accounted for 12% of the variance in intention ($R^2 = .120$, $F_{3, 335} = 15.231$, $p < .01$), with female gender and increased severity making significant independent contributions. At step 2, attitude, subjective norm and perceived behavioural control accounted for a further 33.6% of the variance ($R^2 = .456$, $\Delta F_{3, 332} = 68.308$, $p < .001$). None of the psychological variables at steps 3 to 5 added significantly to the prediction of intention (all $p > .05$).

Predicting Gluten Free Diet Adherence. The same hierarchical regression analysis was used to predict gluten free diet adherence (see Table 3). At step 1 gender, severity and knowledge accounted for 6.7% of the variance in adherence, with intention and perceived behavioural control adding a further 17.8% to the prediction at step 2. Importantly, depression and anxiety

(step 3) and eating disorder risk (step 4) added significantly to model, accounting for a further 6.9% and 1.1% of the variance respectively, although only depression and eating disorder risk, but not anxiety, made independent contributions. Task- and emotion-oriented coping (step 5) did not add to the prediction of adherence ($p > .05$).

Table 3 here

The Intention-Behaviour Gap. Participants were classified into one of four intention-behaviour consistency groups: inclined actors, inclined abstainers, disinclined actors, and disinclined abstainers (Sheeran, 2002). Participants were classified as having positive intentions (inclined) if they scored 7 (maximum score) on the item: "I intend to maintain a strict gluten free diet," and as having negative intentions (disinclined) if they scored 1 to 6 on this item. Participants falling in the excellent or very good range on the adherence measure (≤ 12) were classified as actors, while those falling in the moderate or fair to poor categories (≥ 13) were classified as abstainers. While not all participants in the latter category actually have poor gluten free diet adherence, given the importance of strict adherence in coeliac disease and the fact that even minor gluten exposures can have serious negative consequences, a conservative approach to differentiating between actors and abstainers was adopted. Identical results were obtained using a median split (median = 12).

Of the people with inadequate adherence (N = 169) only 30% had negative intentions, while the remaining 60% actually had positive intentions to adhere strictly to the gluten free diet but were unable to translate these positive intentions into behaviour. In contrast, only 10% of the people showing good adherence (N = 220) actually had negative intentions to do so, while the remaining 90% were successful in translating their positive intentions into strict adherence.

A series of one-way ANOVAs and pairwise contrasts indicated that inclined abstainers scored significantly higher on depression, anxiety, stress, eating disorder risk and emotion-oriented coping, and lower on task-oriented coping than the inclined abstainers (all $p < .01$).

Discussion

This study had two primary aims. Firstly, to apply a social-cognitive model to the prediction of gluten free diet adherence in coeliac disease; and secondly, to improve the predictive ability of the theory of planned behaviour and narrow the intention-behaviour gap with the addition of psychological symptoms and coping behaviour. It was hypothesised that participants with higher levels of psychological symptoms and greater reliance on maladaptive coping strategies would exhibit poorer gluten free diet adherence, primarily in the context of positive intentions.

The theory of planned behaviour (combined with symptom severity, knowledge and gender) predicted significant variance in both behavioural intentions (46%) and gluten free diet adherence (33%). This is consistent with the previous study (Sainsbury & Mullan, 2011) in which 37% and 30% of the variance was accounted for respectively. Further, having more severe current coeliac disease symptoms was associated with both higher intentions and better adherence, presumably reflecting the more salient motivation in symptomatic individuals to reduce or avoid symptoms. In contrast, fewer symptoms following gluten exposure contributed to poorer adherence. This is the first study to confirm an association between adherence and symptom severity upon consuming gluten post-gluten free diet (Hall et al., 2009), and is also consistent with research demonstrating that the highest rates of medical treatment non-adherence are amongst asymptomatic individuals engaged in preventative treatment regimes (Christensen & Johnson, 2002).

The moderate correlation between intention and gluten free diet adherence confirmed the existence of an intention-behaviour gap (Sainsbury & Mullan, 2011); that is, while having positive intentions was related to better adherence a proportion of people exhibited inconsistent intention-behaviour relationships. As hypothesised, this gap was predominantly attributable to the failure to translate positive intentions into strict adherence (inclined abstainers). In contrast, only a small number of people had good adherence despite negative intentions to do so (disinclined actors). This is consistent with previous intention-behaviour gap research, which similarly indicated that in four of the six studies examined the gap could be attributed to the inclined abstainers (Sheeran, 2002). Together these findings suggest that clarifying the factors that limit the ability to translate positive intentions into behaviour, and further developing interventions to improve such factors, is an important endeavour.

The inclusion of psychological symptoms and coping behaviour added significantly to the prediction of gluten free diet adherence but not intentions. That is, coeliac disease participants who held positive attitudes and had higher perceived behavioural control had similar intentions despite large variations in the levels of psychological symptoms and frequency of coping behaviours reported. As hypothesised, higher levels of psychological symptoms were related to poorer adherence in the univariate analyses; however, only depression and eating disorder risk remained significant predictors of adherence in the multivariate analysis. While broadly consistent with previous findings (Edwards-George et al., 2009; Leffler et al., 2008) importantly this study represents the first attempt to explicitly link psychological symptoms to adherence by examining the unique predictors of adherence, after accounting for demographic and disease factors. Although the additional amount of variance accounted for was modest (8%), given the utmost importance of strict adherence in this population, this was deemed clinically as well as

statistically meaningful. Further, given the finding that the inclined abstainers exhibited higher levels of psychological symptoms and greater reliance on maladaptive coping behaviours than the inclined actors, it appears that the presence of psychological symptoms in coeliac disease has the real potential to impede adherence.

While the present study did not utilise a healthy control group and so comparisons with regard to the prevalence of psychological symptoms is not possible, the mean scores on the depression, anxiety, stress, eating disorder, and coping scales all fell in the average or normal ranges (Antony et al., 1998; Cohan et al., 2006; Garner, 2004). This is the first study to assess for the impact of depression on gluten free diet adherence after controlling for other factors (e.g., gender, knowledge, symptoms, and social-cognitive factors). Again, although absolute rates of depression were low (only 5.8% scoring in the severe or extremely severe categories) a higher incidence of depressive symptoms had a direct negative effect on adherence. When combined with evidence that depression is a known risk factor for medical non-adherence (DiMatteo et al., 2000), this finding suggests that independent treatment of depressive symptoms may be required to ensure strict adherence is achieved and maintained. In contrast, the lack of predictive power of anxiety, which was not attributable to its high comorbidity and correlation with depression, is consistent with the assertion that anxiety in coeliac disease is unlikely to require independent treatment (Addolorato et al., 2004).

The finding that increased eating disorder risk was significantly related to poorer adherence in both the correlational and regression analyses supports previous research showing that adolescents with comorbid coeliac disease and eating disorders had poorer adherence than those with coeliac disease alone (Karwautz et al., 2008). Further, the observation that eating disorder risk remained a significant predictor of adherence even after controlling for depression, a

commonly comorbid condition with eating disorders (Hudson, Hiripi, Pope, & Kessler, 2007), also suggests that any pre-existing or newly emerging eating pathology should be addressed in the context of the gluten free diet to ensure adequate adherence.

There is limited data available on the coping styles employed to manage the gluten free diet, with this being the first study to explicitly assess this relationship. Interestingly, although the two main types of coping behaviour (task-oriented and emotion-oriented) were significantly correlated with gluten free diet adherence, their inclusion in the regression model did not add to the prediction of adherence after controlling for psychological symptoms. Adaptive coping was also associated with a more favourable psychological profile, more positive attitudes, and higher perceived behavioural control and intentions, suggesting that an individuals' use of different coping behaviours may play a role in the development of psychological symptoms (Wingenfeld et al., 2009), as well as the ability to manage the challenges associated with the gluten free diet, which then have a direct impact on adherence.

Despite careful attention to the methodology, this study has several limitations. Firstly, the recruitment method may have biased the sample towards a more highly adherent population than is typical – members of the coeliac society, and particularly responders, may be more invested in their health and diet than coeliac disease individuals who are not members. Having said this, only 56.7% of the sample reported excellent or very good adherence, suggesting there was both sufficient variance for the purposes of analysis and significant room for improvement. Given the online nature of the research combined with the lack of a national coeliac disease treatment facility, alternate options for recruitment were necessarily limited. Since it was relationships between the variables that were of interest, however, there is no reason to believe that these relationships would differ in a more or less adherent sample. There was also a

significant gender bias in responses (82.8% female), although as previously stated this is largely consistent with both the gender distribution in coeliac disease diagnoses (Green & Cellier, 2007) and the gender breakdown within the coeliac society's database. Despite this is it possible that the factors contributing to gluten free diet adherence differ for males and females.

Although validated, the use of a dietitian rated estimate of adherence, in addition to the adherence questionnaire used here (Leffler et al., 2009) would likely strengthen the findings; however, the results can still be interpreted with more confidence than studies that use Likert or visual analogue scales, which are poorly related to objective measures (Leffler et al., 2007). The use of questionnaires (again, although standardised and well-validated) in the assessment of psychological symptoms and coping behaviour may also represent a limitation, as high scores do not necessarily indicate the presence of a diagnosable condition. Importantly though, this study was not concerned with psychiatric diagnoses but rather the impact of symptoms on adherence, and therefore the questionnaire measures were deemed adequate. Finally, the cross-sectional design means that the direction of causality in the observed relationships is unclear.

This study confirms that the theory of planned behaviour is an appropriate model for predicting gluten free diet adherence in coeliac disease. The results also demonstrated that the addition of psychological symptom measures contributed significantly to the prediction of adherence over and above the social-cognitive factors, and aided in determining the reasons behind the intention-behaviour gap. Future research using a prospective rather than cross-sectional design would be beneficial in confirming the direction of such relationships. Finally, when considered in light of the finding that it was the inclined abstainers, characterised by increased psychological symptoms, who were predominantly responsible for the intention-behaviour gap, this study strongly suggests that interventions to improve gluten free diet

adherence should include a combination of validated behaviour change techniques shown to modify behaviour via social-cognitive pathways, *and* validated strategies to treat psychological symptoms and improve coping. This combination should allow coeliac disease individuals to more successfully translate their positive intentions into strict adherence, in turn reducing the risk of potential long-term health complications.

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References

Addolorato, G., Capristo, E., Ghittoni, G., Valeri, C., Mascianà, R., Ancona, C., & Gasbarrini, G. (2001). Anxiety but not depression decreases in coeliac patients after one-year gluten-free diet: A longitudinal study. *Scandinavian Journal of Gastroenterology, 36*, 502-506.

Addolorato, G., De Lorenzi, G., Abenavoli, L., Leggio, L., Capristo, E., & Gasbarrini, G. (2004). Psychological support counselling improves gluten-free diet compliance in coeliac patients with affective disorders. *Alimentary Pharmacology and Therapeutics, 20*, 777-782.

Addolorato, G., Leggio, L., D'Angelo, C., Mirijello, A., Ferrulli, A., Cardone, S., . . . Gasbarrini, G. (2008). Affective and psychiatric disorders in celiac disease. *Digestive Diseases, 26*, 140-148.

Addolorato, G., Stefanini, G. F., Capristo, E., Caputo, F., Gasbarrini, A., & Gasbarrini, G. (1996). Anxiety and depression in adult untreated celiac subjects and in patients affected by inflammatory bowel disease: A personality "trait" or a reactive illness? *Hepato-Gastroenterology, 43*, 1513-1517.

Ajzen, I. (1991). The theory of planned behavior. *Organisational Behaviour and Human Decision Processes, 50*, 179-211.

Ajzen, I. (2006). Constructing a TPB questionnaire: Conceptual and methodological considerations Retrieved 18th September 2009, from http://people.umass.edu/aizen/pdf/tpb.measurement.pdf

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections. *Psychology and Health, 26*, 1113-1127.

Anderson, R. P. (2008). Coeliac disease: Current approach and future prospects. *Internal Medicine Journal, 38*, 790-799.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*, 176-181.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *The British Journal of Social Psychology, 40*, 471-499.

Bai, J. C., Gonzalez, D., Mautalen, C., Mazure, R., Pedreira, S., Vasquez, H., . . . Maurino, E. (1997). Long-term effect of gluten restriction on bone mineral density of patients with coeliac disease. *Alimentary Pharmacology and Therapeutics, 11*, 157-164.

Christensen, A. J., & Johnson, J. A. (2002). Patient adherence with medical treatment regimens: An interactive approach. *Current Directions in Psychological Science, 11*, 94-97.

Ciacci, C., Iavarone, A., Mazzacacca, G., & De Rosa, A. (1998). Depressive symptoms in adult coeliac disease. *Scandinavian Journal of Gastroenterology, 33*, 247-250. doi: 10.1080/00365529850170801

Coeliac Society of NSW (2010). [Gender breakdown].

Cohan, S. L., Jang, K. L., & Stein, M. B. (2006). Confirmatory factor analysis of a short form of the Coping Inventory for Stressful Situations. *Journal of Clinical Pathology, 62*(3), 273-283.

Conner, M., & Sparks, P. (2005). Theory of planned behaviour and health behaviour. In M. Conner & P. Norman (Eds.), *Predicting health behaviour* (2nd ed., pp. 170-222). Maidenhead: Open University Press.

DiMatteo, M. R., Lepper, H. S., & Croghan, T. W. (2000). Depression is a risk factor for noncompliance with medical treatment: Meta-analysis of the effects of anxiety and depression on patient adherence. *Archives of Internal Medicine, 160*, 2101-2107.

Edwards-George, J., Leffler, D. A., Dennis, M., Franko, D. L., Blom-Hoffman, J., & Kelly, C. P. (2009). Psychological correlates of gluten-free diet adherence in adults with celiac disease. *Journal of Clinical Gastroenterology, 43*, 301-306.

Endler, N. S., & Parker, J. D. A. (1999). *Coping Inventory for Stressful Situations (CISS): Manual* (2nd ed.). Toronto: Multi-Health Systems.

Fera, T., Cascio, B., Angelini, G., Martini, S., & Guidetti, C. S. (2003). Affective disorders and quality of life in adult coeliac disease patients on gluten-free diet. *European Journal of Gastroenterology & Hepatology, 15*, 1287-1292.

Francis, A. J. J., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., . . . Bonetti, D. (2004). *Constructing questionnaires based on the theory of planned behaviour: A manual for health services researchers*. Newcastle upon Tyne: Centre for Health Services Research.

Garner, D. M. (2004). *Eating Disorder Inventory - 3. Professional Manual*. Lutz, Florida: Psychological Assessment Resources, Inc.

Goodwin, R. E., & Mullan, B. (2009). Predictors of undergraduates' intention to incorporate glycaemic index into dietary behaviour. *Nutrition & Dietetics, 66*, 54-59.

Green, P. H. R., & Cellier, C. (2007). Celiac disease. *The New England Journal of Medicine, 357*, 1731-1743.

Green, P. H. R., & Jabri, B. (2003). Coeliac disease. *Lancet, 362*, 383-391.

Green, P. H. R., & Jabri, B. (2006). Celiac disease. *Annual Review of Medicine, 57*, 207-221.

Hall, N. J., Rubin, G., & Charnock, A. (2009). Systematic review: Adherence to a gluten-free diet in adult patients with coeliac disease. *Alimentary Pharmacology and Therapeutics, 30*, 315-330.

Hallert, C., Sandlund, O., & Broqvist, M. (2003). Perceptions of health-related quality of life of men and women living with coeliac disease. *Scandinavian Journal of Caring Sciences, 17*, 301-307.

Hauser, W., Musial, F., Caspary, W. F., Stein, J., & Stallmach, A. (2007). Predictors of irritable bowel-type symptoms and healthcare-seeking behavior among adults with celiac disease. *Psychosomatic Medicine, 69*, 370-376.

Hudson, J. I., Hiripi, E., Pope, H., & Kessler, R. C. (2007). The prevalence and correlates of eating disorders in the national comorbidity survey replication. *Biological Psychiatry, 61*, 348-358.

Karwautz, A., Wagner, G., Berger, G., Sinnreich, U., Grylli, V., & Huber, W.-D. (2008). Eating pathology in adolescents with celiac disease. *Psychosomatics, 49*, 399-406.

Kemppainen, T., Kroger, H., Janatuinen, E., Arnala, I., Lamberg-Allardt, C., Karkkainen, M., . . . Uusitupa, M. (1999). Bone recovery after a gluten-free diet: A 5-year follow-up study. *Bone, 25*, 355-360.

Kothe, E., Mullan, B., & Butow, P. (2012). Promoting fruit and vegetable consumption. Testing an intervention based on the theory of planned behaviour. *Appetite, 58*(3), 997-1004.

Leffler, D. A., Dennis, M., Edwards-George, J., Jamma, S., Magge, S., Cook, E. F., . . . Kelly, C. P. (2009). A simple validated gluten-free diet adherence survey for adults with celiac disease. *Clinical Gastroenterology and Hepatology, 7*, 530-536.

Leffler, D. A., Edwards-George, J., Dennis, M., Schuppan, D., Cook, F., Franko, D. L., . . . Kelly, C. P. (2008). Factors that influence adherence to a gluten-free diet in adults with celiac disease. *Digestive Diseases and Sciences, 53*, 1573-1581.

Leffler, D. A., Edwards George, J. B., Dennis, M., Cook, E. F., Schuppan, D., & Kelly, C. P. (2007). A prospective comparative study of five measures of gluten-free diet adherence in adults with coeliac disease. *Alimentary Pharmacology and Therapeutics, 26*, 1227-1235.

Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales (DASS)* (2nd ed.). Sydney, Australia: Psychology Foundation of Australia.

Mullan, B., Wong, C., Allom, V., & Pack, S. L. (2011). The role of executive function in bridging the intention-behaviour gap for binge-drinking in university students. *Addictive Behaviors, 36*, 1023-1026.

Norman, P., & Conner, M. (2005). The theory of planned behaviour and exercise: Evidence for the mediating and moderating roles of planning on intention-behaviour relations. *Journal of Sport and Exercise Psychology, 5*, 121-140.

Olsson, C., Hornell, A., Ivarsson, A., & Sydner, Y. M. (2008). The everyday life of adolescent coeliacs: Issues of importance for compliance with the gluten-free diet. *Journal of Human Nutrition and Dietetics, 21*, 359-367.

Povey, R., Conner, M., Sparks, P., James, R., & Shepherd, R. (2000). Application of the theory of planned behaviour to two dietary behaviours: Roles of perceived control and self-efficacy. *British Journal of Health Psychology, 5*, 121-139.

Rubio-Tapia, A., & Murray, J. A. (2010). Celiac disease. *Current Opinion in Gastroenterology, 26*, 116-122.

Safren, S., Gonzalez, G., & Soroudi, N. (2008). *Coping with chronic illness: A cognitive behavioural approach for adherence and depression*. Oxford: Oxford University Press.

Sainsbury, K., & Mullan, B. (2011). Measuring beliefs about gluten free diet adherence in adult coeliac disease using the theory of planned behaviour. *Appetite, 56*, 476-483.

Sharpe, L., & Curran, L. (2006). Understanding the process of adjustment to illness. *Social Science and Medicine, 62*, 1153-1166.

Sheeran, P. (2002). Intention-behavior relations: A conceptual and empirical review. *European Review of Social Psychology, 12*, 1-36.

Siniscalchi, M., Iovino, P., Tortora, R., Forestiero, S., Somma, A., Capuano, L., . . . Ciacci, C. (2005). Fatigue in adult coeliac disease. *Alimentary Pharmacology and Therapeutics*, 489-494.

West, J., Logan, R. F. A., Hill, P. G., Lloyd, A., Lewis, S., Hubbard, R., . . . Khaw, K.-T. (2003). Seroprevalence, correlates, and characteristics of undetected coeliac disease in England. *Gut, 52*, 960-965.

West, J., Logan, R. F. A., Smith, C. J., Hubbard, R. B., & Card, T. R. (2004). Malignancy and mortality in people with coeliac disease: Population based cohort study. *BMJ, 329*, 716-719.

White, K. M., Terry, D. J., Troup, C., Rempel, L. a., & Norman, P. (2010). Predicting the consumption of foods low in saturated fats among people diagnosed with Type 2 diabetes and cardiovascular disease. The role of planning in the theory of planned behaviour. *Appetite, 55*, 348-354.

Wingenfeld, K., Mensebach, C., Rullkoetter, N., Schlosser, N., Schaffrath, C., Beblo, T., & Driessen, M. (2009). Relationship between coping with negative life-events and psychopathology: Major depression and borderline personality disorder. *Psychology and Psychotherapy: Theory, Research and Practice, 82*, 421-425.

Wong, C., & Mullan, B. (2009). Predicting breakfast consumption: An application of the theory of planned behaviour and the investigation of past behaviour and executive function. *British Journal of Health Psychology, 14*(489-504).

Table 1. Relationship between adherence and demographic and disease factors

	gluten free diet adherence	
	r	t
Age	-.15**	
Education	-.12*	
Age at diagnosis	-.13*	
No. of symptoms	.03	
Symptom duration	.01	
GFD duration	-.06	
Time to improvement	.18***	
Symptom recurrence	-.20***	
Gender		1.43
Symptom vs. screen detected		.09
Additional intolerances		-.01
Medical comorbidities		-.32
GFD knowledge	-.12*	

Note: GFD = gluten free diet; adherence measure: higher scores indicate poorer adherence; r = correlation coefficient; t = t statistic based on independent samples t tests; * $p < .05$; ** $p < .01$; *** $p < .001$

Table 2. Correlations between adherence, social-cognitive factors, psychological symptoms and coping

	Depression	Anxiety	Eating	Task	Emotion	Intention	Attitude	SN	PBC
Adherence	.33***	.25***	.29***	-.23***	.27***	-.37***	-.34***	-.09	-.42***
Depression	-	.63***	.43***	-.18**	.51***	-.15**	-.21***	-.01	-.21***
Anxiety		-	.35***	-.11*	.48***	-.01	-.14**	.09	-.14**
Eating			-	-.17**	.46***	-.05	-.19**	-.03	-.12*
Task				-	-.18***	.12*	.20***	.03	.15**
Emotion					-	-.08	-.19***	.09	-.13*
Intention						-	.52***	.29***	.55***
Attitudes							-	.14**	.56***
SN								-	.19***
PBC									-

Note: Eating = eating disorder risk; Task = task-oriented coping; Emotion = emotion-oriented coping; SN = subjective norm; PBC = perceived behavioural control; Adherence: higher scores indicate poorer adherence; * $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. Summary of hierarchical regression analyses predicting GFD adherence

	B	*β*	R^2	*F*
Step 1				
Gender	-.97	-.12*		
Symptom severity	-.60	-.22***		
Knowledge	-.03	-.11*	.067	8.00***
Step 2				
Gender	-1.38	-.17**		
Symptom severity	-.25	-.09		
Knowledge	-.03	-.12*		
Intention	-.98	-.21**		
PBC	-1.26	-.30***	.245	21.60***
Step 3				
Gender	-1.31	-.16**		
Symptom severity	-.27	-.10*		
Knowledge	-.03	-.13**		
Intention	-.94	-.20**		
PBC	-1.02	-.24***		
Depression	.09	.24***		
Anxiety	.02	.04	.314	21.68***
Step 4				
Gender	-1.00	-.12*		
Symptom severity	-.25	-.09		

Knowledge	-.03	-.12**		
Intention	-.94	-.20**		
PBC	-.99	-.24***		
Depression	.08	.20**		
Anxiety	.02	.03		
Eating disorder risk	.02	.12*	.325	19.88***

Note: Adherence measure (dependent variable): higher scores indicate poorer adherence

PBC = perceived behavioural control; * $p < .05$, ** $p < .01$, *** $p < .001$