Interconnections Among Perceived Stress, Social Problem Solving, and Gastrointestinal Symptom Severity

Natalie M. Roy[1] · Rebecca Schwartz-Mette[1] · Douglas W. Nangle[1]

Abstract

Maladaptive social problem-solving (SPS) plays a significant mediating role in the negative impact of stressful life events on wellbeing. With a basis in D'Zurilla and Nezu's (Problem-solving therapies, 2nd ed., The Guilford Press, New York, pp. 211–245, 2001) relational/problem-solving model of stress and wellbeing, we examined interrelations amongst stress, SPS, and gastrointestinal (GI) symptoms and tested several mediational models: maladaptive forms of SPS as mediators of the relationship between stress and GI symptoms, and stress as a mediator of maladaptive forms of SPS and GI symptoms. Undergraduates ($N=345$) completed the Perceived Stress Scale, the Social Problem-Solving Inventory-Revised, and the Birmingham IBS Symptom Questionnaire. Pearson correlation coefficients revealed that all measures were significantly related in the expected directions. Stress was a significant mediator in the models with maladaptive SPS dimensions as independent variables, but SPS did not mediate the stress/GI symptom relationship. Results demonstrate links amongst stress, SPS, and GI symptoms, and suggest that poorer SPS leads to higher levels of stress, which, in turn, increases GI symptom severity.

Keywords Stress · Gastrointestinal symptoms · Social problem-solving · Descriptive survey study

Introduction

Social problem solving (SPS) is a self-guided cognitive and behavioral process by which a person attempts to manage problems or stressful situations, and is considered a distinct form of coping as it involves adapting to stressful life events (Nezu 2004). Adaptive SPS is thought to facilitate adaptation to stress by increasing the likelihood of better outcomes through the resolution of existing problems, prevention of new problems, or the enhancement of one's ability to manage emotions in

✉ Natalie M. Roy
  natalie.holbrook@maine.edu

[1] University of Maine, Orono, ME, USA

unchangeable situations (D'Zurilla and Nezu 2010). In contrast, maladaptive SPS is presumed to adversely impact adaptation to stress and is associated with a range of documented negative outcomes, including interpersonal difficulties, depression, anxiety, and physical health issues (Nezu 2004).

Containing several related, yet distinct components, SPS is one of the more robust constructs in clinical psychology. According to SPS theory, problem-solving outcomes are largely determined by two independent processes, problem orientation and problem-solving style (D'Zurilla and Nezu 2010). Problem orientation refers to how people generally think or feel about problems and their problem-solving ability. Two types of orientations exist, positive problem orientation (PPO) and negative problem orientation (NPO; Nezu 2004). PPO is the tendency to view problems as solvable and as learning opportunities that can lead to personal growth, whereas NPO is the tendency to doubt personal problem-solving ability and to view problems as significant threats to wellbeing. Although features of PPO and NPO overlap, they are distinct constructs that are best conceptualized as two separate dimensions rather than the opposite ends of a single dimension. This is due to PPO eliciting positive emotions and approach tendencies that tend to facilitate problem-solving performance, whereas NPO elicits negative emotions and avoidance tendencies that are likely to hinder or disrupt problem-solving performance (D'Zurilla and Nezu 2010).

SPS theory also affirms that three problem-solving styles, independent of orientation, help to determine problem-solving outcomes (Nezu 2004). These styles are rational problem-solving style (RPS), impulsive/careless style (ICS), and avoidant style (AS). RPS is a constructive problem-solving approach that is deliberate and systematic in generating solutions and decision making; ICS is a tendency to make careless and hurried attempts to solve problems, and AS involves procrastination, passivity, and inaction towards problem-solving. RPS is further divided into four components: Problem Definition and Formulation (i.e., defining the problem by obtaining relevant and factual information, and formulating a set of realistic problem-solving goals), Generation of Alternative Solutions (i.e., maximizing the likelihood of the best possible solution by identifying or creating as many solution alternatives as possible), Decision Making (i.e., comparing the solution alternatives identified or created, and implementing the best one), and Solution Implementation and Verification (i.e., self-monitoring and evaluating the outcome after the best solution is implemented). As such, higher levels of PPO and RPS are considered adaptive, whereas higher levels of NPO, ICS, and AS are considered maladaptive (see Nezu 2004, for a review).

The Relational/Problem-Solving Model of Stress and Wellbeing

D'Zurilla and Nezu (2001) assert that the relationship between stress, SPS, and adjustment is best conceptualized in their relational/problem-solving model of stress and wellbeing. The model posits that increased stress and/or problems, poorer problem-solving ability, and decreased wellbeing act in a transactional manner, interacting and evolving with time. The first major application of this 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). The model has been supported by a number of empirical investigations with psychological symptoms, including positive associations with SPS deficits and depressive and anxiety symptomatology (e.g., Anderson et al. 2009; Becker-Weidman et al. 2010).

The model has also garnered support in studies examining physical problems often linked with stress (e.g., tension and migraine headaches, noncardiac chest pain; Eskin et al. 2013; Nezu et al. 2008). For example, a recent study compared patients with migraine headaches, patients with tension type headaches, and healthy controls using the Perceived Stress Scale (PSS; Cohen et al. 1983) and the Social Problem-Solving Inventory-Revised (SPSI-R; D'Zurilla et al. 2002). Patients who reported either migraines or tension type headaches reported higher PSS and NPO scales and lower PPO scores than controls, supporting links between physical health problems and increased stress and physical health problems in the context of less adaptive SPS. Additionally, Nezu et al. (2008) tested each SPS dimension as a mediator of the relationship between perceived stress and noncardiac chest pain in adults. This study also included the PSS and SPSI-R, and self-ratings of chest pain and frequency during the past month on a Likert scale of 1 (*no pain*) to 7 (*severe pain*). Regression analyses confirmed that higher levels of stress predicted higher pain frequency. Further, NPO, AS, and ICS each mediated the effects of stress on chest pain frequency, indicating that less adaptive coping was associated with worsened pain symptoms. In sum, maladaptive SPS appears to exacerbate stress' impact on both psychological symptoms and physical health problems.

Gastrointestinal Symptoms

Although the relational/problem-solving model of stress and wellbeing has been tested with several psychological and physical health problems, it has not yet been examined with GI symptoms. To date, studies have identified associations between perceived stress and inflammatory bowel symptom activity for Crohn's disease and ulcerative colitis (Sexton et al. 2017; Targownik et al. 2015). Other studies have linked daily stressful events, as well as stress levels, with gastrointestinal symptom severity (see Pletikosić and Tkalčić 2016, for a review). As one example, Blanchard et al. (2008) assessed gastrointestinal symptoms and daily prospective measures of stress in 200 patients with Irritable Bowel Syndrome, a gastrointestinal disorder characterized by abdominal pain and irregular bowel behaviors. They found that that stress predicted subsequent GI symptoms one and 2 weeks later. According to the brain-gut axis theory, impaired cognitive appraisals of the environment increase stress, adversely impact coping abilities, and worsen GI symptom severity, which can further impair cognitive appraisals (Boeckxstaens et al. 2016; Kennedy et al. 2012; Van Oudenhove et al. 2016). This makes sense as stress can lead to increased vulnerability to negative cognitions (e.g., doubting one's own ability to solve GI-related problems), which can increase GI symptom severity. Further, GI symptoms may increase stress and/or serve as stressors themselves, thereby fueling a negative cycle that is self-maintaining. Due to this self-maintaining cycle of negative

cognitions, impaired appraisals, heighted stress, and debilitating GI symptoms—all of which are transactional—the relational/problem-solving model of stress and well-being is an ideal framework to examine the interactive influences of stress, SPS, and GI symptom severity.

The Current Study

The present study examined the interactive influences of stress, SPS, and GI symptom severity. Though some past studies have examined associations between stress and GI symptoms, this study is the first to investigate the influence of SPS on both variables. Consistent with the relational/problem-solving model of stress and well-being, we hypothesized positive relationships amongst stress, maladaptive SPS (i.e., NPO, AS, and ICS), and GI symptoms. Conversely, we hypothesized that adaptive SPS (i.e., PPO and RPS) would be negatively related to stress and GI symptom severity. Further testing the model, we examined SPS dimensions as mediators of the relationship between perceived stress and GI symptoms. Consistent with the relational/problem solving model, we also tested perceived stress as a mediator between SPS and GI symptoms (Kant et al. 1997). Many past studies have focused their examination of the model on SPS as a mediator in the relationship between stress and wellbeing (e.g., Nezu et al. 2008). Alternately, Kant et al. (1997) proposed that, because of the transactional nature of the model, it is equally important that stress be included as a mediator.

Methods

Participants

Three hundred and forty-five undergraduate students (130 men, 215 women) from a rural New England university were recruited via a web-based scheduling program. For the purposes of this study, GI symptoms were treated as a continuous variable and participants were not screened for particular diagnoses (e.g., Irritable Bowel Syndrome). They received credit as part of an introductory psychology course. Participants were aged 18–25 years old ($M_{age} = 18.89$; $SD = 1.16$) and self-identified as 89.6% White, 3.8% Latino, 3.5% Black, 1.7% Asian, 1.2% American Indian/Native American, and 1.4% Other.

Measures

Demographic Questionnaire

A demographic questionnaire was used to collect information about participants' age, gender, and race/ethnicity.

Social Problem-Solving Ability

The Social Problem-Solving Inventory-Revised (SPSI-R; D'Zurilla et al. 2002) is a multidimensional self-report measure that assesses strengths and weaknesses in social problem-solving ability. It has 52 items that describe general response tendencies in problem situations, and responses best characterize how individuals believe they would resolve such problems. Items are rated 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 and Nezu's revised problem-solving model, two of orientation: Positive Problem Orientation (PPO) and Negative Problem Orientation (NPO), and three of style: Rational Problem Solving (RPS), Impulsivity/Carelessness Style (ICS), and Avoidance Style (AS). Higher scores on PPO and RPS are associated with the use of adaptive problem-solving strategies, whereas higher scores on NPO, ICS, and AS are associated with the use of maladaptive strategies. Previous investigations have shown significant associations between the SPSI-R and measures of depression and anxiety in college students (e.g., Anderson et al. 2009) and the measure has demonstrated good psychometric properties in this population (D'Zurilla et al. 2002).

Perceived Stress

The Perceived Stress Scale (PSS; Cohen et al. 1983) is a 14-item self-report measure that assesses the degree to which individuals perceive particular situations to be stressful. PSS items are rated on a 5-point Likert scale from *never* (0) to *very often* (4). Half of the items are negative in format, while the other half are positive. An example of a negative item is "In the last month, how often have you been able to control irritations in your life?"; positive item, "In the last month, how often have you felt nervous and 'stressed'?" The current study only examined the total scores, which can be calculated by reverse-coding the positive items and then summing the scores for all items. Higher scores indicate higher levels of perceived stress. Studies have demonstrated good psychometric properties in college samples (Örücü and Demir 2009), as well as in populations with physical health ailments (e.g., Eskin et al. 2013; Nezu et al. 2008).

Gastrointestinal Symptom Severity

The Birmingham IBS Symptom Questionnaire (B-IBS; Roalfe et al. 2008) is an 11-item self-report measure that assesses GI distress. The B-IBS items are rated on a 5-point Likert scale ranging from *none of the time* (0) to *all of the time* (5). Sample

items include: "During the last 4 weeks, how often had you had discomfort or pain in your abdomen?" and "How often have you been troubled with loose, mushy, or watery bowel motions during the last 4 weeks?" A total score can be created by summing the scores for all items. The current study only examined total scores, and higher scores indicate higher symptom severity. The B-IBS has demonstrated good psychometric properties in an IBS-diagnosed sample (Roalfe et al. 2008) and in a non-IBS-diagnosed university student sample, similar to the current investigation (Jasper et al. 2015). In both studies, total scores were negatively associated with the well-validated irritable bowel syndrome quality of life assessment (IBS-QOL).

Procedure

Approval to conduct the present study was obtained from the university's Institutional Review Board for the Protection of Human Subjects, and informed consent was obtained from all participants. All participants completed a battery of questionnaires at one time point using online survey software. Completion of all questionnaires took participants approximately 40 min.

Results

Taking a conservative approach, only participants who completed all items on every measure were included in the analyses. Moreover, in an effort to remove overly rushed responses, participants who completed the entire battery of questionnaires in 10 min or less were excluded. Outliers above or below three standard deviations were winsorized (Field 2014).

Descriptive Statistics, *T* tests, and Correlational Analyses

See Table 1 for obtained score ranges on the measures. Independent sample *t* tests revealed that women reported significantly higher total scores than men for NPO [$t(343) = -3.16$, $p = .002$], RPS [$t(343) = -2.16$, $p = .031$], PSS [$t(343) = -4.01$, $p < .001$] and B-IBS [$t(343) = -2.41$, $p = .016$]. Men and women did not report significantly different levels of any other variables.

Next, Pearson correlation coefficients among all variables were computed to determine bivariate relationships (see Table 2). As expected, PSS scores were significantly related to each of the maladaptive SPS dimensions (NPO, ICS, and AS) in the positive direction and to PPO in the negative direction (*r*'s ranged from .32 to .66 for the maladaptive dimensions, $r = -.36$ for PPO; all *p*'s < .01). PSS scores were not significantly related to RPS. As hypothesized, each of the maladaptive SPS dimensions was positively related to B-IBS scores (*r*'s ranged from .16 to .26; all *p*'s < .01). In contrast, the adaptive SPS dimensions (PPO and RPS) were not significantly related to B-IBS scores. As hypothesized, the PSS scores were significantly related to B-IBS scores ($r = .32$, $p < .01$).

Table 1 Mean group differences in study variables

Variable	Possible range	Observed range	M (SD)
PSS	0–56	5–48	26.05 (7.61)
		5–43	**23.98 (7.12)**
		8–48^	27.31 (7.66)^
PPO	0–20	0–20	9.56 (4.60)
		0–20	**9.48 (4.74)**
		0–20^	9.60 (4.52) ^
NPO	0–40	0–39	12.35 (8.88)
		0–37	**10.43 (7.73)**
		0–39^	13.51 (9.34)^
RPS	0–80	0–74	35.17 (15.76)
		0–73	**32.82 (15.21)**
		0–74^	36.59 (15.95)^
ICS	0–40	0–26	9.94 (6.13)
		0–26	**10.27 (5.89)**
		0–25^	9.74 (6.28)^
AS	0–28	0–25	8.78 (5.83)
		0–20	**8.07 (5.03)**
		0–25^	9.20 (6.24)^
B-IBS	0–55	0–29	6.85 (7.47)
		0–29	**5.61 (7.35)**
		0–29^	7.60 (7.46)^

Normal font = whole sample; Bolded font = males; Normal font with ^ = females

PSS Perceived Stress Scale, *PPO* Positive Problem Orientation, *NPO* Negative Problem Orientation, *RPS* Rational Problem Solving, *ICS* Impulsive/Careless Style, *AS* Avoidant Style, *B-IBS* Birmingham IBS Symptom Questionnaire

Table 2 Correlations among study variables for the entire sample

Variable	1	2	3	4	5	6	7
1. PSS	–	− .361**	.658**	− .092	.318**	.440**	.323**
2. PPO		–	− .247**	.762**	− .032	− .218**	− .091
3. NPO			–	.069	.663**	.752**	.257**
4. RPS				–	− .010	− .007	.042
5. ICS					–	.702**	.167**
6. AS						–	.161**
7. B-IBS							–

PSS Perceived Stress Scale, *PPO* Positive Problem Orientation, *NPO* Negative Problem Orientation, *RPS* Rational Problem Solving, *ICS* Impulsive/Careless Style, *AS* Avoidant Style, *B-IBS* Birmingham IBS Symptom Questionnaire

$*p < .05$; $**p < .01$

Table 3 Correlations among study variables for men and women

Variable	1	2	3	4	5	6	7
1. PSS	–	−.351**	.643**	−.050	.374**	.448**	.303**
2. PPO	−.411**	–	−.314**	.742**	−.131	−.315**	−.110
3. NPO	.656**	−.140	–	.045	.681**	.756**	.161*
4. RPS	−.251**	.806**	.062	–	−.097	−.095	.018
5. ICS	.261**	.136	.683**	.165	–	.690**	.036
6. AS	.397**	−.039	.735**	.146	.758**	–	.038
7. B-IBS	.310**	−.068	.404**	.044	.422**	.390**	–

Lower diagonal = men; upper diagonal = women

PSS Perceived Stress Scale, *PPO* Positive Problem Orientation, *NPO* Negative Problem Orientation, *RPS* Rational Problem Solving, *ICS* Impulsive/Careless Style, *AS* Avoidant Style, *B-IBS* Birmingham IBS Symptom Questionnaire

*$p < .05$; **$p < .01$

Correlations were also examined by gender (see Table 3). Similar to results for the entire sample, men's and women's PSS scores were significantly related to each maladaptive SPS dimension (*r*'s ranged from .26 to .66, all *p*'s < .01) and PPO in the expected directions ($r = −.41$, $p < .01$). Men's B-IBS scores also followed the same pattern as the entire sample; the B-IBS scores were significantly related to each maladaptive dimension (*r*'s ranged from .39 to .42, all *p*'s < .01). Unlike the entire sample, men's PSS scores were also significantly related to RPS (negative direction; $r = −.25$, $p < .01$). Regarding the B-IBS, women's scores contrasted with the entire sample, NPO was the only SPS dimension significantly related to the B-IBS (positive direction; $r = .16$, $p < .05$).

Social Problem Solving as a Mediator of the Relation Between Stress and Gastrointestinal Symptoms

Prior to conducting mediation analyses, the direct effect of the proposed independent variable, perceived stress, and the dependent variable, GI symptom severity, was tested using simple linear regression (Baron and Kenny 1986). PSS scores significantly predicted B-IBS scores ($b = .32$, $p < .001$). Next, conducting separate models, we tested each SPS dimension as a mediator of the relationship between stress and GI symptom severity, using PROCESS (Field 2014). PROCESS was selected as it uses a bootstrapping method that does not assume a normal distribution (Hayes 2013). Using 95% confidence intervals, results not including a 0 were considered significant (Field 2014). None of the SPS dimensions emerged as significant mediators in this relationship, indirect effect for PPO: $b = −.01$, BCa CI [−.0478, .0261]; NPO: $b = .05$, BCa CI [−.0479, .1499]; RPS: $b = −.01$, BCa CI [−.0237, .0043]; AS: $b = .01$, BCa CI [−.0521, .0680]; ICS: $b = .02$, BCa CI [−.0189, .0654]; see Fig. 1 for model.
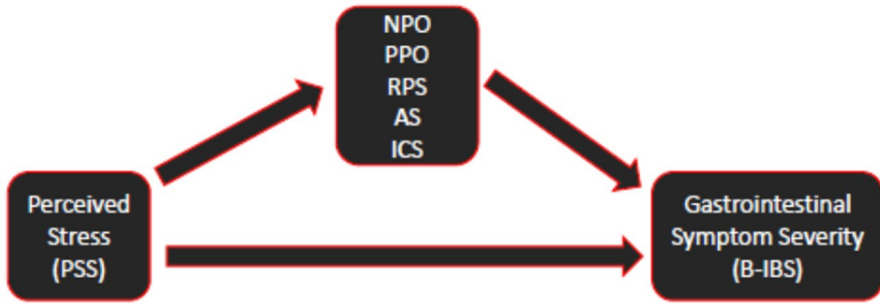
Fig. 1 Testing each social problem-solving dimension as a mediator of the relationship between perceived stress and gastrointestinal symptom severity; *NPO* Negative Problem Orientation, *PPO* Positive Problem Orientation, *RPS* Rational Problem Solving, *AS* Avoidant Style, *ICS* Impulsive Careless Style

Stress as a Mediator Between Social Problem Solving and Gastrointestinal Symptoms

Prior to conducting mediation analyses, the direct effects of each SPS dimension on GI symptom severity were tested using simple linear regression. Each maladaptive SPS dimension significantly predicted the B-IBS (NPO: $b = .22$; AS: $b = .21$; ICS: $b = .20$, all p's < .01). The adaptive SPS dimensions did not significantly predict B-IBS scores (PPO: $b = -.15$, $p = .09$; RPS: $b = .02$, $p = .44$). Then, using separate models, we tested PSS as a mediator of the relationship between each maladaptive SPS dimension and B-IBS scores (see Fig. 2 for model). There was a significant indirect effect of NPO, AS, and ICS through PSS (in the model with NPO: $b = .15$, BCa CI [.0790, .2249]; with AS: $b = .18$, BCa CI [.1063, .2623]; with ICS: $b = .12$, BCa CI [.0648, .1763]). This accounted for 17.9%, 13.8%, and 9.5% of the variance, respectively.

To explore potential further moderation by gender in these mediation analyses, conditional process analysis was used to determine whether gender moderated the
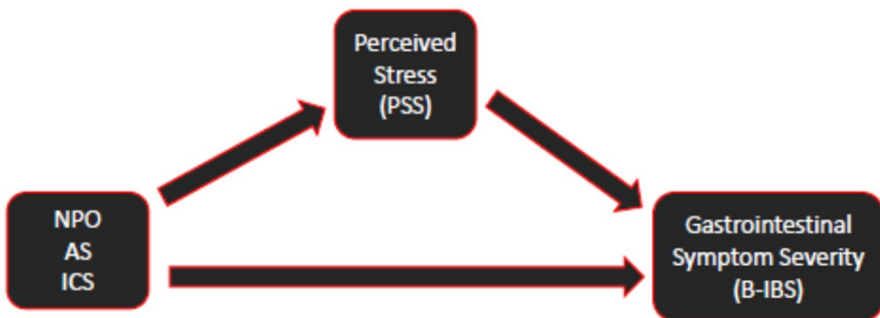

Fig. 2 Testing perceived stress as a mediator of the relationship between each maladaptive social problem-solving dimension and gastrointestinal symptom severity; *NPO* Negative Problem Orientation, *AS* Avoidant Style, *ICS* Impulsive Careless Style
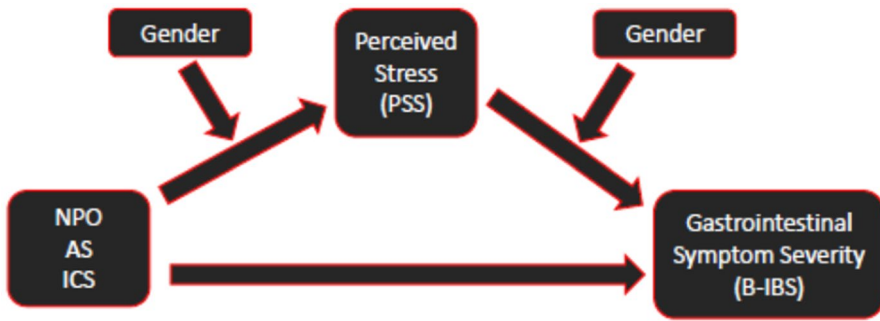
Fig. 3 Testing whether gender moderated the association between the maladaptive social problem-solving dimensions and perceived stress and/or the association between perceived stress and gastrointestinal symptom severity; *NPO* Negative Problem Orientation, *AS* Avoidant Style, *ICS* Impulsive Careless Style; NPO/AS/ICS to the PSS illustrates pathway *a*, and the PSS to the B-IBS illustrates pathway *b* (combined is the indirect pathway)

association between the maladaptive SPS dimensions and perceived stress and/or the association between perceived stress and GI symptom severity (Field 2014; see Fig. 3). Gender did not significantly moderate any of the paths tested, suggesting that each of the paths in the mediation models functioned similarly for men and women.

Discussion

Stress, Social Problem Solving, and Gastrointestinal Symptom Severity

By linking SPS and GI symptom severity, this study extends the prior demonstrated associations between stress and SPS (e.g., Bell and D'Zurilla 2009; Chang and Videlock 2017). and between stress and GI symptoms (e.g., Blanchard et al. 2008). In doing so, GI distress joins a list of physiological symptoms, including tension and migraine headaches (Eskin et al. 2013) and chest pain (Nezu et al. 2008) found to be related to SPS. This finding is consistent with the brain-gut axis theory, which connects maladaptive cognitive appraisals, higher levels of stress, poorer coping, and worsening of GI symptom severity (Kennedy et al. 2012). Since GI symptoms can be exacerbated by stress and psychological factors, learning more about the possible contributions of cognitive processes, such as SPS, is particularly important.

A second significant contribution is our testing of two potentially viable mediation models extrapolated from the literature on relational/problem-solving models of stress. We found mixed support for the propositions based on this model. Perceived stress mediated the relationship between each maladaptive SPS dimension and GI symptom severity, consistent with the transactional assertions of Kant et al. (1997). Stress appears to at least partially explain the relationship between poorer coping appraisals and the worsening of GI symptom severity. Stress as a mediator is consistent with the findings of Davila et al. (1995), who found that poorer problem-solving

ability predicted higher levels of stress, which, in turn, led to increased depressive symptoms. These authors described their findings in the context of the stress-generation hypothesis that asserts people 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 risk for depression. Applied to the current study, the stress-generation hypothesis would suggest that those prone to experience GI symptoms behave in ways that increase their level of perceived stress (i.e., they will engage in more maladaptive SPS), thereby creating more stress by not resolving, and perhaps even exacerbating, their problems. This can result in additional stress (i.e., worsening of problems or increase in number of problems), which can further impair problem-solving ability and worsen GI symptoms.

Importance of Maladaptive Social Problem Solving Styles

As found in a number of past studies, it was the maladaptive SPS styles (NPO, AS, and ICS) that accounted for the majority of the significant findings (e.g., Frye and Goodman 2000; Reinecke et al. 2001). Significant stress mediation emerged only in the models testing the relations between the maladaptive styles and GI symptom severity. Further, as in past studies, the maladaptive SPS dimensions were significantly related to wellbeing, whereas the adaptive dimensions were not (e.g., D'Zurilla et al. 1998a). Brain-gut theory highlights the possibility that GI symptom-sufferers also exhibit some dysfunctional cognitive patterns (Kennedy et al. 2012). This makes sense as GI symptom sufferers with inefficient ways of handling problems in daily life (e.g., symptom flare ups) may view these problems as unsolvable and as a threat to wellbeing, doubt their own self-efficacy or ability to solve problems, and have a low frustration tolerance (all features characteristic of NPO). Additionally, the tendency to make decisions without carefully assessing a situation (i.e., ICS) or avoiding one's problems altogether (i.e., AS) could lead to exacerbated GI symptoms due to a lack of resolution (e.g., more problems and stress could flare symptoms) or higher levels of maladaptive cognitions, which also can result in symptom flare ups and poorer problem-solving attempts. The absence of findings for the RPS dimension also fits with past research on depression and anxiety (e.g., Reinecke et al. 2001; Siu and Shek 2010). This supports the notion that problem orientation is perhaps the most influential SPS element; even if a person has relatively adaptive RPS skills, having high levels of NPO may hinder the employment of those adaptive skills.

Role of Gender

An added contribution of this study was its examination of the role of gender, something surprisingly absent from the vast majority of past SPS investigations. Women reported higher levels of perceived stress, GI symptom severity, NPO, and RPS than men. Also for women, NPO was the only SPS dimension significantly related to GI symptom severity, whereas all three maladaptive dimensions were significantly related for the men. The fact that women in our sample reported higher levels of

perceived stress is not surprising (Baker 2003; Bell and 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. 1998b). 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 PSI) and turning against self and denial. 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 GI symptoms is consistent with the fact that GI symptoms are more prevalent in women than men (Chey et al. 2015) and GI symptoms have been paired with poorer cognitive appraisals (Kennedy et al. 2012).

Limitations

Of course, the present study also has limitations and due caution in interpreting the findings is warranted. First, the study targeted university students at a New England University as the participants. Thus, the sample was fairly homogenous in regard to ethnicity and age. When considering sample limitations, it is also important to consider that the participants were not screened for any formal GI diagnoses, such as Irritable Bowel Syndrome (IBS), and it is possible that the findings would not generalize to those with diagnosable disorders. Additionally, as is the case in most SPS research, this study relied on self-report measures. Self-reports are subjective and participants may answer questions in a manner that are viewed more favorably by others (e.g., under-reporting less desirable attributes). As an example, the SPS measure in our study, the SPSI-R, assesses what participants they think they would do in problematic situations as opposed to assessing what they would actually do. While acknowledging those limitations, we did use well-validated measures that are regularly used in published SPS studies (i.e., SPSI-R, PSS). Likewise, the B-IBS is a well-validated measure and has demonstrated good psychometric properties (Jasper et al. 2015; Roalfe et al. 2008). Nevertheless, future studies may consider including other types of measures. For instance, for SPS, studies could use a self-monitoring task that assesses real-life problem-solving performance (e.g., Anderson et al. 2011). It may also be fruitful to test the associations between stress, SPS, and GI symptoms in samples diagnosed with a gastrointestinal disorder. Lastly, as discussed above, the design of the study is concurrent. Though we found interesting results in our mediation model tests, studies employing longitudinal designs are needed.

Future Directions

In summary, this investigation found that perceived stress and GI symptom severity were positively and significantly related to each of the maladaptive SPS dimensions. Stress and each of the maladaptive SPS dimensions also predicted GI symptom severity and stress mediated the relationship between each maladaptive SPS dimension and GI symptom severity. These findings provide some

support for the brain-gut axis theory. Notwithstanding, however, was the failure of the maladaptive SPS dimensions to mediate the stress/GI symptom severity relationship. This is puzzling in light of past studies showing that maladaptive SPS mediates the association between stress and other health conditions. Clarifying the true interactional nature of these variables will require studies employing longitudinal rather than concurrent designs in which stress, SPS, and the outcome are measured at multiple points in time. In closing, we hope that this study will inspire future investigations into the importance of cognitive variables in the manifestation of diagnosed gastrointestinal conditions. Emphasizing the recognition of connections between beliefs about symptoms and the continuation of gastrointestinal distress, cognitive-behavioral therapy (CBT) has been recommended for the treatment of such disorders (Levy et al. 2006). By targeting maladaptive styles, problem-solving therapy (PST; D'Zurilla and Nezu 1999) in particular, may prove useful in treating those suffering from GI distress.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval Approval to conduct the present study was obtained from the university's Institutional Review Board for the Protection of Human Subjects.

Informed Consent Informed consent was obtained by all participants prior to their participation.

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