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Relationships between gastrointestinal (GI) problems, anxiety, and depression were investigated in two studies using non-clinical populations. Study 1 measures included the trait anxiety scale from the State-Trait Anxiety Inventory (STAI), the Center for Epidemiology Studies Depression scale (CES-D), and the Trauma Symptom Checklist (TSC-40). Study 2 measures included the STAI, and the Profile of Mood States (POMS), portions of which were used to assess anxious mood state and depressed mood state. Trait anxiety predicted stomach cramps; anxious mood state predicted nausea and general GI problems; and depression predicted stomach problems. Findings suggest that psychological factors may be involved in physical symptoms.

A growing body of literature suggests that anxiety and depression can affect physical health and well-being. The mind/body connection has become a popular topic in recent years, and many researchers have found that the mind and body influence each other more than previously thought. Recent studies have found positive correlations between a wide range of physical complaints, including gastrointestinal (GI) problems, and trait anxiety (Drews, 2007; Sharma, Ghosh & Spielberger, 1995), anxiety disorders (Harter, Conway & Merikangas, 2003; Kaplan, Masand & Gupta, 1996) and depression (Masand et al., 1995; Lee et al., 2000; Karling, Adolfsson & Norrback, 2007). Many replications have supported this relationship using clinical populations, yet few replications focus on the general population (Haug, Myklentun, and Dahl, 2002). The purpose of this study was to investigate the relationship between gastrointestinal symptoms and trait anxiety, symptoms of anxiety and depression using a non-clinical population. Knowledge of this relationship could increase our understanding of the mind body connection.

Anxiety

The relationship between psychological factors such as anxiety disorders and trait anxiety, and physical problems such as GI disturbances may change the way we dichotomize physical and psychological health as separate entities. For example, Harter, Conway and Merikangas (2003) found a significant positive correlation between anxiety disorders and GI problems such as ulcer, colitis, and indigestion. After controlling for the effects of gender, substance abuse, and depression, they found that participants with a diagnosed anxiety disorder were at a 2.4 fold risk for self-reported GI problems than were participants without an anxiety disorder. Kaplan, Masand, and Gupta

(1996), found a similar relationship between panic disorder and irritable bowel syndrome (IBS). They found that patients who met the diagnostic criteria for panic disorder were more likely to meet the diagnostic criteria for IBS; nineteen patients who met the criteria for panic disorder also met the criteria for IBS, compared to only one control patient who met the criteria for IBS. Haug, Myklentun, and Dahl (2002) found that in a general population sample, self-reported clinical levels of anxiety most strongly predicted symptoms of nausea and was also a significant risk factor in predicting heartburn, diarrhea, and constipation. In a study of children with recurrent abdominal pain (RAP), Drews (2007) found that those with RAP had significantly higher levels of trait anxiety and somatic symptoms compared to children without RAP. Sharma, Ghosh and Spielberger (1995) found that men diagnosed with gastric ulcer had higher levels of trait anxiety than men without gastric ulcer. Although a relationship between anxiety disorders and GI problems has been evinced, few researchers have sought to determine whether anxiety symptoms must reach clinical levels to predict GI problems.

Many of the same symptoms involved in anxiety disorders and associated with GI problems are suffered by people when they experience a temporary state of anxiety. State anxiety differs from an anxiety disorder in that state anxiety is a transient feeling in response to a situation, whereas anxiety disorders are chronic and by definition interfere significantly with daily functioning. In order to diagnose an anxiety disorder, anxiety symptoms must be recurrent (Obsessive Compulsive Disorder, Panic Disorder), last for at least 6 months (Generalized Anxiety Disorder, Phobias) and/or occur in response to a particular stimulus (Posttraumatic Stress Disorder, Acute Stress Disorder, Phobias); and the disorder must cause significant impairment in functioning (American Psychiatric Association, 2000). About 18% of the adult population meet the diagnostic criteria for anxiety disorders, and are diagnosed as such (National Institute of Mental Health). Many people in the population may experience transient symptoms of anxiety, or state anxiety, but do not meet diagnostic criteria for an anxiety disorder. By measuring anxious mood state, it may be possible to determine whether state anxiety symptoms predict GI symptoms in a wider range of people.

Depression

The relationship between depression and GI disturbances also indicates that both physical and psychological health contribute to an individual's overall sense of well-being. In a study of ambulatory care patients, Masand et al. (1995) found that patients who met the diagnostic criteria for major depression were more likely to meet the diagnostic criteria for IBS than non-depressed patients. They found only 2.5% of non-depressed

patients reported IBS symptoms, whereas about a quarter of the patients with major depression reported them. In a related study, Sharma et al. (2003) examined the prevalence of IBS among psychiatric patients in India. In their sample, patients being treated for major depression had a higher prevalence rate of diagnosed IBS (18%) than non-depressed controls (3.5%). In another study of functional GI disorders, Lee et al. (2000) found that those with diagnosed non-ulcer dyspepsia (NUD), a functional disorder characterized by upper GI symptoms in the absence of any medical evidence of GI disease, reported more symptoms of depression. Haug, Myklentun, and Dahl (2002), found that in a general population sample, a self-reported clinical level of depression was a significant risk factor in predicting GI symptom categories of nausea, heartburn, diarrhea, and constipation.

As with anxiety, the research has focused primarily on clinical populations and symptoms of depressive disorder, but has not fully explored relationship between a state of depression and GI problems (Karling, Adolfsson & Norrback, 2007). At least one study indicates there may be a relationship worth investigating. Karling, Adolfsson and Norrback (2007) studied patients for whom recurrent depression was in remission and found that the positive correlation between depression and IBS symptoms was significant only for those patients currently experiencing depression symptoms. Patients who remained in remission tended to report IBS symptoms at similar rates as non-depressed controls. According to the surgeon general's report, in any given year about 6.5% of the U.S. population is affected by a major depressive episode, however, only 5.3% of the population is affected by unipolar major depressive disorder (U.S. Department of Health and Human Services, 1999), suggesting that in any given year, 1.2% of the population may experience a major depressive episode that does not escalate to major depressive disorder. Therefore about 3.6 million Americans may be struggling with major depression symptoms, but are not formally considered depressed and thus they are not included in studies of depression. These statistics, along with Karling, Adolfsson and Norrback's findings, indicate that being in a state of depression may be more influential in predicting GI problems than being depressed in general and that the field would benefit from closer examination of state depression.

Current Research

In an effort to replicate and extend prior research, archival data from two surveys of a non-clinical population that included questions about trait anxiety, anxious mood state, depression, depressed mood state and gastrointestinal problems, was examined using ANCOVA. After finding significance using an ANCOVA, individual univariate between groups tests were used on dichotomized data to determine directionality. Based

on prior research, it was hypothesized that in both samples those with higher anxiety and depressive symptom scores would report more frequent gastrointestinal problems. Given that the study was archival, the operational definitions of state and trait symptomology varied and are explained in more detail below.

STUDY 1

Method
Participants
Three hundred-forty undergraduate students (236 women, 101 men, 1 other, 2 undisclosed) participated as part of an Introductory Psychology course requirement at Bridgewater State College, Bridgewater, Massachusetts. Participants ranged in age from 16 to 56 (*M*= 21 years).

Materials
Measures on a pencil and paper survey included the trait anxiety scale from the State-Trait Anxiety Inventory (STAI; Spielberg, Gorsuch, & Lushene, 1970), the Center for Epidemiology Studies Depression scale (CES-D; Radloff, 1977), and the Trauma Symptom Checklist (TSC-40; Briere & Runtz, 1989), which was used to measure physical symptoms.

Procedure
Participants completed a pencil and paper survey which included 20 items measuring trait anxiety, 24 concerning depression symptoms, and 1 item regarding stomach problems, indicating on a 4 point Likert scale for each measure. Participant's scores for trait anxiety were computed as the mean of the 20 items on the trait anxiety scale, and a score for depression symptoms were computed as the mean of the 20 items on the CES-D scale plus 4 additional items regarding depression (had thoughts about death, though about killing myself, was down in the dumps, and was told I wasn't acting like myself). Higher scores indicated more frequent symptoms on both measures.

Results
An analysis of covariance (ANCOVA) was performed to simultaneously test the relationship between trait anxiety,

depression symptoms and general gastrointestinal (GI) problems. Depression symptom score, as reported on the CES-D scale, was a significant covariate in predicting general GI problems (F (1, 333) = 11.042, p = .001, η^2 = .032). To determine directionality, individual univariate between groups tests were used on dichotomized data. Higher scores indicated more frequent symptoms, and nonsignificant results were in the predicted direction (means for dichotomized groups and the significance of univariate tests appear in Table 1 for comparison). Trait anxiety was not a significant covariate in predicting general GI problems.

Discussion
The hypothesis was partially supported and prior work replicated in that participants with more frequent depression symptoms tended to report more frequent "stomach problems." That trait anxiety was not a significant covariate in predicting stomach problems was a surprising finding based on results from previous research. However, in Study 1, GI problems were defined in a very general way. Perhaps examining more specific GI symptoms would have yielded different results. It is also noteworthy that anxious mood state, and depressed mood state were not examined in Study 1. Given that the sample was not a clinical one, being in a state of anxiety or depression may be more significant than having symptoms of anxiety or depression in general. Perhaps anxious mood state and depressed mood state would be more significant predictors of GI problems than trait anxiety and depression. The data for Study 2 allowed for a more thorough investigation of these questions, as gastrointestinal problems were defined more specifically, and mood state variables were included as well.

STUDY 2

Method
Participants
One hundred-four undergraduate students (101 women, 3 men) at Bridgewater State College, Bridgewater, Massachusetts, volunteered to participate. Participants ranged in age from 17 to 25 (*M*= 20 years).

Table 1: Mean scores for dichotomized trait anxiety and depression symptoms

	Trait Anxiety		Depression	
	Low *M*	High *M*	Low *M*	High *M*
Stomach Problems	0.756	0.991	0.705*	1.041*

* p = .001

Materials

Measures on a pencil and paper survey included the trait anxiety scale (STAI; Spielberg, Gorsuch, & Lushene, 1970), and the Profile of Mood States (POMS; McNair, Lorr & Droppelman, 1971), portions of which were used to assess anxious mood state and depressed mood state. Participants were also asked to provide information about specific GI symptoms.

Procedure

Participants completed a pencil and paper survey. Measures included the trait anxiety scale, as well as 5 items regarding GI problems (stomach cramps, nausea or upset stomach, loss of appetite, constipation, diarrhea), 5 items from the POMS used to measure anxious mood state (tense, uneasy, nervous, anxious, weary), and 9 items from the POMS used to measure depressed mood state (worn out, sad, grouchy, unworthy, fatigued, lonely, exhausted, gloomy, sluggish), indicating on a 5 point Likert scale for each measure.

Participants' scores for trait anxiety were computed as in Study 1, scores for general GI problems were computed as the mean of the 5 items regarding GI problems, scores for anxious mood state were computed as the mean of the 5 items used to measure anxious mood state, and scores for depressed mood state were computed as the mean of the 9 items used to measure depressed mood state. Higher scores for trait anxiety and GI problems indicated more frequent symptoms, and higher scores for anxious mood state and depressed mood state indicated more severe symptoms.

Results

An ANCOVA was performed to simultaneously test the relationship between trait anxiety symptoms, anxious mood, depressed mood, general GI problems and several specific GI symptoms. Anxious mood state was a significant covariate in predicting both general GI problems (F (1,128) = 7.089, p = .009, η^2 = .052), and specific symptoms of "nausea or upset stomach" (F (1, 128) = 5.683, p = .019, η^2 = .043). To determine directionality, individual univariate between groups tests were used on dichotomized data. Higher scores indicated more frequent symptoms, and nonsignificant results were in the predicted direction (means for dichotomized groups and the significance of univariate tests appear in Table 2 for comparison). Trait anxiety was a significant covariate in predicting the specific symptom of "stomach cramps" (F (1, 128) = 6.966, p = .009, η^2 = .052), with higher scores indicating more frequent symptoms (Table 2 contains means for dichotomized groups). Depressed mood state was not a significant covariate in predicting general GI problems or specific symptoms.

Discussion

As hypothesized, prior research was extended in that anxious mood state was a significant covariate in predicting both general GI problems, and the specific symptoms of "nausea or upset stomach." In addition, prior research was replicated by the finding that trait anxiety was a significant covariate in predicting the specific symptom of "stomach cramps." However, depressed mood state was not a significant covariate in predicting general GI problems or specific symptoms.

General Discussion

The findings supported the hypothesized link between psychological factors and gastrointestinal disorders. In Study 1, depression symptom score, as reported on the CES-D scale, was a significant covariate in predicting general GI problems. These findings were consistent with research linking GI complaints with depressive disorder (Masand et al., 1995; Sharma et al., 2003; Lee et al., 2000; Haug, Myklentun, and Dahl, 2002). However, trait anxiety was not a significant covariate in predicting stomach problems, perhaps due to the general definitions of GI problems used in the Study 1 materials.

The extension to include more specific GI symptoms in Study 2 demonstrated that trait anxiety may be linked to particular GI symptoms (stomach cramps) rather than general GI problems,

Table 2: Mean scores for dichotomized trait anxiety, anxious mood state and depressed mood state symptoms

	Trait Anxiety		Anxious Mood State		Depressed Mood State	
	Low M	High M	Low M	High M	Low M	High M
General GI problems	0.545	0.756	0.445**	0.856**	0.611	0.691
Stomach Cramps	0.455**	0.930**	0.492	0.892	0.642	0.742
Nausea or Upset Stomach	0.885	0.989	0.581**	1.293**	0.793	1.080
Diarrhea	0.484	0.593	0.367*	0.709*	0.588	0.489

** $p < .050$

* $p = .052$

and that transient symptoms of anxiety and trait anxiety may be a factor in predicting different GI symptoms. Higher anxious mood state scores predicted more frequent general GI problems, and more frequent symptoms of nausea and diarrhea. These findings are consistent with previous research (Haug, Myklentun, & Dahl, 2002), especially in that anxious mood was most strongly associated with specific symptoms of nausea. However, unlike the study done by Haug, Myklentun, and Dahl (2002), the current study did not support the relationship between anxiety and constipation. The findings regarding trait anxiety support previous research done by Drews (2007), in which a correlation was found between trait anxiety and recurrent abdominal pain, but extends Drews to indicate that trait anxiety may be a factor in transient symptoms of stomach cramps or pain, and that the stomach pain need not be recurrent to find such a relationship. In addition, the extension to include state variables in Study 2 revealed that transient symptoms of anxiety may be linked to specific and general GI problems, but transient symptoms of depression may not be as predictive as chronic depressive symptomology. Although higher depression symptom scores predicted general stomach problems in Study 1, depressed mood state failed to predict general or specific GI problems in Study 2.

These studies speak to the generalizability of earlier works and extend the findings, most of which have been focused on clinical populations. Considering that a non-clinical sample of generally healthy individuals was used, and the ad-hoc measures were derived entirely from self-reports, the findings indicate that the relationship between psychological factors and GI symptoms may be quite strong. These studies indicate that normal, everyday people may be likely to experience transient GI problems during emotionally challenging times of their life and that there may be a reciprocal relationship between daily fluctuations in emotional and physical well-being, even for those who would be considered medically healthy.

The findings reported here do not imply a causal relationship and the study is limited in that the data were collected from small samples of mostly female college aged students. Though the generalizability of findings is not known, they suggest that more work is warranted and the information regarding the relationship between psychological and physical states may be of particular interest to college students. This knowledge may be especially useful during more anxious times such as finals.

The results do have implications in the treatment and prevention of physical disorders. Generally the focus of treatment and prevention is on physical disorders; however, knowing that psychological factors may contribute to physical disorders may promote psychological health as well. Perhaps maintaining psychological health would help prevent physical disorders, and patients with physical disorders may benefit from psychological treatments. That trait anxiety was not useful in predicting general gastrointestinal problems, but was useful in predicting specific gastrointestinal symptoms indicates that future research should focus on the complexity of the human experience and the most specific information possible regarding symptoms should be obtained. Future research should also focus on factors that may mediate the relationship between anxiety, depression and GI problems such as explanatory style, coping strategy, locus of control, or chronic self focus.

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