

Understanding the Unique Relationships Between Self-Compassion, Mindfulness, and Individual Adolescent
Depressive Symptoms: A Network Analysis

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Abstract

Disentangling the unique associations of self-compassion and mindfulness with adolescent depression has been an empirical challenge. Taking a symptom-level approach to adolescent depression using network analysis can address some of the most common conceptual and psychometric challenges in this area. Under this network analysis framework, some symptoms are more central, or predictive of the presence of other symptoms, than others. When evaluating associations between adolescent depressive symptoms and protective factors like self-compassion and mindfulness, stronger unique associations with more central symptoms may therefore be of particular interest. In this study, we estimate a mixed graphical model network containing individual depressive symptoms, mindfulness, and self-compassion in 1,055 adolescents. Self-compassion had stronger unique associations with more central symptoms (self-compassion edge-weight: -0.43, mindfulness edge-weight: -0.22) while mindfulness had stronger unique associations with all of the depressive symptoms (self-compassion edge-weight: -0.92, mindfulness edge-weight: -1.68). Self-compassion and mindfulness provided additive, unique associations to some symptoms, but there were multiple symptoms that were uniquely associated only with mindfulness or only with self-compassion. These findings suggest that self-compassion and mindfulness both can play uniquely important roles in adolescent depression, but their effectiveness as protective factors may depend on the individual symptoms the adolescent is at risk for or currently experiencing.

Keywords: depression, adolescence, network analysis, self-compassion, mindfulness, symptom-level

Depressive symptoms are a fact of life for a substantial number of adolescents. Approximately 10% experience major depressive disorder, or a clinically high elevation of symptoms, before turning 19 (Merikangas et al., 2010). An additional 20% of adolescents experience subclinical levels of symptoms (Bertha & Balázs, 2013).

Adolescent depressive symptoms are associated with a wide range of negative outcomes during adolescence and into adulthood (Birmaher et al., 1996; Parker & Roy, 2001; Thapar, Collishaw, Pine, & Thapar, 2012). Experiencing major depressive disorder in adolescence predicts a greater likelihood of a suicide attempt (Lewinsohn, Rohde, & Seeley, 1994) and worse functioning in school during adolescence (Jaycox et al., 2009). Further, experiencing major depressive disorder in adolescence predicts increased work impairment (Keenan-Miller, Hammen, & Brennan, 2007), and worse social functioning (Zisook et al., 2007) in adulthood. Even the presence of subclinical depressive symptoms is associated with greater likelihood of school dropout (Quiroga, Janosz, Bisset, & Morin, 2013) and increased suicidality (Balázs et al., 2013) during adolescence, along with increased risk of MDD and suicide attempts in adulthood (Fergusson, Horwood, Ridder, & Beautrais, 2005). So, even subclinical depressive symptoms are associated with negative outcomes during and beyond developmental stage defined by biological and social transitions (Cicchetti & Toth, 1998; Crone & Dahl, 2012).

Given these maladaptive short and long-term consequences of adolescent depressive symptoms, identifying protective factors is of theoretical and clinical interest. Mindfulness, or the ability to pay attention to the present moment with openness, curiosity, and acceptance (Bishop et al., 2004), and self-compassion, or being aware of one's suffering, showing kindness to oneself at these difficult times, and seeing difficulties as part of a common human experience (Neff, 2003), have been proposed as potential protective factors for depressive symptoms. While self-compassion and mindfulness are overlapping constructs, they are also distinct protective factors. It is possible to be mindful and aware and open to the current moment without being kind to oneself or remembering that suffering is part of the universal human experience (Neff & Dahm, 2015). In other words, being mindful prioritizes being accepting of one's thoughts and feelings, while self-compassion prioritizes being accepting of the self. There is meta-analytic evidence that higher trait self-compassion is associated with fewer depressive symptoms in adolescents (Marsh, Chan, & MacBeth, 2018), and initial evidence demonstrates that an intervention focused on self-compassion can improve depressive symptoms relative to a wait-list control (Bluth, Gaylord, Campo, Mullarkey, & Hobbs, 2016). A meta-analysis of mindfulness-based interventions in both clinical and non-selected, or not selected based on clinical elevation, children and adolescents shows that they improve depression at a small-

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4 medium effect ($d = 0.27$) relative to control groups (Dunning et al., 2018). There is also direct evidence of within-
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6 person changes in both mindfulness and self-compassion are associated with within-person changes in depressive
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8 symptoms over time in the context of a self-compassion intervention (Bluth & Eisenlohr-Moul, 2017). These
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10 findings are not limited to clinically elevated adolescents or to the intervention context. For example, self-
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12 compassion (Stolow, Zuroff, Young, Karlin, & Abela, 2016) and mindfulness (Royuela-Colomer & Calvete, 2016)
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14 also protect against increases in depressive symptoms over time in non-selected children and adolescents. Therefore,
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16 higher levels of mindfulness and self-compassion could theoretically improve overall trajectories from adolescence
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18 into adulthood by reducing the impact of depressive symptoms.

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20 Further, understanding how much mindfulness and self-compassion each uniquely protect against
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22 depressive symptoms is important to better track potential risk and more efficiently intervene during adolescence.
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24 Preliminary evidence indicates self-compassion may be more predictive of depressive symptoms in adolescents than
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26 mindfulness (Van Dam, Sheppard, Forsyth, & Earleywine, 2011). Within-person changes in self-compassion better
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28 predict changes in depressive symptoms following a meditation retreat than within-person changes in mindfulness
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30 (Galla, 2016). Self-compassion also predicts change in depressive symptoms over time absent an intervention in
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32 trauma-exposed adolescents after controlling for mindfulness (Zeller, Yuval, Nitzan-Assayag, & Bernstein, 2015).
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34 In the intervention context, self-compassion mediated changes in depression following a meditation retreat while
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36 mindfulness did not (Galla, 2017). However, these results are not definitive, as the meditation retreat increased self-
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38 compassion but not mindfulness, precluding a direct comparison. Further, within-person changes in mindfulness and
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40 self-compassion both uniquely predict within-person changes in depression in the context of a self-compassion
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42 intervention (Bluth & Eisenlohr-Moul, 2017).
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45 The non-definitive nature of these findings may be explained in part by conceptual and psychometric
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47 problems with sum scoring depressive symptoms. Depression severity in adolescence is typically determined by
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49 adding up the severity of all the symptoms on a given depression scale (Brooks & Kutcher, 2001). The types of
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51 symptoms assessed can vary widely from scale to scale (Fried, 2017), which means an adolescent could endorse all
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53 of the symptoms on two different measures and end up with two non-equivalent depression sum scores. If one views
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55 depression as a latent disease, this outcome may be less problematic. Taking a latent disease perspective implies that
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57 all symptoms are equal, interchangeable indicators of an underlying disorder (Insel, 2014). This model would
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59 predict strong associations between symptoms of depression, such as self-hatred and sadness, in the presence of a
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latent disease (a major depressive episode) but weak associations in the latent disease's absence (Borsboom, 2008). To use an example from physical health, we would expect headaches and painful, dark skin pustules to occur at the same time in the presence of the smallpox virus, but these two symptoms would be unrelated in the disease's absence (Fried, 2015). However, the associations between individual depressive symptoms are not actually stronger among people diagnosed with major depressive disorder compared to people below the cutoff for major depressive disorder (Mullarkey, Stewart, Wells, & Beevers, 2018; Santos, Fried, Asafu-Adjei, & Ruiz, 2017). This implies that a latent disease model, where symptoms more strongly co-occur in the presence of the disease than in its absence, is not fully capturing the phenomenology of depression.

From a psychometric standpoint, using depression sum scores to determine the relative contributions of mindfulness and self-compassion can be problematic because sum scores lack unidimensionality and measurement invariance (Fried & Nesse, 2015). Summing a set of items into a single total score implicitly assumes that those items all load onto a single latent factor (Hemker, Sijtsma, Molenaar, & Junker, 1997; van der Ark, 2005), or an assumption of unidimensionality. Tests for whether one, two, or more factors best fit adolescent depression explicitly reject the possibility of adolescent depression loading onto a single latent factor (Craighead, Smucker, Craighead, & Ilardi, 1998). Adolescent depression scales may have as many as five latent factors (Weber, 2000), and the number of factors is not consistent across measures or samples (Byrne, Baron, & Campbell, 1993; Osman et al., 1997; Roberts, Andrews, Lewinsohn, & Hops, 1990; Weiss & Weisz, 1988). We also observe that depression sum scores can load onto different numbers of underlying factors over time in the same sample (Brunet et al., 2014; Fried, van Borkulo, et al., 2016; Orlando, Ellickson, & Jinnett, 2001; Strong, Tsai, Lin, & Cheng, 2016), which indicates depression sum scores are not measuring the same construct over time. If we are not measuring the same construct over time, or we lack measurement invariance, it cannot be determined whether the changes in scores are due to true changes in the construct of interest or due to artefactual changes in which the construct is being measured (Vandenberg & Lance, 2000). Therefore, previous attempts to disentangle the unique relationships of self-compassion and mindfulness with depression may have been undermined by conceptual and psychometric issues.

Fortunately, taking a symptom-level approach to adolescent depression can alleviate these conceptual and psychometric concerns while increasing our understanding of self-compassion and mindfulness's unique contributions to depression. The network theory of psychopathology, or the perspective that symptoms and the mutually reinforcing relationships between them constitute the disorder (Hofmann, Curtiss, & McNally, 2016), can

inform this symptom-level approach. From a network perspective, symptoms are not passive, interchangeable indicators but instead may relate differentially to each other, potential risk/protective factors, and depression related outcomes (Borsboom, 2017). Indeed, there is evidence that different depressive symptoms respond differentially to risk factors (Fried, Nesse, Zivin, Guille, & Sen, 2014), are more and less strongly associated with one another (Mullarkey, Marchetti, & Beevers, 2018), and relate differentially to well-being (Mullarkey, Marchetti, Bluth, Carlson, & Beevers, 2018) cognitive biases (Beevers et al., 2018), and psychosocial functioning (Fried & Nesse, 2014). However, few previous analyses have examined protective factors within the network context, and doing so can advance the empirical approach derived from network theory: network analysis (Jones, Heeren, & McNally, 2017).

Network analysis allows us to examine the unique associations (edges) between potential protective factors and individual depressive symptoms (nodes). This type of analysis allows us not only to control for the contributions of other protective factors, but also the contributions of other individual depressive symptoms (Epskamp & Fried, 2016). This approach extends previous efforts to examine partial associations between mindfulness, self-compassion, and depression (Van Dam et al., 2011). Further, network analyses typically apply a LASSO penalty to each edge (unique association) in the network. This practice, common in machine learning contexts, shrinks associations below an empirically derived threshold to zero (Foygel & Drton, 2010). Applying this penalty decreases the likelihood of overweighting spurious associations and increases the likelihood that the results will replicate in future samples (Yarkoni & Westfall, 2017). So, while network analysis is far from the only approach to evaluating protective factors at the symptom-level, it has some advantages that have not yet been explored in the context of mindfulness, self-compassion, and adolescent depressive symptoms.

In the present study, we will conduct a network analysis including mindfulness, self-compassion, and individual depressive symptoms in a large, non-selected sample of adolescents. Given that self-compassion has been more consistently related to depression sum scores, we expect self-compassion will be more strongly related than mindfulness to the “central symptoms” of adolescent depression, or symptoms most strongly associated with other depressive symptoms (Valente, 2012). Previous analyses in large ($Ns > 1,000$) adolescent samples have indicated that *sadness*, *self-hatred*, and *loneliness* are consistently central symptoms of adolescent depression, and *worthlessness* might also be more central (McElroy, Fearon, Belsky, Fonagy, & Patalay, 2018; Mullarkey, Marchetti, & Beevers, 2018; Mullarkey, Marchetti, Bluth, et al., 2018). More central symptoms are more predictive

of future depression related difficulties and severity (Boschloo, Borkulo, Borsboom, & Schoevers, 2016), so protective factors that more strongly relate to these symptoms may better protect against maladaptive outcomes over time (Hofmann et al., 2016). Therefore, we hypothesize that the unique associations between self-compassion and *sadness*, *self-hatred*, and *loneliness* will be stronger than the associations between those symptoms and mindfulness. We will re-run the analyses with *worthlessness* as a sensitivity test. We will also conduct exploratory analyses to examine how many individual symptoms each protective factor relates to and which protective factor relates more strongly to all of the symptoms in network.

Method

Participants

The sample ($n = 1,055$) of adolescents (M age = 14.72 ± 1.79 years; range: 11 – 19 years; 12-17 years old = 94.28% of sample) was primarily female (65.21% female, 32.51% male, 1.61% transgender/gender-unsure, .66% missing), and racially diverse (68.34% White/Caucasian, 16.30% Black/African-American, 3.51% Hispanic, 4.36% Asian/Pacific Islander, 1.04% Native American, 5.88% Other, 0.57% missing). Based on maternal education status, the sample was diverse in socioeconomic status (5.88% did not finish high school, 17.44% high school or equivalent, 14.60% some college courses but no college degree, 33.08% bachelor's degree, 19.72% master's degree, 7.68% lawyer, doctor, or PhD, 1.61% missing).

Students were recruited from one public high school, one public middle school, and one private high/middle school located in the Southeastern United States. Recruitment and data collection began in October of 2015 and ended in December of the same year. All students at each school were invited to participate. Additional recruitment details are outlined in existing work assessing different outcomes within the same adolescent sample (Bluth, Campo, Futch, & Gaylord, 2017; Bluth, Mullarkey, & Lathren, 2018)

To reduce biases due to inattention (Hauser & Schwarz, 2016) and misleading network associations (Borsboom, 2017), 312 participants were excluded throughout recruitment and data analysis: 58 excluded due to lack of consent, 244 excluded due to failure to correctly answer at least 2 attention-check questions included in the survey, 10 excluded due to missing item-level data on the depression, mindfulness, or self-compassion scales. A total sample of 1,055 participants was included in our analyses.

Measures

Student surveys included additional questionnaires unrelated to the present study; these additional questionnaires are not outlined below.

Mood and Feelings Questionnaire-Short Form. The Mood and Feelings Questionnaire-Short Form (SMFQ; Thapar & McGuffin, 1998) is a 13-item self-report questionnaire used to assess depressive symptoms. Responders rate each symptom in the context of the past two weeks (e.g. “I hated myself”) on a 3-point Likert scale, 0 (“*Not True*”), 1 (“*Sometimes*”), and 2 (“*True*”). The SMFQ has good internal reliability (Thabrew, Stasiak, Bavin, Frampton, & Merry, 2018) and is used to measure youth depressive symptoms across a variety of research and clinical settings (Cohen, Andrews, Davis, & Rudolph, 2018; Kuo, Stoep, & Stewart, 2005). Internal reliability in this sample was excellent ($\alpha = .92$).

Self-Compassion Scale Short-Form. The Self-Compassion Scale Short Form (SCS-SF; (Raes, Pommier, Neff, & Gucht, 2011) is a 12-item questionnaire used to assess compassion toward oneself during difficult times. Responder rate how often they behave a certain way (“I try to see my failings as part of the human condition”) on a 5-point Likert scale from 1 (“*Almost Never*”) to 5 (“*Almost Always*”). The SCS-SF has good internal reliability in clinical and non-selected samples (Castilho, Pinto-Gouveia, & Duarte, 2015). The internal reliability of this sample was acceptable ($\alpha = .76$).

Child and Adolescent Mindfulness Measure. The Child and Adolescent Mindfulness Measure (CAMM; (Greco, Baer, & Smith, 2011) is a 10-item questionnaire designed to evaluate mindfulness in youth. Each item exists on a 4-point Likert scale, where responders rate how often each of 10 statements is true (“At school, I walk from class to class without noticing what I’m doing”) from 0 (“*Never True*”) to 4 (“*Always True*”). The CAMM has shown good internal reliability in samples of adolescents (Kuby, McLean, & Allen, 2015). In this sample, internal reliability was good ($\alpha = .86$).

Statistical Analysis

We assessed descriptive data for each SMFQ, SCS, and CAMM item (mean, standard deviation, kurtosis, and skew). An ideal method to model networks using trichotomous items (e.g. the SMFQ items) has not yet been determined (Fried et al., 2015). In response to this limitation, we binarized our SMFQ item values to represent symptoms as either “absent” or “present” using methods in line with the existing literature (Mullarkey, Marchetti, & Beevers, 2018; Rhemtulla et al., 2016). SMFQ item values of “0” (“*Not true*”) were included as 0’s, for absent

symptoms, and SMFQ item values of “1” (“*Sometimes True*”) or “2” (“*True*”) were included as 1’s, for present symptoms.

We used these binarized SMFQ items, continuous CAMM composite scores, and continuous SCS composite scores to estimate a network using a Mixed Graphical Model (Haslbeck & Waldorp, 2015). We utilized a Mixed Graphical Model (MGM) because, unlike more traditional Gaussian Graphical Models or Ising Models (Epskamp, Borsboom, & Fried, 2017; van Borkulo et al., 2014), MGMs allow for analyzing relationships between variables of different data types (i.e. categorical, continuous, count) simultaneously, rather than being restricted to analyzing data of one type (Haslbeck & Waldorp, 2015). These network models include each variable as a “node” that is connected to other variables, or nodes, in the network via “edges”. Each network “edge” represents a unique partial association between two variables that accounts for all other nodes included in the network. To avoid the inclusion of spurious relationships in our model, we utilized the LASSO regularization technique (Tibshirani, 1996) to shrink all edge-weights based on a set parameter. Under this penalty, smaller, potentially spurious edge-weights shrink to a value of 0. The present network was fitted using the *R*-package *mgm* version 1.2-4 (Haslbeck & Waldorp, 2016) and was visualized using the *qgraph* version 1.5 *R*-package (Epskamp et al., 2012).

We examined the relationship between each protective factor and individual depressive symptoms as indexed by two separate comparisons. First, we evaluated the number of significant relationships each protective factor had with individual SMFQ items in our network following LASSO regularization. Second, we assessed which of the protective factors had stronger relationships with the individual symptoms determined to be most central in existing networks of adolescent depression (*sadness, loneliness, self-hatred*; Mullarkey, Marchetti, & Beevers, 2018). We compared relationship strength between individual depressive symptoms and each protective factor by summing edge-weights for symptom edges connected to mindfulness versus those connected to self-compassion. As a sensitivity test, we performed a second comparison of edge weight sums including *worthlessness*, a depressive symptom recently identified as a more central symptom of adolescent depression (Mullarkey, Marchetti, Bluth, et al., 2018).

In keeping with existing robustness techniques (Epskamp, Borsboom, & Fried, 2017), we evaluated the accuracy of our edge-weights using bootstrapped 95% CIs. CIs were calculated using the range of 100 bootstrapped samples for each edge-weight, with larger edge-weight CIs indicating more variable and less precise estimates for those edges (Fried et al., 2018).

Results

Descriptive statistics

Item-level mean across all depressive symptoms was $M = 7.50$, and standard deviation was $SD = 6.56$. Mean composites for mindfulness ($M = 24.49$; $SD = 8.43$) and self-compassion ($M = 3.05$; $SD = .64$) were also assessed. Further descriptive statistics of all symptoms and protective factors are reported in Table 1.

[Table 1]

Network estimation

Item informativeness, or the standard deviation of each depressive symptom, was assessed to evaluate whether each symptom had enough variation to be able to contribute to the network analysis (Mullarkey, Marchetti, & Beevers, 2018). SMFQ item 2, *anhedonia*, had the lowest variance of each of the parameters with a standard deviation of .60. The informativeness of SMFQ item 2 was within 2.5 standard deviations of the average informativeness for all parameters, therefore no parameters were excluded from the analyses.

The network between depressive symptoms, self-compassion, and mindfulness was estimated using an MGM model (see Figure 1). Centrality was not directly assessed within the present network. Relationships were evaluated between each protective factor and individual symptoms previously identified to be more central to adolescent depression (*self-hatred*, *sadness*, *loneliness*, and *worthlessness*) (Mullarkey, Marchetti, & Beevers, 2018; Mullarkey, Marchetti, Bluth, et al., 2018). No stability tests were warranted in the present sample for centrality indices as we are not directly estimating centrality in this study. The correct methods for estimating centrality and centrality stability in mixed graphical models of psychopathology symptoms and maintaining factors are also not yet established (Haslbeck & Waldorp, 2018), thus our reliance on the most central symptoms determined by previous Ising and Gaussian Graphical Models, which have established methods for estimating centrality and centrality stability (Epskamp, Borsboom, & Fried, 2017).

[Figure 1]

Fig. 1 Our estimated network, with “nodes” (individual depressive symptoms, self-compassion, and mindfulness variables) and “edges” (unique associations between each variables, positive associations = green; negative associations = red)

Edge weight accuracy

Edge weight accuracy was acceptable as indexed by width of non-parametric CIs for all 74 non-zero edges in the network. After creating a sampling distribution using 100 bootstrapped samples for each edge, narrower CIs indicated relatively accurate edge weight estimates. As seen in Figure 2, proportions included for each edge weight indicate the number of times the edge weight was determined to be non-zero out of 100 bootstraps (Fried et al., 2018). Because we used LASSO regularization to shrink potentially spurious edges to zero, the underlying sampling distribution for our edge weights estimates, and resulting CIs, are biased toward zero. Thus, CIs included in Figure 2 are not good indicators of edge weight significance and should only be used to assess accuracy of edge weight estimates (Epskamp, Borsboom, & Fried, 2017). 31 edge weights were penalized to zero and therefore not included in the network (indicated by asterisks in Figure 2).

[Figure 2]

Fig. 2 Bootstrapped CIs used to determine edge weight accuracy for each edge (edge weights penalized to zero are marked with an asterisk)

Relationships between symptoms, mindfulness, and self-compassion

After applying the LASSO penalty, mindfulness was negatively associated with 11 out of 13 depressive symptoms (symptoms and corresponding edge weights: *sadness* = -0.08, *anhedonia* = -0.08, *fatigue* = -0.08, *feeling restless* = -0.13, *worthlessness* = -0.19, *crying* = -0.15, *difficulties concentrating* = -0.26, *feeling like a bad person* = -0.12, *loneliness* = -0.14, *feeling unloved* = -0.18, *do everything wrong* = -0.26) and self-compassion was negatively associated with 7 of 13 symptoms (symptoms and corresponding edge weights: *sadness* = -0.18, *anhedonia* = -0.05, *worthlessness* = -0.16, *self-hatred* = -0.25, *feeling like a bad person* = -0.05, *feeling worse than others* = -0.15, *do everything wrong* = -0.08). Mindfulness and self-compassion were each negatively associated with 2 of the most central symptoms of adolescent depression (mindfulness: *sadness* and *loneliness*; self-compassion: *sadness* and *self-hatred*). We also noted the partial association between mindfulness and self-compassion (edge weight: +0.13).

After evaluating how the individual symptoms related to each protective factor, we next evaluated the overall size of relationships between each protective factor and the central depressive symptoms. Edge weight sums indicated weaker relationships between mindfulness and more central symptoms (-0.22) by almost half compared to negative associations between self-compassion and more central symptoms (-0.43). However, mindfulness had stronger cumulative negative associations across all symptoms of depression (-1.68) compared to self-compassion (-0.92).

Sensitivity test

As a sensitivity test, we evaluated the relationship between each protective factor and an additional, fourth symptom found to be central in a recent adolescent sample (Mullarkey, Marchetti, Bluth, et al., 2018).

Worthlessness was negatively related to both self-compassion (-0.16) and mindfulness (-0.19). Summing edge weights across all four central depressive symptoms, including *worthlessness*, self-compassion had a stronger overall relationship with central symptoms (-0.59) than the overall relationship between mindfulness and central symptoms (-0.41).

Discussion

We took a novel network analysis approach to disentangling the unique associations of mindfulness and self-compassion with individual symptoms of adolescent depression in a non-selected sample. This symptom-level approach provided evidence for our hypothesis that self-compassion is more strongly associated with previously identified more central symptoms of depression than mindfulness. Still, mindfulness is uniquely associated with more symptoms (11 symptoms for mindfulness vs. 7 symptoms for self-compassion) and more strongly associated with depression symptoms overall than self-compassion. Even after controlling for associations with all depression symptoms and applying a LASSO penalty, the positive association between self-compassion and mindfulness remained significant. These findings extend previous work comparing the ability of self-compassion and mindfulness to predict variance in depression, and also suggest avenues for future work.

Self-compassion's stronger unique associations with more central symptoms may help explain previous evidence indicating self-compassion is more predictive than mindfulness of sum score depression over time (Galla, 2016; Van Dam et al., 2011; Zeller et al., 2015). Central symptoms of depression theoretically (Hofmann et al., 2016) and empirically (Boschloo et al., 2016) better predict severity over time in adults compared to more peripheral symptoms. Therefore, self-compassion's stronger unique associations with more central symptoms may drive its

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4 seeming superiority to mindfulness for protecting against depressive symptoms. However, the importance of central
5 symptoms in general (Fried & Cramer, 2017) and adolescent depression severity over time in particular (Mullarkey,
6 Marchetti, & Beevers, 2018) remain empirical questions. More research into the relationship between central
7 symptoms and depression related outcomes in adolescence would help us better assess the value of having stronger
8 negative associations with these more central symptoms.
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15 Still, our symptom-level approach indicated that the two protective factors relate differentially to different
16 individual depressive symptoms. Self-compassion was uniquely associated with *self-hatred* and *feeling worse than*
17 *others* while mindfulness was not, but mindfulness was uniquely associated with 6 symptoms that self-compassion
18 was not (*fatigue, feeling restless, feeling unloved, crying, difficulties concentrating, loneliness*). This suggests that
19 adolescents may be more at risk for certain symptoms depending on their relative levels of mindfulness and self-
20 compassion. These findings are in line with previous work suggesting depressive symptoms respond differentially to
21 different risk factors (Fried et al., 2014). Therefore, our data is also consistent with mindfulness playing an
22 important role in adolescent depression. Mindfulness also had stronger negative unique associations with all
23 measured depressive symptoms, primarily driven by its significant, unique associations with 4 more symptoms
24 overall than self-compassion. Symptom level work is needed in longitudinal data sets, so we can directly examine
25 the ability of the self-compassion and mindfulness to protect against individual depressive symptoms over time.
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37 These findings can also lead to hypotheses about which interventions we would expect to be most effective
38 for adolescent depressive symptoms. Rather than using interventions that universally prioritize either self-
39 compassion or mindfulness, we could tailor interventions to the specific symptoms the adolescent is experiencing or
40 may be at risk for in the future. For example, an adolescent experiencing *sadness, self-hatred, feeling worse than*
41 *others, anhedonia, and worthlessness* may respond better to an intervention that prioritizes self-compassion, as all
42 the symptoms they are experiencing have unique negative associations with self-compassion and two of them (*self-*
43 *hatred* and *feeling worse than others*) do not have unique negative associations with mindfulness. On the other hand,
44 an adolescent experiencing *fatigue, feeling restless, feeling unloved, crying, and difficulties concentrating* may
45 respond better to an intervention that prioritizes mindfulness given its unique negative associations with all of those
46 symptoms vs. self-compassion having unique negative associations with none of them. However, these findings can
47 only generate hypotheses about how interventions might perform, so randomized studies comparing this tailored
48 approach to more universal approaches are needed to evaluate these hypotheses.
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4 Interestingly, there were negative associations between at least one of the protective factors and all
5 depressive symptoms assessed in this sample. Future work examining the coverage of other depressive symptoms,
6 including non-traditional depressive symptoms like anger and irritability that appear to be just as central to the
7 experience of depression (Fried, Epskamp, Nesse, Tuerlinckx, & Borsboom, 2016), can help determine how much
8 coverage mindfulness, self-compassion, and other protective factors have over the wide variety of individual
9 depressive symptoms (Fried, 2017). There are also some symptoms where both mindfulness and self-compassion
10 have unique negative associations (*sadness, anhedonia, worthlessness, feeling like a bad person, do everything*
11 *wrong*). These results would imply that individuals with high mindfulness and self-compassion should be especially
12 low on these symptoms where both protective factors provide added value compared to individuals who are only
13 high on one protective factor (e.g. mindfulness) but not another (self-compassion).

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25 Further, even after controlling for all individual depressive symptoms and applying a LASSO penalty, the
26 positive, unique association between mindfulness and self-compassion was retained in the network model. This
27 result is in line with a model where self-compassion and mindfulness reciprocally reinforce one another and lead to
28 more adaptive outcomes (Bluth & Blanton, 2014). However, as these data are cross-sectional, this finding is also
29 consistent with other models, such as one where self-compassion and mindfulness are both caused by an
30 unmeasured factor and are not causally related (Morgan & Winship, 2014). So, while these data are well suited to
31 answering which protective factors are associated uniquely with which individual depressive symptoms, it is not
32 well suited to provide definitive answers on temporal precedence or causality.

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41 Indeed, one limitation of these analyses is the cross-sectional nature of the data. This study cannot directly
42 test all aspects of the network theory of psychopathology or determine whether the protective associations between
43 mindfulness, self-compassion, and individual depressive symptoms are causal in nature. However, the analyses are
44 conducted on a large sample and apply techniques that allow the results to better generalize to out of sample data
45 (Yarkoni & Westfall, 2017). Therefore, the findings in this study can be used not only to make substantive
46 conclusions (e.g. self-compassion has stronger contemporaneous associations with more central symptoms of
47 adolescent depression) but also generate new hypotheses (e.g. self-compassion will better protect against increases
48 in depressive symptoms over time, as it is more strongly associated with more central depressive symptoms).
49 Further, while we cannot test whether the relationships between symptoms are causal, we can test another key
50 prediction of network theory: whether different symptoms will relate differentially to different protective factors
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(Borsboom, 2017). We demonstrate that different protective factors relate to different depressive symptoms with varying amounts of strength. So, while the cross-sectional nature of our data certainly limits the types of conclusions we can draw, there are still many important contributions it can make. Further, the central symptoms of depression may differ across development, as different central symptoms of depression have been identified in adults compared to adolescents (Beard et al., 2016; Mullarkey, Marchetti, & Beevers, 2018). Therefore, our findings are limited to an adolescent population as central symptoms of depression and their relationships with mindfulness and self-compassion may differ across development.

This study helps advance our understanding of the unique associations between mindfulness, self-compassion, and depression in adolescence. By taking a symptom-level approach and applying advanced analytic techniques, we can better dissociate the signal of unique relationships from the noise of measurement issues and conceptual ambiguity. These findings could help inform future work like examining whether these unique associations are similar over time, generating risk profiles for different depressive symptoms based on levels of protective factors, or creating interventions to target certain individual depressive symptoms. Continuing to approach self-compassion, mindfulness, and other protective factors using these techniques may allow us to better understand, prevent, and treat depression in adolescence.

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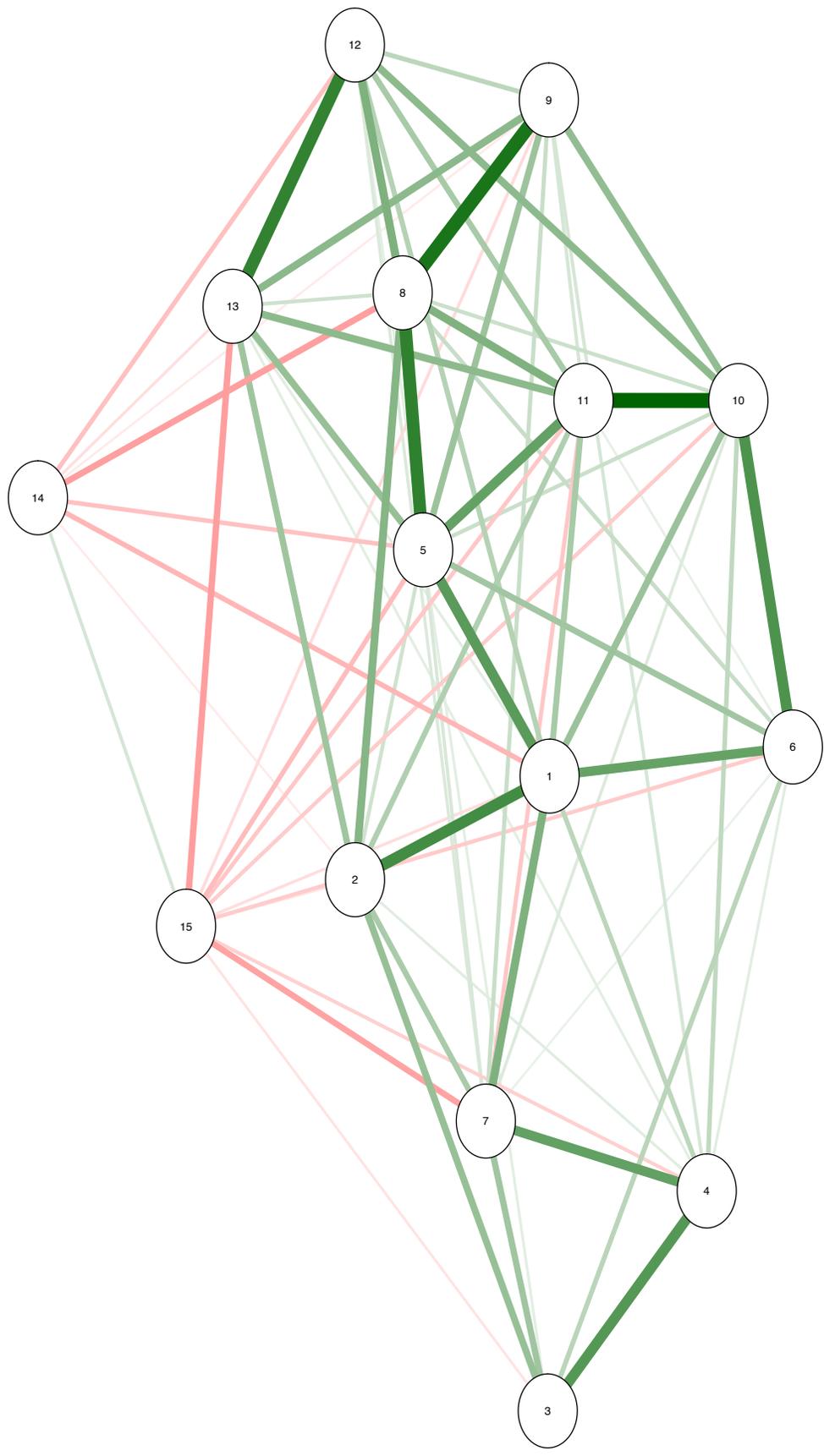
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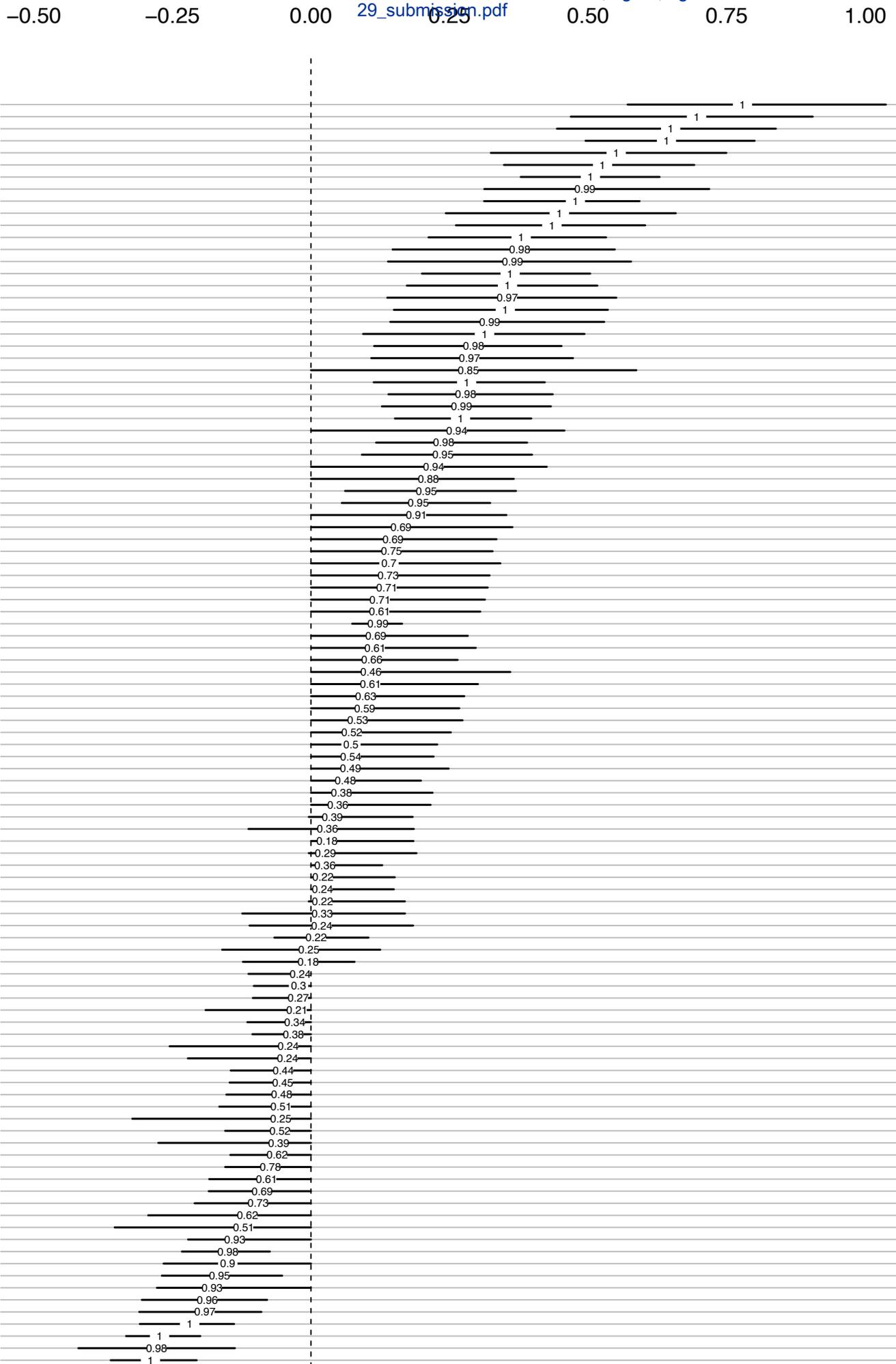
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- 1: Sadness
- 2: Anhedonia
- 3: Fatigue
- 4: Restless
- 5: Worthless
- 6: Crying
- 7: Concentration
- 8: SelfHatred
- 9: BadPerson
- 10: Lonely
- 11: Unloved
- 12: WorseOthers
- 13: DidWrong
- 14: SCS
- 15: CAMM





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Supplementary Material

[SC and Indiv Dep Network Data Oct 29_submission.csv](#)

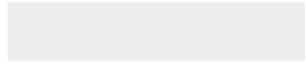


Table 1 Mean, standard deviation, minimum, maximum, skewness, and kurtosis, and frequency of MFQ Symptoms, CAMM mindfulness composite, and SCS self-compassion mean (n = 1055)

Symptoms	Item #	Mean	St.Dev	Min	Max	Skewness	Kurtosis	% Absence ("0")	% Presence ("1")
Sadness	1	0.78	0.69	0.00	2.00	0.31	-0.91	37.06	62.94
Anhedonia	2	0.39	0.60	0.00	2.00	1.25	0.51	66.64	33.36
Fatigue	3	0.92	0.78	0.00	2.00	0.14	-1.35	34.88	65.12
Restless	4	0.80	0.75	0.00	2.00	0.34	-1.15	39.81	60.19
Worthless	5	0.47	0.69	0.00	2.00	1.13	-0.05	63.79	36.21
Crying	6	0.53	0.75	0.00	2.00	1.01	-0.51	62.94	37.06
Concentration	7	0.85	0.75	0.00	2.00	0.26	-1.19	36.87	63.13
Self-hatred	8	0.37	0.67	0.00	2.00	1.55	0.97	73.55	26.45
Bad Person	9	0.35	0.61	0.00	2.00	1.56	1.24	72.61	27.39
Loneliness	10	0.63	0.74	0.00	2.00	0.72	-0.85	53.08	46.92
Feel Unloved	11	0.35	0.65	0.00	2.00	1.63	1.25	74.69	25.31
Worse Than Others	12	0.56	0.75	0.00	2.00	0.92	-0.62	59.81	40.19
Did Wrong	13	0.50	0.69	0.00	2.00	1.03	-0.22	61.14	38.86
CAMM		24.49	8.43	0.00	40.00	-0.22	-0.41		
SCS		3.05	0.64	1.08	4.75	-0.22	-0.11		