Stress, Social Problem Solving, and Irritable Bowel Syndrome: A Cross-Lagged Panel Design Investigation of Interactive Influences

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STRESS, SOCIAL PROBLEM SOLVING, AND IRRITABLE BOWEL SYNDROME:
A CROSS-LAGGED PANEL DESIGN INVESTIGATION
OF INTERACTIVE INFLUENCES

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The current study examined the interplay of three key variables: stress, maladaptive social problem-solving (SPS), and Irritable Bowel Syndrome (IBS) symptom severity. According to SPS theory, SPS is the self-directed cognitive and behavioral process by which individuals attempt to manage real-life problems or stressful situations. There are two main types of SPS: adaptive or maladaptive (D’Zurilla & Chang, 1995). Individuals who have adaptive SPS tendencies tend to view problems in an optimistic light; they perceive problems as solvable challenges and opportunities for personal growth. On the other hand, individuals who have maladaptive SPS tendencies often see problems as threatening and unsolvable, and they generally exhibit an impulsive or careless problem-solving style, or an avoidant style such as ignoring problems.

D’Zurilla and Nezu (2001) assert that the connection among stress, SPS, and adjustment is best understood by examining their relational/problem-solving model of stress and wellbeing. The relational/problem-solving model of stress and wellbeing suggests that risk factors such as increased stress or problems, maladaptive problem-solving ability, and decreased wellbeing form transactional relationships that interact with one another and evolve with time (D’Zurilla &
Nezu, 2001). This model has been supported by a substantial number of studies that demonstrate links between maladaptive SPS and a wide range of psychological problems such as depression and anxiety (Anderson et al., 2009; Chang & D’Zurilla, 1996; Kant et al., 1997; Siu & Shek, 2010; Wilson, Bushnell, Rickwood, Caputi, & Thomas, 2011) and physical health problems such as non-cardiac chest pain, asthma, and migraines (Eskin et al., 2013; Nezu, Nezu, & Jain, 2008; Witty, Heppner, Bernard, & Thoreson, 2001).

Although the relational/problem-solving model of wellbeing has been tested with several psychological and physical health problems, it had yet to be tested with IBS, which is one of the most common disorders diagnosed in primary care and gastroenterology settings (Mayer, 2008). IBS is characterized by a cluster of potentially debilitating symptoms that can include chronic abdominal pain and cramping, bloating, gas, irregular bowel patterns (i.e., diarrhea, constipation, or watery stools), and uncomfortable sensations of incomplete evacuation.

IBS has no clear etiology or mechanism to explain dysfunction, but the biopsychosocial perspective is the predominant approach for understanding IBS (Kennedy et al., 2012; Tanaka et al., 2011). The biopsychosocial perspective links biological, psychological, and social factors to the onset, severity, and course of IBS (Pletikosić & Tkalčić, 2013; van Tilburg et al., 2013). IBS is often referred to as the “brain-gut disorder” due to the notion that bidirectional relationships exist between the mind (i.e., psychological factors) and the body (i.e., physiological factors), and that individuals with IBS have dysregulation of the communication between the “brain” and the “gut” (Kennedy et al., 2012). For example, individuals who have maladaptive cognitive appraisals might tell themselves: “I can’t handle this” in stressful situations, which, in turn, increases their level of stress. The increased stress leads them to engage in maladaptive SPS
which adversely impacts their ability to cope with their environment, and this may result in an increase in the severity of their gastrointestinal symptoms (Kennedy et al., 2012).

The current study’s evaluation of the relational/problem-solving model of stress and wellbeing with IBS contributed to the body of research that has established relationships between stress and SPS (Bell & D’Zurilla, 2009) and stress and IBS symptoms (Dancey et al., 1995). Consequently, the current study examined the interplay amongst stress, maladaptive SPS, and IBS using this model. Results supported all of the testable hypotheses, providing evidence for previously established connections between stress and maladaptive SPS, and stress and IBS. This investigation also contributed to the SPS literature in two major ways: it used a longitudinal design in a research area dominated by cross-sectional studies, and it also found support for a previously unexplored association between IBS and maladaptive SPS.
DEDICATIONS

To my thoughtful and incredible husband, Jon,

my encouraging and selflessly devoted parents, Stuart and Iliana,

and my uplifting and beyond-supportive sisters, Adine, Iris, and Lisa.

I am so very fortunate to have such an amazing, generous, and fiercely loyal
family. Thank you for all that you have poured into being my advisors, advocates,
and a source of strength at every stage of my life.
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CHAPTER I: IRRITABLE BOWEL SYNDROME

The current study aimed to identify connections among stress, social problem-solving, and a condition known as Irritable Bowel Syndrome (IBS). The focus of this chapter is to provide a broad overview of the syndrome. A description of IBS symptoms, prevalence, course, diagnostic process, and treatment is provided. IBS is a complicated syndrome with no known etiology; thus, researchers have identified several risk factors and posited some etiological theories. These etiological theories will also be summarized. The chapter concludes with a description of gastrointestinal assessment measures and the rationale for the selection of a measure of IBS symptom severity for the present study.

Description

Irritable Bowel Syndrome (IBS) is characterized by a cluster of symptoms that include chronic abdominal pain and cramping, bloating, gas, irregular bowel patterns (i.e., diarrhea, constipation, or watery stools), and uncomfortable sensations of incomplete evacuation. These symptoms are potentially debilitating and tend to occur when people experience irregular contractions in the colon (Gorard, Libby, & Farthing, 1994). Normal, healthy colons have regular contractions that push stools towards the rectum where they are stored and can later be evacuated, whereas a colon with IBS tends to have spastic contractions leading to irregular bowel movements (i.e., constipation, diarrhea) that are often accompanied by discomfort and pain (Manning, Thompson, Heaton, & Morris, 1978). For example, when the gut contractions are strong, they move loose stools prematurely into the rectal area, leading to gas, bloating, and diarrhea. Conversely, when contractions are too weak, the stool is retained and becomes hard, dry, and difficult to evacuate, leading to constipation (Mayo Foundation for Medical Education and Research, 2018). Interestingly, these irregular contractions occur without any identifiable
physical or structural abnormalities in the body. IBS has no clear etiology or mechanism to explain dysfunction, and therefore it does not qualify as an organic disease (Attree, Dancey, Keeling, & Wilson, 2003). Instead, it is classified as a functional gastrointestinal disorder (FGID; Attree et al., 2003). The lack of etiology or explanation for dysfunction can be frustrating for patients and physicians who are trying to manage IBS symptoms (Whitehead et al., 2004).

**Prevalence and Course**

IBS is among one of the most common disorders diagnosed in primary care and gastroenterology settings, and is the most common FGID (Mayer, 2008). It affects approximately 15 to 22% of individuals in the United States and 10 to 15% worldwide (Kennedy et al., 2012; Mayer 2008; Talley, Boyce, & Jones, 1997). IBS is more prevalent in women than men, with a ratio of 2:1 (National Institute of Diabetes and Digestive and Kidney Diseases, 2015). The peak prevalence in North America is 20 to 39 years of age (Wilkins, Pepitone, Alex, & Schade, 2012) and the general trend is that symptoms decline with age (Chey, Kurlander, & Eswaran, 2015). Having said that, it is important to evaluate prevalence rates with some skepticism. One issue is that most people who suffer from IBS symptoms do not seek treatment for a variety of reasons (e.g., their ability to function moderately with bowel discomfort may outweigh their uneasiness in seeking help) and thus IBS rates may be largely underrepresented (Koloski, Talley, & Boyce, 2001). Another issue is that among diagnosed patients, it is common for them to report that they suffered for several years before they received a formal diagnosis (Casiday et al., 2008). Thus, it is reasonable to suspect that although the peak prevalence extends to the age of 39, the reality may be that for most people the peak is closer to the early
20s (or even earlier). In the current study, participants were undergraduates and most were in the 18- to 24-year-old range.

There are several important reasons why the prevalence and course of IBS should be examined in a college population. In university samples, prevalence rates of 10.9% and 19% of IBS have been identified (Gulewitsch, Enck, Schwille-Kiuntke, Weimer, & Schlarb, 2013; Hazlett-Stevens, Craske, Mayer, Chang, & Naliboff, 2003). College can be a particularly tumultuous time, and signs of IBS often emerge when experiencing heightened stress (Pletikosić & Tkalčić, 2013). College is particularly stressful because it introduces a variety of life changes, such as a new school, increased distance from friends and family, and a whole new level of responsibility and independence (Anderson, Goddard, & Powell, 2009). Another important reason is that people beginning college are in late adolescence, which is a period often associated with a heightened sense of self-consciousness and challenges with peer socialization, which are in turn associated with higher levels of depression and anxiety, both of which are associated with IBS (Steinberg, 2005).

**Diagnosis**

**The Exclusion Process**

IBS is a diagnosis of exclusion; in order to avoid a misdiagnosis, a physician or gastroenterologist must first rule out the possibility of organic gastrointestinal problems (e.g., inflammatory bowel disease, celiac disease, parasitic infection; Manning et al., 1978; Schuster, 2010). First, the physician obtains information from patients about their medical history, such as asking about their typical bowel patterns, how much they exercise, and how much stress they are experiencing. A physical examination is also conducted to look for other causes of gastrointestinal issues. These include blood tests, such as examining one’s blood count or blood
chemistry to assess if a person has anemia or allergies to certain foods (e.g., gluten; Torpy & Golub, 2011). Stool samples are often taken to check for blood in the stool or infections. Additionally, hydrogen breath tests may be conducted in order to check for small intestinal bacterial overgrowth (National Institute of Diabetes and Digestive and Kidney Diseases, 2015). An endoscopy of the gastrointestinal tract is often performed, which may include a colonoscopy (i.e., passing a flexible instrument with a light through the rectum to view the inner surface of the colon) or an esophagogastroduodenoscopy, which looks at the inner surface of the esophagus, the stomach, and the small intestine. During the endoscopy, a biopsy (i.e., tissue sample) may be collected and sent to the laboratory to assess for cancer, celiac disease, or inflammatory bowel disease. Lastly, X-rays or computed tomography of the gastrointestinal tract may be conducted, in order to seek causes of diarrhea or constipation or persistent abdominal pain (Torpy & Golub, 2011).

The Inclusion Process

After organic gastrointestinal problems have been explored and ruled out as explanations for the cause of a person’s bowel symptoms, physicians then refer to diagnostic criteria in order to assess if the symptoms are severe enough and have persisted long enough to warrant an IBS diagnosis (Manning et al., 1978). The evolution of diagnostic criteria for IBS is explained below and concludes with the study’s decision to select an IBS measure that is based on the Rome II criteria, what appears to be the most comprehensive, conservative, and validated criteria to date.

In 1978, Manning and colleagues made the first attempt to create an objective, reliable criterion to diagnose IBS, called the Manning Criteria. Although the Manning Criteria were widely used since they were created in 1978, Talley and colleagues (1990) reported that data on their validity were not available until they evaluated it with a sample of 361 outpatients. These
patients completed a bowel disease questionnaire that objectively measured Manning’s criteria, in addition to independent clinical evaluations. Logistic regression models revealed that when trying to discriminate IBS from organic gastrointestinal disease, the Manning criteria yielded 58% sensitivity (true positive rate) and 74% specificity (true negative rate), and when trying to discriminate IBS from all non-IBS gastrointestinal disease, the criteria yielded 42% sensitivity and 85% specificity. This indicates that the Manning’s criteria are fairly good in correctly identifying people who do not have IBS, but not as good at correctly identifying those who do have IBS.

In 1989, the International Congress of Gastroenterology, a non-profit international organization, held a meeting in Rome to create new standardized criteria for diagnosing IBS, aptly called the Rome Criteria. They were based on the notion that pain was dependent on bowel movements, such as pain relief with defecation, and that pain was the primary symptom of IBS (Dang, Ardila-Hani, Amichai, & Pimental, 2012). In their meta-analysis, Dang and colleagues (2012) reported that studies examining the validity of the Rome criteria reported ranges of 65 to 85% of sensitivity, and 70 to 100% for specificity. These ranges are wide and make it unclear as to how helpful these criteria are. It should also be noted that the Rome criteria were criticized for lacking symptoms, such as diarrhea and urgency, and for containing overly strict requirements for diagnosis (Drossman et al., 1990). To address these issues, they were revised into the Rome II criteria in 1999, one of the most comprehensive and conservative systems for diagnosing IBS (Drossman, 1999). To meet these criteria, a person needs to experience abdominal discomfort or pain for at least 12 weeks in the preceding 12 months, and this discomfort or pain must consist of two out of the three following features: (1) relieved with defecation and/or (2) onset associated with a change in frequency of stool and/or (3) onset
associated with a change in the form (appearance) of stool. Symptoms that cumulatively support the diagnosis of IBS are: (a) abnormal stool frequency (more than 3 bowel movements per day or less than 3 bowel movements per week), (b) abnormal stool form (lumpy/hard or loose/watery), (c) abnormal stool passage (straining, urgency, feeling of incomplete evacuation, (d) passage of mucus, and (e) bloating or feeling of abdominal distension. Again, the sensitivity and specificity ranges are wide and somewhat unclear.

In 2006, the Rome III criteria were created. The largest difference between the Rome II and Rome III criteria is that the Rome III criteria are less restrictive in that symptoms must occur at least six months before a diagnosis and be currently active (i.e., meet criteria) for the last three months, as opposed to Rome II’s criteria of 12 weeks of symptoms within the last 12 months (Drossman, 2006). The other notable change is that Rome III shifted away from IBS subtypes (diarrhea, constipation, and mixed) to a simple classification derived from stool consistency (Drossman, 2006). However, Rome II continues to be more popular, and while validation of the Rome II exists, there is no validation of the Rome III criteria (Dang et al., 2012). A major criticism of the Rome III is that they are too liberal and that more conservative criteria, such as the Rome II, may be better suited for clinical trials (Dang et al., 2012). Unlike the Rome II criteria, which were widely adopted when they emerged, there is a major lack of utilization of the Rome III criteria by researchers, regardless of study type (Dang et al., 2012). Since the Rome II criteria appear to be the most useful criteria to date, the current study employed a measure based on the Rome II criteria to assess IBS symptom severity. A detailed description of this measure is provided in the assessment measures section.
Treatment

Since IBS is a heterogeneous disorder with varying treatments, the optimal approach for any individual can be difficult to determine. No treatment for IBS has been found to be lastingly effective (Dancey, Whitehouse, Painter, & Backhouse, 1995), but medications are common for the management of individual symptoms, such as constipation, diarrhea, and abdominal pain (Mayer, 2008). For example, antispasmodic agents (e.g., hyoscyamine or mebeverine) have been used for IBS pain and discomfort (Trinkley et al., 2011). Another common set of tactics are dietary and include adhering to regular meal times, restricting caffeine and alcohol intake, adjusting fiber, lowering gluten intake, increasing probiotics, and reducing intake of fatty foods (Ahmed & Akbar, 2015; Trinkley et al., 2011). Stress-reduction and exercise are also commonly recommended to manage IBS symptoms. Tanaka, Kanazawa, Fukudo, and Drossman (2011) recommended appropriate social supports to manage the effects of life stress, abuse, and psychological factors that impact IBS. Psychological treatments such as mindfulness training and cognitive behavioral therapy (CBT) are often useful for IBS patients. For example, CBT helps patients learn new ways to take a proactive approach in controlling symptoms, coping with negative emotions, and improving attitudes regarding their chronic pain (Tanaka et al., 2011).

Theories of Etiology

IBS is a complicated illness, and there is no clear consensus about its cause or causes. Researchers have worked to identify many risk factors (e.g., gastrointestinal bacterial issues, bowel inflammation, a family history of IBS, a history of sexual or physical abuse, high stress levels, and maladaptive coping strategies) and posit some etiological theories stemming from biological, psychological, and biopsychosocial perspectives. The biopsychosocial perspective is
of particular importance for this investigation, as it integrates biological, psychological, and social factors. Each etiological theory is reviewed below.

**The Biological Perspective**

There are many biological risk factors associated with IBS. These include muscle contractions, poor bowel motility, gastrointestinal bacterial issues, nervous system abnormalities, visceral pain sensitivity, food sensitivity, bowel inflammation, and gender (i.e., being female).

**Genetics.** Heredity may play a role in the etiology of developing IBS. Studies show that IBS is more common in people who have family members with a history of gastrointestinal problems (Levy et al., 2001; Locke et al., 2000; Morris-Yates et al., 1998). Morris-Yates and colleagues (1998) conducted the Australian Twin Registry study and found that of 686 individual twins from same-sex pairs, 186 monozygotic (MZ) and 157 dizygotic (DZ) twins, had IBS symptoms that were not diagnosable as a functional bowel disorder, and 56.9% of the variance was attributed to genetic variance. Levy and colleagues (2001) found in 6,060 twin pairs that 17% of MZ twins (who share 100% of DNA) had concordant IBS, compared to only 8% of DZ twins (who share 50% of DNA), supporting a genetic contribution for IBS. Another study, which examined the association between gastrointestinal symptoms and family history, also provided evidence of a genetic contribution for IBS. Locke and colleagues (2000) administered a self-report questionnaire about gastrointestinal symptoms and first-degree relatives’ history of abdominal pain or bowel problems to an age- and sex-stratified random sample aged 30 to 64 years old. They found that reporting IBS was significantly associated with reporting having a first-degree relative with abdominal pain or bowel problems. Having said that, any investigation of genetic influences must also consider intertwined environmental factors. Locke and colleagues acknowledged the limitation that they were unsure if these associations may also be
due to having a shared environment or a due to the families having a heightened awareness of gastrointestinal symptoms. As one example, Levy and colleagues (2001) examined twins and found that for both MZ and DZ twins with IBS, there was a higher likelihood that the mother would have IBS compared to the other twin (contrary to what would be expected). Thus, a social learning component may be involved (e.g., parents may indirectly teach children to pay attention to trivial symptoms). This idea of a social learning component will be expanded on in the psychological perspective section, under maladaptive parental influences.

**Muscle contractions and poor motility.** Maladaptive muscle contractions in the intestine, or poor bowel motility, may lead to IBS (Tanaka et al., 2011). The intestinal walls are lined with muscles that contract to move food through the digestive tract. Contractions that are strong and long-lasting may cause faster transit time of the bowels, gas, bloating, and diarrhea (Mayo Foundation for Medical Education and Research, 2018). Spasms and rapid transit times can also cause abdominal pain. On the other hand, when contractions are weak, it can lead to slower transit time for bowels to move through the digestive tract and create hard, dry stools (Mayo Foundation for Medical Education and Research, 2018). Muscle contractions that are too fast or too slow are related to abnormal intestinal motility, which may explain small intestinal bacterial overgrowth (SIBO) in IBS patients (Lin, 2004).

**Gastrointestinal bacterial issues.** Gastrointestinal tract bacterial infections may cause IBS in some individuals (see Halvorson, Shlett, & Riddle, 2006 for a review). Everyone has bacteria in their small intestine, but when the bacteria increase in number, SIBO can occur, producing gas and diarrhea. Gastrointestinal bacterial issues can also occur when not enough “good” bacteria, called microflora, reside in the intestines (Balsari et al., 1982; Madden & Hunter, 2002). Research shows that people with IBS might not have enough microflora, and
damage to microflora can be permanent (Madden & Hunter, 2002). For example, studies have shown that IBS patients often have lower counts of lactobacilli and bifidobacteria (two types of microflora) compared to healthy controls (Balsari et al., 1982). Parallel to this, Bradley and colleagues (1987) found that in IBS patients, clostridium (i.e., bad bacteria that contains human pathogens) was more present than bifidobacteria. However, despite evidence that intestinal microflora is different in people with IBS compared to those without, the directionality is unclear. This means that changes in the intestinal microflora may cause IBS, or changes in intestinal microflora could be a result of disturbed gut motility from IBS (Madden & Hunter, 2002).

Nervous system abnormalities and visceral pain sensitivity. Nervous system abnormalities and visceral (i.e., gut) pain sensitivity may partially explain why certain people experience IBS symptoms (Mayer, 2000). Abnormalities in the nerves of the digestive system may cause people to experience higher levels of discomfort when their abdomens stretch from passing gas or a stool (Barbara et al., 2004). The nerves in the gut may be extra sensitive for people with IBS, and their brains may process pain signals differently. Positron emission tomography imaging, which creates images showing the way tissues and organs function, has suggested abnormalities in the central nervous system (CNS) related to visceral pain sensitivity (Mertz, 2002). For example, fMRIs during painful and nonpainful rectal distension show that for IBS patients (compared to healthy controls), pain leads to greater activation of the anterior cingulate cortex (ACC), a critical pain center in the CNS, signifying heightened pain sensitivity in the IBS patients (Mertz, 2002).

Additionally, IBS patients have been reported to have lower pain thresholds than healthy controls (Kanazawa et al., 2008). This is often assessed via a barostat test, which is a computer-
controlled pump used for testing sensory thresholds in bowel lumens (Kanazawa et al., 2008). To do this, a plastic bag is inflated with air to a predefined pressure and holds the pressure constant for a fixed amount of time (Kanazawa et al., 2008). Dorn et al. (2007) also found that patients with IBS had lower thresholds than healthy controls. They examined 121 IBS patients who met Rome II criteria and 28 controls who underwent balloon distensions in the descending colon using the ascending methods of limits (AML) to assess pain thresholds. Additionally, neurosensory sensitivity was measured by the ability to discriminate between 30mm Hg vs. 34 mm Hg distensions, and psychological influences were assessed using a report criterion of one’s tendency to report pain, indexed by the median intensity rating for all distensions. Having said that, their results indicated that increased colonic pain sensitivity in IBS patients was the result of an increased tendency to report pain (i.e., a psychological tendency) rather than actual increased neurosensitivity (Dorn et al., 2007).

**Food sensitivity.** There seems to be a link between food sensitivities and IBS. IBS sufferers often report that certain foods trigger their symptoms (National Institute of Diabetes and Digestive and Kidney Diseases, 2015). Although heterogeneous, these foods include coffee, alcohol, spicy or fatty foods, or foods rich in carbohydrates (Park & Camilleri, 2006). For example, researchers suspect that poor absorption of sugars, or that bile acids, may cause IBS. In a review, Lin (2004) indicated that there has been recent interest in fructose (i.e., fruit sugar) intolerance as a cause of IBS. Interestingly, for many patients the association between sugar intolerance and IBS may be related to bacteria overgrowth (i.e., SIBO) described above. This is evidenced in a study by Nucera et al. (2005) examining 98 patients with a diagnosis of IBS according to Rome II criteria. For the majority of these patients, malabsorption of lactose (i.e., milk sugar), fructose (i.e., fruit sugar), and sorbitol (i.e., sugar alcohol) disappeared once SIBO
was eradicated. Nucera and colleagues (2005) conducted another study, using lactose, fructose, and sorbitol hydrogen breath tests, which are widely employed to detect specific sugar malabsorption. Eradicating SIBO in IBS patients resulted in normalized sugar breath tests in most of the patients, and asserted that testing for SIBO is imperative before testing for sugar malabsorption to avoid misdiagnosis. Adding support to this, Pimentel and colleagues (2002) reported that with eradication of SIBO, patients had a dramatic improvement in IBS symptoms. They also used a lactulose breath test, a reliable and non-invasive test to diagnose SIBO (Pimentel et al., 2002), on IBS patients in their study, and reported that true lactose intolerance was indeed very low (only 16%) and that in nearly all participants who had recurring IBS symptoms, these symptoms co-occurred with a return of SIBO.

**Bowel inflammation.** Low grade mucosal inflammation may play a role in IBS. This is evidenced by an increased number of immune-system cells in the intestines of IBS patients (Barbara et al., 2004). The inflammation, in turn, disrupts gastrointestinal reflexes and may increase visceral sensitivity. Factors that may contribute to low grade muscle inflammation are genetic factors, undiagnosed food allergies, and changes in microflora (i.e., good bacteria). As an example of how genetics may play a role in inflammation, a study by Gonsalkorale and colleagues (2003) extracted DNA from blood samples of 230 IBS patients and 450 healthy controls. They found a cytokine called interleukin 10 (which has anti-inflammatory properties) was significantly lower in patients with IBS compared with healthy controls. Allergic reactions may also cause inflammation in the gastrointestinal tract. To test this involves documenting a careful history and diagnostic tests, such as breath hydrogen tests for lactase and fructose. However, there is no gold standard for testing food allergies, and often people report food allergies that cannot be discriminated from food intolerance (see Park & Camilleri, 2006, for a
review). As such, attributing food allergies to increased muscle inflammation and/or IBS should be approached with caution. Lastly, a lack of microflora in the intestines may be at least partially responsible for low grade inflammation in IBS.

**Gender.** Gender may play a role in the development and the diagnosis of IBS. IBS is more common in women than men, with a ratio of two to one (Lee et al., 2001; Talley, Boyce, & Jones, 1997). One potential explanation is that estrogen levels are higher in women, and estrogen may lead to an increased sensitivity in the gut (Mulak, Taché, & Larauche, 2014). Among women, IBS is most prevalent during years of menstruation, with symptoms being most severe during post-ovulatory and premenstrual phases, both phases in which estrogen levels peak (Mulak et al., 2014). Additionally, cortisol, a steroid hormone that is positively associated with stress, is unusually high in women with IBS (Palsson & Whitehead, 2005). Of note, gender as a risk factor also has psychological components that should not be overlooked. For example, women are more likely to engage in help-seeking behavior, in that they are more willing to report persistent pain, and this may partially explain why there appears to be higher rates of IBS in women (Anbardan et al., 2012). Additionally, men are less likely to visit medical professionals even if they have IBS symptoms, and women tend to see doctors more often for a variety of reasons and on a more regular basis (Bertakis, 2009; Bertakis et al., 2000). Lastly, psychologically, women tend to suffer more from depression, abuse, and anxiety than men, all of which are positively associated with IBS symptoms (Chitkara, van Tilburg, Blois-Martin, & Whitehead, 2008; Drossman et al., 1999).

**The Psychological Perspective**

There are multiple psychological risk factors associated with IBS. These include maladaptive coping strategies (e.g., hypervigilance, somatization, pain catastrophizing),
emotional problems (e.g., depression, anxiety), a history of abuse, maladaptive parent-child interactions, and high levels of stress. These psychological risk factors are discussed below.

**Maladaptive coping strategies.** Maladaptive coping strategies, such as hypervigilance, somatization, and pain catastrophizing may play a role in IBS (Lackner, Quigley, & Blanchard, 2004; Tanaka et al., 2011; van Tilburg, Palsson, & Whitehead, 2013). Furthermore, these dysfunctional strategies are related to stress (Tanaka et al., 2011). Hypervigilance in this context refers to believing that gastrointestinal sensations are due to an organic disease, meaning that a disease process can be identified (Kennedy et al., 2012). This is problematic because IBS can only be diagnosed in the absence of organic disease (Thompson et al., 2008). Those who engage in hypervigilance selectively attend to information that fits with their set of beliefs about their IBS symptoms (e.g., noticing when symptoms precede a suspected cause), while ignoring information that is inconsistent with their set of beliefs (e.g., not paying attention to instances when symptoms occur without being triggered by that speculated cause). Understandably, being told by doctors there is no organic link to IBS (yet only perceiving evidence that suggests the contrary) could create significant frustration and distress in IBS patients.

Somatization is another maladaptive coping strategy identified with IBS. Somatization refers to experiencing multiple bodily pains (not just IBS symptoms) that have no medically identifiable basis, and that these pains may be better explained by stress and negative mood (Kennedy et al., 2012). In clinical settings, it is common for IBS-sufferers to report chest pain, dizziness, and weakness, and up to 50% have been found to at least border the diagnosis of somatization disorder (Kennedy et al., 2012). Supporting the presence of somatization in IBS patients, van Tilburg and colleagues (2013) examined 286 patients with IBS who were diagnosed using the Rome II or Rome III criteria (Drossman, 1999; 2006). These patients completed a
battery of questionnaires, including the Somatization subscale in the Brief Symptom Inventory-18 (BSI-18; Derogatis; 1982) and the IBS Severity Scale (IBS-SS; Francis & Whorwell, 1997). Van Tilburg and colleagues (2013) found that somatization was positively and significantly associated with IBS severity. They also reported that IBS sufferers who somaticize receive diagnoses of other functional gastrointestinal disorders, chronic pain syndromes, heart palpitations, frequent urination, and chronic fatigue, all of which are not explainable by a common pathophysiology.

A third maladaptive coping strategy related to IBS is pain catastrophizing. This refers to the tendency to focus on and exaggerate the threat value of painful stimuli, and to negatively evaluate one’s ability to deal with the pain (Kennedy et al., 2012). It has also been described as emotional distress and a morbid pessimism about IBS, which may lead to perceived helplessness and decreased physical activity, and greater disability (Kennedy et al., 2012). In fact, catastrophizing is one of the most robust predictors of pain intensity (van Tilburg et al., 2013). In this context, it makes sense that catastrophizing is associated with more intense pain and greater disability in patients who suffer from pain, including IBS-sufferers. Van Tilburg and colleagues’ (2013) study described above also assessed catastrophizing’s relationship to IBS, using the BSI-18’s Catastrophizing subscale. Like somatization, catastrophizing was positively and significantly associated with IBS severity. Consistent with their findings, Lackner and colleagues (2004) also found a link between catastrophizing and IBS. More specifically, they examined 244 IBS patients who were diagnosed by Rome II criteria. Catastrophizing was assessed via the Catastrophizing subscale in the Coping Strategies Questionnaire (CSQ; Rosenstiel & Keefe, 1983), depression was assessed via the Beck Depression Inventory (BDI; Beck, Steer & Brown, 1996), and pain was assessed via the Bodily Pain subscale in the Short
Form Health Survey (SF-36; Ware & Sherbourne, 1992). They confirmed that catastrophizing played a significant mediating role in the link between depression and pain severity.

**Emotional problems.** Emotional problems have also been linked to IBS. Reported rates of comorbid anxiety and depression in IBS range between 30 and 60% (Sibelli et al., 2016). Moreover, psychological distress, which refers to feeling anxious and depressed, is associated with more gastrointestinal symptoms in IBS, disability, and quality of life impairment. For example, patients with abdominal pain or IBS, compared to control patients, have been shown to report significantly higher BDI scores (Rose, Harvey, & Smith, 1986). This is further supported by Talley, Boyce, and Owen (1995), who found that the depression scale on the Symptoms Checklist-90 (SLC-90; Derogatis, Lipman, & Covi, 1977) was the most elevated scale in IBS patients compared to healthy controls. In van Tilburg and colleagues’ (2013) study, anxiety had also been assessed using the BSI-18’s Anxiety subscale, and it had a significant indirect effect on IBS through catastrophizing and somatization. Anxiety, in turn, was predicted by neuroticism (assessed via the NEO Personality Inventory, Neuroticism subscale; Costa & McCrae, 1992). This makes sense as neuroticism involves readily experiencing negative affect, being reactive to stress, and having strong reactions to recurring problems (van Tilburg et al., 2013). Of note, neuroticism is one of the few personality traits that has been consistently found to be increased in IBS patients compared to controls. Philips, Wright, and Kent (2013) discovered that IBS was associated with high traits of neuroticism and maladaptive forms of coping, including higher levels of self-blame, and lower levels of active coping, instrumental support, and positive reframing.

A link between IBS and internalizing distress might be expected given that IBS can lead to distress, negative social consequences, and isolation. For example, people with frequent
abdominal distress often fear they may have a “sudden attack” of symptoms in front of others (e.g., public places, parties, social gatherings) and thereby restrict their activity choices (e.g., avoid going out, frequently turn down friends’ social invitations; Schneider & Fletcher, 2008). Although such actions help prevent IBS-sufferers from potential embarrassment, it comes at the cost of missing opportunities to socialize (Schneider & Fletcher, 2008). Additionally, others with IBS symptoms may feel guilty or that they are a burden when spending time with friends or family who “bend over backwards” to accommodate their health (Schneider & Fletcher, 2008). This can lead to distancing oneself from others, and dissipating social ties and support, which may in turn lead to social isolation, loneliness, and disconnectedness from others.

**History of abuse.** A history of abuse during childhood is also thought to be a contributor to the development of IBS. Park and colleagues (2016) conducted the first study to evaluate early adverse life events in gastrointestinal disease. They analyzed data from 148 IBS patients who completed the Adverse Childhood Experiences (ACE) questionnaire, a bowel symptom questionnaire to measure the presence of IBS using the Rome III criteria, and a 0 to 20 numeric rating scale for IBS symptom severity and pain severity. IBS status was predicted by a history of emotional abuse, and ACE scores significantly correlated with abdominal pain severity, as well as with IBS symptom severity specifically. They also found that 20% of their IBS patients reported sexual abuse, which is consistent with other studies with reported rates of 13 to 54%. In support of this link, Drossman and colleagues (1990) surveyed 206 patients suffering from gastrointestinal disorders in a university-based gastroenterology clinic, and the patients with functional gastrointestinal disorders, compared to patients with organic disorders, were more likely to report sexual abuse during childhood (odds ratio 2.08 to 1) and physical abuse during childhood (odds ratio 11.39 to 1). Salmon, Skaife, and Rhodes (2003) also yielded parallel
findings in their survey study. They asked 64 patients with IBS and 61 patients with bowel symptoms explained by physical disease to complete the Medical History Questionnaire (Drossman et al., 1990), which assessed recollections of abuse as children. Results revealed that IBS patients recalled more sexual and physical abuse experiences than control patients who had organic gastrointestinal disorders. Lastly, Talley and colleagues (1994) also obtained supporting findings. They conducted a population-based study, recruiting 919 residents of Minnesota, 130 of which had IBS. They initially reviewed Mayo Clinic medical records and via mail sent the Medical Health Questionnaire and the Bowel Disease Questionnaire (Talley, Philips, Melton, Wiltgen, & Zinsmeister, 1989) to assess IBS. In those with IBS, 36% reported some type of abuse in childhood, 35% had some type of abuse in adulthood, and 43% had a history of sexual abuse in general. Additionally, a history of physical or sexual abuse is linked to higher IBS symptom severity; when compared with patients without abuse history, gastrointestinal clinic patients who have a history of abuse reported more severe pain and greater psychological distress (Tanaka et al., 2011). As an explanation for the above, Tanaka and colleagues (2011) asserted that a child’s genetics, early learning, and environmental stressors (e.g., divorce, relationship difficulties, serious illness of self or other) uniquely affect the child’s behavior, stress levels, and ability to cope with stress. In other words, their perception of control over stressful unresolved events (or lack thereof) may influence the impact of stress (Tanaka et al., 2011).

**Maladaptive parental influences.** The attitudes and behaviors of parents might play a role in the development of IBS. Children of patients with IBS are more prone to having gastrointestinal symptoms and have significantly more health care visits compared to children of patients without IBS (Tanaka et al., 2011). Social learning may play a role in that parents with IBS may engage in illness behavior (i.e., pay attention to trivial symptoms), and their children
may learn to pay attention to these trivial symptoms and worry more about their consequences (Tanaka et al., 2011). Levy and colleagues (2004) postulated that social learning of illness behavior follows when parents respond to their children’s abdominal complaints with increased attention (i.e., reinforcing their children’s behavior). They also suggested that when parents behave in ways that show they are clearly worried about illness, their children may learn to do the same through modeling. In line with this, Levy and colleagues (2004) examined 208 mothers with IBS and their 296 children (i.e., case children), and 241 non-IBS mothers and their 335 children (i.e., control children). They found that mothers who made more statements that reinforced illness complaints (assessed via the Illness Behavior Encouragement Scale, IBES; Walker & Zeman, 1992) had children who reported more stomach aches on the Child Symptoms Checklist (CSCL; Walker, Garber, & Greene, 1991). They also found that case children, compared to control children, reported more gastrointestinal symptoms on the CSCL.

Attachment style, also formed by parent-child interactions, may likewise play a role in IBS development. Gerson and colleagues (2015) examined 463 IBS patients with moderate to severe symptom scores [assessed via the Irritable Bowel Syndrome-Symptom Severity Scale (IBS-SS; Francis, Morris, & Whorwell, 1997)] and 192 healthy controls from the United States, Mexico, Italy, Romania, Iran, India, and China. Attachment style was also assessed, via the Experience in Close Relationship (ECR; Brennan, Clark, & Shaver, 1998), which is a highly-validated measure for attachment style. Gerson and colleagues found that 41.7% of IBS patients across the various geographical sites had fearful-avoidant attachment (i.e., a desire for closeness compromised by fear) compared to 28.1% of the controls, and this difference was statistically significant. Additionally, anxious and avoidant attachment scores were significantly higher for IBS patients than for the healthy controls.
**High levels of stress.** High stress appears to play a key role in IBS. The unpredictable nature of IBS symptoms (waxing and waning in severity) may increase feelings that IBS is out of a person’s control and thereby exacerbate stress levels. Additionally, there are many consequences of IBS that are stressful, including strained social situations when gatherings take place far away from a bathroom (e.g., may avoid vacations with friends or family that involve long car rides) or when partaking in events that might exacerbate symptoms (e.g., eating at a restaurant and focusing attention to one’s gut; Schneider & Fletcher, 2008). IBS symptom severity is also linked to stressful workplace situations, such as decreased work productivity due to large amounts of time spent in the bathroom or missed workdays (Bertram, 2001; Drossman, 1999). In general, it can lead to frustration, anger, and embarrassment about one’s symptoms, and sufferers may feel distressed when seeking help. Additionally, due to the fact that stress has an established link with IBS, many patients fear that doctors will discount its reality (say it is “in their head”) and not provide adequate treatment (Gaynes & Drossman, 1999).

Many studies have supported a relationship between IBS and stress (Dancey et al., 1995; Dancey, Taghavi, & Fox, 1997). For example, Dancey and colleagues (1995) recruited 30 women with IBS from the IBS Network, a national organization that gives advice and support to IBS sufferers. They examined the relationship between reported weekly hassles as the stress variable and IBS symptoms, and these were assessed via the Combined Hassles and Uplifts Questionnaire (Larazus & Folkman, 1989) and the Daily Symptom Questionnaire (rating seven typical IBS symptoms on a scale of 0 to 7, with higher scores indicating higher severity; Dancey et al., 1995). The results revealed that stress and IBS symptoms were significantly linked in the positive direction. Although there is mixed evidence for whether IBS exerts a stronger influence on stress or whether stress exerts a stronger influence on IBS, stress and IBS symptoms’
influence on one another appear to be bidirectional and transactional in nature, evolving over time. To illustrate this, Dancey et al. (1997) conducted a within-person time-series analysis with questionnaire data provided by 29 non-clinical IBS sufferers. They found that increases in IBS symptoms (using the Daily Symptom Questionnaire) lead to increases in the perception of stress (using the Daily Hassles Questionnaire; Larazus & Folkman, 1989) and also found that the perception of stress increased IBS symptoms. The effects of stress on IBS symptoms were stronger than the effects of IBS symptoms on stress. Conversely, Dancey and colleagues (1995) found that the relation of IBS symptoms and next week’s stress was stronger than the association between stress and next week’s IBS symptoms, indicating that IBS symptoms may have more of an effect on stress than the other way around. More studies examining the interplay of stress and IBS overtime are warranted to further tease apart directionality. The current study used a longitudinal design similar to Dancey and colleagues, examining the interplay among stress, social problem-solving ability, and IBS symptom severity over time. The entire next chapter is dedicated to stress, as it was one of the key variables in the current study.

The Biopsychosocial Perspective

The biopsychosocial perspective is the predominant approach for understanding IBS (Burnett & Drossman, 2004; Kennedy et al., 2012; Tanaka et al., 2011). From this perspective, biological, psychological, and social factors are interconnected in their contribution to the onset, severity, and course of IBS (Pletikosić & Tkalčić, 2013; van Tilburg et al., 2013). One example is the cognitive behavioral (CBT) model of IBS. According to this model, cognitive, behavioral, and physiological responses are bidirectional and responsible for maintaining IBS (Kennedy et al., 2006; Pletikosić & Tkalčić, 2013). The model considers predisposing factors (e.g., genetics and early experiences that make a person vulnerable to IBS), precipitating factors (e.g., stressful
life events before the onset of IBS), and perpetuating factors that maintain IBS symptoms, such as maladaptive perceptions, cognitions, emotions, and behaviors (Deary, Chalder, & Sharpe, 2007). For example, stress can lead to maladaptive cognitions and IBS symptoms, and, in turn, IBS symptoms can lead to more stress. The model’s core conceptualization is that these factors can contribute to a self-perpetuating vicious cycle.

The CBT model of IBS largely parallels another valuable model, the brain-gut axis model, which is also rooted in the biopsychosocial perspective. IBS is often referred to as the “brain-gut” disorder due to the notion that bidirectional relationships exist between the mind (i.e., psychological factors) and the body (i.e., physiological factors), and that individuals with IBS have dysregulation of the communication between the “brain” and the “gut” (Burnett & Drossman, 2004). For example, individuals can have maladaptive cognitive appraisals about their environment, and this will increase their level of stress. This increased stress adversely impacts their ability to cope with their environment and thus worsens their gastrointestinal symptom severity (Kennedy et al., 2012). This process is thought to occur through bidirectional communication between the enteric nervous system (ENS), which governs the function of the gastrointestinal tract, and the central nervous system (CNS), which governs the brain (e.g., cognitions and appraisals). The CNS can send signals to the ENS and influence gastrointestinal functioning (i.e., a descending pathway). Alternately, the gastrointestinal tract can send signals and influence the CNS (i.e., an ascending pathway). These pathways are autonomic, meaning that they are involuntary or unconscious, and signals can be sympathetic, eliciting a flight-or-flight response, or parasympathetic, eliciting a calming response. To illustrate, an ascending pathway may become activated when the intestines are in discomfort or pain. This in turn, can send fight-or-flight signals to the brain and increase maladaptive cognitions (e.g., “my symptoms
are uncontrollable and a threat to my wellbeing”). On the other hand, a descending pathway may activate when a person experiences stress. In this scenario, the CNS elicits a sympathetic signal (of danger) to the ENS, and this will induce IBS symptoms. Stress is thought to play a large role in this communication, fueling an ongoing crosstalk between the CNS and ENS, thereby perpetuating a damaging cycle (Elsenbruch, Lovallo, & Orr, 2001; Kennedy et al., 2012). Due to the nature of the brain and the gut, investigating the way stress, maladaptive cognitive appraisals, and IBS symptoms interplay overtime (as the current study did) added to the existing literature.

**Psychological Assessment Measures**

There are a variety of gastrointestinal measures used in research to address different research questions. A variety of types and their functions are reviewed below. Included in this review is the rationale for the selection of a measure of IBS symptom severity for the current study.

Some questionnaires relate broadly to functional bowel diseases and were intended to aid in diagnosis. These included the BDQ (Talley et al., 1990), mentioned above, and the Elderly Bowel Symptom Questionnaire (EBSQ; O’Keefe, Talley, Tangalos, & Zinsmeister, 1992). As an example, the BDQ is a 71-item questionnaire that assesses symptoms of functional gastrointestinal disease. Items ask about gastrointestinal symptoms (46 items; e.g., “Have you had an ache or pain in your stomach or belly (gut) in the last year?”), past and current health (6 items; e.g., “How many drinks a week have you had on average in the past year?” “Do you smoke regularly now?”), one childhood question (i.e., “Did you have many bouts of stomach or belly pain as a child before age 15?”), sociodemographic information (3 items: marital status, employment status, and educational training), health habit questions (5 items), and questions adapted from the Psychosomatic Symptom Checklist (17 items). This questionnaire has been
validated and used extensively with adults to assess functional bowel diseases (Talley et al., 1990) and has also been used to examine gastrointestinal symptoms in adolescents and young adults (Walker, Guite, Duke, Barnard, & Greene, 1998). These types of measures, however, are not only lengthy and time consuming for participants to complete, but also they do not assess symptom severity.

Other measures have been developed to assess gastrointestinal symptom severity, but not specifically IBS severity. One such example is the Gastrointestinal Symptom Rating Scale (GSRS; Svedlund, Sjödin, & Dotevall, 1988) that assesses the severity of a wide range of gastrointestinal symptoms. The GSRS is a 15-item questionnaire that asks about five symptom clusters: reflux, abdominal pain, indigestion, diarrhea, and constipation. It contains a 7-point Likert scale ranging from absence of troublesome symptoms (1) to very troublesome symptoms (7). Although this measure is designed to assess gastrointestinal symptom severity, it was ill-suited for the current study that sought to assess IBS symptom severity specifically.

Some investigations attempt to assess IBS symptom severity by creating patient-perceived severity checklists with simple Likert scales. These IBS severity checklists may be suitable for assessing symptom severity specific to IBS; however, these derived measures are not always validated. For example, Hahn, Kirchdoerfer, Fullerton, and Mayer (1997) created a checklist that asked the following question, “How bad is the discomfort usually?” with discomfort referring to pain associated with IBS symptoms. The responses range from can be ignored if you don’t think about it (mild) to markedly affects your lifestyle (very severe). Another study, by Cho et al. (2011), simply asked IBS patients to rate the severity of their bowel problems (“In your own opinion, how would you describe your bowel problems?”) on a 3-point scale, with responses ranging from can be ignored if I don’t think about it (mild) to affects my
They were also asked the duration of their IBS-related symptoms. Although severity checklists are simple and capture useful information, the validation of these types of measures is often not prioritized. Perhaps this is due to researchers relying on face validity (i.e., the measure appears to assess the target variable, IBS symptoms, and thus is assumed to do so when it could really be measuring something else).

Some measures of IBS symptom severity are validated, but are based on outmoded criteria. These include the Irritable Bowel Severity Scoring System (IBS-SS; Francis et al., 1997) that contains five self-report items that ask for (in the past 10 days) the average intensity of abdominal pain, number of days with abdominal pain, average severity of abdominal distension, dissatisfaction with bowel habits, and the degree to which bowel symptoms interfered with usual activities. Responses to all items, with the exception of the pain frequency item, are on a none (1) to worst ever (100) scale. The number of days of abdominal pain is multiplied by 10 to compute a 0 to 100 score, and the five scores are added together for a total score. Although it is a brief measure and has been used to examine IBS’s relationship with psychological distress (e.g., depression, anxiety, somatization; Kanazawa et al., 2008), this questionnaire is based on the Manning Criteria, which, as described above in the diagnostic section, are currently outdated and have been replaced with more useful diagnostic criteria (i.e., the Rome II criteria).

A more recently developed measure is the Birmingham IBS symptom severity questionnaire (B-IBS; Roalfe, Roberts, & Wilson, 2008), which is a well-validated measure based on the Rome II criteria. The B-IBS contains eleven items on a 6-point Likert scale, with scores ranging from 0 (none of the time) to 5 (all of the time). There are three dimensions: pain (3 items; e.g., “During the last four weeks, how often have you had discomfort or pain in your abdomen?”), diarrhea (5 items; e.g., “How often have you been troubled with loose, mushy, or
watery bowel motions during the last 4 weeks”), and constipation (3 items; e.g., “During the last 4 weeks how often have you been troubled by hard bowel motions?”). Dimension scores can be calculated, as well as a total score by summing the scores for all items. For all scales, higher scores indicate higher symptom severity.

The B-IBS has demonstrated good psychometric properties in a non-IBS-diagnosed university student sample (Jasper, Egloff, Roalfe, & Witthoft, 2015), as well as an IBS-diagnosed sample (Roalfe et. al., 2008). For example, in the non-IBS-diagnosed university sample, a latent structure bifactor model of IBS symptom severity, compared to other models, was significantly superior (CFI = 0.99, RMSEA = 0.05) and was based on the B-IBS subscales. This indicated that IBS symptom severity may be best understood as a multidimensional and continuous construct, and that it can be reliably and validly assessed with the B-IBS. In the IBS-diagnosed sample, Cronbach’s α was .74 to .90 for the dimension scores and .75 for the total score, and construct validity was established by finding a negative association between the B-IBS scores and the well-validated irritable bowel syndrome quality of life assessment (IBS-QOL; Patrick et al., 1998). Of note, the IBS-QOL is a 34-item self-report measure that assesses the extent to which individuals’ IBS symptoms interfere with their overall quality of life, and how much IBS symptoms interfere with 8 specific life domains: dysphoria, interference with activity, body image, health worry, food avoidance, social reactions, relationships, and sexual relations. Some examples of items are: “I have to watch the amount of food I eat because of my bowel problems,” “I feel like I irritate others because of my bowel problems,” “My bowel problems limit what I can wear.” The items relate to symptoms with respect to the “past month (last 30 days)” and are rated on a 5-point scale ranging from 1 to 5, with 1 representing maximum quality
of life and 5 indicating poor quality of life. More specifically, the overall QOL score and the B-IBS total score yielded a Pearson’s correlation coefficient of -.07.

Monitoring IBS symptom severity over time was essential to the current investigation and the B-IBS seemed very well suited for this purpose. It assesses IBS symptom severity, has been validated in college samples, and is based on the Rome II criteria.
CHAPTER II: STRESS

As described in the previous chapter, many studies have found a significant positive relationship between IBS and stress (Dancey et al., 1995; Dancey et al., 1997). This finding is quite consistent with the biopsychosocial framework, which asserts that cognitive and physiological responses are bidirectional and responsible for maintaining stress and IBS symptoms (Kennedy et al., 2006; Pletikosić & Tkalčić, 2013). This is the conceptual basis for the current study and measures of both IBS symptom severity and stress are included. This chapter provides an overview of the stress construct, covering definitions, history, various approaches to measurement, and the rationale for the current study’s measure selection.

Definitions of Stress

To understand the concept of stress, one must recognize that there are several definitions stemming from different disciplines. Stress can be environmental, physical, and/or psychological. In physics, stress is viewed as a cause or as a result, meaning it can be a stressor or a stress response (Koolhas et al., 2011). In biology, more generally, stress is conceptualized as the body’s nonspecific response to any demand. Getting more specific, at the neuroendocrine level, stress is any stimulus that will trigger the release of hormones and adrenal glucocorticoids (Fink, 2009). In the behavioral sciences, stress is the perception of threat, which often results in emotional tension, anxiety, or difficulties with adjustment (Fink, 2009). Richard Lazarus, famous for his work in stress and coping, refers to stress as events in which environmental or internal demands (or both) tax or exceed an individual’s adaptive resources (Lazarus & Folkman, 1984). Lazarus’ definition of stress is the one used in the current study’s conceptualization of stress because it seems well suited to the biopsychosocial approach.
**Concept History**

To best conceptualize stress, it is important to understand the evolution of its development. In 1936, Hans Selye (known as the “father” of stress) published an innovative work on stress, which made it observable through chemical reactions and measurable through physiological characteristics (Johnson & Johnson, 2010). Selye’s view was that stress pushes the body out of psychological or physical equilibrium and, in the body’s attempt to return to homeostasis, the body requires a period of readjustment (Johnson & Johnson, 2010). Selye referred to stress as a reaction and labeled it general adaptation syndrome, which consisted of three stages: alarm, resistance/adaptation, and exhaustion (Johnson & Johnson, 2010; Krohne, 2002). Alarm is the stage at which the body has an immediate reaction, such as an initial shock, to a stressor. This creates a sympathetic-adrenal (“fight-or-flight”) response, in which the body gets ready for physical activity (e.g., adrenaline and corticosterone increases, which raises respiration, heart rate, and blood pressure). The next stage, resistance/adaptation, occurs when the body attempts to compensate for the negative impact of a stressor (e.g., an individual may experience a decreased desire to be physically active in order to conserve energy resources when food is scarce). The third stage, exhaustion, can occur when the presence of a stressor is persistent. Resistance to the stressor decreases, and the body becomes more vulnerable to disease (i.e., the immunity response is lowered).

Contemporaneously with Selye, Walter Cannon (1935) conceptualized stress as a stimulus that was directly linked to the environment in the form of stressful life events (Brantley & Ames, 2001). This led to the investigation of the impact of major life events on physical illness (Holmes & Rahe, 1967). More recently, researchers have investigated the relationship between illness and small life events (i.e., daily hassles). Examples of daily hassles are small life
events, such as taking care of one’s daily responsibilities (e.g., dealing with challenging tasks at work, sitting in traffic while running errands). There is reasonable theoretical speculation for linking such hassles and illness: (1) diseases that develop over a long period may be susceptible to small persistent stressors as opposed to larger, more time limited ones; (2) smaller persistent stressors may exacerbate the negative impact of major life stressors; (3) attempting to deal with persistent stressors likely causes both physical and mental fatigue, which could lead to poorer mental performance and increased stress, as well as immunity dysregulation, and (4) persistent stressors may inspire social avoidance and decreased seeking of social support, which in turn could lead to decreased health (Brantley & Ames, 2001). This makes sense, as many studies suggest that minor life events are more predictive of physical health problems than major life events (Ames, Jones, Howe, & Brantley, 2001; Brantley, Jones, Boudreaux, & Catz, 1997; Brantley, Waggoner, Jones, & Rappaport, 1987; Kanner, Coyne, Schaefer, & Lazarus, 1981).

A more recently evolved approach to conceptualizing stress is that of Lazarus. Key to his conceptualization are the concepts of appraisal (i.e., an individual’s evaluation of a potential stressor, such as how challenging or threatening it is) and coping (i.e., an individual’s efforts to manage the demands of the stressor; Krohne, 2002). These components are covered in more detail later in this section, but for now it is important to establish that Lazarus views the manner of coping as possibly more important than the objective stressor in evoking stress. Further, reactions (i.e., cognitive appraisals) to events are considered as more important than the events themselves (Lazarus & Launier, 1978). The current investigation closely followed this definition and conceptualization of stress.
Major Conceptual Frameworks

The following section reviews the major conceptual frameworks of stress (i.e., biological and psychological), as well as typical ways stress is measured within each framework. In keeping with the scope of the present study, coverage of the psychological framework is more extensive.

Biological

Physiological responses. As mentioned, the term stress is conceptualized as the body’s nonspecific response to any demand. A demand, which can be viewed as a disturbance or a perceived threat to the body’s physiological homeostasis, will elicit a systematic stress response (Tasker & Joels, 2015). The sympathetic response, which elicits a flight-or-fight response, occurs when the adrenal medulla is activated, resulting in adrenaline into the bloodstream (i.e., what is often referred to as the adrenaline rush). A primary neuroendocrine response to stress is activation of the hypothalamic-pituitary-adrenal (HPA) axis, a response triggered by corticotrophin releasing hormone (CRH). Subsequently, CRH is sent to the pituitary gland, which leads to the stimulation and secretion of adrenocorticotropic hormone (ACTH). ACTH travels to the adrenal glands, where it binds to their receptors and stimulates the synthesis and secretion of glucocorticoids, which include corticosteroid hormones (i.e., cortisol for humans) and mineralocorticoids into the general bloodstream (Tasker & Joels, 2015). Glucocorticoids contribute to the stress response by directing resources to attend to stressful situations in order to promote survival, to anticipate a psychological threat, and to reinstate physiological homeostasis (Tasker & Joels, 2015).

Many of the above elements are considered biomarkers of stress and are therefore analyzed in attempts to measure stress. Cortisol can be measured through salivary alpha-amylase
(SAA; Pruessner, Ali, & McGill, 2015). Dehydroepiandrosterone (DHEA) counter-regulates cortisol and can also be used as a stress marker by itself or as a ratio to cortisol (Oken et al., 2015). ACTH is collected via blood samples and can be used to measure acute stressor-induced changes (Yalow, 1964). However, measurement of these elements is complicated by timing. For example, with chronic stress, there are alterations in diurnal fluctuations (e.g., in cortisol awakening response) in that HPA activity is stimulated during the active day phase of the circadian cycle, making it a challenge to measure properly (Tasker & Joels, 2015). Additionally, acute and chronic stress are also associated with changes in blood pressure, electrodermal response, skin temperature, respiratory rate, heart rate, and heart rate variability and are used in the measurement of the stress response (Oken et al., 2015; Pruessner, Ali, & McGill, 2015). Furthermore, measurements of this nature are complicated in that any state of arousal that activates sympathetic nervous system (SNS), such as anxiety, fear, or anger, could result in heightened responses (Pruessner et al., 2015). As an example, an individual’s heart rate would increase if she felt nervous interacting with others at a social gathering, or if she felt furious about her car getting rear-ended in traffic. As such, examining physiology alone to decipher between various heightened emotions can be a challenge, but data suggests some identifiable differences. For example, when examining heart rate, previous research has shown that although anger and shame both elicit significant increases in heart rate compared to a baseline neural condition, anger appears to accelerate heart rate significantly more than shame (Kassam & Mendes, 2013). With that said, using physiological measures in conjunction with other forms stress measurements (e.g., self-report, self-monitoring) is prudent as integrating them will likely be more informative than using physiology measures alone.
Changes in the brain. Stress is associated with many brain changes, including structural, physiologic, and cognitive. Regarding structural brain changes, stress-related states (e.g., fear conditioning, post-traumatic stress disorder) are associated with decreased hippocampal size, prefrontal cortex (PFC) decline, and decreased inhibition of the amygdala and related brain regions by the frontal lobe (Oken et al., 2015). Regarding physiologic brain changes, stress has been associated with functional magnetic resonance (fMRI) and electroencephalography (EEG) changes, particularly frontal asymmetries and alternations in event-related potentials (Oken et al., 2015). However, these types of stress measurements also come with limitations. Chronic psychological stress impairs sleep, and sleep deprivation may also impact EEG and fMRIs, thus hindering the ability to detect changes due to experimental stressors. Further, most physiological parameters change with other biorhythms (e.g., circadian or prandial) and thus cannot be relied on solely as stress indicators.

Stress also significantly alters cognitive functioning (e.g., memory). The PFC and hippocampus provide inhibitory restraint of the HPA axis, whereas the amygdala (i.e., a center for fear and anxiety behavior in the brain) is excitatory (Pruessner, Ali, & McGill, 2015). PFC dysfunction is particularly impacted by stress; to release cortisol, PFC is deactivated. The PFC, the hippocampus, and amygdala are all critically involved in scanning and evaluating the environment, as well as in triggering stimulation of the hypothalamus once a potential or real threat has been detected (Steimer, 2002). Stress may affect speed, attention, and executive function, and therefore it is also associated with cognitive decline (Oken et al., 2015). There is a notable limitation, however, in interpreting impaired brain regions and impaired cognitive functioning as stress reactions because these impairments are associated with a higher risk of suffering from stress (e.g., smaller hippocampi are common in people with PTSD, and smaller
hippocampi are also associated with a higher risk of developing PTSD; Oken et al., 2015). Thus, determining directionality is a challenge with these types of measurements.

**Psychological**

Although the biological framework focuses on physiological changes in the body, it still highlights the psychological impact of the environment. More specifically, the biological framework views stress and physiological changes as being elicited by an individual’s perception of an event, and this perception is affected by prior experiences through attention and memory (Oken et al., 2015). As such, negative reactions to events are more predictive of emotional wellbeing than the events themselves. This is in line with a psychological framework of stress, which asserts that stress is an emotional process that is dependent on an individual’s appraisal of the significance and consequences of a specific event, and this appraisal is dependent on personal (i.e., individuals’ motives, goals, and expectations) and situational factors (i.e., how predictable, controllable, and imminent potential stressors are; Krohne, 2002).

Lazarus and Folkman’s (1984) cognitive-transactional theory is the most widely accepted model of stress in psychology, and it integrates the already described psychological and biological concepts. In this theory, stress is defined by a quality of experience that results in psychological or physiological distress, and this is shaped by the interaction of an individual and the environment (Lazarus & Folkman, 1984). In other words, objective stressors interact with personal factors, such as one’s perception or appraisal of the objective stressors. If an individual appraises that the demands of the stressor exceed his or her coping resources (i.e., cognitive and behavioral efforts to deal with a stressful situation), this creates stress. If an individual appraises that the demands of the stressor do not exceed his or her coping resources, the situation does not
result in stress. As such, one needs to consider coping ability whenever considering stress, as it is inextricable from the formulation of stress.

There are several theoretical approaches to coping: individual-based, situational-determinant, and cognitive approaches (Carver, Scheier, & Weintraub, 1989; Lazarus & Folkman, 1984; Mattlin, Wethington, & Kessler, 2018). The individual-based approach highlights that the way individuals cope is dependent on their disposition or personality characteristics and that the derived strategies are relatively static across time and situations (Carver et al., 1989). The situational-determinant approach is rooted in the belief that the coping strategies individuals use are dependent on situational demands, in that different situations call for different strategies (Mattlin et al., 2018). Lastly, the cognitive approach asserts that the way individuals cope with problems depends on their appraisal of the problems (Lazarus & Folkman, 1984). Examples of adaptive coping include processes such as active coping (i.e., taking steps to try to remove the stressor or lessen its effects), planning (i.e., thinking about how to cope with a stressor, coming up with action strategies), restraint (i.e., waiting for an appropriate opportunity to tackle a problem, holding back and not acting prematurely), suppression of competing activities (i.e., putting other projects aside in order to tackle the problem), and seeking social support for instrumental and emotional reasons (Carver et al., 1989). Seeking social support for instrumental reasons includes seeking advice, assistance, or information, and seeking social support for emotional reasons includes getting moral support, sympathy, or understanding. In contrast, maladaptive coping consists of behavioral and mental disengagement. Behavioral disengagement is reducing one’s efforts to deal with the stressor or giving up the attempt to attain goals that the stressor is interfering with, and mental disengagement is distracting oneself
from the stressor or using alternative activities to escape thinking about a problem (Carver et al., 1989).

Social problem-solving (SPS), a focus of the current study, is a form of coping, and it can also be adaptive or maladaptive. According to SPS theory, problems are actual or anticipated situations that require effective coping responses that are not immediately identifiable to the individual (Nezu, 2004). SPS is the self-directed cognitive and behavioral process by which individuals attempt to manage real-life problems or stressful situations, and it constitutes a distinct form of coping as it involves appraising and adapting to stressful life events (D’Zurilla & Chang, 1995; Nezu, 2004). Increased stress and/or problems, poorer problem-solving ability, and decreased wellbeing are posited to act in a transactional manner, interacting with one another and evolving with time (D’Zurilla & Nezu, 2001). While important to mention here, the concept of SPS will be extensively reviewed in the next chapter.

Lazarus’ cognitive-transactional theory also contains a transactional component, as implied by the name. In this context, transaction implies that stress is neither the environment nor the individual. Instead, stress is the interplay between the environment that threatens or challenges an individual, and the individual has unique motives and beliefs that influence how the environment is interpreted or appraised (Lazarus, 1990). Due to this ongoing interaction between the individual and environment, transaction also implies that stress is a constantly changing process. Thus, stress is fluid and involves many variables that influence one another across changing contexts and across time (Lazarus, 1990).

Lazarus (1990) emphasizes that stress is viewed as a complex, multivariate process, and, therefore, the search for a single satisfactory measure (which he describes as “the stress of the stress process”) is destined to fail. Instead, he suggests that researchers should attempt to capture
important elements of the stress process, such as life events and daily encounters, antecedents such as individuals’ beliefs and motives that influence their appraisal and coping, and response markers of the stress process. He also emphasizes that because stress is a process, it must be measured repeatedly in each distinct context (i.e., moment to moment, and encounter to encounter). Lastly, Lazarus acknowledged that this is a very difficult thing to do and this approach may be more of an idealization rather than a reality.

Lazarus (1990) points out several controversial issues with stress measurement: (1) stress is mainly a subjective rather than an objective phenomenon; (2) stress is better measured as minor annoyances than major negative events; and (3) some confounding between measures of stress and illness outcomes is inevitable because individuals who are experiencing high levels of stress may be more likely to appraise their dysfunction or illness as more severe or debilitating. Also, according to Lazarus (1990), only two measurement solutions have been offered. The first solution is that appraisal and coping are assessed repeatedly, since the individual-environment interplay evolves over time. Lazarus points out that there is an issue with this first solution. In most stressful situations, changes in the transaction are associated with the passage of time; however, it is not clear how these units of time should be determined in these repeated assessments. The second solution is to use measures that presume to be a main outcome of the stress process. In other words, the appraised stress is aggregated either across encounters or over a large time period. The potential issue with this solution is that temporal and contextual fluctuations are lost for the benefit of creating what appears to be a stable trait. As such, Lazarus (1990) suggests a process approach (i.e., measuring stress by repeating assessments of all the variables in the system). This differs from the more typical approach used in psychological research that is more structural (i.e., a single assessment is made, followed by assumptions that it
is representative of the individual or representative of the type of situation). For the current investigation, the assessment approach was more in line with the recommendations of Lazarus: variables were repeatedly measured (i.e., stress, SPS ability, and irritable bowel symptom severity) across fairly short intervals, two weeks apart, across three time points.

Review of Psychological Stress Measures

In the current study, stress was one of the major variables, and two psychological measures of it were used. As such, this section is devoted to a review of psychological stress measures, and it provides the rationale for the study’s measure selection. The review is pointed and focuses on two major measure types: objective and subjective.

Objective Measures

Objective measures target the external conditions, such as life events, eliciting stress reactions. These types of measures are considered less biased because the occurrence of life events (e.g., having car trouble) is less susceptible to interpretation than the occurrence of subjective experiences (e.g., feeling excluded or ignored by others; Lazarus, 1990). An assumption of all life events scales is that life changes require adaptational struggles and that stress is quantifiable by measuring the level of distress these life changes create (Lazarus, 1990). Although measuring major life events (e.g., death of a loved one, job loss, divorce) has been popular in research for the past few decades, more recently there is a trend favoring the measurement of minor stressors, such as daily hassles, because they appear to be better at predicting health outcomes than major life events (Ames et al., 2001). Examples of daily hassles are small life events, such as taking care of one’s daily responsibilities (i.e., dealing with challenging tasks at work, sitting in traffic while running errands). This section reviews several of the more frequently used objective measures: Problems Checklist (PCL; Nezu, 1985), Life
Experiences Survey (LES; Sarason et al. 1978), the Hassles Scale (Kanner et al., 1981), the Daily Stress Inventory (DSI; Brantley, Waggoner, Jones, & Rappaport, 1987), and the Weekly Stress Inventory (WSI: Brantley et al., 1997).

The Problems Checklist (PCL; Nezu, 1985) contains a list of 15 areas of living in which problems may occur (e.g., job, school, living conditions, and relationships with others). Individuals rate the frequency of their current problems on a 7-point Likert scale, with higher scores representing a greater frequency. Somewhat similar to the current study, Nezu and Ronan (1985) used the PCL to investigate the links among stress, SPS (Problem-Solving Inventory; Heppner & Petersen, 1982), and wellbeing (via the BDI) in a sample of college students and found that the PCL accounted for 37.4% of the variance when predicting depression, such that a greater frequency of problems was directly related to higher levels of depressive symptoms.

Another objective measure is the Life Experiences Survey (LES; Sarason et al. 1978), a 60-item self-report measure that asks participants to report both the incidence and stressful impact of major life events. The above described Nezu and Ronan (1985) study also included the LES. Interestingly, when predicting depression, the LES accounted for much less variance than the PCL, 20.3% compared to 37.4% respectively. These findings are consistent with the notion that measuring chronic or recurrent stressors, such as frequent problems, may be more informative than major life events in predicting the effects of stress on wellbeing (Ames et al., 2001). This makes sense, as mentioned above, as many of the criticisms of major life event scales point to the utility of capturing daily hassles or recurrent problems instead.

The Hassles Scale (Kanner et al., 1981) is a measure that fits the specifications of capturing chronic and recurrent stressors. A longitudinal study used the Hassles Scale to examine the link between stress and daily IBS symptoms in a non-clinical sample of IBS
sufferers (Dancey et al., 1997). Results indicated that for over 43% of the participants, IBS symptoms were predicted by hassles in the previous 4 days, and that for 37%, hassles were predicted by IBS symptoms in the previous 4 days. Thus, using this measure, the authors found support for a bidirectional relationship between stress and IBS across a short time span.

Consistent with Nezu and Ronan’s (1985) finding that the PCL was a better predictor of depression than the LES, Kanner and colleagues (1981) found that the Hassles Scale was a better predictor of concurrent and subsequent psychological symptoms than life events scores. The high temporal stability of the Hassles Scale was an issue arguing against its inclusion in the present study. Kanner and colleagues (1981) demonstrated that problem frequency had a high test-retest reliability with average r’s of .79 between adjacent months over a nine-month period. As such, its ability to detect change across the two-week intervals in the present study was questionable.

The Daily Stress Inventory (DSI; Brantley et al., 1987) is another hassles-type measure with a similar profile to the Hassles Scale. It is a 58-item self-report measure that assesses minor stress in the form of specific daily problems and hassles (e.g., frustrations, annoyances). Participants are asked to think about events of the past 24 hours and then to rate how stressful each event was on a 7-point Likert scale. The DSI consists of a frequency score (FREQ), a sum score (SUM), and an average impact rating score (AIR; indicates on average how stressful events are for individuals by dividing the sum score by the frequency score). The DSI has convergent validity with endocrine stress measures, including cortisol and metabolites of epinephrine and norepinephrine (Brantley et al., 1987). Also, relevant to the current study, past investigations have examined the relationship between stress and SPS using the DSI. One example is Bell and D’Zurilla (2009), who examined SPS as a moderator and mediator of the relationship between
daily stressful events and adjustment in college students. Daily stress was correlated in the expected directions with internalizing symptoms and externalizing symptoms (as indicated on the Adult Self-Report for Ages 18-59; ASR; Achenbach & Rescorla, 2003), as well as poor SPS on the Social Problem Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002).

Studies have also examined predictive links between stress and IBS symptoms using the DSI. Blanchard (2008) examined daily stress and IBS symptoms with a design similar to that in the present study. In the Blanchard (2008) investigation, IBS patients and the role of stress in exacerbating IBS symptoms were examined every day for 4 weeks. For daily symptoms, data were aggregated (7-day period to form a weekly index). Blanchard tested a four-wave panel model, which permitted reciprocal same-week effects for stress and gastrointestinal (GI) symptoms, as well as lagged effects. He found that there were carryover effects of previous stress not only from the prior week but also the week before, and it appears the carryover effects do not persist across more than two weeks. This same pattern was demonstrated with GI symptoms affecting GI symptoms. GI symptoms predicted stress, in that: GI symptoms at week one impacted the severity of GI symptoms at week two, which impacted the severity of GI symptoms at week three, which impacted stress at week three. Also, GI symptoms at week one had a delayed mediated and independent effect on GI symptoms at week three, which in turn affected stress at week three. Additionally, stress predicted GI symptoms: Stress during week one impacted stress at week two, which impacted stress at week three, which, in turn, impacted the severity of GI symptoms at week three. Test-retest reliability for the DSI over 28 consecutive days was calculated by coefficient alphas, which were .72, .41, and .26 for FREQ, SUM, and AIR scores respectively (Brantley et al., 1987). In considering measures that were included in the current study, the demonstrated sensitivity of the DSI to changes in stress and
IBS was a major advantage, but was balanced with the need to incorporate daily monitoring in the study design.

The Weekly Stress Inventory (WSI; Brantley et al., 1997) is an 87-item self-report measure that assesses minor stress, much like the DSI. In fact, the DSI and WSI share two of the same developers, Brantley and Jones. Brantley and colleagues (2007) assert that measuring stress over a one-week span has several benefits over using a daily stress measure, such as a greater comparability with other weekly measures and a better ability to reduce potential error and scoring variability due to participant fatigue or burn-out. Additionally, Brantley and Jones point out that before the WSI’s development, minor stressors could be assessed only on a daily basis (which may be too short of a period) or on a monthly basis (which may be too long of a period), and thus they designed the WSI to address this limitation. The WSI asks about the occurrence of stressors over the past week as well as the impact, or how distressing, those events were to the individuals. It uses an 8-point Likert scale from did not occur (0) to extremely stressful (7). This yields a score totaling the number of events, called WSI-Event (similar to the DSI’s FREQ score) and an impact score, called WSI-Impact (similar to the DSI’s AIR score).

Like the DSI, studies have examined the link between the WSI and health outcomes. For example, a two-year longitudinal study, consisting of 249 individuals diagnosed with hypertension, examined the relationships between the WSI and emotional and physical health outcomes (Ames et al., 2001). For the WSI, the mean of the seven administrations in Year 1 (i.e., month 0, 2, 4, 6, 8, 10, and 12) was calculated. To assess health outcomes, the 36-Item Short-Form Health Survey (SF-36; Hays, Sherbourne, & Mazel, 1993) was used by calculating the mean of the four administrations in Year 2 (i.e., month 15, 18, 21, and 24). Regression analyses revealed that the higher mean scores on the WSI were a significant predictor of several
health outcomes on the SF-36: poorer physical functioning, role limitations due to physical
health, role limitations due to emotional problems, and poorer emotional wellbeing. This finding
highlights the negative impact of recurring, minor life stressors on subsequent health outcomes.
To add, the same study also examined the impact of mean LES scores (i.e., major life events),
calculated using the same time points as the WSI. They found that the WSI scores predicted
these health outcomes above what was accounted for by the LES scores. This finding is
consistent with Nezu and Ronan’s (1985) finding above, in that minor life stressors may be more
informative than major life stressors in predicting wellbeing.

The WSI appears to have good psychometric properties. The WSI has concurrent
validity with the DSI; the obtained correlation between WSI-Event and DSI FREQ scores in one
study was $r = .77$; WSI-Impact and DSI’s AIR score $r = .84$ (Scarinci Ames, & Brantley, 1999).
In a study examining 173 college students, a coefficient of $r = .69$ suggests that the WSI has
some concurrent validity with the Hassles Scale (Brantley et al., 1997). In a large undergraduate
student sample, same-week test-retest reliability for the WSI-Event was $r = .83$, and WSI-impact
was $r = .80$ (Brantley et al., 1997). Mosley and colleagues (1991) conducted a study examining
130 headache patients, which revealed moderate stability across one week ($r = .76$ for the WSI-
Event; $r = .78$ for WSI-Impact; as cited in Brantley et al., 1997). Mosley and colleagues (1996)
later conducted another study, examining coronary heart disease patients, and demonstrated that
the test-retest reliability decreased over time, such that the one-week coefficients for the WSI-
Event and WSI-Impact were .84 and .70, whereas the three-week coefficients were .64 and .56,
respectively. Brantley and colleagues (1997) assert that the WSI is suitable for use with both
community and clinical populations and that it is appropriate for a repeated measures research
design in which sensitivity to weekly changes in stress is important. The WSI offers many of the
advantages of the DSI, but does not require daily monitoring. For this reason, the WSI was incorporated into the current study.

Despite their important role in research, there are problems associated with objective stress measurements. Major life events are somewhat infrequent, and recall reliability tends to decrease significantly after only a few months (Whitehead, Crowell, Robinson, Heller, & Schuster, 1992). Also, life scales are often not representative across diverse populations (e.g., various age groups, socioeconomic status), life scales focus on stressful life changes and thus neglect to capture stress that is persistent, and the contributions made by the individual (e.g., poor life choices leading to a major negative event) are not taken into account (Lazarus, 1990). Additionally, with objective stress measures, differences in reactions to the same events are not captured (Whitehead et al., 1992). Each item may or may not have highly personal meaning to an individual (Hammen, 2005). Researchers need to ensure that the stressfulness of an event can be understood from the individual’s point of view and personal circumstances. With these limitations in mind, consideration was also given to including a subjective stress measure in the current study.

**Subjective Measures**

Subjective measures capture the individual’s perception or subjective appraisal of the stressor rather than the stressor itself. In other words, researchers evaluate how stressful individuals perceive their problems to be and what impact those problems may have on their wellbeing. Because everyone’s appraisal of stressors is unique and subjective, operationalizing it is a challenge; this is evidenced by the fact that there are only a few measures designed for tracking stress perception (Kocalevent et al., 2007). Despite this challenge, individual perception may be more important to evaluate than a stressor itself. This is consistent with Lazarus and
Folkman’s cognitive-transactional theory described above, in that one’s perception or appraisal of an objective stressor (i.e., whether the demands of the stressor will exceed an individual’s resources to deal with the stressor) is what facilitates or prevents the creation of stress. For instance, if individuals perceive they have ample resources to resolve a problem, stress will not be generated. Three subjective measures of stress are reviewed below: Perceived Stress Questionnaire (PSQ; Levenstein et al., 1993), Perceived Stress Inventory (PSI; Lee et al., 2015), and Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983).

The Perceived Stress Questionnaire (PSQ; Levenstein et al., 1993) is a 30-item self-report questionnaire that assesses whether individuals feel under pressure from stressful events, consisting of variety of real-life situations (e.g., being criticized or judged, feeling under pressure from deadlines, and finding oneself in situations of conflict). It contains a 4-point Likert scale from *almost never* (1) to *usually* (4). It can be used in a general format (i.e., the General PSQ), which specifically asks participants to rate how often statements about stress apply to them during the last year or two. It can also be used in a recent format (i.e., the Recent PSQ) which asks the same questions but about how often the items applied over the last month. Using a sample of 182 individuals comprised of ulcerative colitis out-patients, gastroenterology in-patients, undergraduate college students, and health care workers, Levenstein and colleagues (1993) found the following: the General and Recent PSQ correlation coefficient was $r = .71$; the 8 day ($SD = 1.64$) test-retest reliability coefficient for the General PSQ was .82; the General PSQ correlated ($r = .56$) with the Perceived Stress Scale (PSS; Cohen et al., 1983), the most widely used stress measure in psychological literature, and it also correlated ($r = .69$) with trait anxiety on the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1983), an anxiety measure related to stress; and the Recent PSQ also correlated with the PSS ($r = .73$) and with the
STAI ($r = .75$). The same study also examined the Recent PSQ’s month-to-month test-retest reliability over 6 months and yielded a coefficient of $r = .37$. The study sample, however, for this analysis was limited to 12 ulcerative colitis patients and individual highest to lowest scores varied by only 1.94 points ($SD = .53$). Given the small size of this subsample, these findings should be interpreted with caution.

The Perceived Stress Inventory (Lee et al., 2015) is another measure of subjective stress. The PSI is a 20-item measure of subjective stress, contains a 5-point Likert scale, and was created by pooling together items from three stress instruments: the PSQ, the Stress-induced Cognitive Scale (SCS; Koh, Park, & Cho, 2006) and the Stress Response Inventory (SRI; Koh et al., 2001). The PSI was designed for population surveys and is comprised of three dimensions: tension, depression, and anger. Of note, this measure was developed in Korea, where anger is considered a unique aspect of the stress response, unlike Western society. In a validation study by Lee and colleagues (2015), which examined data from 387 individuals (patients, caregivers, and family members of hospital employees) recruited from several hospitals in Korea, the PSI’s tension score was significantly correlated with the PSS ($r = .72$). Additionally, this study demonstrated that PSI’s total score test-retest reliability over two weeks was $r = .88$, with $r$’s ranging from .67 to .86 on the three dimensions.

The Perceived Stress Scale (PSS; Cohen et al., 1983) is the most widely used psychological measure assessing the perception of stress. The PSS is brief 14-item questionnaire that measures the degree to which situations in one’s life are appraised as stressful (i.e., how unpredictable, uncontrollable, and overloaded individuals find their lives). Cohen (1986) asserts that the scale attempts to represent situations in which individuals perceive that life demands will exceed their ability to cope. Importantly, the PSS is consistent with the assertion of Lazarus: it is
the appraisal of the stressor, and not the objective stressor, that is critical to assess stress. All PSS items are rated on a 5-point Likert scale ranging from never (0) to very often (4). Half of the items are negative in format, with higher scores indicating higher perceived stress, while the other half are positive, with higher scores indicating lower perceived stress. An example of a negative item is: “In the last month, how often have you felt that you were unable to control the important things in your life?” An example of a positive item is: “In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?” The PSS does not have subscale scores, only a unidimensional total score, which is calculated by summing the score for all items after the positive items are reverse-coded.

Of relevance to the current study, the PSS has been extensively evaluated in undergraduate samples. More specifically, Cohen and colleagues (1983) examined two college student samples (N’s = 332 and 114) and found that in both samples the PSS correlated with the College Student Life-Event Scale (CSLES; Levine & Perkins, 1980), a measure of stressful life events pertaining to college demands (e.g., academic struggle, romantic relationships). Of note, the CSLES contains two scales, one that assesses the number of life events, and another that assesses the impact of these events. In the sample of 332, the number of life events scale and the impact of life events scale correlated with the PSS, with coefficient r’s = .20 and .35 respectively. In the sample of 114, the PSS also correlated with the impact of life events scale, with r = .24. This makes sense, as the CSLES (which measures objective stress) should be somewhat related to the PSS (which measures subjective stress), but not overlap so much that it indicates it is measuring the same construct. Also, as expected, the PSS was more strongly associated with the CSLES’s impact of life events scale than the number of events scale, supporting the notion that the impact more closely mirrors the appraisal aspect of stress. The
PSS may be more of a trait-like than state measure and its test-retest reliability suggests that it may not be particularly sensitive over two-week intervals \((r = .85; \text{Cohen et al., 1983})\). Nonetheless, it does become less stable across a longer time span \((r = .55 \text{ after six weeks; Cohen et al., 1983})\).

The PSS is often used in stress and health research (Eskin, Akyol, Celik, & Gultekin, 2013; Spence & Moss-Morrow, 2007). For example, Eskin and colleagues (2013) used the PSS to compare migraine and tension-headache patients with healthy controls and found that patients reported higher levels of stress and maladaptive SPS. Additionally, Spence and Moss-Morris (2007) used the PSS to predict IBS symptom severity in IBS patients, and found an anxious-achievement cluster of variables (anxiety, perceived stress, and perfectionism) were important predictors of IBS. Some of this research has also demonstrated that the PSS is better at predicting various health outcomes (e.g., depressive symptoms, physical symptomatology) in short periods than life events scales (Cohen et al., 1983). For example, the above study by Cohen and colleagues (1983) not only assessed stress via the PSS and CSLES, but also assessed depression via the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) and physical symptoms via the Cohen-Hoberman Inventory of Physical Symptoms (CHIPS; Cohen & Hoberman, 1983). Across both college samples, they found that the CSLES’s scales predicted only depressive symptoms, with coefficients ranging from \(r = .18 \text{ to } .33\), whereas the PSS predicted depressive symptoms with much higher coefficients, ranging from \(r = .65 \text{ to } .76\). Cohen and colleagues (1983) also found that that the CSLES’s scales predicted only physical symptoms with coefficients ranging from \(r = .23 \text{ to } .36\), whereas the PSS better-predicted physical symptoms, with coefficients ranging from \(r = .52 \text{ to } .65\). Given that the PSS has been used in numerous stress and health studies, has been used to predict IBS symptom severity
(Spence & Moss-Morris, 2007), and is the most widely used stress measure to date, it was utilized in the current study.

Just like objective stress measures, subjective measures are not free from criticism, and their potential limitations are important to weigh along with their strengths. In subjective measures, the source of the stress reaction is not examined, and they also neglect to take mediating processes into account (Lazarus, 1990). For example, coping is an overlooked component in all subjective measures because when coping ability is poor, stress increases, and when coping ability is adaptive, it can dampen a stress reaction (Lazarus, 1990). Lastly, to address the issue of coping often being an overlooked component, the present study also included a measure of SPS, which is a distinctive and important form of coping (this will be outlined in the following chapter, which is dedicated to the concept of SPS). Lastly, the scores subjective stress measures generate are unidimensional and do not take different types of stress reactions into account (Lazarus, 1990).

Summary

The WSI and PSS paired together appeared to be a strong combination. With the WSI being objective and the PSS being subjective, when used together, they capture both approaches to measuring stress and address significant limitations that each one would have if used in isolation. Objective measures, for instance, assess stress from external conditions (i.e., major and minor life events) and are considered less biased than subjective measures since they are less susceptible to personal perceptions often colored by previous life experience. The issue with objective stress measurements are that they tend to focus on stressful life changes and may neglect to capture stress that is ongoing or persistent. They also neglect to take into account individual characteristics of the responder, such as the differences in reactions individuals may
have to the same events, and the difference in personal meaning each of the items may have. Thus, objective measures lack the ability to consider that the stressfulness of an event is understood from the individual’s point of view and personal circumstances. Subjective measures, on the other hand, come with their own strengths and limitations. As a major strength, subjective measures assess the individual’s perception or appraisal of the stressor rather than the stressor itself, which is consistent with Lazarus and Folkman’s view that individual perception may be more important to evaluate than a stressor itself. After all, if one individual perceives that she has sufficient resources to manage a stressor, the importance of that stressor and level of threat to her wellbeing will be minimized. However, a different individual, who believes that the same stressor will exceed his resources, will perceive the stressor as a larger threat and as more significant. As a weakness, subjective measures are unidimensional and do not take different types of stress reactions into account (Lazarus, 1990). Also, subjective measures do not take the external world (i.e., life events) into account and are considered more biased than objective measures. As such, it was a practical decision to include both an objective measure and a subjective measure, in order to capture a more complete picture of stress.

In consideration of which objective and subjective measures to use, the WSI and PSS surfaced as the strongest candidates during the review process. The WSI is a valuable objective measure; it shares concurrent validity with its predecessor, the DSI, which has examined links between stress and IBS symptom severity (Blanchard, 2008), and the WSI eliminates the need to incorporate daily monitoring. Weekly measurement instead of daily measurement increased its comparability with other weekly measures and likely helped to avoid participant fatigue, thereby reducing scoring errors and participant attrition (Brantley et al., 2007). The PSS is a valuable subjective measure because of the substantial base of past studies and the importance of
capturing perceptions of stress. In fact, the PSS is the most widely used psychological measure assessing the perception of stress (Cohen et al., 1983). It is used in stress and health research (see Lee et al., 2015 for a review) and has demonstrated significant links to IBS symptom severity (Spence & Moss-Morris, 2007).
CHAPTER III: SOCIAL PROBLEM-SOLVING

As reviewed, Lazarus described stress as a person-environment transaction or relationship in which demands are appraised as taxing and exceeding coping resources, thus endangering well-being (Lazarus & Folkman, 1984). Additionally, cognitive appraisal and coping are considered important mediators in the link between stressful situations and the emotional stress response. This notion is fundamental to the problem-solving model of stress and wellbeing, which posits that problem-solving plays a central role as a general coping strategy and constitutes a distinct form of coping as it involves appraising and adapting to stressful life events (Nezu, 1987). This model served as a conceptual base for the current study and a measure of social problem-solving (SPS) was included. This chapter provides an overview of social problem-solving theory, covering definitions, processes, the relational problem-solving model of stress and wellbeing, types of problem-solving measures, and the rationale for the inclusion of the SPS measure.

Social Problem-Solving Theory

Definitions

Social problem-solving. SPS is the self-directed cognitive and behavioral process by which individuals attempt to manage real-life problems or stressful situations (D’Zurilla & Chang, 1995). It refers to problem solving as it occurs in the natural social environment (D’Zurilla & Nezu, 1982) and includes personal (e.g., finances), intrapersonal (e.g., cognitive, emotional, behavioral, health problems), and interpersonal problems (e.g., marital and family conflicts). SPS is simultaneously considered a learning process, a general coping strategy, and a self-management method. It is considered a learning process because the solving of problems requires changes in performance capabilities. It is considered a coping strategy because effective
SPS increases the likelihood of adaptive outcomes (e.g., resolving problems) and ineffective SPS decreases the likelihood of maladaptive outcomes (e.g., compounding of problems). Lastly, since SPS is a coping strategy and a self-directed learning process, it is viewed as a self-management method (D’Zurilla & Nezu, 2010). In clinical, counseling, and health psychology, SPS has become the most popular term, but other terms that are often used interchangeably include interpersonal problem solving (Shure, 1981), interpersonal cognitive problem-solving (Shure & Spivack, 1979), and personal problem solving (Heppner & Peterson, 1982).

**Problems.** Problem situations are existing or anticipated life situations or tasks that require responses for adaptive functioning for which no effective coping responses are immediately identifiable or available due to the obstacles or barriers (Nezu, 2004). These obstacles or barriers include performance deficits, an absence of resources, and novel, ambiguous, and unpredictable demands (D’Zurilla & Nezu, 2010). A specific problem can be a single time-limited event (e.g., a car accident), a series of similar or related events (e.g., repeated unreasonable demands from a spouse), or a chronic ongoing situation (e.g., continuous pain or discomfort). The demands of a problem can originate in the environment (e.g., bills need to be paid) or can stem from an individual’s personal goals, needs, or commitments (e.g., an individual seeks a raise at work so that he can buy a bigger house).

**Solutions.** Solutions are coping responses designed to alter the nature of problems, one’s negative emotional reactions to them, or both (Nezu, 2004). Effective solutions are those coping responses that not only achieve such goals, but also simultaneously maximize other positive consequences or benefits and minimize other negative consequences or costs (Nezu, 2004). In contrast, ineffective solutions may lead to a cycle of negative consequences and poor emotional reactions (Anderson, Goddard, & Powell, 2011). Of note, a distinction is made between
processing solutions and enacting them; some individuals may have the skills necessary to engage in the process of problem-solving (e.g., generate adaptive solutions, consider their consequences), but when faced with problems, they might not have the skills to carry out those solutions (D’Zurilla & Nezu, 2010).

**Social Problem-Solving Model**

The social-problem solving model was developed by D’Zurilla and Goldfried in 1971 and later revised by the authors in 1982 and again in 1990 (D’Zurilla & Nezu, 1999; 2010). In the revised model, SPS consists of several related, yet distinct components, and problem-solving outcomes are largely determined by two related yet independent dimensions: (1) problem orientation (i.e., how people generally think or feel about problems and their problem-solving ability), and (2) problem-solving skills (i.e., attempts to find effective solutions to problems; D’Zurilla & Nezu, 1999).

**Problem Orientation**

Having a positive problem orientation (PPO) is the tendency to optimistically view problems as challenges that are solvable, and those with this tendency tend to have a strong sense of self-efficacy regarding their ability to cope with problems. Individuals with high levels of PPO also tend to understand that successful problem solving requires sufficient time and effort. On the other hand, people with a negative problem orientation (NPO) have the tendency to view problems as threats, expect problems to be unsolvable, and doubt their personal ability to cope with problems. This can lead to feelings of frustration and becoming upset when faced with problems. It should be noted that PPO and NPO are not considered to be opposites on a single orientation dimension; they are distinct yet overlapping constructs, as one is facilitative and the other inhibitive (Chang & D’Zurilla, 1996). More specifically, PPO elicits positive emotions and
approach tendencies that facilitate problem-solving performance, whereas NPO elicits negative emotions and avoidance tendencies that hinder or disrupt problem-solving performance (D’Zurilla & Nezu, 1999).

The major orientation variables that impact SPS performance are problem perception, problem attribution, problem appraisal, perceived control, and time/effort commitment. Problems in the real world are usually ambiguous or difficult to identify as problems because they tend to include relevant and irrelevant information that must be sorted, and adaptive problem perception is the ability to recognize true problems as problems instead of failing to identify them or ignoring them. Problem attribution that is adaptive involves accurately identifying causes of a problem, whether due to environment or due to personal influence, and whether these causes are changeable. Next is problem appraisal, which is based on Lazarus’s primary appraisal (Lazarus & Folkman, 1984). A positive appraisal is the tendency to view problems as potential benefits to wellbeing, such as personal growth, and this leads to approaching problems in an effortful and planful way. In contrast, a tendency to view problems as harmful or threatening to wellbeing is more likely to cause individuals to disengage or to avoid problems. Next, perceived control, based on Bandura’s (1997) concept of self-efficacy, is the belief in one’s own ability to solve problems and the belief that problems are generally solvable (i.e., not impossible). This can reduce distress and increase adaptive coping, whereas having negative self-efficacy beliefs would increase anxiety and maladaptive coping. Lastly, another key variable is time/effort commitment. It has two components: the likelihood that the estimated time it will take to solve a particular problem is accurate, and the willingness to devote the necessary time and effort to solving the problem. Both of these contribute to facilitate problem-solving performance. On the other hand, the inability to estimate how long it will take
to solve a particular problem or the unwillingness to put in the time will hinder problem-solving performance (D’Zurilla & Nezu, 1999).

**Problem-Solving Skills**

Another important component of SPS is problem-solving skills. This was referred to as problem-solving proper in the original model and refers to adaptive and maladaptive cognitive-behavioral styles. Problem-solving skills entail attempts to understand social problems and find effective solutions (Anderson et al., 2009; Nezu, Nezu, & D’Zurilla, 2007; D’Zurilla et al., 2004). According to SPS theory, an adaptive, systematic, and strategic style of problem-solving is rational problem solving (RPS). RPS is described as the process by which individuals search for a solution to a problem by applying the following four problem-solving skills: (1) problem definition and formulation, (2) generation of alternate solutions, (3) decision making (i.e., comparing and evaluating solutions before choosing one), and (4) solution verification and implementation (i.e., evaluating the outcome; D’Zurilla & Nezu, 2010; D’Zurilla et al., 2004).

The RPS skills are applied in sequential steps, which are detailed below. There are two maladaptive styles, impulsive careless style (ICS) and avoidant style (AS). ICS is a style of problem-solving that is impulsive, rushed, and careless, whereas AS is a style that involves procrastination, passivity, and overdependence on others to provide a solution to problems.

**Problem definition and formulation.** The first RPS skill, which is used in the first step, is problem definition and formulation. This is the ability to understand the nature of the problem and identify a realistic goal for problem solving. The idea is that appropriately defining a problem will lead to producing more relevant solutions and will increase accuracy when appraising how effective those solutions were (Nezu, 1987). Nezu (1987) outlined several types of cognitive distortions provided by Beck (1967) that can be associated with poor usage of this
skill: arbitrary inference (i.e., making conclusions without any evidence of such conclusions),
selective abstraction (i.e., poorly conceptualizing a situation by focusing on details that are taken
out of context), overgeneralization (i.e., drawing conclusions based on isolated incidents), and
magnification and minimization (i.e., making grossly inaccurate errors when assessing the
significance of an incident; Beck, 2011). An individual who engages in these distortions is likely
to define problems in an inaccurate manner, which leads to ineffective problem resolution. The
other piece of this skill, as described above, is setting realistic goals (D’Zurilla & Nezu, 1999).
It is important to set realistic goals. Unrealizable goals set individuals up for failure and other
negative consequences (e.g., failures can change individuals’ views from believing problems are
solvable to believing they are unsolvable, and can contribute to increased stress and less effortful
problem-solving attempts in the future; Nezu, 1987).

**Generation of alternatives.** The second skill in RPS is generation of alternatives.
The goal of this skill is to attempt to generate as many alternative solutions as possible to
maximize the likelihood that the most effective solution will be generated. D’Zurilla and Nezu
(1982) asserted that two brainstorming principles assist with the effective usage of this particular
skill, deferment to judgement and quantity breeds quality. Deferment to judgement is the
principle in which high-quality solutions will be created if individuals delay their evaluation of
these solutions (Nezu, 1987). Quantity breeds quality is the principle in which the production of
a larger number of solutions will increase the likelihood that high-quality solutions will be
produced.

**Decision making.** The third skill in RPS is decision making. The goal of this
component is to evaluate the available solutions and to implement the most effective choice.
Causal and consequential thinking (i.e., identifying cause-effect relations, anticipating the
consequences) have been identified as being instrumental in decision making (Nezu, 1987). Errors in this process can involve overestimation or underestimation of the likelihood that a particular consequence will follow implementation of a solution, as well as lack of consideration of the range of potential consequences associated with each potential alternate solution.

Solution implementation and verification. The fourth skill, applied in the final step of the RPS process, is solution implementation and verification. Contrary to what the name suggests, it does not include actual solution implementation (as discussed above, implementation is a skill of enactment rather than process). Instead, this skill entails the evaluation of a solution during and after a solution is implemented (D’Zurilla & Nezu, 2010). More specifically, the major function of this component is to compare the predicted and actual consequences of a given solution. If the predicted and actual consequences match (i.e., the anticipated outcome of an implemented is accurate), the individual can exit the problem-solving process (Nezu, 1987). If the predicted and actual consequences do not match, reengagement in the preceding steps may be needed.

Although it has not yet been established what basic abilities are most important for effective problem-solving, D’Zurilla and Nezu (2010) emphasize the significance of cognitive concepts summarized in Spivack and Shure’s (1976) interpersonal cognitive problem-solving model. These include causal thinking (i.e., the ability to understand that thoughts, actions, and feelings are in response to prior events in the social environment), consequential thinking (i.e., the ability to anticipate the effects of behavior on oneself and others), alternative thinking (i.e., the ability to produce alternative solutions to problems), means-end thinking (i.e., the ability to conceptualize relevant means to a goal), and perspective-taking (i.e., the ability to perceive a situation from another’s perspective).
Consequences of Social Problem-Solving

Taking the above together, higher levels of PPO and RPS are considered adaptive, whereas higher levels of NPO, ICS, AS are considered maladaptive. Adaptive SPS is thought to enhance one’s ability to adapt to stress because it increases the likelihood of adaptive outcomes, such as resolving existing problems, preventing new problems, or increasing one’s ability to manage emotions in unchangeable situations (D’Zurilla & Nezu, 2010). In contrast, maladaptive SPS (which worsens existing problems or creates new problems) adversely impacts adaptation to stress and is associated with a range of negative outcomes, including interpersonal difficulties, depression, anxiety, and physical health issues (Nezu, 2004).

The first major application of the social problem-solving model used a life stress framework of depression, suggesting that stressful life events increased the likelihood of depression and that SPS strengthened or weakened the impact of stress (Nezu, 1987). In an illustrative example, Nezu (1987) described a man who loses his job. The job loss results in a host of stress-inducing events, such as the accumulation of unpaid bills, the need to find a new job, etc. Under increasing levels of stress, the man engages in less adaptive SPS, thus compounding the stress with the addition of new problems. A vicious cycle ensues, leaving him more vulnerable to depressed mood. In line with this, the SPS literature supports a relation between depression and social problem-solving deficits.

The social problem-solving model was later integrated with Lazarus’ relational model of stress, which defines stress as a person-environment relationship by which demands are appraised by the individual to tax or exceed coping resources and threaten his or her wellbeing (similar to SPS’s definition of a problem; D’Zurilla & Nezu, 1999). This merging of concepts created a new model, called the relational/problem-solving model of stress and wellbeing. The
A relational/problem-solving model of stress and wellbeing will be described in detail below, as it was the conceptual basis for the current study.

**Relational/Problem-Solving Model of Stress and Wellbeing**

**Overview**

D’Zurilla and Nezu (2001) assert that the connection amongst stress, SPS, and adjustment is best conceptualized via their relational/problem-solving model of stress and wellbeing. Similar to the problem-solving model, the relational/problem-solving model of stress and wellbeing conceptualizes SPS as an important type of coping that can positively or negatively impact one’s stress and wellbeing (i.e., positive or negative mental and/or physical health). It explains this process by illustrating that increased stress and/or problems, poorer problem-solving ability, and decreased wellbeing act in a transactional manner, interacting with one another and evolving over time.

Stress is not actually isolated in the model, but rather is assumed as varying consonant with the experience of problems and adverse life events. More specifically, stress is considered a function of the reciprocal relationships among (1) stressful life events, (2) emotional stress and wellbeing, and (3) problem-solving coping. Stressful life events are divided into two types: major negative events (e.g., death of a loved one, job loss, major illness) and daily problems (e.g., difficulty paying bills, dealing with children’s needs). These two types of stressors are often interrelated and can cause each other to occur. A simplified illustration of the model is provided below (see Figure 1).

The relational/problem-solving model of stress and wellbeing also suggests that effective problem-solving coping entails high levels of PPO and RPS, and that maladaptive/ineffective coping entails high levels of NPO, AS, and ICS. Lastly, it emphasizes that social problem-
solving is a general and versatile coping strategy that can increase adaptive functioning and positive wellbeing, thereby reducing negative impacts of stress on wellbeing and adjustment, and that psychopathology symptoms can be understood and treated if they are considered to be ineffective, maladaptive, and self-defeating coping behaviors that have negative psychological and social consequences (Nezu, 2004).

**Figure 1**

*Simplified Illustration of D’Zurilla and Nezu’s Relational/Problem-Solving Model of Stress and Wellbeing*

![Diagram](image)

**Empirical Support**

The relational/problem solving model of stress and wellbeing has been supported by a substantial number of studies establishing links between SPS and a wide range of psychological (e.g., depression and anxiety) and physical health (e.g., non-cardiac chest pain, asthma, migraines) problems. As discussed, the relational/problem-solving model of stress and wellbeing evolved from the previous SPS models. Support for the current form of the model, therefore, also comes from the large number of past studies based on prior versions of the SPS model. Both psychological and physical health studies pertaining to SPS are reviewed below.

**Psychological health.** In early studies, Kant, D’Zurilla, and Maydeu-Olivares (1997) examined the relations amongst life stress, SPS, anxiety, and depression in 100 middle-aged and 100 elderly community individuals. Stress was measured via the Problems Inventory (PI; Kant et al., 1997), SPS via the Social Problem-Solving Inventory-Revised (SPSI-R; D’Zurilla et al.,
anxiety symptoms via the State-Trait Anxiety Inventory (STAI; Spielberger, 1983), and depressive symptoms via the BDI. A consistency in both the middle-aged and elderly groups was that all of the maladaptive SPS dimensions and PPO correlated significantly with depressive and trait anxiety symptoms in the expected directions (i.e., RPS was only related, in the negative direction, for the middle-aged group). In both groups, NPO was the sole SPS predictor of anxiety and depressive symptoms, and examination of the entire sample revealed that NPO mediated the relationship between PI scores and BDI scores (accounting for 19.7% of the variance) and STAI scores (accounting for 53.7% of the variance). Additionally, D’Zurilla, Chang, Nottingham, and Faccini (1998) examined the relations between SPS and depression in 283 undergraduate college students and in 100 adult psychiatric patients, using the SPSI-R and the BDI. They found, for both samples, that all SPS dimensions, except for RPS, correlated significantly with depression in the expected directions. To summarize the above, the maladaptive SPS dimensions accounted for the majority of the significant findings. Consistent with this, more recent studies have suggested that NPO, in particular, is associated with depression and anxiety (Anderson et al., 2009; Frye & Goodman, 2000; Haugh, 2006; Siu & Shek, 2010). The lack of findings for the RPS dimension is also consistent with many other depression and anxiety studies (Reinecke, DuBois, & Shultz, 2001; Reinecke et al., 2001; Siu & Shek, 2010).

Physical health. Studies examining physical health problems (e.g., tension and migraine headaches, chest and lower back pain; Eskin et al., 2013; Nezu, Nezu, & Jain, 2008; Witty, Heppner, Bernard, & Thoreson, 2001) have also supported the relational/problem-solving model of stress and wellbeing. A notable study by Nezu and colleagues (2008) tested each SPS dimension as a mediator of the relationship between perceived stress and noncardiac chest pain
(NCCP) in 166 patients referred to a cardiovascular imaging laboratory to obtain stress myocardial perfusion imaging (MPI). These individuals sought MPI due to complaints of chest pain, but the researchers did not know the outcomes of their MPI evaluations. The study included a measure of stress [Perceived Stress Scale (PSS); Cohen et al., 1983], the Social Problem-Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002), and self-ratings of NCCP and frequency during the past month on a Likert scale ranging from no pain (1) to severe pain (7). Regression analyses confirmed that higher levels of stress predicted higher pain frequency, and NPO, AS, and ICS each mediated the effects of stress on NCCP frequency, indicating that less adaptive coping was associated with worsened NCCP symptoms. The significance of the maladaptive dimensions is consistent with many of the above-mentioned SPS studies that examined psychological health.

Other studies isolating single pathways have also supported the relational/problem-solving model of stress and wellbeing (Baker, 2003; Elliot, 1992; Eskin et al., 2013). For example, a recent study compared 49 patients with migraine headaches, 42 patients with tension type headaches, and 49 matched healthy controls using both the PSS and SPSI-R (Eskin et al., 2013). Both patient groups (i.e., those with headaches) reported higher scores on the PSS and NPO scales and lower scores on PPO than the controls, supporting links between physical health problems and increased stress and physical health problems in the context of less adaptive SPS. Demonstrating SPS’s ability to predict stress levels, Baker (2003) conducted a study using another measure of problem-solving ability, the Problem Solving Inventory (PSI; Heppner & Peterson, 1982) and the PSS in 104 psychology undergraduate students. They found that lower levels of problem-solving predicted higher stress levels on the PSS 17 months later.
In sum, maladaptive SPS appears to exacerbate the impact of stress on both psychological symptoms and physical health problems. Those under stressful circumstances and who are not adequately able to cope with them (i.e., are making ineffective attempts at SPS) may find themselves struggling with negative consequences (e.g., physical symptoms) and the creation of new stressful problems. These physical symptoms can also serve as problems by themselves. As such, poor physical health symptoms can be viewed as the direct or indirect outcome of ineffective coping (Nezu et al., 2008).

**Psychological Measures of Social Problem-Solving**

D’Zurilla and Maydeu (1995) highlight the importance of distinguishing between two major types of SPS measures: process and outcome. Descriptions and examples of both of these types of measures are provided below, as well as the rationale for the measure selection in the current study.

**Process Measures**

Process measures assess the general cognitive and behavioral activities that facilitate or inhibit the discovery of an effective or adaptive problem-solving solution. In contrast, outcome measures (which are outlined later in this chapter) assess the quality of solutions, or the product of the problem-solving process. Thus, process measures are considered most useful for assessing specific strengths and deficits in problem-solving attitudes and skills. Process measures are easy and quick to administer, as they are usually self-report inventories (i.e., broad surveys of adaptive and maladaptive problem-solving attitudes, strategies, and techniques) using a paper-and-pencil questionnaire format with Likert scale ratings. Examples of two widely used process measures are the Problem Solving Inventory (PSI; Heppner & Petersen, 1982) and the Social
Problem Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002), both of which are discussed below.

The Problem-Solving Inventory (PSI; Heppner & Petersen, 1982) is a 32-item self-report measure of personal problem-solving and is based on the D’Zurilla and Goldfried (1971) model of social problem-solving. More specifically, the PSI assesses how individuals perceive they would solve problems, as well as their attitudes towards problems (Heppner et al., 2004). Although the measure was designed to assess five problem solving stages (general orientation, problem definition, generating alternatives, decision making, and evaluation), a factor analysis showed that items from each of these stages loaded into three factors: Problem-Solving Confidence (PSC; self-assurance and belief in one’s own ability to cope with problems), Personal Control (PC; self-control of emotions and behaviors when faced with problems), and Approach-Avoidant Style (AAS; the tendency to approach or avoid problems; Heppner et al., 2004; Hepper & Petersen, 1982). Although each of these factors is represented by a subscale score, the total PSI score (overall problem-solving ability) is the most common PSI score used. For all of the PSI scores, lower scores indicate better social problem-solving ability (D’Zurilla & Nezu, 1990). Hepper and colleagues (2004) conducted a comprehensive review of one hundred and twenty studies using the PSI and evaluated its psychometric properties. Examining internal consistency, they found that summing across studies, average alpha coefficients were in the high .80s for the total score (good range), in the low to mid .80s for the PSC and AAS (also in the good range), and in the low .70s for the PC (in the adequate range). Examining test-retest reliability, they reported that across samples of white and black college students and French Canadian adults, total PSI scores were correlated .80 over two weeks, and .81 for three weeks.
and four months, indicating there is little fluctuation over several weeks and that SPS on this measure is more trait-like than state-like.

Many SPS studies have used the PSI to establish links with poorer SPS and psychological wellbeing (e.g., more depressive or anxiety symptoms) in college students (Dixon, 2000; Heppner et al., 1982; Tanaka-Matsumi, 1996). Two cross-sectional studies and one longitudinal study are included here as examples. Heppner and colleagues (1982) examined the link between SPS and anxiety in undergraduate college students’ SPS ability. They divided their sample into effective problem-solvers (i.e., those who obtained PSI scores in the bottom 18%) and ineffective problem-solvers (the top 18%). They found that undergraduate college students with more effective problem-solving were more confident, approached problems more, and reported higher levels of personal control and self-esteem. They also found that ineffective problem solvers reported more anxiety, frustration, dysfunctional thoughts, and avoidance of problems. SPS’s link to depression using the PSI has also been supported. Examining depression, Mayo and Tanaka-Matsumi (1996) compared SPS abilities, via the PSI, in dysphoric undergraduate students (those who scored 13 or higher on the BDI) and nondysphoric undergraduate students (those who scored below a 5 on the BDI). T-tests revealed that dysphoric participants scored significantly higher on the total PSI scale and on all three subscales (i.e., indicating lower SPS ability). Further, PSI scores have predicted depressive symptoms over time. Dixon (2000) conducted a longitudinal study that assessed BDI and PSI scores two months apart in undergraduate students. They found that those with low PSI scores at baseline one displayed only mild levels of depressive symptoms two months later, and those with high PSI scores at baseline showed moderate to severe depressive symptoms two months later.
Despite the impact of these findings, there is a major theoretical issue with the PSI: the three factors identified by Heppner and Peterson (1982) describe SPS only in a global sense and are not linked to any specific components of the theoretical model from which they were derived (D’Zurilla & Nezu, 2010). As one example, Heppner and Peterson conceptualized the PSI’s factors as motivational and expectancy-based, similar to social learning theory, and the conceptualization of the PSC factor was inspired by Bandura’s self-efficacy construct (1986). Yet, self-efficacy is a situation-specific appraisal of one’s own SPS abilities, whereas the appraisal associated with the PSC factor is more global (i.e., a general appraisal of one’s own SPS abilities; Heppner, 2004).

The Social Problem Solving Inventory (SPSI; D’Zurilla & Nezu, 1990) is another frequently used SPS measure. The SPSI was based on the D’Zurilla and Goldfried SPS model discussed earlier in this chapter (D’Zurilla & Nezu, 1999; 2010). It contains 70 items and is a multidimensional self-report measure of SPS ability. The SPSI consists of two major scales: Problem Orientation Scale (POS) and the Problem-Solving Skills Scale (PSSS). Within the Problem Orientation Scale (POS) are three subscales: (1) Cognition subscale (CS): involves recognizing problems as they occur, appraisals of their significance, and beliefs and expectancies of personal control of problems; (2) Emotion subscale (ES): involves immediate emotional states that are associated with problematic situations, such as negative affect (e.g., anxiety, anger, depression) and positive affect (e.g., exhilaration, hope, and eagerness); and (3) Behavior subscale (BS): focuses on behavioral approaches (i.e., confronting and handling problems) and avoidance tendencies (i.e., putting off dealing with problems or depending on others to solve them). Within the Problem-Solving Skills Scale (PSSS) are four subscales: (1) Problem Definition and Formulation subscale (PDFS): defining the problem by obtaining relevant and
factual information, and formulating a set of realistic problem-solving goals; (2) Generation of Alternative Solutions subscale (GASS): maximizing the likelihood of best possible solution by identifying or creating as many solution alternatives as possible; (3) Decision Making subscale (DMS): comparing the solution alternatives identified or created, and implementing the best one; and (4) Solution Implementation and Verification subscale (SIVS): self-monitoring and evaluating the outcome after the best solution is implemented. Each item on the SPSI is a self-statement reflecting either a positive (i.e., facilitative) or negative (i.e., inhibitive) cognitive, affective (i.e., emotional), or behavioral response to real-life problem-solving situations. Items are arranged in a random order throughout the SPSI, one half being positive and the other half being negative. The SPSI utilizes a 5-point Likert scale, and ratings for the negative items are reversed when scoring. Higher scores reflect greater problem-solving ability. The SPSI can be scored for the total inventory, the two major scales, or the seven subscales.

Psychometrics for the SPSI have been estimated by D’Zurilla and Nezu (1990), who recruited two separate undergraduate college student samples for their analyses, one in 1987 (n = 192) and another in 1988 (n = 89). Using the 1988 sample, internal consistency was excellent for the total inventory (r = .92), POS major scale (r = .94), and PSSS major scale (r = .92). For the subscales, respectable levels for internal consistency were demonstrated for most: CS (r = .74), ES (r = .90), BS (r = .86), PDFS (r = .85), GASS (r = .78), DMS (r = .75), and SIVS (r = .65). Using the 1987 sample, D’Zurilla and Nezu estimated that three-week test-retest reliability correlation coefficients were in good ranges for the total inventory (r = .87), POS major scale (r = .83), and PSSS major scale (r = .88). For the subscales, the ranges were adequate for CS (r = .73), ES (r = .83), BS (r = .79), PDFS (r = .86), GASS (r = .84), DMS (r = .78), and SIVS (r = .85). The SPSI has also suggested concurrent validity, and is significantly correlated with two
other social problem-solving measures, the Problem-Solving Inventory (PSI) and the Means-End Problem-Solving Procedure (MEPS; Platt & Spivack, 1975).

Although the SPSI demonstrates good psychometric properties and has been widely used in the SPS literature, a newer variant of this measure exists, the Social Problem Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002). The SPSI-R is based on factor analyses conducted by Maydeu-Olivares and D’Zurilla (1995, 1996) using 601 undergraduate college students. Using polychoric correlations, a variant of the social problem-solving model was supported, which makes distinctions among five components (two problem orientation dimensions and three problem-solving skills/styles). The SPSI-R contains 52 items and is a self-report questionnaire utilizing the five components as major scales: positive problem orientation (PPO), negative problem orientation (NPO), rational problem solving style (RPS), impulsivity/carelessness style (ICS) and avoidance style (AS). These components are defined as follows: PPO: appraising a problem as a challenge/opportunity for growth, being optimistic (e.g., believing a problem is solvable), and believing in one’s ability to solve the problem (i.e., high self-efficacy); NPO: appraising a problem as a threat to one’s wellbeing, and having low self-efficacy and low tolerance for a problem (i.e., getting frustrated easily by problems); RPS: using effective constructive-problem solving that is deliberate, rational, and systematic; ICS: engaging in active but dysfunctional (i.e., narrow, impulsive, careless, rushed) problem-solving tactics; and AS: using passive or inactive problem-solving tactics (i.e., procrastination and dependency). Higher scores on PPO and RPS and lower scores on NPO, ICS, and AS indicate better SPS ability. RPS is divided into four subscales: PDF, GAS, DM, and SIVS (i.e., the subscales belonging to the original SPSI’s PSSS major scale). Like its predecessor, the SPSI-R also has estimated good psychometric properties (D’Zurilla et al., 2002). Internal consistency ranges
from adequate to excellent across the domains: PPO ($r = .76$), NPO ($r = .91$), RPS ($r = .92$), ICS ($r = .83$), and AS ($r = .88$). For three-week test-retest reliability, $r$’s ranged from .72 to .88 (PPO and NPO, respectively). This suggests that, similar to the PSI, the SPSI-R may be more trait-like than state-like, and some caution should be used when assessing time points that are three weeks or shorter.

Numerous SPS studies have used the SPSI-R, and these investigations further bolster support for the relational/problem-solving model of stress and wellbeing with college students (Anderson et al., 2009; 2011; Haugh 2006). Three examples are provided here. Haugh (2006) conducted a study with 245 undergraduate students, who completed the Beck Depression Inventory–Second Edition (BDI-II; Beck, Steer, & Brown, 1996), the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988), and the SPSI-R, and found that depressive and anxiety symptoms were significantly related to PPO, NPO, and ICS in the expected directions. Anderson and colleagues (2009) also found links between SPS and depression/anxiety in undergraduate college students. They utilized the SPSI-R, the Hospital Anxiety Scale (HADS-A; Zigmond & Snaith, 1983), and the Hospital Depression Scale (HADS-D; Zigmond & Snaith, 1983). Students who obtained HADS-A and HADS-D scores above 11 were placed in the mixed depression/anxiety group, and showed deficits in problem orientation (i.e., negative attitudes towards problems). Additionally, the mixed depression/anxiety group, compared to a healthy control group, obtained higher scores on the ICS and AS subscales of the SPSI-R. Further, Anderson and colleagues (2011) later completed a follow-up study of undergraduate college students examining SPS and depressive symptoms on the BDI. They found that all SPSI-R dimensions, except RPS, correlated with current and future BDI scores.
One consistent issue with the SPSI-R is what appears to be a weakness in the RPS component. As reviewed earlier in this chapter, RPS often does not emerge as a significant factor associated with depression and anxiety (D’Zurilla et al., 1998; Kant et al., 1997; Reinecke et al., 2001; Siu & Shek, 2010). As an example, D’Zurilla et al. (1998) found that RPS was the only SPSI-R dimension not significantly related to depression in both college undergraduate students and adult psychiatric patients. This supports the notion that although an individual may have a relatively adaptive RPS, perhaps what is more important is one’s problem-orientation. One way to conceptualize this is that having high levels of NPO may hinder the employment of adaptive skills even if one has such skills (Chang & D’Zurilla, 1996). Or, it could be that RPS is not a good measure of problem-solving skills that is tied to actual problems and outcomes.

In sum, process measures have many benefits and limitations to consider. As mentioned, process measures are quick and easy to administer since they are brief and in a self-report format. In addition, they have been used in numerous SPS and health studies and are considered standard, often labeled as traditional measures (Anderson et al., 2009). Despite these advantages, a limitation is that the hypothetical problems (which process measures use) may differ from real-life problems that are personally relevant for the individual. This leaves some room for doubt as to whether they generalize to real-life problem-solving ability (Heppner et al., 2004). Another limitation is that process measures do not actually allow for examination of the way individuals apply their skills to a specific problem. Instead, they capture more what individuals think they would do without testing to see if they can actually do it (i.e., the skills are not actually implemented or employed). Despite these issues, process measures appear to tap into a very important aspect of problem-solving (i.e., the process), and when considering what
was relevant to the current study, SPS attitudes appeared to be more important in predicting IBS symptom severity than problem-solving performance.

**Outcome Measures**

Outcome measures, compared to process measures, are most useful for evaluating problem solving performance, which is the ability to apply skills effectively to specific problems. All outcome measures are performance tests, in that they measure overall problem-solving performance (D’Zurilla & Nezu, 1999). This is done by presenting individuals with problems and asking them to solve them, and subsequently evaluating the quality of the solutions. Most outcome measures involve hypothetical test problems, but more recently participants’ solutions for their actual current problems have also been assessed. Two examples of outcome measures are the Means-End Problem-Solving Procedure (MEPS; Platt & Spivack, 1975) and the Problem-Solving Self-Monitoring (PSSM; D'Zurilla et al., 1999).

The Means-End Problem-Solving Procedure (MEPS; Platt & Spivack, 1975) is a measure of “means-end” thinking and focuses on the ability to conceptualize relevant means towards achieving a specific social or interpersonal goal. The MEPS consists of 10 items, and individuals are asked to picture themselves as the protagonist in a problematic situation (House & Scott, 1996). They then provide as many steps (i.e., means) as they can to produce a successful ending (i.e., to achieve the desired, specified goal). Scores are based on the number of relevant means (i.e., responses that are effective in achieving the successful ending), irrelevant means (i.e., responses that are not effective for the successful ending), and no means (i.e., no responses). The most common score used in research is a total score calculated by summing the number of relevant means (D’Zurilla & Nezu, 1999). The MEPS is often confused for a process measure, but is actually considered by D’Zurilla and Nezu (1999) as an outcome measure, or
problem-solving performance test, because the components of means-end thinking represent a problem solution. A study by Marx and colleagues (1992) estimated the MEPS’ psychometric properties in a sample of 20 depressed individuals (i.e., individuals scoring 18 or higher on the BDI and who also had a diagnosis of major depressive disorder according to the Research Diagnostic Criteria; Spitzer, Endicott, & Robins, 1978) and 20 matched controls. They found good interrater reliability for the total score of relevant means, with $r = .82$. Additionally, the MEPS constructors provided evidence for satisfactory levels of test-retest reliability for two-and-a-half weeks ($r = .59$), five weeks ($r = .64$), and eight months ($r = .43$; Schotte & Clum, 1987).

Unfortunately, there are many issues with the MEPS. As reviewed by House and Scott (1996), the limitations include a lack of consistency in application of MEPS across studies: instructions are often altered, such as the wording of stories (e.g., the use of second- or third-person), and alternative scoring techniques are often added (i.e., effectiveness), which make assessing the MEPS’ reliability a challenge (House & Scott, 1996). Also, studies that use the third-person may not capture how individuals would solve their own problems (House & Scott, 1996). Further, it is not clear what MEPS responses are most valid, for what purpose, and under what conditions, and the MEPS evaluates only the quantity of effective problem-solving responses, and not how effective the responses are (Marx et al., 1992). In addition, the external validity of the procedure has been criticized due to artificial restrictions on the types of problems assessed (House & Scott, 1996). Lastly, the MEPS situations are unusual, such as gaining revenge on a trooper (Butler & Meichenbaum, 1981). With so many issues, the MEPS was not included in the current study.

Another outcome measure is the Problem-Solving Self-Monitoring task (PSSM; D'Zurilla et al., 1999). The PSSM was designed as a companion to the SPSI-R (Nezu, 2004). The PSSM
asks individuals to identify significant real-life problematic situations and to record their response to them (D’Zurilla & Nezu, 1999). Instead of assessing hypothetical situations, the PSSM’s diary entry format allows for reporting on real life personal problems that occur in real time (Anderson et al., 2009; 2011). Participants are given definitions of the terms: problem, problem solving, and solution. The PSSM assesses the following SPS dimensions: Wellbeing (how important the problem was for the individual’s physical, social, psychological, and/or economic well-being); Threat (the extent to which the individual viewed the problem situation as threatening or harmful); Challenge (the extent to which the individual viewed the problems as a challenge that provided an opportunity to benefit in some way from having the problem); Control (the extent to which the individual viewed the problem as controllable); Confidence (the individual’s confidence in his or her ability to control the problem or to change it for the better); Effort (how much time and effort the individual was willing to commit to solving his or her problem independently); Emotion (the intensity of the individual’s negative feelings or emotional distress in response to the problem); Situation Change (the extent to which the problem situation changed for the better); Emotion Change (the extent to which the individual’s emotions changed for the better); and Satisfaction (the individual’s overall satisfaction with the outcome upon implementing a solution to the problem).

Only two published studies have used the PSSM (e.g., Anderson et al., 2009; 2011) and these studies did not even use the full measure. Anderson and colleagues (2009; 2011) used derived scores (created by the authors and not part of the established PSSM) rather than the full measure. More specifically, Anderson et al. (2009) derived an actual effectiveness score (i.e., score of participants’ explanations of how they tried to solve problems) and an ideal effectiveness score (i.e., score of the strategies participants reported in retrospect would have
been ideal to solve the problems). These authors reported an inter-rater reliability coefficient of .75 and an actual effectiveness score coefficient of .85. Although the ideal effectiveness scores were not compared, the actual effectiveness scores were significantly different for the mixed depression/anxiety group, compared to controls. Anderson and colleagues (2011) conducted a hierarchical regression analyses to explore SPS’s role in predicting future depressive symptoms, using baseline BDI, SPSI-R NPO, MEPS, and PSSM scores, and subsequent BDI scores obtained three months later. After controlling for baseline BDI scores and accounting for the SPSI-R’s NPO and MEPS’ variance, the PSSM actual effectiveness score accounted for an additional 8% of unique variance, indicating that the PSSM predicted depressive symptoms above and beyond the other SPS measures. The PSSM-derived score and the SPSI-R total score correlated significantly with one another, \( r = .41 \). This suggests that these two measures are somewhat related to one another, but do not overlap so much that they are tapping into the same aspect of SPS.

The PSSM appears to have many strengths and limitations. A major strength of the PSSM is that individuals report on real life personal problems that occur in real time (Anderson et al., 2009; 2011). Thus, results are less likely than process measures to be affected by recall bias or by distortion of one’s abilities since they capture the individual’s current ability to solve problems rather than a recollection of past problem-solving performance (D’Zurilla & Nezu, 1999). It should be noted, though, that it can be unclear if participants followed instructions to record details of their problem as soon after the event as possible, which may make it susceptible to recall bias (Anderson et al., 2011). Another strength of the PSSM is that individuals are problem-solving under more emotionally-provoking conditions, which is more realistic than the calm demeanor a hypothetical situation may induce (Anderson et al., 2009). In considering its
disadvantages, it can be rather expensive to use, requires daily participation, and has questionable validity (D’Zurilla & Nezu, 1999). Lastly, like other outcome measures, it does not tap into the specific abilities or particular components of the problem-solving process.

**Summary**

In selecting an SPS measure for the present study, a number of factors were considered. The vast majority of the SPS literature uses process measures such as the PSI and the SPSI-R given their ease of use, low cost, and ability to tap into specific components of the problem-solving process. Outcomes measures also have benefits, such as measuring real life problem-solving in real time as opposed to hypothetical ones that process measures provide, but they appear to lack validity and have costs associated with them: the MEPS was ruled out for many reasons (e.g., lack of consistency in administration and in scoring), and the PSSM lacks psychometric evaluation and requires daily monitoring, which might lead to poorer quality of responses and participant attrition. Another advantage of the process measures is that they tap into the problem-solving process (i.e., individuals’ perceptions, appraisals, and expectations about their SPS ability), the component of SPS thought to most influence susceptibility to developing poorer health outcomes (e.g., anxiety, depression, physical health problems; Nezu, 2004).

Ultimately, the decision to use the SPSI-R in the present study was made. The SPSI-R has demonstrated good psychometric properties in undergraduate college samples. It is the most widely-used process measure, and it has direct links to D’Zurilla and Nezu’s (1995) refined SPS model, containing scales associated with the five theoretical factors that arose from the Maydeu-Olivares and D’Zurilla (1995) factor analysis. It has been used in many studies demonstrating the link between stress and wellbeing (e.g., depression, anxiety, and a variety of physical health
issues) and has been employed in studies supporting the relational/problem-solving model of stress and wellbeing (Nezu, 2004).
CHAPTER IV: THE CURRENT STUDY

This chapter synthesizes the literature from the previous chapters to help frame the theoretical and empirical bases for the design and hypotheses of the present study. In brief, the current investigation aimed to examine the interplay amongst stress, maladaptive social problem-solving (SPS), and irritable bowel syndrome (IBS). A first goal was to replicate the already established connections between stress and maladaptive SPS and stress and IBS. Breaking new ground, the study also examined the heretofore unexplored association between IBS and maladaptive SPS. The mediational roles of SPS in the relationship between stress and IBS symptom severity, and stress in the relationship between maladaptive SPS and IBS symptom severity, were also tested. A major strength of the current study was its longitudinal design, given that participants were assessed at baseline and two and four weeks later. The vast majority of previous SPS studies have been cross-sectional, and this limits their ability to detect directionality in the variable relationships. The rationale and empirical support for study design decisions are outlined below.

Major Variables

Stress, Social Problem-Solving, and Wellbeing

Stress is linked to maladaptive SPS (see Nezu, 2004 for a review). Indeed, problem-solving is defined as the self-directed cognitive and behavioral process by which a person attempts to manage stressful situations (D’Zurilla & Chang, 1995). Additionally, both stress and SPS impact psychological and physical health problems (D’Zurilla & Chang, 1995; Nezu, 2004). This is predicted in the D’Zurilla and Nezu (2001) relational/problem-solving model of stress and wellbeing. This model asserts that adaptive SPS enhances one’s ability to adapt to stress by increasing the likelihood of positive outcomes (e.g., overcoming a stressful problem), whereas
maladaptive SPS hinders adaptation to stress by increasing the likelihood of negative outcomes (e.g., an increase in the number or severity of problems; Nezu, 2004).

As reviewed, the relational/problem-solving model of stress is supported by a number of empirical investigations with psychological symptoms, particularly depression and anxiety (e.g., Anderson et al., 2009; Chang & D’Zurilla, 1996; Kant et al., 1997; Siu & Shek, 2010; Wilson, Bushnell, Rickwood, Caputi, & Thomas, 2011). The model also enjoys support of several studies examining physical problems as the outcome variable (e.g., tension and migraine headaches, chest and lower back pain; Eskin et al., 2013; Nezu et al., 2008; Witty et al. 2001). A notable example was that of Nezu and colleagues (2008), whose study tested each SPS dimension as a mediator of the relationship between perceived stress and noncardiac chest pain (NCCP) in adults. This investigation included the Perceived Stress Scale (PSS; Cohen et al., 1983) and the Social Problem Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002), two measures that the present study used, and self-ratings of NCCP and frequency. Regression analyses revealed that higher levels of stress predicted higher pain frequency, and NPO, AS, and ICS each mediated the effects of stress on NCCP frequency. Taking all of the above together, maladaptive SPS appears to exacerbate the impact of stress on both psychological symptoms and physical health problems.

**Stress and Irritable Bowel Syndrome**

Studies have also linked stress levels and daily stressful events with IBS symptom severity (see Pletikosić & Tkalčić, 2016, for a review). For example, a longitudinal study by Dancey and colleagues (1997) examined daily IBS symptoms and stress in the form of daily hassles. They found that in over 43% of the participants, IBS symptoms could be predicted by hassles in the previous 4 days, and that in 37% of the participants, hassles could be predicted by
IBS symptoms in the previous 4 days. Another longitudinal study by Blanchard (2008) also found that stress predicted gastrointestinal symptoms and that gastrointestinal symptoms predicted stress. More specifically, stress during week one impacted stress at week two, impacting stress at week three, which in turn impacted the severity of gastrointestinal symptoms at week three; and gastrointestinal symptoms at week one impacted gastrointestinal symptoms at week two, impacting gastrointestinal symptoms at week three, which in turn impacted stress during week three. Thus, both of these longitudinal studies have demonstrated bidirectional effects of stress and gastrointestinal symptoms.

**Interplay of Stress, Maladaptive Social Problem-Solving, and Irritable Bowel Syndrome**

The relational/problem-solving model of stress and wellbeing has not yet been examined with IBS. Stress is hypothesized to play a prominent role in triggering, maintaining, and worsening IBS symptoms. As reviewed, the biopsychosocial perspective is the predominant approach for understanding IBS (Burnett & Drossman, 2004; Kennedy et al., 2012; Tanaka et al., 2011). Rooted in the biopsychosocial perspective is the brain-gut axis theory, which asserts that individuals with IBS have dysregulation of the communication between the “brain” and the “gut” (Burnett & Drossman, 2004). Maladaptive cognitive appraisals of the environment (“I can’t handle this”) increase stress, adversely impact coping abilities (e.g., worsen problem-solving ability), and exacerbate IBS symptom severity (Kennedy et al., 2012). In turn, IBS symptom severity can further impair cognitive appraisals and fuel a harmful self-maintaining cycle.

Although maladaptive SPS has been linked to stress (see Nezu, 2004 for a review), and stress has been linked to IBS (Blanchard et al., 2008; Dancey et al., 1997), to date no studies have examined the link between SPS and IBS (with the exception of a pilot study conducted by the dissertation author, which is discussed below). As such, the current study explored the
potential link between maladaptive SPS and IBS, and investigated the interplay amongst maladaptive SPS, stress, and IBS.

**Stress as an Independent Variable and a Mediator**

The majority of SPS studies testing the relational/problem-solving model of stress and wellbeing examine SPS as a mediator in the link between stress and wellbeing (Chang, D’Zurilla, & Sanna, 2009; Nezu et al., 2008; Nezu & Ronan, 1985). Due to the transactional relationships of the variables involved, the current study also investigated the model with stress as a mediator in the relationship between SPS and wellbeing (Kant et al., 1997).

**Participants**

There are several important reasons why stress, IBS, and SPS should be examined in a college population. First, college students fall in what appears to be the prime age range for studying IBS. The peak prevalence in North America is 20 to 39 years of age (Wilkins et al., 2012), but it is reasonable to suspect that the peak may actually be closer to the early 20s (e.g., individuals tend to report symptoms several years after symptoms emerge). Signs of IBS often emerge when experiencing heightened stress (Pletikosić & Tkalčić, 2013), and college introduces many stressful life changes, including increased responsibility and a need to sustain oneself (Anderson et al., 2009). College is also a time of increased self-consciousness and social demands, which add to stress and potentially exacerbate subsequent IBS severity (Steinberg, 2005). Supportive of this line of reasoning, the rates of IBS in university samples are notable; studies have identified prevalence rates of 10.9 to 19% in college students (Gulewitsch et al., 2013; Hazlett-Stevens et al., 2003).

Second, the typical college student age falls between 18 to 25 years, a period often referred to as emerging adulthood or a period of prolonged adolescence (Schwartz et al., 2011).
Important to this study, this life stage significantly increases stress levels as it involves major changes, and exploration of new roles, identity, and lifestyles (Bell & Lee, 2008). It is often called the age of instability or the age of feeling in-between (i.e., not quite an adolescent, not quite an adult; Arnett, 2004). In fact, it is often facetiously referred to as the “quarter life crisis,” and several researchers consider it to be the most stressful stage of the modern Western life cycle (Arnett, 2007; Bell & Lee, 2008). This stage has also been compared to the concept of “identity vs. role confusion,” a stage that developmental theorist Erickson described in the 1950s. It appears that having an identity crisis is no longer most abundant during adolescence, particularly for individuals living in industrialized societies. This is likely due to evolving societal norms over time that allow for more self-exploration, such as increased number of individuals entering post-secondary education; increased number of years to complete post-secondary education; greater acceptance of non-married individuals cohabitating with romantic partners; and later onset of marriage and having children (Arnett, 2007; Schwartz et al., 2011). Individuals in this stage, compared to children and adolescents, have fewer obligations imposed on them from parents (i.e., they often have more autonomy and fewer restraints), and they also have fewer obligations compared to older, more settled adults (i.e., their lives are far-less structured by work and family). While this may seem like an ideal scenario for many, Arnett (2007) also asserted that mental health functioning can plummet for emerging adults because the perception of endless possibilities can become overwhelming and can cause individuals to feel lost, without purpose or direction, and unaccomplished. This may be especially true for college students, as many do not seek employment, or work in jobs that are not likely to lead to their future careers (e.g., retail store cashier, restaurant food server; Schwartz et al., 2011). Additionally, some individuals may choose to enroll in college as a means to delay engagement or commitment to
higher-level adult roles and responsibilities, and these individuals may be at risk for health-compromising behaviors (Schwartz et al., 2011).

**Design**

This section discusses the rationale of the current study’s design. This includes a review of pilot study findings, which guided the development of the present investigation. It also highlights the benefits of using a cross-lagged panel design compared to other designs.

**Pilot Study**

Pilot data were collected to inform the directions of the current study. The pilot investigation utilized the SPSI-R, the PSS, and the Birmingham IBS Symptom Questionnaire (B-IBS; Roalfe et al., 2008), and all three of these measures were used for the current study. Undergraduates ($N = 345$), aged 18 to 25 years old, participated, completing a battery of questionnaires concurrently using Qualtrics, an online survey software.

The pilot findings guided the design of the current study. Pearson correlation coefficients revealed that perceived stress and IBS symptom severity were positively and significantly related to one another. Both perceived stress and IBS symptoms were also positively and significantly related to all of the maladaptive SPS dimensions. Simple linear regressions indicated that perceived stress and each of the maladaptive SPS dimensions predicted IBS symptom severity. Lastly, stress mediated the relationships between each maladaptive SPS dimension and IBS symptom severity. These findings provide some tentative support for the brain-gut axis theory, which connects impaired cognitive appraisals about the environment, higher levels of stress, poorer coping, and worsening of gastrointestinal symptom severity (Kennedy et al., 2012). Of note, the mediational regression analyses examining each SPS dimension as a mediator in the link between stress and IBS did not yield significant results. Having said that, clarifying the true
interactional nature of these variables would require a study employing a longitudinal rather than a cross-sectional design so that stress, SPS, and IBS can be measured at multiple points in time.

**Cross-Lagged Panel Model**

The cross-lagged panel model (CLPM), a type of structural equation model also referred to as a cross-lagged path model and a cross-lagged regression model, uses longitudinal data (i.e., two or more variables are measured at two or more time points) in order to estimate the directional influences that variables have on each other across time (Kearney, 2017). The minimal number of variables and time points (i.e., waves) for a cross-lagged panel design is two; however, Kenny (2005) asserts that two waves may be insufficient to understand how processes unfold over time. In the current study, four variables (i.e., maladaptive SPS, perceived stress, minor life stress, and IBS symptom severity) at three waves, each two weeks apart, were assessed. There is a substantial advantage to using a CLPM over a cross-sectional model, as cross-sectional designs cannot draw causal conclusions since all variables are captured simultaneously just once (Nezu, 2004). Compared to other longitudinal designs, the CLPM has major advantages. For example, an alternate way to examine similar data would be to use a structural regression model, in which the regression parameters of the path from prior variables to later variables are estimated (Rogosa, 1980). However, structural regression models come with a restriction that CLPMs do not have; they assume that all causal influences are lagged and simultaneous causal influences among the variables at each time point are not examined (Rogosa, 1980). Another way to investigate similar data would be to use cross-lagged correlations (CLC), which also assess cross-lagged relationships. However, CLPMs have the added benefit of controlling for correlations within waves and stability across time (Kearney,
Thus, CLPMs are the most comprehensive. As such, the present study employed a cross-lagged panel design.

**Summary of the Current Study**

The current study examined the relationships among maladaptive SPS, perceived stress, minor life stress, and IBS symptom severity concurrently and across time. Undergraduates, aged at least 18 years old, were the participants, and they completed a battery of questionnaires online at three time points, each of which were two weeks apart (i.e., Session 1, Session 2, and Session 3). The battery consisted of the Perceived Stress Scale (PSS; Cohen, Kamarck, & Memelstein, 1983), the Weekly Stress Inventory (WSI; Brantley et al., 1997), the Social Problem-Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002), and the Birmingham IBS Symptom Questionnaire (B-IBS; Roalfe, Roberts, & Wilson, 2008). The exception to this is that the Session 1 battery also contained a demographic questionnaire. More details regarding all these measures are described in the Measures section of Chapter V.

**Study Hypotheses**

The study hypotheses are outlined below and are organized by the investigation of (1) gender; (2) concurrent correlates among stress, SPS, and IBS; (3) stress, SPS, and IBS predicting themselves across time (see Figure 2); and (4) mediations using the D’Zurilla and Nezu (2001) relational/problem-solving model of stress and wellbeing. Figures 3, 4, 5, and 6 illustrate the mediational hypotheses.

**Gender.** Mean-level gender differences were examined in the present study. Consistent with prior research (see review by Lee, 2012), it was predicted that women would report higher levels of perceived stress than men (Hypothesis 1). Scarinci et al. (1999) found that women reported higher levels of minor life stress than men, and thus the same pattern with
minor life stress was also predicted (Hypothesis 2). Next, due to the fact that IBS diagnoses are
twice as common in women as in men (National Institute of Diabetes and Digestive and Kidney
Diseases; 2015), it was predicted that women would report higher levels of IBS symptom
severity than men (Hypothesis 3). This gender difference could be related to a host of factors:
estrogen levels are higher in women and may lead to an increased sensitivity in the gut; cortisol
levels are positively associated with stress and are unusually high in women with IBS; and
women are more likely to engage in help-seeking behavior and visit medical professionals if they
have IBS symptoms. Lastly, research is limited on gender differences in SPS. In one of the only
studies to include gender, D’Zurilla, Maydeu-Olivares, and Kant (1998) found that young men,
compared to young women, had a less negative orientation towards problems, but also tended to
be more impulsive and careless when attempting to solve problems. Consistent with their
findings, it was hypothesized that women, compared to men, would report higher levels of NPO
(Hypothesis 4) and lower levels of ICS (Hypothesis 5).

**Concurrent correlates among stress, SPS, and IBS.** As reviewed in previous chapters,
maladaptive SPS has been linked to stress (see Nezu, 2004, for a review). For example, Bell and
D’Zurilla (2009) found that daily stress on the DSI was correlated with poorer SPS on the SPSI-
R (the SPS measure the current study used). Additionally, Eskin and colleagues (2013) used the
PSS (one of the stress measures that the current study used) and found that higher levels of stress
were associated with higher levels of maladaptive SPS. In light of these findings, it was
predicted that both perceived stress and minor life stress would be positively associated with
each maladaptive SPS dimension at each time point (Hypothesis 6). Stress has also been linked
to IBS (Blanchard et al., 2008; Dancey et al., 1997). As examples, Dancey and colleagues
(1995; 1997) found in both studies that minor life events were significantly related to IBS
symptoms. As such, it was predicted that perceived stress, minor life stress, and IBS symptom severity would be positively associated with each other at each time point (Hypothesis 7). Lastly, it was predicted that maladaptive SPS would be positively associated with IBS symptom severity at each time point (Hypothesis 8).

**Stress, SPS, and IBS predicting themselves across time.** See Figure 2 for an illustration of all the study variables predicting themselves across the three time points. As discussed in preceding chapters, Blanchard (2008) examined reciprocal same-week effects for stress and gastrointestinal (GI) symptoms, as well as lagged effects. In Blanchard’s study, it was found that there were carryover effects of previous GI and stress not only from the prior week, but also the week before. In light of these findings, it was hypothesized that perceived stress at Session 1 would predict perceived stress at Session 2 (Hypothesis 9), and that perceived stress at Session 2 would predict perceived stress at Session 3 (Hypothesis 10). It was also hypothesized that minor life stress at Session 1 would predict minor life stress at Session 2 (Hypothesis 11), and that minor life stress at Session 2 would predict minor life stress at Session 3 (Hypothesis 12).

Previous research has suggested that three-week test-retest reliability for the SPSI-R dimensions is adequate to good, with r’s ranging from .72 to .88 (PPO and NPO, respectively; D’Zurilla et al., 2002). Consistent with this, it was also expected that each maladaptive SPS dimension would predict itself across time. More specifically: NPO at Session 1 would predict NPO at Session 2 (Hypothesis 13); NPO at Session 2 would predict NPO at Session 3 (Hypothesis 14); ICS at Session 1 would predict ICS at Session 2 (Hypothesis 15); ICS at Session 2 would predict ICS at Session 3 (Hypothesis 16); AS at Session 1 would predict AS at Session 2 (Hypothesis 17); and AS at Session 2 would predict AS at Session 3 (Hypothesis 18).
Consistent with Blanchard’s findings, it was also hypothesized that IBS symptom severity at Session 1 would predict IBS symptom severity at Session 2 (Hypothesis 19), and that IBS symptom severity at Session 2 would predict IBS symptom severity at Session 3 (Hypothesis 20).

**The relational/problem-solving model of stress and wellbeing.** Research following D’Zurilla and Nezu’s relational/problem-solving model of stress and wellbeing (2001) has supported that maladaptive SPS serves as a significant mediator in the relationship between stress and depression (Nezu & Ronan, 1985), stress and anxiety (Kant et al., 1997), and stress and various physical health issues (Baker, 2003; Elliot, 1992; Eskin et al., 2013; Nezu et al., 2008; Witty et al., 2001). However, no research to date had examined maladaptive SPS as a mediator in the relationship between stress and IBS symptom severity. As such, exploratory analyses were conducted to investigate if the model is applicable to IBS. More specifically, the following mediations with maladaptive SPS as mediators were hypothesized: higher levels of perceived stress at Session 1 would predict higher levels of NPO at Session 2, and higher levels of NPO at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 21); higher levels of perceived stress at Session 1 would predict higher levels of ICS at Session 2, and higher levels of ICS at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 22); higher levels of perceived stress at Session 1 would predict higher levels of AS at Session 2, and higher levels of AS at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 23). See Figure 3 for an illustration of these mediation models.

Similar mediational patterns with minor life stress were also hypothesized: higher levels of minor life stress at Session 1 would predict higher levels of NPO at Session 2, and higher
levels of NPO at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 24); higher levels of minor life stress at Session 1 would predict higher levels of ICS at Session 2, and higher levels of ICS at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 25); higher levels of minor life stress at Session 1 would predict higher levels of AS at Session 2, and higher levels of AS at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 26). See Figure 4 for an illustration of these mediation models.

Examining perceived stress as a mediator, the following were also hypothesized: higher levels of NPO at Session 1 would predict higher levels of perceived stress at Session 2, and higher levels of perceived stress at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 27); higher levels of ICS at Session 1 would predict higher levels of perceived stress at Session 2, and higher levels of perceived stress at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 28); higher levels of AS at Session 1 would predict higher levels of perceived stress at Session 2, and higher levels of perceived stress at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 29). See Figure 5 for an illustration of these hypotheses.

Examining minor life stress as a mediator, it was predicted that: higher levels of NPO at Session 1 would predict higher levels of minor life stress at Session 2, and higher levels of minor life stress at Session 2 would predict higher levels of IBS symptom severity at Session 3 (Hypothesis 30); higher levels of ICS at Session 1 would predict higher levels of minor life stress at Session 2, and higher levels of minor life stress at Session 2 would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 31); higher levels of AS at Session 1 would predict higher levels of minor life stress at Session 2, and higher levels of minor life stress at Session 2
would lead to higher levels of IBS symptom severity at Session 3 (Hypothesis 32). See Figure 6 for an illustration of these hypotheses.

**Figure 2**

*Proposed Relationships Among Same Variable Across Time*

![Diagram of relationships among variables across sessions](image)

*Note.* PSS = Perceived Stress Scale; WSI = Weekly Stress Inventory; NPO = Negative Problem Orientation; ICS = Impulsive/Careless Style; AS = Avoidant Style; B-IBS = Birmingham IBS Symptom Questionnaire
Proposed Mediation Models with Social Problem-Solving as Mediators

Note. PSS = Perceived Stress Scale; WSI = Weekly Stress Inventory; NPO = Negative Problem Orientation; ICS = Impulsive/Careless Style; AS = Avoidant Style; B-IBS = Birmingham IBS Symptom Questionnaire
Figure 4

*Proposed Mediation Models with Social Solving as Mediators*

Note. PSS = Perceived Stress Scale; WSI = Weekly Stress Inventory; NPO = Negative Problem Orientation; ICS = Impulsive/Careless Style; AS = Avoidant Style; B-IBS = Birmingham IBS Symptom Questionnaire
Figure 5

Proposed Mediation Models with Perceived Stress as a Mediator

Note. PSS = Perceived Stress Scale; WSI = Weekly Stress Inventory; NPO = Negative Problem Orientation; ICS = Impulsive/Careless Style; AS = Avoidant Style; B-IBS = Birmingham IBS Symptom Questionnaire
Figure 6

*Proposed Mediation Models with Daily Stress as a Mediator*

Note. PSS = Perceived Stress Scale; WSI = Weekly Stress Inventory; NPO = Negative Problem Orientation; ICS = Impulsive/Careless Style; AS = Avoidant Style; B-IBS = Birmingham IBS Symptom Questionnaire
CHAPTER V: METHODS

Participants

Undergraduate students from a rural New England university were recruited via Sona, a web-based scheduling program (see Appendix A for recruitment posting). \( N \) of 200 was estimated using Mplus, a statistical modeling program, with a cross-lagged path coefficient effect size of .2 (small effect) and a power of .8 to detect significant effects for all of the variables (Muthén & Muthén, 2017). Participants received 3 credits as part of a course requirement (e.g., General Psychology) or $30 in Amazon e-gift cards. For participants who received course credit: 3 credits were given after completing batteries of questionnaires online for Sessions 1, 2, and 3. These credits were earned incrementally for incentive to continue participation; thus participants earned 1 credit after completing Sessions 1 and 2 (i.e., they did not earn course credit for completing only Session 1), and 2 credits for completing Session 3. For participants who received Amazon e-gift cards: Up to $30 in e-gift cards were given after completing batteries of questionnaires online for Sessions 1, 2, and 3. Similar to course credit, these were earned incrementally for incentive to continue participation; participants earned a $5 e-gift card after the completion of Session 1, a $10 e-gift card after the completion of Session 2, and a $15 e-gift card after the completion of Session 3. A combination of course credit and Amazon e-gift cards was also offered under the circumstance that, due to timing of study sign-up, a participant would not be able to complete the four-week study window within the same semester; however, all participants’ four-week windows ended within the same semester that they began the study.
Measures

Primary Measures

**Demographic Questionnaire (Appendix B).** Participants were asked to complete a questionnaire assessing age, gender, and ethnicity/race. The demographic information was used to describe the sample and explore group differences.

**Social Problem-Solving Inventory-Revised (SPSI-R; Appendix C).** The SPSI-R is a multidimensional self-report measure that assesses strengths and weaknesses in social problem-solving ability (D’Zurilla et al., 2008). It contains 52 items that describe general response tendencies in problem situations and responses best characterize how individuals believe they would resolve such problems. Each item is answered on a 5-point Likert scale from *not at all true of me* (0) to *extremely true of me* (4). The measure consists of five scales based on the dimensions in D’Zurilla et al.’s (2008) problem-solving model, two of orientation: Positive Problem Orientation and Negative Problem Orientation, and three of style: Rational Problem Solving, Impulsivity/Carelessness Style, and Avoidance Style. An example of an NPO item is: “I feel threatened and afraid when I have an important problem to solve.” An example of an ICS item is: “When I am attempting to solve a problem, I act on the first idea that occurs to me.” An example of an AS item is: “I prefer to avoid thinking about the problems in my life instead of trying to solve them.” Higher scores on NPO, ICS, and AS are associated with the use of maladaptive strategies. The SPSI-R has demonstrated good psychometric properties in college students, the population that this study recruited (D’Zurilla & Chang, 1995; D’Zurilla, Nezu, & Maydeu Olivares, 1995). For the current investigation, all items were included, but only the maladaptive scales scores were calculated since these dimensions accounted for the majority of
significant links with stress (D’Zurilla et al., 1998; Kant et al., 1997). NPO scores range from 0-40, ICS scores range from 0-40, and AS scores range from 0-28.

**Weekly Stress Inventory (WSI; Appendix D).** The WSI is an 87-item self-report measure that assesses minor life stress. The WSI asks about the occurrence of stressors over the past week as well as the impact, or how distressing, those events were to the individuals. It uses a 7-point Likert scale from *occurred but was not stressful* (1) to *extremely stressful* (7). This yields a score totaling the number of events, called WSI-Event, and a total impact score, called WSI-Impact. The WSI appears to have good psychometric properties. The WSI has demonstrated a degree of concurrent validity with the Daily Stress Inventory (DSI; Brantley et al., 1987), which was developed by two of the same researchers, Brantley and Jones. The WSI-Event and DSI-FREQ scores yielded a correlation coefficient of \( r = .77 \), and the WSI-Impact and DSI-AIR scores yielded an \( r = .84 \) (Scarinci et al., 1999). Data examining 173 college students also demonstrate some convergence with the Hassles Scale (Kanner et al., 1981), with a correlation coefficient of \( r = .69 \) (Brantley et al., 1997). Same-week test-retest reliability coefficients were found for the WSI-Event (\( r = .83 \)) and the WSI-impact (\( r = .80 \)) in a large undergraduate student sample (Brantley et al., 1997). Mosley and colleagues (1991) conducted a study with 137 headache patients and revealed that one-week test-retest reliability was moderately stable, with \( r = .76 \) for the WSI-Event and \( r = .78 \) for the WSI-Impact (c.f. Brantley et al., 1997). Mosley and colleagues (1996) later conducted another study, examining coronary heart disease patients, and demonstrated that the test-retest reliability decreased as time between the two time points expanded, such that the WSI-Event’s \( r \) for one week was .84 but decreased to .64 for three weeks, and the WSI-Impact’s \( r \) for one week was .70 for 1 week but decreased to .56 for three weeks. The current study examined the WSI-Event and WSI-Impact scores.
**Perceived Stress Scale (PSS; Appendix E).** The PSS is a 14-item self-report measure that assesses the degree to which individuals perceive particular situations to be stressful (Cohen, Kamarck, & Memelstein, 1983). The PSS contains a 5-point Likert scale from *never* (0) to *very often* (4). Half of the items are negative in format, with higher scores indicating higher perceived stress, while the other half are positive, with higher scores indicating lower perceived stress. An example of a negative item is: “In the last month, how often have you felt that you were unable to control the important things in your life?” An example of a positive item is: “In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?” The PSS asks about a short period, one month, and has been empirically validated with college students, the population involved in the present study (Cohen et al., 1983). Test-retest reliability suggests that it may not be particularly sensitive over two-week intervals (*r* = .85; Cohen et al., 1983). It does, however, become less stable across a longer time span (*r* = .55 after six weeks; Cohen et al., 1983) and a somewhat less stable, and hopefully sensitive, alternative stress measure (i.e., WSI) was also included. The PSS does not have subscale scores; rather a total score can be calculated by reverse-coding the positive items and then summing the scores for all items. For the current study, total scores were used. Higher total scores indicate higher levels of perceived stress and range from 0-56.

**Birmingham IBS Symptom Questionnaire (B-IBS; Appendix F).** The B-IBS is an 11-item self-report measure that assesses the frequency of IBS-related symptoms (Roalfe, Roberts, & Wilson, 2008). These symptoms are based on Rome II criteria (Drossman, 1999), one of the most comprehensive and conservative systems for diagnosing IBS. The B-IBS contains a 5-point Likert scale from *none of the time* (0) to *all of the time* (5). There are three dimensions: pain (e.g., “During the last four weeks, how often had you had discomfort or pain in your
abdomen?”), diarrhea (e.g., “How often have you been troubled with loose, mushy, or watery bowel motions during the last 4 weeks”?), and constipation (e.g., “During the last 4 weeks how often have you been troubled by hard bowel motions?”). Dimension scores can be calculated, as well as a total score, by summing the scores for all items. For all scales, higher scores indicate higher symptom severity. In an IBS-diagnosed sample, Cronbach’s alpha was .75 for the total score (Roalfe et. al., 2008). In a non-IBS-diagnosed university sample, a latent structure bifactor model of IBS symptom severity, compared to other models, was significantly superior (CFI = 0.99, RMSEA = 0.05), indicating that IBS symptom severity can be reliably and validly assessed with the B-IBS. Also, construct validity was established by finding a negative association between the B-IBS scores and the well-validated irritable bowel syndrome quality of life assessment (IBS-QOL; Patrick et al., 1998). Since the current study was not interested in the pain, diarrhea, and constipation subcategories, and rather was interested in global symptom severity, only the total scores were computed with scores ranging from 0-55.

Secondary Measures

Center for Epidemiologic Studies Depression-Revised (CESD-R; Appendix G).

The CESD-R contains 20 items in a self-report format that reflect DSM-IV diagnostic criteria for depression (APA, 1994; Eaton, Smith, Ybarra, Muntaner, & Tien, 2004). The items are answered on a 5-point Likert scale ranging from not at all or less than 1 day (0) to nearly every day for 2 weeks (4). Respondents are instructed to answer regarding how they felt or behaved within the past week. Example items include, “I lost interest in my usual activities,” and “I felt depressed.” A total score can be calculated by summing the scores for all items. The CESD-R has demonstrated good psychometric properties (Eaton et al., 2004; Van Dam & Earleywine, 2011). In a sample of 6,971 community members, the CESD-R was demonstrated to have high
internal consistency ($\alpha = .92$) and convergent validity as evidenced by a positive correlation with a measure of anxiety ($r = .73, p < .01$). As a secondary measure in the current study, total scores were computed. Higher total scores indicate higher levels of depressive symptoms and range from 20-80.

**Procedure**

In regards to recruitment, undergraduate students were invited to participate in the study via Sona, a web-based scheduling program to receive 3 credits as part of a course requirement (General Psychology), $30 in Amazon e-gift cards, or a combination thereof.

Once they signed up, they were emailed an informed consent form (Appendix H), which they electronically sent back in an email to the researcher. On this consent, participants were informed that they could withdraw from the project at any time and were told that if there were any questions they felt uncomfortable answering, they could skip those items. Once consent was obtained, participants received an email link to enter Qualtrics, a website used to facilitate data collection, with their randomly-assigned ID number, on the days they were to complete questionnaires. They also received email reminders the day before. Participants were not asked to provide their name on the online survey in order to maintain anonymity.

Participants completed a battery of questionnaires online at three time points, each two weeks apart (i.e., Session 1, Session 2, and Session 3). The battery took approximately 40 minutes to complete, and it consisted of the Perceived Stress Scale (PSS; Cohen, Kamarck, & Memelstein, 1983), the Weekly Stress Inventory (WSI; Brantley et al., 1997), the Social Problem-Solving Inventory-Revised (SPSI-R; D’Zurilla et al., 2002), and the Birmingham IBS Symptom Questionnaire (B-IBS; Roalfe, Roberts, & Wilson, 2008). The exception to this is that during Session 1, participants also completed a demographic questionnaire (which took an
additional 1-2 minutes). They were prompted via email the day before, and the day of, at each time point. The email prompts on the day of contained the survey link for them to follow, along with their participant ID number. This was facilitated through a program called Boomerang, an automated messaging system in which dates that reminders are sent can be scheduled in advance by the researcher. At the conclusion of each survey battery, participants were provided with a statement thanking them for their participation and were provided with a resource list of counseling services in the area should they feel distress (Appendix I). They were also requested to click on a link that took them to a separate Qualtrics survey page to provide their names and email addresses, which were not associated with their survey answers, in order to claim compensation for the study (Appendix J).
CHAPTER VI: RESULTS

Testing the more than 30 study hypotheses required a variety of analysis types and was done in a step-by-step sequence. As such, this chapter begins with a brief overview of the analysis plan. First, preliminary analyses and descriptive statistics for all measures were computed. Next, gender hypotheses were tested by examining means and standard deviations on all measures for men and women, followed by independent samples t-tests to assess meaningful differences in scores. This was followed by bivariate correlations (whole sample, by gender) assessing concurrent variable relationships. The remainder of the analyses were based on a cross-lagged panel model (CLPM), a type of structural equation model. The first CLPM examined each variable predicting itself across time. Subsequently, latent variables for stress and maladaptive social problem-solving (SPS) were created and placed into a combined CLPM examining interrelationships of stress, SPS, and irritable bowel symptom (IBS) severity over time. Lastly, two post-hoc analyses were conducted. First, depressive symptoms were added as a covariate in the combined CLPM. Second, gender differences within this new model were tested using structural equation modeling multi-group analyses.

Preliminary Analyses

Prior to testing hypotheses, data were examined for univariate and multivariate outliers. Using z-scores, scores that fell above or below three standard deviations were identified as univariate outliers and were subsequently winsorized (Field, 2009). Winsorizing is a transformation technique that decreases skewness caused by outliers in the overall distribution, and, compared to removing outliers, it has the added benefit of preserving more data by changing the outlier scores to mirror the first highest score that does not fall outside of three standard deviations (Field, 2009). All other data were normally distributed. To assess for multivariate
outliers, Cook’s Distance and Centered Leverage Values were computed (Hanna & Dempster, 2012). Cook’s Distance scores above 1 and Centered Leverage Values greater than three times its mean indicate potential outliers by influence (Hanna & Dempster, 2012). Two participants’ scores were identified as potential outliers. These scores were included in the analyses and are reflected in the results below. A comparison of the results with and without the two participants’ scores revealed no significant or meaningful differences.

Descriptive Statistics

Three hundred and fifteen participants were recruited, however, there was a loss of 16 subjects across the intervals: 8 individuals only completed Session 1, 7 individuals only completed Sessions 1 and 2, and 1 individual completed Sessions 1 and 3 but not Session 2. All participants who completed all three sessions were included in the correlation and cross-lag panel analyses for the whole sample, which yielded an N of 299 ($M_{age} = 18.77$; 198 women; 98 men; 3 transgender, nonbinary, or gender nonconforming). The sample identified as 90% White, 2% Latino, 3.3% Black, 2.3% Asian, .3% American Indian/Native American, and 2% other. When examining gender differences (e.g., comparing Pearson’s correlation coefficients and independent samples t-tests for men and women separately), data for transgender, nonbinary, or gender nonconforming were not included because of the very small sample size of 3 and resulting lack of power (Field & Hole, 2003). For all measures at each of the three sessions, the means and standard deviations were calculated (see Table 1). Additionally, internal consistency, using Cronbach’s $\alpha$, for Session 1 was calculated. Internal consistencies for all measures were good to excellent ($\alpha$’s ranging from .80 to .97 see Table 1).
Table 1

Means, Standard Deviations, and Internal Consistency for All Variables

<table>
<thead>
<tr>
<th>Measure</th>
<th>Session 1 M (SD)</th>
<th>Session 2 M (SD)</th>
<th>Session 3 M (SD)</th>
<th>Cronbach’s α (Session 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPO</td>
<td>14.40 (8.46)</td>
<td>13.88 (6.68)</td>
<td>13.61 (8.78)</td>
<td>.91</td>
</tr>
<tr>
<td>AS</td>
<td>9.41 (5.76)</td>
<td>9.91 (5.94)</td>
<td>9.58 (5.87)</td>
<td>.85</td>
</tr>
<tr>
<td>ICS</td>
<td>11.35 (6.34)</td>
<td>12.25 (7.25)</td>
<td>11.69 (7.06)</td>
<td>.81</td>
</tr>
<tr>
<td>PSS</td>
<td>26.79 (7.29)</td>
<td>26.03 (7.25)</td>
<td>25.83 (7.38)</td>
<td>.80</td>
</tr>
<tr>
<td>WSI-E</td>
<td>39.29 (17.20)</td>
<td>37.67 (18.18)</td>
<td>35.70 (19.29)</td>
<td>.95</td>
</tr>
<tr>
<td>WSI-I</td>
<td>113.98 (76.78)</td>
<td>101.46 (74.07)</td>
<td>93.59 (72.48)</td>
<td>.97</td>
</tr>
<tr>
<td>B-IBS</td>
<td>8.78 (7.30)</td>
<td>7.99 (7.58)</td>
<td>7.46 (7.85)</td>
<td>.86</td>
</tr>
<tr>
<td>CESD-R</td>
<td>16.70 (11.57)</td>
<td>16.20 (11.80)</td>
<td>16.46 (11.54)</td>
<td>.93</td>
</tr>
</tbody>
</table>

Note. NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised.

Mean Differences by Gender

Means and standard deviations for all measures at each session were calculated for men and women (see Table 2) followed by independent samples t-tests to compare meaningful differences between men and women’s scores. The hypotheses that women would report significantly higher mean scores than men on perceived stress (PSS; Hypothesis 1) and on negative problem orientation (NPO; Hypothesis 4) were fully supported; for all three sessions, women reported significantly higher mean scores than men for perceived stress \( t(284) = -3.83 \) to \(-3.99, \text{all } p’s < .001 \) and for NPO \( t(284) = -2.58 \) to \(-4.25, \text{all } p’s \leq .01 \). The hypothesis that women would have significantly higher mean scores than men on minor life stress (WSI-Event and WSI-Impact; Hypothesis 2) was not supported; for Session 1, men reported slightly higher
scores than women on the WSI-Event, approaching significance \( t(294) = 1.93, p = .054 \), and for Sessions 2 and 3, men and women did not report significantly different levels on the WSI-Event (\( p \)'s = .06 and .19). Additionally, for all three sessions, men and women did not report significantly different levels on the WSI-Impact (\( p \)'s ranged from .70 to .90). The hypothesis that women would report significantly higher mean scores than men on IBS symptom severity (B-IBS; Hypothesis 3) was partially supported; it held true for Session 1 \( t(294) = -2.97, p < .01 \), but not for Sessions 2 and 3 (\( p \)'s = .15 and .18). Lastly, the hypothesis that men would report significantly higher mean scores than women on impulsive/careless style (ICS; Hypothesis 5) was partially supported; it held true for Session 1 \( t(293) = 2.43, p = .02 \), but not for Sessions 2 and 3 (\( p \)'s = .12 and .47). Of note, more analyses examining gender are presented in the correlations and post-hoc sections of this chapter.
Table 2

Mean Group Differences in Study Variables by Gender

<table>
<thead>
<tr>
<th>Measure</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
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<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>NPO</td>
<td>12.57 (8.89)*</td>
<td>15.08 (8.72)**</td>
<td>15.03 (9.05)**</td>
</tr>
<tr>
<td></td>
<td>12.26 (7.39)</td>
<td>11.29 (8.18)</td>
<td>10.46 (7.27)</td>
</tr>
<tr>
<td>AS</td>
<td>9.62 (5.87)</td>
<td>10.26 (6.22)</td>
<td>10.03 (6.10)</td>
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<tr>
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<td>8.91 (5.57)</td>
<td>9.13 (5.38)</td>
<td>8.53 (5.23)</td>
</tr>
<tr>
<td>ICS</td>
<td>10.75 (6.38)*</td>
<td>11.74 (7.19)</td>
<td>11.45 (7.03)</td>
</tr>
<tr>
<td></td>
<td>12.65 (6.28)</td>
<td>13.18 (7.33)</td>
<td>12.09 (7.05)</td>
</tr>
<tr>
<td>PSS</td>
<td>26.79 (7.29)*</td>
<td>27.05 (6.92)**</td>
<td>26.89 (6.87)**</td>
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<tr>
<td></td>
<td>24.66 (7.36)</td>
<td>23.66 (7.26)</td>
<td>23.31 (7.51)</td>
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<tr>
<td>WSI-E</td>
<td>37.92 (15.81)</td>
<td>36.63 (17.58)</td>
<td>34.13 (18.04)</td>
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<tr>
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<td>42.02 (19.74)</td>
<td>39.65 (19.52)</td>
<td>38.73 (21.63)</td>
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<tr>
<td>WSI-I</td>
<td>112.86 (75.01)</td>
<td>102.05 (71.57)</td>
<td>94.30 (75.27)</td>
</tr>
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<td>115.83 (81.64)</td>
<td>99.15 (79.71)</td>
<td>90.73 (71.37)</td>
</tr>
<tr>
<td>B-IBS</td>
<td>9.58 (7.50)*</td>
<td>8.35 (7.59)</td>
<td>7.82 (7.93)</td>
</tr>
<tr>
<td></td>
<td>6.94 (6.53)</td>
<td>6.99 (7.43)</td>
<td>6.50 (7.56)</td>
</tr>
<tr>
<td>CESD-R</td>
<td>17.49 (11.98)**</td>
<td>17.23 (12.08)*</td>
<td>17.59 (11.63)**</td>
</tr>
<tr>
<td></td>
<td>14.44 (9.93)</td>
<td>13.31 (9.91)</td>
<td>13.61 (10.41)</td>
</tr>
</tbody>
</table>

Note. NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. Results for women are in bolded font; results for men are in regular font. ** p < .001 * p < .05

Correlational Analyses

Pearson correlation coefficients among all variables at each session were computed to determine bivariate relationships (see Tables 3, 4, and 5 for Sessions 1, 2, and 3 respectively). The hypothesis that scores on all stress measures (PSS, WSI-Event, and WSI-Impact) would be positively and significantly related to each of the maladaptive SPS dimensions (NPO, ICS, and AS; Hypothesis 6) was fully supported across the three sessions. Patterns of stress’ relationship with maladaptive problem-solving for the three sessions were as follows: the PSS correlations
resulted in $r$’s ranging from .27 to .69, with ICS being the lowest and NPO being the highest; the WSI-Event revealed $r$’s ranging from .27 to .52, with AS being the lowest and NPO being the highest; and the WSI-Impact revealed $r$’s ranging from .32 to .52, with ICS being the lowest and NPO being the highest (all $p$’s < .001).

The hypothesis that all of the stress measures would be significantly related to IBS symptom severity in the positive direction (B-IBS; Hypothesis 7) was fully supported across the three sessions; $r$’s ranged from .32 to .47, with PSS being the lowest and WSI-Impact being the highest (all $p$’s < .001). Lastly, the hypothesis that all of the maladaptive SPS dimensions would be positively related to IBS symptom severity (Hypothesis 8) was supported for Sessions 2 and 3, $r$’s ranged from .21 to .37, with ICS being the lowest and NPO being the highest (all $p$’s < .001). However, it was not supported for Session 1 ($r = .10, p = .08$). Of note, the Center for Epidemiologic Studies Depression Scale–Revised (CESD-R) was included as a secondary measure and therefore was not included in the hypotheses. For all three sessions, women reported significantly higher mean scores on the CESD-R than men, and the CESD-R was positively and significantly associated with all other variables (all $p$’s < .001). In sum, as expected, all measures were significantly and positively related to each other at every time point with the one exception of B-IBS and ICS at Session 1.

Several of the bivariate relationships described above raised multicollinearity concerns. Multicollinearity is the extent to which variables are interrelated or share variance with other variables (Tabachnick & Fidell, 2013). The more this shared variance increases, the more difficult it is to detect the effect of any singular variable (Tabachnick & Fidell, 2013). The $r$’s for all variables ranged from .27 (between PSS and WSI-Event being the lowest at Session 1) to .87 (between WSI-Event and WSI-Impact being the highest at Session 3). Notably, in the
present study, the $r$’s for correlations between NPO and AS ranged from .71 to .78, the $r$’s for correlations between NPO and PSS ranged from .66 to .69, and the $r$’s for correlations between NPO and WSI-Event ranged from .45 to .52. Values that are .70 or larger are typically deemed problematic as they create severe distortions in model estimation and prediction (Drossman et al., 2012; Tabachnick & Fidell, 2013), though some researchers set a lower bar of .40 and above as an indicator of multicollinearity concerns (e.g., Suzuki et al., 2008).
### Table 3

**Whole Sample: Correlations of All Variables at Session 1**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
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<th>7</th>
<th>8</th>
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</thead>
<tbody>
<tr>
<td>1. NPO</td>
<td>--</td>
<td>.707**</td>
<td>.460**</td>
<td>.660**</td>
<td>.309**</td>
<td>.518**</td>
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<td>.653**</td>
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<td>.318**</td>
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<td>.226**</td>
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<tr>
<td>3. ICS</td>
<td>--</td>
<td>.265**</td>
<td>.328**</td>
<td>.374**</td>
<td>.102</td>
<td>.297**</td>
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<td>4. PSS</td>
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<td>6. WSI-I</td>
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<td>.500**</td>
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<tr>
<td>7. B-IBS</td>
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<td>.452**</td>
<td></td>
<td></td>
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<tr>
<td>8. CESD-R</td>
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</tbody>
</table>

**Note.** NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. **p < .001
### Table 4

**Whole Sample: Correlations of All Variables at Session 2**

<table>
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<td>.564**</td>
<td>.689**</td>
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</tr>
<tr>
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<td>.363**</td>
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<tr>
<td>6. WSI-I</td>
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<td>.556**</td>
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<tr>
<td>7. B-IBS</td>
<td>--</td>
<td>.457**</td>
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<td>8. CESD-R</td>
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</table>

*Note. NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. **p < .001*
Table 5

Whole Sample: Correlations of All Variables at Session 3

<table>
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<td>.595**</td>
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<td>.629**</td>
<td>.460**</td>
<td>.239**</td>
<td>.316**</td>
<td>.215**</td>
<td>.445**</td>
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<td>.283**</td>
<td>.337**</td>
<td>.364**</td>
<td>.211**</td>
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<td>.521**</td>
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<td>7. B-IBS</td>
<td>--</td>
<td>.452**</td>
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<td>8. CESD-R</td>
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</table>

Note. NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. **p < .001

By Gender

Pearson’s correlations for men and women for all variables at each session were also examined and closely mirrored the results for the whole sample. The only two exceptions were that for men, ICS and B-IBS were significantly related at Session 1, and for women, ICS and B-IBS were not significantly related at Session 3. For more details, see Tables 6, 7, and 8 for Sessions 1, 2, and 3 respectively.
### Table 6

**Gender Comparisons: Correlations of All Variables at Session 1**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>NPO</td>
<td>--</td>
<td>.710*</td>
<td>.492*</td>
<td>.665*</td>
<td>.310*</td>
<td>.516*</td>
<td>.321*</td>
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<tr>
<td>2.</td>
<td>AS</td>
<td>.704*</td>
<td>--</td>
<td>.584*</td>
<td>.488*</td>
<td>.297*</td>
<td>.433*</td>
<td>.183*</td>
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<tr>
<td>3.</td>
<td>ICS</td>
<td>.504*</td>
<td>.596*</td>
<td>--</td>
<td>.299*</td>
<td>.323*</td>
<td>.402*</td>
<td>.065</td>
</tr>
<tr>
<td>4.</td>
<td>PSS</td>
<td>.628*</td>
<td>.423*</td>
<td>.322*</td>
<td>--</td>
<td>.309*</td>
<td>.492*</td>
<td>.334*</td>
</tr>
<tr>
<td>5.</td>
<td>WSI-E</td>
<td>.391*</td>
<td>.388*</td>
<td>.313*</td>
<td>.298*</td>
<td>--</td>
<td>.855*</td>
<td>.262*</td>
</tr>
<tr>
<td>6.</td>
<td>WSI-I</td>
<td>.566*</td>
<td>.489*</td>
<td>.333*</td>
<td>.454*</td>
<td>.895*</td>
<td>--</td>
<td>.357*</td>
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<tr>
<td>7.</td>
<td>B-IBS</td>
<td>.449*</td>
<td>.296*</td>
<td>.292*</td>
<td>.255*</td>
<td>.400*</td>
<td>.441*</td>
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</tr>
<tr>
<td>8.</td>
<td>CESD-R</td>
<td>.732*</td>
<td>.467*</td>
<td>.430*</td>
<td>.730*</td>
<td>.407*</td>
<td>.576*</td>
<td>.397*</td>
</tr>
</tbody>
</table>

*Note.* NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory—Event; WSI-I = Weekly Stress Inventory—Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale—Revised. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table.

** ** $p < .001$
Table 7

**Gender Comparisons: Correlations of All Variables at Session 2**

<table>
<thead>
<tr>
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<th>1</th>
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<td>.668**</td>
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<td>.420**</td>
<td>.337**</td>
<td>.568**</td>
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<td>2. AS</td>
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<td>.643**</td>
<td>.478**</td>
<td>.262**</td>
<td>.346**</td>
<td>.167**</td>
<td>.371**</td>
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<tr>
<td>3. ICS</td>
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<td>.679**</td>
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<td>.391**</td>
<td>.335**</td>
<td>.415**</td>
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<td>.407**</td>
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<td>.851**</td>
<td>.287**</td>
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Note. NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table.

** p < .001
Table 8

Gender Comparisons: Correlations of All Variables at Session 3

<table>
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<tr>
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<td>.652**</td>
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<td>.406**</td>
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<td>.238**</td>
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<td>.313**</td>
<td>.136</td>
<td>.339**</td>
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<td>4. PSS</td>
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<td>.707**</td>
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<td>.446**</td>
<td>.495**</td>
<td>.540**</td>
<td>.851**</td>
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<td>.416**</td>
<td>.486**</td>
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<td>.254**</td>
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</tbody>
</table>

Note. NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; B-IBS = Birmingham IBS Symptom Questionnaire; CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table.

**p < .001

Associations Across Time

Next, potential issues of temporal stability were explored. When variables are more stable or trait-based (i.e., represent chronic, longstanding characteristics that endure) than state-related (i.e., represent temporary reactions or short-lasting characteristics), detecting changes across time can be a challenge. A major aim of the current study was to examine the influences variables have on each other over time; if the variables are more stable or trait-based, this is
problematic as changes in variables from one session to the next need to occur in order to detect if other variables are exerting influence on them.

To examine temporal stability, Pearson’s correlations for the whole sample were examined for maladaptive SPS, perceived and minor life stress, IBS symptom severity, and depressive symptoms across time (see Tables 9 to 12). Results indicated high stability for the maladaptive SPS dimensions. More specifically, NPO r’s ranged from .80 to .81, AS r’s ranged from .71 to .73, and ICS r’s ranged from .68 to .69 (all p’s < .001). Results indicated high stability for the stress measures. More specifically, PSS r’s ranged from .67 to .76, WSI-Event r’s ranged from .61 to .71, and WSI-Impact r’s ranged from .69 to .79 (all p’s < .001). Additionally, results indicated high stability for IBS and depressive symptoms. More specifically, B-IBS r’s ranged from .66 to .71, and CESD-R r’s ranged from .71 to .79 (all p’s < .001). These relationships were also examined by gender, and results for men and women followed the same patterns as the whole sample (see Tables 13 to 16). The high degree of stability found for several study variables raised concerns about the longitudinal analyses involving them.
Table 9

Whole Sample: Correlations of Maladaptive SPS Variables for All Sessions

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
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</tbody>
</table>

*Note.* NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style. ** *p* < .001
Table 10

Whole Sample: Correlations of Stress Variables for All Sessions

<table>
<thead>
<tr>
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<th>2</th>
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</tbody>
</table>

*Note.* PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact. **p < .001
Table 11
Whole Sample: Correlations of Irritable Bowel Symptom Severity for All Sessions

<table>
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<td>3. B-IBS3</td>
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*Note. B-IBS = Birmingham IBS Symptom Questionnaire. ** p < .001*

Table 12
Whole Sample: Correlations of Depressive Symptom Severity for All Sessions

<table>
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*Note. CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. ** p < .001*
### Table 13

*Gender Comparisons: Correlations of Maladaptive SPS Variables for All Sessions*

<table>
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<tr>
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</table>

*Note.* NPO = Negative Problem Orientation; AS = Avoidant Style; ICS = Impulsive/Careless Style. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table. **p < .001
### Table 14

**Gender Comparisons: Correlations of Stress Variables for All Sessions**

<table>
<thead>
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<td>.687**</td>
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<td>3. WSI-I₁</td>
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<td>.490**</td>
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<td>.540**</td>
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</table>

**Note.** PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table. **p < .001
Table 15

*Gender Comparisons: Correlations of Irritable Bowel Symptom Severity for All Sessions*

<table>
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<th></th>
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<td>.704**</td>
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<td>2. B-IBS2</td>
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<td>.762**</td>
</tr>
<tr>
<td>3. B-IBS3</td>
<td>.530**</td>
<td>.529**</td>
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</table>

*Note.* B-IBS = Birmingham IBS Symptom Questionnaire. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table. ** *p < .001*

Table 16

*Gender Comparisons: Correlations of Depressive Symptom Severity for All Sessions*

<table>
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<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
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<tbody>
<tr>
<td>1. CESD-R1</td>
<td>--</td>
<td>.787**</td>
<td>.666**</td>
</tr>
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<td>2. CESD-R2</td>
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</table>

*Note.* CESD-R = Center for Epidemiologic Studies Depression Scale–Revised. Correlations for women are shown in the top half of the table, whereas correlations for men are shown in the lower half of the table. ** *p < .001*

**Cross-Lagged Panel Analyses**

**Stability Across Time**

For the remainder of the hypotheses, a structural equation modeling technique was utilized; the cross-lagged panel model (CLPM; SPSS V.24 Amos). First, a CLPM allows variables to correlate with each other at each time point was constructed (see Figure 7).

Reflecting the different waves of data collection, assessments within each time point were
allowed to correlate. The fit of the model was primarily assessed by examination of the Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA). A CFI higher than .90 and a RMSEA equal to or less than .08 are desirable and indicate a good model fit (Hooper et al., 2008; Kline, 2005). The model’s CFI was .99, and RMSEA was .04. It was expected that each variable would predict itself at the subsequent session, and this expectation was fully supported for each variable. Using PSS as an example to illustrate the patterns expected, it was hypothesized that Session 1 PSS predicted Session 2 PSS (Hypothesis 9) and Session 2 PSS predicted Session 3 PSS (Hypothesis 10). See Figure 7 to view the standardized regression weights (SRWs) for each of the variables. As expected, each of the hypotheses (Hypotheses 9 - 20) held true with all p’s < 0.01. SRWs ranged from .81 (with B-IBS being the lowest) to .96 (with PSS being the highest).

Possible problems with multicollinearity and temporal stability became clear with high magnitudes observed in the Pearson correlations described in previous sections, as well as the relative number of large SRWs in the CLPM. Given the nature of the design, strong paths from Session 1 to Session 2, and from Session 2 to Session 3 were expected; however, the magnitude of the SRWs suggested potential multicollinearity problems would likely arise with more complex models (e.g., models involving different variables predicting each other) as proposed in the current study. The variables that most contributed to these issues were those associated with stress and maladaptive SPS. To address these multicollinearity concerns, latent variables were created (Drossman et al., 2012), and this process is described in the subsequent section.
**Figure 7**

*Simplified Cross-Lag Panel Model with Each Variable Predicting Itself Across Time*

![Diagram of the model with variables and path coefficients](image)

*Note.* S1 = Session 1; S2 = Session 2; S3 = Session 3; PSS = Perceived Stress Scale; WSI-E = Weekly Stress Inventory- Event; WSI-I = Weekly Stress Inventory- Impact; NPO = Negative Problem Orientation; ICS = Impulsive/Careless Style; AS = Avoidant Style; B-IBS = Birmingham IBS Symptom Questionnaire; Numbers above pathways indicate standardized regression weights. All $p’s < 0.001.$

**Creating Latent Variables**

Addressing the multicollinearity issues, latent variables for stress and maladaptive SPS were created. Latent variables are unobserved (i.e., hidden) variables that reflect underlying fundamental constructs in the measured variables. Finding constructs that underlie observed variables can be useful because observable variables often overlap in content (shared variance). When this overlap is excessive, it muddles the ability to accurately predict effects of one variable on another variable (Drossman et al., 2012). This was a potential threat to the present study as one of the goals was to investigate these effects.
Stress. A measurement model for the stress variables was created through a series of confirmatory factor analyses – factoring in the repeated assessments – for the stress latent variable alone. With the goal of making a latent variable model of stress, a model utilizing all measures of stress (PSS, WSI-Event, and WSI-Impact) was first tested. This model generated an inadmissible solution. Then, models excluding one set of the three stress variables were tested: (1) PSS and WSI-Event, (2) WSI-Event and WSI-Impact; and (3) PSS and WSI-Impact. These models generated inadmissible solutions. In addition, the process of attempting to create models with admissible solutions involved adding theoretically-appropriate constraints, which were setting the paths equal within time, setting the paths equal across all time points, and making the loadings of each variable the same at each time point. This exploration revealed that all models with WSI-Impact included in the latent variable continued to have inadmissible solutions. The latent variable measurement model of stress using PSS and WSI-Event (see Figure 8) initially generated an inadmissible solution, but once the above constraints were applied it became admissible with a CFI of .97 and RMSEA of .11. As such, the model with PSS and WSI-Event was selected.
Maladaptive social problem-solving. With the goal of making a measurement model of maladaptive SPS, all combinations of maladaptive SPS were similarly explored. This exploration revealed that all models with NPO included in the latent variable generated inadmissible solutions: (1) NPO, ICS and AS; (2) NPO and AS; and (3) NPO and ICS. A latent variable model of maladaptive SPS model using ICS and AS was created (see Figure 9). The solution for this maladaptive SPS model was admissible, and the same constraints described above (for the stress latent variable model) were applied in order to improve the model’s fit. Ultimately the best fit, a CFI of .99 and RMSEA of .08, were achieved using fewer restraints; it was not favorable (or necessary, based on the natural similarity of the SRWs .82 and .85) to set the paths equal across time. Once the latent variables of stress and maladaptive problem-solving were selected, a combined CLPM could be created using these two latent variables and the IBS symptom severity variable.
Figure 9

**Simplified Structural Equation Model: Maladaptive Social Problem-Solving as a Latent Variable**

Note. SPS = Social Problem Solving; NPO = AS = AvoidantStyle; ICS = Impulsive/Careless Style; Text with red font indicates constraints; Numerical text with black font indicate standardized regression weights. All p’s < 001.

**Combined Model**

Finally, with the goal of examining interactive influences across time, a combined CLPM was created using the maladaptive SPS and stress latent variables and the IBS symptom severity measure (i.e., B-IBS; see Figure 10 for combined model). The remaining hypotheses (Hypotheses 21 to 32) addressed the questions of whether the maladaptive SPS dimensions served as mediators in the relationship between stress and IBS symptom severity, and whether perceived and minor life stress served as mediators in the relationship between each maladaptive SPS dimension and IBS symptoms. After creating latent variables (described in the previous section), the PSS and WSI-Event variables were combined into a single latent variable, as were AS and ICS. NPO and WSI-Impact were discarded as they resulted in inadmissible solutions.

With these modifications, the above hypotheses were simplified: (1) Session 1 maladaptive SPS latent variable would predict Session 2 stress latent variable, and Session 2 stress latent variable would predict Session 3 IBS symptom severity; and (2) Session 1 stress latent variable would predict Session 2 maladaptive SPS latent variable, and Session 2 maladaptive latent variable would predict Session 3 IBS symptom severity. The combined CLPM was admissible with a CFI of .95 and RMSEA of .08.; however, several SRWs were
greater than 1.00 (e.g., Session 1 stress to Session 2 stress pathway = 1.28; Session 2 stress to Session 3 stress pathway = 1.21). Further exploratory adjustments to the model suggested that this was a result of multicollinearity among items across the different latent variables. As such, the SRWs were not logically interpretable, and the simplified hypotheses could not be tested (Dormann et al., 2013).

**Figure 10**

*Simplified Cross-Lag Panel Design: Combined Model*

![Diagram of simplified cross-lag panel design](image)

*Note. S1 = Session 1; S2 = Session 2; S3 = Session 3; SPS = social problem-solving; IBS = irritable bowel symptom severity. Text with red font indicates constraints; standardized regression weights and p values not provided as they were uninterpretable.*

**Post-Hoc Analyses**

**Depression as a Covariate**

To address issues of multicollinearity in the combined model above, there are three tactics that can be used. The first two are to decrease the number of variables, or to create latent variables (Dormann et al., 2013). Both of these suggestions were followed by creating latent variables for social problem-solving and stress, which resulted in the removal of NPO and WSI-Impact from the analyses. The third tactic is to add a variable that shares variance with the
existing variables in the model. In some cases, doing so may decrease variance shared by variables, resulting in a cleaner and more interpretable model in which variables can accurately predict one another. As a post-hoc exploration, the CESD-R, a secondary measure assessing depressive symptoms, was included for this purpose. When Session 1 depressive symptoms was added as a predictor of Session 1 stress, social problem solving, and IBS, the model solution was still admissible with a CFI of .94 and RMSEA of .08. Additionally, the model’s previous issues diminished, evidenced by all standardized regression coefficients falling below one (see Figure 11). As such, the results of the combined model with depression as a covariate were more readily interpretable.

Results suggested that depressive symptoms predicted concurrent stress, maladaptive SPS, and IBS symptom severity (p’s < .001). Stress predicted subsequent maladaptive SPS and IBS symptom severity (all p’s < .02), but maladaptive SPS did not predict subsequent stress (p’s = .26) or IBS symptom severity (both p’s = .58). Additionally, IBS symptom severity did not predict maladaptive SPS (both p’s = .63). Given how stable stress was across time (i.e., SRWs at .94 and .96), it is not surprising that the other variables did not influence stress after controlling for prior stress.

Gender was also explored in the new combined model by using multi-group analyses (See Figures 12a for men and 12b for women). This method is a beneficial because it enables testing of gender differences within the CLPM without decreasing the overall N, which in turn would decrease power (Field & Hole, 2003). Using the same restraints as the whole sample (depicted in Figure 11a), the model fit was excellent, with a CFI of .93 and RMSEA of .06. The results, however, should be interpreted with caution as the sample of men is quite small (n = 98). The results suggested that men shared the same significant pathways as the whole sample with
one exception: stress did not predict the following session’s IBS symptom severity (both $p$’s = .12). The results for women followed the same pattern as the whole sample with two exceptions: stress did not predict the following session’s IBS symptom severity (both $p$’s = .11) or maladaptive SPS (both $p$’s = .20).

Figure 11

*Post-Hoc Exploration: Simplified Combined Model with Depression as a Covariate*

*Note.* For a) and b): S1 = Session 1; S2 = Session 2; S3 = Session 3; SPS = social problem-solving; IBS = irritable bowel symptom severity. For a) Text with red font indicates constraints. For b) Text indicates standardized regression weights; Blue arrows indicate significant pathways with $p < .001$, with exception of Stress to IBS pathways in which $p$’s = .02.
**Figure 12**

*Post-Hoc Exploration: Simplified Multi-Group Analyses for Men and Women*

\[\text{Note. For a) and b): S1 = Session 1; S2 = Session 2; S3 = Session 3; SPS = social problem-solving; IBS = irritable bowel symptom severity. For a) Text indicates standardized regression weights for men; Blue arrows indicate significant pathways with } p < .001, \text{ with exception of Stress to SPS pathways in which } p \text{'s } = .01. \text{ For b) Text indicates standardized regression weights for women; Blue arrows indicate significant pathways with } p < .001.\]
CHAPTER VII: DISCUSSION

The current study aimed to examine the interrelations among stress, social problem solving, and IBS using the relational/problem-solving model of stress and wellbeing. It replicated the already-established connections between stress and maladaptive social problem solving (SPS) and stress and Irritable Bowel Syndrome (IBS). It also bridged gaps in the existing literature by: (1) examining the heretofore unexplored association between IBS and maladaptive SPS; (2) investigating both stress and maladaptive SPS as potential mediators; and (3) using a longitudinal design.

Relational Model: Concurrent Associations

This section describes the concurrent associations between study variables, placing them in the context of the relational/problem-solving model of stress and wellbeing. This includes the replication of the established links between stress and maladaptive SPS and stress and IBS, as well as a newly examined association between maladaptive SPS and IBS symptom severity. Lastly, these concurrent associations are discussed in the context of gender, often overlooked in SPS investigations.

Replications

Previously established connections between stress and maladaptive SPS (see Nezu, 2004, for a review) were replicated in the present investigation, providing further support for one of the three pathways in the relational/problem-solving model of stress and wellbeing. As reviewed, it is typical in stress-SPS investigations to rely on just one form of stress measurement. The current study measured both objective and subjective (i.e., perceived) stress, and the findings suggest that both forms of stress are linked to poor problem-solving ability. More specifically, objective and subjective stress, as assessed by the Weekly Stress Inventory (WSI; Brantley et al.,
1997) and the Perceived Stress Scale (PSS; Cohen et al., 1983), respectively, were associated with each of the maladaptive SPS dimensions (i.e., NPO, AS, and ICS). Applying theory to these results, D’Zurilla and Nezu (2001) emphasized a destructive cycle in which heightened stress due to problems increases tendencies to engage in poor problem-solving tactics. These tactics include perceiving problems as threatening to wellbeing and believing that one is not capable of solving problems. Consequently, individuals are more likely to avoid problems. These unattended-to problems worsen and/or create new problems, leading to doubt in self-efficacy and further increases in stress (Nezu, 2004). Another reaction to perceiving problems as threatening could be to act impulsively or carelessly when problem-solving, which may result in inadequate solutions that could also exacerbate problems. Following this line of reasoning, it is no surprise that maladaptive SPS is associated with several psychological ailments, including stress, anxiety, and depressive symptoms (Nezu, 2004).

The findings also support previously established connections between stress and IBS (see Pletikosić & Tkalčić, 2016, for a review), another pathway in the relational/problem-solving model of stress and wellbeing. Just like the stress-SPS literature, the vast majority of studies in stress-IBS literature include assessments of just one form of stress. The present study findings suggest that both measurements of stress are linked to IBS symptom severity. These results lend support to the longstanding beliefs held by many general practitioners, nurses, and IBS sufferers that IBS is triggered, or at least exacerbated, by stress (Dancey et al. 1995). Further, the findings suggest that IBS symptoms themselves may induce stress, feelings of urgency to evacuate the bowels, abdominal pain, and bloating (or even the fear that any of these symptoms will emerge unexpectedly at any time) and therefore can be highly stressful in numerous everyday situations. These everyday situations may include, but are not limited to, giving a presentation at work,
going anywhere where restrooms are not nearby or easily accessible, or attempting to make a good impression at a dinner function while eating and activating intestinal movements (Dancey, Taghavi, & Fox, 1998). Brain-gut theory asserts that the brain and the gut communicate through a network of nerves located in the brain and spinal cord (central nervous system) and a network of nerves that run along the stomach and intestines to the anus (enteric nervous system). In fact, the latter network is often referred to as the “second brain” because these two networks respond to the same neurotransmitters, including neurotransmitters that are released when the body perceives danger and engages in the fight or flight response (Harvard Health Publishing, 2019). In other words, for many individuals when the brain panics, the gut panics, and vice versa, leading to a vicious bidirectional back and forth of discomfort and stress.

**Linking Social Problem Solving and Irritable Bowel Symptom Severity**

The present study examined previously unexplored associations between IBS and maladaptive forms of SPS. This investigation was prudent because stress is clearly linked to SPS (e.g., Bell & D’Zurilla, 2009), and stress is believed to play a prominent role in triggering, maintaining, and worsening IBS symptoms (Chang & Videlock, 2017; Elsenbruch & Enck, 2017; Park et al., 2018; Vanner et al., 2017). As anticipated, all three dimensions of maladaptive SPS were positively and significantly associated with IBS symptom severity. As such, IBS joins a list of medical conditions, including tension and migraine headaches (Eskin et al., 2013) and chest pain (Nezu et al., 2008), found to be related to SPS. D’Zurilla and Nezu’s (2001) relational/problem-solving model of stress and wellbeing asserts that maladaptive SPS hinders adaptation to stress and increases the likelihood of negative outcomes, such as the physical health problems mentioned above. The relational/problem-solving model was originally tested with depression and anxiety as outcomes, but the literature has since widened in scope to include
a range of physical health problems as outcomes. Generally speaking, poor problem-solving appears to negatively impact physical health when individuals are under high levels of stress. Perhaps high levels of stress cause individuals to avoid tackling their physical health problems. For instance, these individuals may neglect to take their medications as prescribed, ignore doctors’ recommendations to exercise or stretch, or fail to plan ahead for predictable obstacles (e.g., may fail to make a healthy lunch for work at the office, which would decrease the desire to purchase junk food while hungry and working under mentally taxing conditions).

Narrowing the scope to IBS and SPS, refer back to the example of stress flaring IBS symptoms and IBS symptoms serving as stressors themselves. Now add SPS into the equation. Low levels of stress may allow for more confidence in one’s ability to manage a problem (e.g., IBS symptoms) and the ability to see problems as solvable, which could increase the likelihood of adaptive problem-solving (e.g., following through with doctors’ recommendations to modify one’s diet and to take medications to alleviate IBS symptoms). However, high stress levels may increase the likelihood that individuals perceive their problems as unsolvable, diminishing confidence in their problem-solving ability. This lack of confidence could further heighten stress. Consequently, those under stress may avoid strategizing because it causes too much added distress, which ultimately (due to lack of action) worsens their IBS symptoms, leading to even more stress. This notion is consistent with the brain-gut axis theory of IBS, which emphasizes that there are interconnections among impaired cognitive appraisals, poor coping, and worsening of gastrointestinal symptom severity (Kennedy et al., 2012). Some of these cognitive appraisals, as discussed in detail in the IBS chapter, are hypervigilance, somatization, and pain catastrophizing. The present study identified a connection between IBS and SPS, and
hopefully will be the first of many studies to examine the interplay of how IBS and SPS interact with stress.

**Gender**

Gender is a variable surprisingly absent from the vast majority of past SPS investigations. Overall, correlations for men and women for all variables at each session closely mirrored the results for the whole sample, suggesting that the links among stress, maladaptive SPS, and IBS are similar for both men and women. Mean level differences were also examined to assess if gender differences were present. As expected, overall patterns revealed that women reported higher levels of subjective stress, NPO, and IBS compared to men. The fact that women in this sample reported higher levels of perceived stress is not surprising (Baker, 2003; Bell & D’Zurilla, 2009). Past investigations have also found that women tend to report higher levels of NPO than men (e.g., D’Zurilla et al., 1998). A potential explanation for this comes from Brems and Johnson (1989), who found that gender accounted for 17.8% of the variance in problem-solving confidence, approach avoidant style, and overall problem-solving ability (all on the Problem-Solving Inventory; Heppner & Peterson, 1982). They theorized that men generally tend to have more confidence in their problem-solving abilities, are more likely to predict positive outcomes for themselves, and more often attribute success to personal ability instead of luck. Of note, the finding that women report higher levels of IBS than men is consistent with the fact that IBS is more prevalent in women than men, with a ratio of 2:1 (National Institute of Diabetes and Digestive and Kidney Diseases, 2015), and IBS has been paired with poorer cognitive appraisals (Kennedy et al., 2012). The gender differences identified above suggested that the subsequent analyses planned for the present study, the cross-lag panel models, should test for men and women separately. These gender differences will be delineated in the post-hoc section below.
Relational Model: Longitudinal Associations

In order to test the relational/problem-solving model of stress across time, mediational analyses with longitudinal data were conducted. Namely, whether Session 2 maladaptive SPS served as a mediator in the relationship between Session 1 stress and Session 3 IBS symptoms, and whether Session 2 stress served as a mediator in the relationship between Session 1 maladaptive SPS and Session 3 IBS symptoms were examined. As described in the Results chapter, stability and multicollinearity led to data analysis concerns and issues that persisted despite exploratory adjustments (e.g., creating latent variables). In sum, the mediational analyses of interest could not be interpreted. The following section discusses challenges of, and possible explanations for, the stability and multicollinearity issues.

Stability Issues

After much consideration in the planning stages, two-week intervals seemed like a reasonable choice for a first-time study examining the interplay of the variables of interest. Though longer intervals were weighed in the decision-making process, there were no precedents or compelling reasons to go beyond the two weeks. From the available psychometric evidence, two weeks appeared to allow for some expected instability in the key measures. Further, the two-week intervals made sense from an efficiency standpoint and were thought to perhaps reduce participant burden and attrition brought on by a longer spacing between assessments. Reality, however, proved different and the measures remained stable (i.e., lacked change) across the assessments. In retrospect, it appears that the variables of interest may have been more trait-based (i.e., longstanding characteristics) than state-based (i.e., short-lasting characteristics). In support of this speculation, consider some of the obtained four-week interval test-retest reliabilities; NPO = .81; AS = .71, ICS = .70; PSS = .67). Another potential issue could be that
some of the measures (e.g., PSS, B-IBS) asked about symptoms during the past month instead of the past two weeks; it is possible that this created some overlap in reported symptoms and may have inflated some variance. It appears that researchers designing future studies using these and similar measures should consider measurement intervals longer than four weeks to detect changes across time in order to examine the key variables’ influence on one another.

**Multicollinearity**

In addition to stability, multicollinearity issues compromised the utility of the cross-lagged panel model (CLPM). Multicollinearity is the extent to which variables are interrelated or share variance with other variables (Tabachnick & Fidell, 2013). As shared variance increases, it becomes more difficult to detect the effect of any singular variable. As outlined in the Results chapter, efforts were made to reduce the amount of shared variance between the study variables, with the goal of testing the hypotheses related to the mediational analyses for the relational/problem-solving model of stress and wellbeing (i.e., latent variables for stress and maladaptive SPS were created).

Two potentially interesting, yet preliminary, findings emerged in the process of identifying admissible latent variables. Although fleshing these out will require further investigation, some speculation is offered here. The first finding of interest is that the only admissible (i.e., acceptable) latent variable for maladaptive SPS did not include NPO; it only included AS and ICS. This is somewhat counter-intuitive, given NPO’s key role in linking social problem-solving to physical and psychological problems. That is, NPO tends to account for the majority of variance in these relationships. One of many examples is that Kant, D’Zurilla, and Maydeu-Olivares (1997) found NPO to be the sole SPS predictor of anxiety and depressive symptoms, accounting for 19.7% and 53.7% of the variance, respectively. Yet
somehow, in the current study, NPO did not “fit” into the latent variable of maladaptive SPS containing AS and ICS. One well-supported explanation is that NPO is easily the most unique of the three maladaptive dimensions; NPO measures one’s problem-solving orientation, whereas AS and ICS measure problem-solving styles. Problem-solving orientation is much different than problem-solving style. Orientation pertains to individuals’ perception and appraisal of their problems (e.g., assess how threatening and solvable they are), whereas style represents individuals’ goal-directed behavior (i.e., their attempts to find effective solutions to the problems; D’Zurilla et al., 2004; Nezu, Nezu, & D’Zurilla, 2007). A factor analysis using polychroic correlations by Maydeu-Olivares and D’Zurilla (1995) confirmed this distinction between orientation and style, and further subdivided these components into two orientations (one of which was NPO) and three styles (two of which were AS and ICS). Following this line of reasoning, perhaps NPO was too much of its own construct as an orientation, and therefore did not fit neatly into a latent variable consisting of two styles. Another possible contributing factor may be that NPO could have been as much of a measure of stress as it was a measure of social problem-solving, and thus NPO did not clearly belong to the SPS latent variable. Perhaps this is because the PSS and NPO measure similar components, as the PSS measures how much control participants perceive that they have over their stressors, and NPO measures participants’ view on how solvable (and thus, how controllable) their problems or stressors are. More studies testing the overlapping variance of NPO and PSS, for example, would help to unravel the meaning of this preliminary finding.

The second notable preliminary finding regarded the latent variable of stress; the only admissible version included WSI-Event and the PSS and did not include WSI-Impact. Past studies have found the WSI to be meaningful; Ames et al. (2001) found that higher mean scores
on the WSI were a significant predictor of several health outcomes on the SF-36: poorer physical functioning, role limitations due to physical health, role limitations due to emotional problems, and poorer emotional wellbeing. This finding highlights the negative impact of recurring, minor life stressors on subsequent health outcomes. The WSI subscales Event and Impact both have concurrent validity with the established Daily Stress Inventory subscales Frequency and Air (Scarinci Ames, & Brantley, 1999), and the WSI also has concurrent validity with the Hassles Scale (Brantley et al., 1997). Although speculative, perhaps when the WSI-Event and PSS were combined, it created a comprehensive stress measure that encompassed the ideal blend of subjective and objective stress, thereby negating the need for inclusion of the WSI-Impact. More studies testing the overlapping variance of WSI-Event, WSI-Impact, and the PSS could help to clarify why the WSI-Impact was excluded in the latent variable of stress.

Unfortunately, the above process did not decrease the CLPM’s multicollinearity enough to obtain interpretable results. As such, the CLPM could not be used to test the relational/problem-solving model of stress and wellbeing. Although the uninterpretable results left many of the hypotheses untested, a post-hoc exploration was conducted. In the post-hoc analysis, a secondary measure assessing depressive symptoms was included with the goal of eliminating more of the shared variance. This is detailed in the next section.

**Post-Hoc Model: Role of Depression**

The current study explored a post-hoc model, namely the CLPM described above with the addition of a secondary measure of depression (Center for Epidemiologic Studies Depression Scale-Revised [CESD-R]; Eaton et al., 2004). The rationale for including a depression measure was that the associations among depressive symptoms, poor SPS, and increased stress are very well-established (Nezu, 2004). Likewise, depression has been linked to IBS (Fond et al., 2014).
Reported rates of comorbid depression in IBS ranges between 30 and 60% (Sibelli et al., 2016), and Talley et al. (1995) found that the depression scale on the Symptoms Checklist-90 (SLC-90; Derogatis, Lipman, & Covi, 1977) was the most elevated scale in IBS patients compared to healthy controls. This makes sense as those who are depressed may be more likely to catastrophize and somaticize, leading to increased IBS symptoms and the perception that they are not equipped to deal with their body’s pain. In order to eliminate a portion of shared variance between stress and SPS, CESD-R at Session 1 was tried as a covariate in the CLPM. As anticipated, this produced an admissible model with interpretable results. This section briefly reviews previously established links among depressive symptoms, stress, and IBS. It also describes the post-hoc CLPM’s results and possible explanations for those results.

As reviewed, depression is linked to IBS, stress, and SPS. The connection between depression and IBS symptoms has been demonstrated in numerous studies (Cole et al., 2006; Derogatis et al., 1977; Rose et al., 1986; Sibelli et al., 2016; Talley et al., 1995). Notably, in a meta-analysis examining 10 studies that included 885 IBS patients and 1,384 healthy controls, Fond and colleagues (2014) found that IBS patients had significantly higher levels of depression compared to healthy control patients. Depression has also been shown to be intertwined with both stress and SPS (D’Zurilla & Chang, 1995; Nezu, 2004). In fact, the first major application of the relational/problem-solving model of stress and wellbeing used a life stress framework of depression, suggesting that stressful life events increased the likelihood of depression through maladaptive SPS (Nezu, 1987). In support, Davila and colleagues (1995) found that poorer problem-solving predicted higher levels of stress, which in turn led to increased depression. These findings were also consistent with the stress generation hypothesis, which asserts that individuals who are prone to depression are likely to behave in ways that contribute to the
occurrence of negative life events, which generates more stress and thereby increases their risk for depression. With these findings in mind, the CESD-R was included in the CLPM as a predictor of Session 1 stress, maladaptive SPS, and IBS. When added, the multicollinearity issues diminished, as evidenced by all standardized regression coefficients falling below one. The end result was a CLPM solution that was admissible and the results thus interpretable. To summarize, many of the present study’s findings mirrored those obtained in previous studies. Consistent with the SPS and health literature, depressive symptoms predicted concurrent stress, maladaptive SPS, and IBS symptom severity, and stress predicted subsequent maladaptive SPS and IBS. Conversely, results were inconsistent with the notion that maladaptive SPS or stress would serve as significant mediators (Kant et al., 1997), maladaptive SPS did not serve as a mediator in the relationship between stress and IBS, and stress did not serve as a mediator in the relationship between SPS and IBS. A contributing factor to the lack of significant mediation appeared to be related to the inability of maladaptive SPS to predict subsequent IBS. Another explanation for the lack of mediational findings compared to past studies is that previous investigations relied on cross-sectional designs. Cross-sectional data can be used to examine mediational factors at only one time point, whereas longitudinal data better captures the inter-variable influences across time. Moreover, the CLPM is a more conservative test; unlike CLPMs, cross-sectional regression analyses do not account for the shared variance obtained from variables predicting themselves in previous time points. As such, regression analyses allow for more inflation of significance in this way. A third possibility of why the mediational patterns did not emerge in the current study could be that the stability across time (due to overly short intervals) left little variance to detect changes. More research would need to be conducted to
tease apart which of the above factors, if any, led to the observed lack of significance in the present study.

Limitations

Although the study had many strengths, as in any study there were a number of limitations. Two were discussed in detail above; issues of stability and multicollinearity. Other possible limitations are discussed in this section. More specifically, the potential shortcomings of self-report measures, as well as possible sampling issues (e.g., non-clinical population, college students) are described and considered.

Self-Report

Using self-report measures in the current study was beneficial in some ways, but also brought with it some limitations. Self-report measures are convenient due to being less costly in terms of administration time and interpretation compared to other types of measures. Often, they are less time consuming for the participants to complete, thereby making participation less demanding, and they can help to curb participant disengagement. Likewise, they are often less time consuming for the researchers to code or interpret. These advantages were particularly important for a longitudinal study with three time points spanning an entire month; asking participants to complete a battery of questionnaires online, as opposed to asking them to go to a laboratory to complete a different type of task would likely reduce participant attrition. Additionally, all of the self-report measures were carefully considered for inclusion prior to conducting the study. The WSI was selected as it contained concurrent validity with its predecessor, the DSI, which has been used in examinations of links between stress and IBS symptom severity (Blanchard, 2008). It also had the added benefit of eliminating the need to incorporate daily monitoring. The PSS was selected as a valuable subjective measure because of
its widespread use in past studies on stress and health (see Lee et al., 2015, for a review) and demonstrated significant relationships with IBS symptom severity (Spence & Moss-Morris, 2007). The SPSI-R was selected because numerous SPS studies have relied on it, and these investigations further bolster support for the relational/problem-solving model of stress and wellbeing with college students (Anderson et al., 2009; 2011; Haugh, 2006). Another advantage of the SPSI-R is that it is a process measure, and process measures tap into the problem-solving process (i.e., individuals’ perceptions, appraisals, and expectations about their SPS ability), which is the component of SPS thought to most influence susceptibility to developing poorer health outcomes (Nezu, 2004).

Despite their many benefits, self-report measures can increase the possibility of response bias (social desirability) or recall bias (distortion of one’s abilities due to potentially faulty recollection). Reliance on them can also contribute to shared method variance and shared informant variance, which can inflate associations among variables (Field, 2014). In retrospect, given the related multicollinearity issues in the present study, future studies would benefit from efforts to broaden their methods and types of informants. One strategy would be to employ a variety of methods. For instance, for SPS, instead of using only a self-report measure, future studies could employ a self-monitoring task that assesses real-life problem-solving performance (e.g., Anderson et al., 2011). Another strategy is to use multiple informants. Instead of gathering reports only from each participant, future studies could gather reports from multiple informants, such as close friends, family members, or significant others.

Sample

The sample was predominately Caucasian (reflective of recruitment at a New England university). The sample identified as 90% Non-Hispanic/Latino White, 3.3% Black, 2.3% Asian,
2% Latino, .3% American Indian/Native American, and 2% other. As such, the racial homogeneity of the study sample likely hinders generalization to the U.S. general population, as well as the college student population. Although Caucasians are the racial majority in the U.S. general population, the 2020 U.S. Census Bureau estimates indicate that the percentage of Hispanic/Latino Whites is 18.3%, African American 13.4%, Asian 5.9%, American Indian or Alaska Native 1.3% and Native Hawaiian and other Pacific Islander .2%. Colleges in the U.S. are also diverse; according to the National Center for Education Statistics, of the 16.6 million undergraduates enrolled in the fall semester of 2018, approximately 8.6 million were Non-Hispanic Whites, 3.4 million were Hispanic, 2.1 million were African American, 1.1 million were Asian, 647,000 identified as two or more races, 120,000 were American Indian or Alaskan Native, and 45,000 were Pacific Islander. These contrasts have probable implications for the present study findings. For example, several minorities, including African Americans and Hispanics, tend to report higher levels of stress than Caucasians (Williams, 2000). Those who research stress in minority populations have postulated that individuals under higher levels of stress, such as stress experienced by being an ethnic minority, may experience more problems (e.g., financial difficulty, discrimination) and have theorized that the presence of these often-persistent problems may place extra challenges on problem-solving ability (Williams, 2000). In contrast, the current study’s results for IBS symptom severity may generalize to both the U.S. general population and to the college student population; Saito and colleagues (2005) assert that U.S. studies on IBS have not shown any significant differences in prevalence among Caucasians, Hispanics, and African Americans and thus IBS does not appear to predominate in any race.

The sample was also primarily composed of women (N = 199, compared to 98 men). In the U.S. general population, the current percentage of women is 50.6% (United Nations
Department of Economic and Social Affairs: Population Division, 2020). Similarly, according to the U.S. Department of Education (2017), the gender ratio of men and women in college is about equal, with approximately 56% enrolled women. Nonetheless, obtaining a gender balance for the current study was a challenge, and two reasons are postulated here. It could be due to saliency; women self-identify themselves as sufferers of the study variables more so than men (e.g., women report higher rates of IBS, stress, and NPO than men), and thus women may have shown more interest in participating. It could also be due to the pool from which participants were selected; students were recruited from psychology courses, which tend to be taken predominantly by women. With that said, the current study’s reported mean levels of stress were comparable to previous studies that also tended to recruit mostly women – likely for the same reasons stated above. Notably, the ability to generalize the data to any gender besides women (not just men, but also transgender or non-binary individuals) is limited. As a whole, it is recommended that future studies extend the research by decreasing the overall homogeneity of recruited samples (e.g., not recruit nearly all Caucasian women), and strive to recruit diverse individuals regarding ethnicity/race and gender.

To add, the study used a non-clinical sample. No IBS diagnostic screening was done, and participants with any level of IBS symptom severity were able to complete the study. As such, the results are likely not generalizable to participants who suffer from IBS. The results, however, are pretty similar to those obtained in other studies conducted with non-clinical undergraduate samples. For example, Jasper and colleagues (2015) collected B-IBS scores from college students \((n = 875; 77\% \text{ women})\) and found that the mean score for the entire sample of men and women was 8.74 \((SD = 2.61)\) and 4.63 for just women. These findings are comparable
to those of the present study and considerably lower than those found with diagnosed samples (e.g., Roalfe et al., 2008).

Lastly, the age range of the current study participants (18 to 24; $M_{age} = 18.77$) may have created some limitations in generalizability to all ages. The current study invited anyone older than the age of 18, however, most of the participants were 18 years old. IBS exists across the lifespan, and the peak prevalence of IBS extends all the way to 39 years of age. Despite this limitation, given the research questions related to IBS’ interaction with stress and SPS, recruiting from a university was advantageous for many reasons that go beyond convenience. College introduces many stressful life changes, including increased responsibility, moving afar, and starting anew (Anderson et al., 2009). To add, the college years often demand a heavy use of SPS skills due to navigating new relationships (e.g., friendships, romantic relationships) and increasing the number and variety of social opportunities (e.g., academic, recreational, professional), while also trying to maintain relationships from afar (e.g., staying in contact with family). These increased demands, in addition to increases in self-consciousness, can add to stress and potentially exacerbate subsequent IBS severity (Steinberg, 2005). In line with this, prevalence rates of IBS are as high as 10.9 to 19% in college students (Gulewitsch, Enck, Schwille-Kiuntte, Weimer, & Schlarb, 2013; Hazlett-Stevens, Craske, Mayer, Chang, & Naliboff, 2003).

**Future Directions**

Future studies should continue to investigate the interplay of stress, SPS, and IBS. More longitudinal studies are needed. Unfortunately, to date, nearly the entire SPS literature is based on cross-sectional or concurrent design, despite the recognition in SPS studies that longitudinal designs are the only way to tease apart causation of these variables. Such acknowledgements can
be found in the publications of many well-cited studies employing cross-sectional designs (e.g., Bell & D’Zurilla, 2009; Nezu et al., 2008; Nezu & Ronan, 1988). More specifically, Nezu and colleagues (2008) highlighted the limitation of cross-sectional investigations by stating that they were not able to test causal pathways directly and, as such, their interpretation was merely speculative. In line with this, Bell and D’Zurilla (2009) asserted that although the relational/problem-solving model assumes that influences amongst stress, SPS, and health outcomes are reciprocal, longitudinal studies are needed to determine the extent to which each of these variables influence one another. Interestingly, despite being conducted 32 years ago, Nezu and Ronan’s (1988) study appears to one of the few existing exceptions to the cross-sectional design. In assessing relationships amongst stress, SPS, and depression, they used a prospective design controlling for previous levels of depressive symptoms. Eventually, two subsequent SPS studies employed longitudinal designs (Anderson et al., 2011; Dixon, 2000). In 2000, Dixon assessed BDI and PSI scores two months apart in undergraduate students, and found that those with lower PSI scores (i.e., better SPS) at baseline displayed only mild levels of depressive symptoms two months later, compared to students with higher PSI scores (i.e., poorer SPS) who showed moderate to severe depressive symptoms two months later. In 2011, Anderson and colleagues tested whether Time 1 SPS would serve as a significant predictor of depressive symptoms at Time 2 “over and above” Time 1 depressive symptoms. Of note, Dixon (2000) and Anderson et al. (2011) used only two sessions, but two waves (compared to three, like the current study used) are likely insufficient to understand how processes unfold over time (Kenny, 2005). This is because two waves are best suited to understand the causes of change, which would be beneficial for an intervention analysis, whereas three or more time points are more adept at understanding the variables of interest and how they change (Kenny, 2014).
In the design of future longitudinal studies, it may be important to consider the use of longer than four-week measurement intervals in order to better detect changes, as suggested by several high correlation r’s when examining temporal stability of measures from Sessions 1 to 3. Relatedly, as discussed below, the use of more sensitive state-like as opposed to trait-like measures should also be considered for the same reason. However, given the lack of longitudinal studies in the related literatures, there is not much in the way of empirical work to base these interval length decisions on.

Multimethod approaches would also help strengthen the literature base. Validation, after all, requires a demonstration that the obtained findings are replicable using maximally different assessment methods (Campbell & Fiske, 1959; Foster & Cone, 1995). In this way, alternative explanations, such as common method variance, can be ruled out. In this case, future studies could consider the inclusion of a wider variety of stress and SPS measures. For example, to assess stress, there are a variety of possible physiological measures, including cortisol via salivary alpha-amylase samples, or measuring changes in blood pressure, electrodermal response, skin temperature, respiratory rate, heart rate, and heart rate variability (Oken et al., 2015; Pruessner et al., 2015). Another type of method that could be considered is self-monitoring. Using SPS as an example, perhaps a self-monitoring task such as the Problem-Solving Self-Monitoring task (PSSM; D’Zurilla et al., 1999) could be utilized to bolster the self-reports. Using a self-monitoring task like the PSSM would add benefit to the study because the PSSM asks individuals to identify significant real-life problematic situations, as opposed to hypothetical ones that self-report measures tend to employ (e.g., PSI, SPSI-R), and to record their response to them in real-time (D’Zurilla & Nezu, 1999). To add even more salience, the PSSM could also be tailored to inquire about SPS in gastrointestinal-related problems or
scenarios (Anderson et al., 2009; 2011). Additionally, results of the PSSM could be integrated with one of the above-mentioned physiological measures. For example, the PSSM assesses several aspects of an individual’s problem-solving orientation, including Threat Appraisal (i.e., the perceived level of threat that a problem will have on an individual’s wellbeing) and Challenge Appraisal (i.e., perceiving a problem as a challenge that, once resolved, will lead to a higher level of mastery or personal growth; D’Zurilla & Nezu, 1999). Threat Appraisal taps into maladaptive SPS (i.e., NPO), whereas Challenge Appraisal appears to resemble adaptive or helpful SPS. For validation purposes, and to explore differential impacts on wellbeing, it would be interesting to see if these SPS elements elicit different physiological responses.

In addition to including multiple methods, researchers might also consider a broader range of self-report measures in their study designs. As an example, when considering how to increase the variety of self-report measures for stress, a future study could expand its examination of objective stress to include a measure of minor life stress, such as the WSI, and a measure of major life events, such as the Life Experiences Survey (Sarason et al. 1978), as both of these assess different forms of stressors. When selecting a measure of minor life stress, using the DSI would be an excellent choice. The DSI has demonstrated sensitivity to changes in stress in a short period in longitudinal research, evidenced by carryover effects of stress on GI symptoms and of GI symptoms on stress from one and two weeks prior (Blanchard, 2008). The DSI involves daily (instead of weekly) monitoring and then aggregates the data into a weekly score, but its sensitivity may be worth the additional effort.
Conclusion

In summary, the present study helped to further solidify a number of standing findings in the literature and also added some new ones. Consistent with the SPS and health literature, depressive symptoms predicted concurrent stress, maladaptive SPS, and IBS symptom severity, and stress predicted subsequent maladaptive SPS and IBS. As far as novel findings, the current study was the first to establish a link between SPS and IBS. In addition, although multicollinearity issues led to some untestable hypotheses, the present study offered the advantage of a longitudinal design in a literature dominated by cross-sectional investigations.

Research should continue to explore connections among cognitive variables such as SPS, stress, and IBS across time. A better understanding of these connections might help lead to strategies to disrupt the deleterious cycle of these elements exacerbating one another. With a growing emphasis on integrated care using the biopsychosocial approach in the medical and clinical psychology fields, expansion in these areas to bridge existing gaps is crucial. The biopsychosocial approach is becoming increasingly popular in interdisciplinary health care. Many primary care doctors who work closely with psychologists are conscious of emotional factors and life stressors that exacerbate symptoms, and (in addition to diet, exercise, and medication) they often encourage therapeutic interventions for IBS (e.g., cognitive-behavioral therapy; Kusnanto, Augstian, & Hilmanto, 2018). However, health care has not yet utilized therapies that target maladaptive problem-solving styles, such as problem-solving therapy (PST; D’Zurilla & Nezu, 1999) for individuals who suffer from gastric distress. This would be a valuable alternative or adjunct at the very least; engaging in effective problem-solving and building small personal successes or triumphs in solving IBS-related problems can serve to empower patients who are proactively managing their gastrointestinal symptoms (Kusnanto et
al., 2018). This, in turn, can help patients improve their ability to cope, regain functioning such as missing fewer social events and days at work, thereby enhancing their productivity, emotional wellbeing, and quality of life (Gatchel & Howard, 2018).
REFERENCES


APPENDICES

Appendix A: Sona Recruitment Summary
Appendix B: Demographic Questionnaire
Appendix C: Social Problem-Solving Inventory-Revised
Appendix D: Weekly Stress Inventory
Appendix E: Perceived Stress Scale
Appendix F: Birmingham IBS Symptom Questionnaire
Appendix G: Center for Epidemiologic Studies Depression–Revised
Appendix H: Informed Consent
Appendix I: Thank you and Resource List
Appendix J: Information for Compensation
Appendix A

Sona Recruitment Summary

You must be at least 18 years old to participate in this study. This study entails participation at three time points, two weeks apart. Each time, you will be asked to answer questions online about your physical health, quality of life, mood, and problem-solving abilities. The first time you participate, you will also be asked to provide your age, sex, and ethnicity. Your identity and responses will remain completely anonymous. Completion of the questionnaires should take approximately 40 minutes, and you will earn three research credits, $30 in e-gift cards, or a combination of these, for your participation. If you have questions about participating in this project, please contact Natalie Roy at Natalie.holbrook@maine.edu
Appendix B

Demographic Questionnaire

1. Age_________

2. Sex: (select one):
   
   ____ Male
   ____ Female
   ____ Transgender, nonbinary, or gender nonconforming (if selected, please specify):_____________

3. Race (select one):
   
   ____ White        ____ Black          ____ American Indian/Native American
   ____ Latino/a     ____ Asian          ____ Other (please specify):_____________
Appendix C

Social Problem-Solving Inventory-Revised

Instructions: Below are some ways that you might think, feel, and act when faced with problems in everyday living. We are not talking about the common hassles and pressures that you handle successfully every day. In this questionnaire, a problem is something important in your life that bothers you a lot but you don't immediately know how to make it better or stop it from bothering you so much. The problem could be something about yourself (such as your thoughts, feelings, behavior, appearance, or health), your relationships with other people (such as your family, friends, teachers, or boss), or your environment and the things that you own (such as your house, car, property, money). Please read each statement carefully and choose one of the numbers below which best shows how much the statement is true of you. See yourself as you usually think, feel, and act when you are faced with important problems in your life these days. Put the number that you choose on the line before the statement.

0 = Not at all true of me
1 = Slightly true of me
2 = Moderately true of me
3 = Very true of me
4 = Extremely true of me

___ 1. I spend too much time worrying about my problems instead of trying to solve them.

___ 2. I feel threatened and afraid when I have an important problem to solve.

___ 3. When making decisions, I do not evaluate all my options carefully enough.

___ 4. When I have a decision to make, I fail to consider the effects that each option is likely to have on the well-being of other people.

___ 5. When I am trying to solve a problem, I often think of different solutions and then try to combine some of them to make a better solution.

___ 6. I feel nervous and unsure of myself when I have an important decision to make.

___ 7. When my first efforts to solve a problem fail, I know if I persist and do not give up too easily, I will be able to eventually find a good solution.

___ 8. When I am attempting to solve a problem, I act on the first idea that occurs to me.

___ 9. Whenever I have a problem, I believe that it can be solved.

___ 10. I wait to see if a problem will resolve itself first, before trying to solve it myself.

___ 11. When I have a problem to solve, one of the things I do is analyze the situation and try to identify what obstacles are keeping me from getting what I want.
12. When my first efforts to solve a problem fail, I get very frustrated.

13. When I am faced with a difficult problem, I doubt that I will be able to solve it on my own no matter how hard I try.

14. When a problem occurs in my life, I put off trying to solve it for as long as possible.

15. After carrying out a solution to a problem, I do not take the time to evaluate all of the results carefully.

16. I go out of my way to avoid having to deal with problems in my life.

17. Difficult problems make me very upset.

18. When I have a decision to make, I try to predict the positive and negative consequences of each option.

19. When problems occur in my life, I like to deal with them as soon as possible.

20. When I am attempting to solve a problem, I try to be creative and think of new or original solutions.

21. When I am trying to solve a problem, I go with the first good idea that comes to mind.

22. When I try to think of different possible solutions to a problem, I cannot come up with many ideas.

23. I prefer to avoid thinking about the problems in my life instead of trying to solve them.

24. When making decisions, I consider both the immediate consequences and the long-term consequences of each option.

25. After carrying out my solution to a problem, I analyze what went right and what went wrong.

26. After carrying out my solution to a problem, I examine my feelings and evaluate how much they have changed for the better.

27. Before carrying out my solution to a problem, I practice the solution in order to increase my chances of success.

28. When I am faced with a difficult problem, I believe I will be able to solve it on my own if I try hard enough.

29. When I have a problem to solve, one of the first things I do is get as many facts about the problem as possible.

30. I put off solving problems until it is too late to do anything about them.
31. I spend more time avoiding my problems than solving them.

32. When I am trying to solve a problem, I get so upset that I cannot think clearly.

33. Before I try to solve a problem, I set a specific goal so that I know exactly what I want to accomplish.

34. When I have a decision to make, I do not take the time to consider the pros and cons of each option.

35. When the outcome of my solution to a problem is not satisfactory, I try to find out what went wrong and then I try again.

36. I hate having to solve the problems that occur in my life.

37. After carrying out a solution to a problem, I try to evaluate as carefully as possible how much the situation has changed for the better.

38. When I have a problem, I try to see it as a challenge, or opportunity to benefit in some positive way from having the problem.

39. When I am trying to solve a problem, I think of as many options as possible until I cannot come up with any more ideas.

40. When I have a decision to make, I weigh the consequences of each option and compare them against each other.

41. I become depressed and immobilized when I have an important problem to solve.

42. When I am faced with a difficult problem, I go to someone else for help in solving it.

43. When I have a decision to make, I consider the effects that each option is likely to have on my personal feelings.

44. When I have a problem to solve, I examine what factors or circumstances in my environment might be contributing to the problem.

45. When making decisions, I go with my "gut feeling" without thinking too much about the consequences of each option.

46. When making decisions, I use a systematic method for judging and comparing alternatives.

47. When I am trying to solve a problem, I keep in mind what my goal is at all times.

48. When I am attempting to solve a problem, I approach it from as many different angles as possible.
49. When I am having trouble understanding a problem, I try to get more specific and concrete information about the problem to help clarify it.

50. When my first efforts to solve a problem fail, I get discouraged and depressed.

51. When a solution that I have carried out does not solve my problem satisfactorily, I do not take the time to examine carefully why it did not work.

52. I am too impulsive when it comes to making decisions.
Appendix D

Weekly Stress Inventory

Below are listed a variety of events that may be viewed as stressful or unpleasant. Read each item carefully and decide whether or not that event happened to you during this past week. If the event did not happen this week, fill in the circle labeled X to the right of that item. If the event did happen, show the amount of stress that it caused you by filling in a circle numbered from 1 to 7 to the right of that item (see scale below). Additionally, if the event happened 3 or more times during this past week, fill in the circle to the far right of that item.

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<th>Event</th>
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<td>Had a job or assignment overdue</td>
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<td>Bothered with red tape</td>
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<td>Argued with a coworker</td>
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<td>Customers or clients gave you a hard time</td>
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<td>Did poorly at a job, task, or chore</td>
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<td>Hunted to meet a deadline</td>
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<td>Interrupted during a job, task, activity, or thinking</td>
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<td>Someone spoiled your completed job, task, or chore</td>
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<td>Did something you were not good at</td>
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<td>Unable to finish job, task, or chore</td>
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<td>Unable to finish all plans for the week</td>
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<td>Was late for work or appointment</td>
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<td>Was graded or evaluated on your performance</td>
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<td>Worked late or overtime</td>
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<td>Not enough money for basics (food, clothing, etc.)</td>
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<td>Ran out of pocket money</td>
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<td>Had unexpected bills (traffic fines, etc.)</td>
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<td>Had problems paying bills</td>
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<td>Not enough money for fun (movie, eating out) or recreation</td>
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<td>Drove under bad conditions (traffic, weather)</td>
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<td>Had car trouble</td>
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<td>Had minor auto accident</td>
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<td>Argued with husband, wife, boyfriend, or girlfriend</td>
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<td>Child misbehaved</td>
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<td>Child had school problems</td>
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<td>Minor illness of husband, wife, child, or loved one</td>
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<td>Husband or wife had problems at work</td>
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<td>Not enough time for family and friends</td>
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<td>31. Had household chores (shopping, cooking, etc.)</td>
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<td>32. Had minor home repairs</td>
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<td>33. Had problems with neighbors</td>
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<td>34. Ran out of food or personal item</td>
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<td>35. Your property was damaged</td>
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<td>36. Store did not have something you wanted</td>
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<td>37. Had problems with pet (dog, cat, etc.)</td>
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<td>39. Was told what to do</td>
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<td>40. Was lied to, fooled or tricked</td>
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<td>41. Was misunderstood or misquoted</td>
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<td>42. Had confrontation with someone of authority (police, boss)</td>
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<td>43. Was criticized or verbally attacked</td>
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<td>44. Was around unpleasant people (drunk, bigot, rude)</td>
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<td>45. Had unexpected guests</td>
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<td>46. Did poorly because of others</td>
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<td>47. Was forced to socialize</td>
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<td>48. Someone broke a promise</td>
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<td>49. Someone broke an appointment</td>
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<td>50. Competed with someone</td>
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<td>51. Argued with a friend</td>
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<td>52. Not enough time to socialize</td>
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<td>53. Was ignored by others</td>
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<td>54. Had someone disagree with you</td>
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<td>55. Spoke or performed in public</td>
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<td>56. Was interrupted while talking</td>
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<td>57. Was stared at</td>
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<td>58. Had someone 'scream' in front of you in line</td>
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<td>59. Unable to express self clearly</td>
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<td>60. Had unwanted physical contact (crowded)</td>
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<td>61. Deal with rude waiter, waitress, or salesperson</td>
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<td>62. Was without privacy</td>
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<td>63. Was excluded or left out</td>
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<td>64. Had too many responsibilities</td>
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<td>65. Had to make important decision</td>
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Fill in 1 box
Important 3 or
more items
this week
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<tr>
<td>66. Did not hear from someone you expected to</td>
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<td>67. Was disturbed while trying to sleep</td>
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<td>68. Forgot something</td>
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<td>69. Heard some bad news</td>
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<td>70. Was clumsy (spilled or knocked something over)</td>
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<td>71. Lost or misplaced something (wallet, keys)</td>
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<td>72. Had legal problems</td>
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<td>73. Waited longer than you wanted</td>
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<td>74. Did something you did not want to do</td>
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<td>75. Had to face a feared situation or object</td>
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<td>76. Had “pet peeve” violated (someone fails to knock, etc.)</td>
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<td>77. Failed to understand something</td>
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<td>78. Had close escape from danger</td>
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<td>79. Had minor accident (broke something, tore clothing)</td>
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<td>80. Someone borrowed something without asking</td>
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<td>81. Had minor injury (stubbed toe, sprained ankle, etc.)</td>
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<td>82. Was physically uncomfortable (cold, wet, hungry)</td>
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<td>83. Stopped unwanted habit (smoking, overeating, etc.)</td>
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<td>84. Interrupted while relaxing</td>
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<tr>
<td>85. Not enough time for fun (move, eating out) or recreation</td>
<td>X</td>
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<td>86. Did poorly at sport or game</td>
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<td>87. Saw an upsetting TV show, movie, or read an upsetting book, etc.</td>
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<td>Any we missed? (List below)</td>
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<td>89.</td>
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</table>
Appendix E
Perceived Stress Scale

INSTRUCTIONS:
The questions in this scale ask you about your feelings and thoughts during THE LAST MONTH. In each case, you will be asked to indicate your response by placing an "X" over the circle representing HOW OFTEN you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don’t try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>24. In the last month, how often have you been upset because of something that happened unexpectedly?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>25. In the last month, how often have you felt that you were unable to control the important things in your life?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>26. In the last month, how often have you felt nervous and “stressed”?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>27. In the last month, how often have you dealt successfully with day to day problems and annoyances?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>28. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>29. In the last month, how often have you felt confident about your ability to handle your personal problems?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>30. In the last month, how often have you felt that things were going your way?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>31. In the last month, how often have you found that you could not cope with all the things that you had to do?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>32. In the last month, how often have you been able to control irritations in your life?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>33. In the last month, how often have you felt that you were on top of things?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tbody>
</table>
34. In the last month, how often have you been angered because of things that happened that were outside of your control?

<table>
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<tr>
<th></th>
<th>Never (0)</th>
<th>Almost Never (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Very Often (4)</th>
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</table>

35. In the last month, how often have you found yourself thinking about things that you have to accomplish?

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<thead>
<tr>
<th></th>
<th>Never (0)</th>
<th>Almost Never (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Very Often (4)</th>
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</table>

36. In the last month, how often have you been able to control the way you spend your time?

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<tr>
<th></th>
<th>Never (0)</th>
<th>Almost Never (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Very Often (4)</th>
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37. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

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<tr>
<th></th>
<th>Never (0)</th>
<th>Almost Never (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Very Often (4)</th>
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Appendix F

Birmingham IBS Symptom Questionnaire

Instructions: The following questions ask you about your abdominal and bowel symptoms. When we use the word abdomen we mean belly/tummy. Some of the questions ask about passing a stool. By this we mean going to the toilet for a reason other than to urinate (pass water). All of these questions refer to the last 4 weeks.

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>A good bit of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
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<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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</table>

1. During the last 4 weeks, how often have you had discomfort or pain in your abdomen?
2. How often have you been troubled with loose, mushy or watery bowel motions during the last 4 weeks?
3. How often during the last 4 weeks have you been troubled with diarrhea?
4. During the last 4 weeks how often have you been troubled by hard bowel motions?
5. During the last 4 weeks how often have you felt the need to strain to pass a motion (stool)?
6. During the last 4 weeks how often have you been troubled by constipation?
7. During the last 4 weeks how often did you experience pain or discomfort in your abdomen after eating?
8. How often has abdominal pain prevented you from sleeping, or woken you during the night during the last 4 weeks?
9. During the last 4 weeks how often have you leaked or soiled yourself?
10. How often during the last 4 weeks have you suffered from a feeling of urgency (feeling that you must immediately rush to the toilet to pass a stool)?
11. How often have you passed mucus or slime in your stools over the last 4 weeks?
Appendix G

Center for Epidemiologic Studies Depression–Revised

Below is a list of some ways you may have felt or behaved. Please indicate how often you have felt this way during the last week by checking the appropriate space. Please only provide one answer to each question.

<table>
<thead>
<tr>
<th>During the past week:</th>
<th>Rarely or none of the time (less than 1 day)</th>
<th>Some or a little of the time (1-2 days)</th>
<th>Occasionally or a moderate amount of time (3-4 days)</th>
<th>Most or all of the time (5-7 days)</th>
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</thead>
<tbody>
<tr>
<td>1. I was bothered by things that usually don't bother me.</td>
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<tr>
<td>2. I did not feel like eating; my appetite was poor.</td>
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<td>3. I felt that I could not shake off the blues even with help from my family or friends.</td>
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<td>4. I felt I was just as good as other people.</td>
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<td>5. I had trouble keeping my mind on what I was doing.</td>
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<td>6. I felt depressed.</td>
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<td>7. I felt that everything I did was an effort.</td>
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<td>8. I felt hopeful about the future.</td>
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<td>9. I thought my life had been a failure.</td>
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<td>10. I felt fearful.</td>
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<td>11. My sleep was restless.</td>
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<td>12. I was happy.</td>
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<td>13. I talked less than usual.</td>
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<td>15. People were unfriendly.</td>
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<td>16. I enjoyed life.</td>
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<td>17. I had crying spells.</td>
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<td>18. I felt sad.</td>
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<td>19. I felt that people disliked me.</td>
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<td>20. I could not get going.</td>
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Appendix H

Informed Consent

Dear Participant,

You are being asked to participate in a University of Maine research project. The study is being conducted by Natalie Roy, M.A., a graduate student in the Department of Psychology, and Dr. Douglas W. Nangle, a Professor in the Department of Psychology. The purpose of this research is to learn more about college students’ physical health, quality of life, mood, and problem solving. You must be at least 18 years old to participate in this study. Your participation will help further the understanding of how the above factors influence one another.

What will you be asked to do during this study?

- You will be asked to answer survey questions online, at three time points, for approximately 40 minutes each time.
  - You will be assigned a random study ID number via email. You will be asked to enter the ID number in the survey online (this will not be associated with your name and cannot be linked back to you).
  - The first time you participate, the survey will ask you for demographic information about yourself (e.g., age, race, gender).
  - You will be asked to answer questions about your mood (e.g., How often do you feel worried) and health-related questions (e.g., how often do you feel aches and pains). Additionally, you will be asked questions about the way you solve problematic social situations.

What are the Risks?

Some questions may make you feel uncomfortable or distressed. You may skip any question that you do not wish to answer, and can elect to end your participation in the study at any time. If you would like to speak with a professional about your experiences, you are encouraged to contact the University of Maine Counseling Center (207-581-1392), which provides free services to UMaine students. Information about the Counseling Center, including their hours of operation, can be found at http://umaine.edu/counseling/contact-us/

The risks associated with completing the online questionnaires at Qualtrics are thought to be no greater than the risks encountered during routine internet access. Qualtrics has enhanced security and safety measures in place to protect the website and its users from fraud, and states that customers’ information will not be used for any other purposes. You can find out more information about their security by clicking on the privacy statement found at www.qualtrics.com.

What are the Benefits?
Although there may be no direct benefit to you for participating in this research, your responses will tell us more about college students with regard to mental and physical well-being and social behavior. This knowledge could help psychologists design more effective intervention programs for individuals who struggle with chronic health conditions and who engage in less-adaptive social behavior.

**Is there Compensation?**

You will receive three research credits, $30 in e-gift cards, or a combination of credits and e-gift cards, for completing the three online sessions. Even if you choose to skip some questions, you will still receive credit for participating. Just be sure to follow the link at the end of each survey that takes you to a separate page to claim your compensation (this link will not be connected to your survey answers in any way and cannot be linked back to you).

**Will my Answers be Private?**

Answers are completely anonymous. Names will not be attached to the responses collected and the information will only be used for research purposes. Participant responses will be downloaded to a desktop computer stored in a locked laboratory room that is only accessible to the principal investigators and research assistants. If the data are used for a research publication or conference presentation, they will be presented in a summary format only. The data will be kept indefinitely.

**Is this Voluntary?**

Your participation in this study is voluntary. You may choose to withdraw from the study at any point and skip any questions that you do not want to answer and still receive your compensation.

**Questions or Concerns?**

If you have questions about this study, please email me at natalie.holbrook@maine.edu You may also email the faculty advisor on this study, Dr. Douglas Nangle at dnangle@maine.edu. If you have any questions about your rights as a research participant, please contact Gayle Jones, Assistant to the University of Maine’s Protection of Human Subjects Review Board, at (207) 581-1498.

Sincerely,

Natalie Roy, M.A.
Graduate Student in the Developmental-Clinical Psychology Ph.D. Program
University of Maine

*I have read and understood the above information and I understand that moving forward with this survey indicates my consent to participate in the project. I understand that I have the right to skip any questions that I wish and to stop my participation at any time.*
Appendix I

Thank you and Resource List

Thank you for your time and participation in our study! In order to obtain your compensation for completion of today’s questionnaires, please click on the following link: https://umaine.qualtrics.com/ Please note, this link is not connected to your survey answers in any way and cannot be linked back to you. If you are experiencing any distress after completing the questionnaires and would like to seek counseling, we have provided a resource list below.

<table>
<thead>
<tr>
<th>Community Resources</th>
<th>University of Maine Counseling Center 125 Cutler Health Building</th>
<th>Community Health &amp; Counseling Services 42 Cedar Street Bangor, ME 04401 (Any costs are your responsibility)</th>
<th>Northeast Crisis Services 1-888-568-1112 (Any costs are your responsibility)</th>
<th>Psychological Services Center 330 Corbett Hall (Sliding fee scale)</th>
<th>Contact Your Primary Care Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weekdays 8:00am – 4:30pm</td>
<td>7 days/week 24 hours</td>
<td></td>
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<tr>
<td>NATIONAL RESOURCES</td>
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<tr>
<td>Mental Health Services Locator <a href="http://store.samhsa.gov/mhlocator">http://store.samhsa.gov/mhlocator</a></td>
<td>National Suicide Prevention Lifeline, Toll-Free, 24-hour Hotline 1-800-273-TALK (1800-273-8255)</td>
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</table>
Appendix J

Information for Compensation

Please enter your name and email address below to receive either course credit or an Amazon e-gift card for today’s participation. You will receive your credits and/or Amazon e-gift cards at the completion of the entire study (after you have completed all three sessions).

Name:

Email address:

Which type of compensation are you requesting for today (select one):

(  ) Course Credit       (  ) Amazon E-gift Card
BIOGRAPHY OF THE AUTHOR

Natalie M. Roy is in the Developmental-Clinical Track of the Doctoral Program in Clinical Psychology at the University of Maine. Before joining the University of Maine, Natalie received her B.A. in Psychology from the University of California, Berkeley. She also worked as a research associate at the University of California, San Francisco where she assisted with intervention research for treatment-resistant depression, including mindfulness-based cognitive therapy and a health enhancement program. Natalie was also involved in psychosocial intervention research, conducting cognitive, achievement, and neuropsychological tests for children with ADHD. At the University of Maine, Natalie’s research interests include the assessment and treatment of internalizing disorders in the emerging adulthood stage, and the transactional relationships among stress, social problem-solving deficits, psychological wellbeing, and physical health problems. To date, she has presented her research as a first- or co-author at nine national conferences. Additionally, she has first-authored an article in the *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, which focuses on the interconnections among perceived stress, social problem-solving ability and gastrointestinal distress. On June 12, 2019, Natalie was commissioned as a Captain in the U.S. Air Force and is currently completing her predoctoral internship at Malcolm Grow Medical Clinics and Surgery Center – Joint Base Andrews in Maryland. She is a candidate for the Doctor of Philosophy degree in Psychology with a concentration in Clinical Psychology from the University of Maine in August 2020.