

The Demands-Buffering Role of Perceived and Received Social Support for Perceived Stress and Cortisol Levels

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Abstract: *Background:* Social support is known as a crucial resource in buffering the effect of stress in terms of negative outcomes. Nevertheless, research on potential buffering effects of support before stress sets in has mostly entailed experimental studies. Thus, the current literature limits the transferability into the field, especially concerning the different roles of perceived and actually received social support. *Aim:* This study aims to extend research on the mechanisms behind the demands-buffering effects of social support. Accordingly, the job demands-resources framework undergirded our analysis of the effects of different aspects of social support (perceived vs. received support and support quality vs. quantity) on the relationship between demands and perceived stress as well as cortisol levels. *Method:* Data were collected from $N = 125$ participants at two measurement points 4 weeks apart, using questionnaires, social network analysis, and salivary cortisol. *Results:* Study findings reveal that (1) buffering effects of support were different for perceived stress and cortisol levels; (2) the buffering effect of perceived support depended on the level of demands, how stress was measured, and whether received support was included in the model; and (3) support quality demonstrated a demand-buffering effect, while support quantity showed contradictory patterns. *Limitations:* Limitations concerning the sample characteristics and measurement approaches are discussed. *Conclusion:* Overall, received support, especially quality, seems most relevant for buffering the effect of demands on stress. Moreover, the findings emphasize the need to assess social support as a multidimensional construct to better understand the mechanism of its demand-buffering effects.

Keywords: stress, cortisol, buffering, social support, SNA

The relevance of social support for health is well-established: Besides the direct link to various stress and health outcomes (e.g., Uchino et al., 2012), researchers have been especially interested in the moderating role of social support on the effects of stress on negative outcomes, as stated in the buffering hypothesis (Cohen & Wills, 1985). For example, social support has been shown to buffer the effect of perceived stress on depression (Raffaelli et al., 2013), burnout dimensions (Hartley & Coffee, 2019), and physical distress (Solberg & Villarreal, 1997). While these results offer fundamental implications about how to buffer the effects of stress, preventative action, that is, before stress even arises, remains unclear. Thus, examining the underlying mechanisms of stress appearance promises a reasonable approach to identify possibilities to prevent or mitigate the occurrence of stress. Meta-analytic findings from experimental studies that manipulated social support prior to a stress task confirm the potential of social support to buffer the effects of demands on laboratory stress (Thorsteinsson & James, 1999). We have built on these

experimental findings as well as on research on the buffering hypothesis in examining the moderating role of social support in the relationship between demands and both the resulting perceived stress (as assessed in most of the research on the buffering hypothesis) and stress biomarkers (as assessed in most of the research on buffering effects on laboratory stress). This combined examination of perceived stress and stress biomarkers may offer useful insights into the mechanisms of stress-inducing demands (Lindholm et al., 2012).

The hypothalamic-pituitary-adrenal axis (HPA) is the main neuroendocrine system underlying the stress adaptation system in human beings, and a recognized biomarker of HPA axis activity is salivary cortisol (Hellhammer et al., 2009). While cortisol secretion varies diurnally, it reaches peak levels during the morning hours, shortly after awakening. This so-called cortisol awakening response (CAR) provides a practical measure of HPA axis activity that is also easy to quantify. Moreover, an elevated CAR correlates with increased stress levels (Kudielka et al., 2012). Accordingly,

the CAR is used as an indicator for stress biomarkers (specifically, cortisol levels) in this study.

This study's examination of the relationship between demands and stress is also in line with the health impairment path within the job demands-resources (JD-R) model (Bakker & Demerouti, 2007). In contrast to this investigation's focus, many previous studies using the JD-R framework have examined the effects of demands on self-rated stress, health, and physiological diseases (e.g., coronary heart disease). However, the effects of demands on underlying physiological reactions to stress, such as cortisol levels or blood pressure, are still not completely understood (Leka et al., 2010). This study extends the previous findings in the JD-R framework by integrating perceived stress and cortisol levels as consequences of demands.

Perceived and Received Social Support

Although previous research has supported the buffering hypothesis, some researchers have been unable to replicate those effects or even found reverse-buffering effects (e.g., Devereux et al., 2009). Possible reasons for these conflicting results include not differentiating between different aspects of social support, such as perceived and received support or network variables (Guilaran et al., 2018), using only standardized self-evaluation questionnaires (e.g., Cohen & Hoberman, 1983) instead of employing multiple methods (Winemiller et al., 1993), and conducting only cross-sectional analyses, leaving mid-term and long-term effects unexamined (Viswesvaran et al., 1999).

To address these points, we examined the influence of both perceived and received social support through a multi-method approach that incorporated both perceived stress and cortisol levels. In order to clarify the topic under consideration, we provide the following detailed introduction of both operationalizations of social support as well as their relevance in the theoretical framework of the buffering hypothesis and the JD-R model.

Most of the previous studies that examined the buffering hypothesis focused on perceived social support (i.e., the conviction of having the possibility of relying on support if needed), resulting in substantial evidence for the moderation role of perceived social support between stress and negative outcomes (for a meta-analysis, see Viswesvaran et al., 1999). The aim of this study was to transfer the buffering mechanisms postulated for social support in the buffering hypothesis into the JD-R framework and thereby focus on the processes that take place before stress occurs by identifying whether the impact of demands on stress could be buffered by social support. Thus, our investigation was based on research supporting the moderating effects of resources on the health-impairing path between demands and burnout or stress as described in the JD-R framework

(e.g., Bakker et al., 2005; Xanthopoulou et al., 2007). However, previous research on the buffering effect in the relationship between demands and stress (i.e., before stress occurs) using the JD-R model as a basis focused on such resources as feedback, self-efficacy, or autonomy. Only initial cross-sectional studies examined the effect of perceived social support within the JD-R framework. For example, perceived availability of support buffered the effect of demands on burnout in volunteer firefighters (Huynh et al., 2013) and the effect of occupational demands (e.g., work overload) on psychological well-being in professors (Moeller & Chung-Yan, 2013).

Although research on the buffering effect of perceived social support and physiological stress biomarkers is rare, previous results have supported direct relationships between these factors. For example, perceived support reduced cortisol levels in breast cancer patients (Turner-Cobb et al., 2000) and lowered firemen's chronic strain in the nervous system (Roy et al., 1998). However, field studies that have examined the demands-buffering role of perceived social support regarding both perceived and physiological stress reactions are missing.

Received support in terms of support networks or enacted support is distinct from perceived support because of the ability to tell who provided what kind of support to help the individual in which specific situation, rather than having the impression that some support may exist in the background (Haber et al., 2007). As another point of distinction, perceived support seems to remain relatively stable throughout the lifespan (Uchino, 2009), while received support seems to be more situational (e.g., occurring in stressful times or during/after stressful live events; Barrera, 1986). Therefore, although both perceived and received support are presumably significant factors in stress-buffering, the importance of received support may increase around stressful situations or in times of high demands. This phenomenon finds support in a study by Schwerdtfeger and Schlagert (2011) on the conjoined effect of perceived available support and enacted support during a speech task. Combining perceived available support with enacted support resulted in an attenuated heart rate and increased heart rate variability. In contrast, the study findings linked perceived available support alone to a greater heart rate, heart rate variability, and baroreceptor reflex sensitivity reactivity to the speech task (Schwerdtfeger & Schlagert, 2011). Other studies have manipulated social support in experimental settings to examine the effects of received social support on physiological stress biomarkers during acute laboratory stress. For example, received social support was shown to suppress salivary free cortisol in response to the Trier Social Stress Test (Heinrichs et al., 2003) or attenuate the volume of secretory immunoglobulin A in saliva before, during, and after making a public speech (Ohira, 2004).

Received support itself can also be conceptualized as a highly differentiated construct (Bavik et al., 2020; Schwarzer et al., 1994). Specifically, research has distinguished three aspects within received support: the type (e.g., instrumental, emotional), the source (e.g., friends, partner), and the dimension of support (Schwarzer et al., 1994). Distinguishing between support *quality* (i.e., the satisfaction with the provided support from specific persons) and support *quantity* (i.e., network size or the amount of support provided) is crucial when considering the dimension aspect (Bavik et al., 2020). Although a limited number of studies have investigated the effect of received support in terms of quality and quantity on stress biomarkers, perceived stress, or health, the first-reported findings were mixed. For example, Wang (2016) determined that network size only had an effect on the subjective well-being of older adults if mediated by perceived social support. A meta-analysis by Pinquart and Sörensen (2000) examining the relationship between social network components and subjective well-being revealed significant effects for both the quality and quantity of social contacts, although the relationship was stronger for support quality. In contrast, a study on the change in support of breast cancer survivors after treatment found that decreases in both support quantity and quality were associated with increased depression symptoms and stress (Fong et al., 2017).

Current Study

This study comprised three steps. First, we sought to replicate the existing research regarding the JD-R model showing that demands are positively linked to perceived stress. Moreover, we aimed to extend the current literature by also analyzing the link to cortisol levels. Second, we combined the assumptions of the buffering hypothesis and the mechanisms within the JD-R framework and expanded on previous insights from experimental and cross-sectional analyses regarding the effects of perceived support on stress. In this step, we hypothesized that perceived support would have a demands-buffering function for both perceived stress and physiological stress reactions (i.e., cortisol levels) over the course of 4 weeks. We based the final step on the theoretical foundations of different mechanisms of perceived and received support as well as previous research concerning the different dimensions of received support. Specifically, we postulated that when confronted with demands, the actual experience of receiving social support (in terms of both quantity and quality) should add to the buffering effect of perceived social support when examined together in one model. Our aim also included extending the previous research by examining the effects of received support quality and quantity on perceived stress and cortisol levels. Accordingly, our hypotheses are as follows:

Hypothesis 1 (H1): Demands are positively related to (a) perceived stress and (b) cortisol levels.

Hypothesis 2 (H2): Perceived social support moderates the relationship between demands and (a) perceived stress and (b) cortisol levels. Persons with high perceived social support show a weaker relationship between demands and stress/cortisol levels.

Hypothesis 3 (H3): The received social support quantity from the actual support network moderates the positive relationship between demands and (a) perceived stress and (b) cortisol levels above and beyond the effect of perceived social support. Persons with a high quantity of received support show a weaker relationship between demands and stress/cortisol levels.

Hypothesis 4 (H4): The received social support quality from the actual support network moderates the positive relationship between demands and (a) perceived stress and (b) cortisol levels above and beyond the effect of perceived social support. Persons with high received support quality show a weaker relationship between demands and stress/cortisol levels.

See Figure 1 for the final research model.

Method

Participants and Procedure

The study was conducted as part of a larger research project on student health. Increasing demands in the university context have led students to report stress and burnout symptoms more frequently (Frost & Mierke, 2013), highlighting the importance of research on stress mechanisms in this field. Students of a German university had the opportunity to participate in the research project.

In this study, we analyzed data from two measurement points. At T1, the participants completed a questionnaire that explored demands, perceived social support, and received social support. Four weeks later, at T2, all participants completed a questionnaire that included perceived stress. Furthermore, we had the opportunity to collect saliva samples from a subsample of the participants at T2 to examine cortisol levels. The students were instructed to complete the questionnaires and the saliva samples, if applicable, on the same weekday, excluding weekends. All participants received comprehensive information on the projects purpose and procedure and signed an informed consent before participating. The responsible ethics committee granted approval for this study.

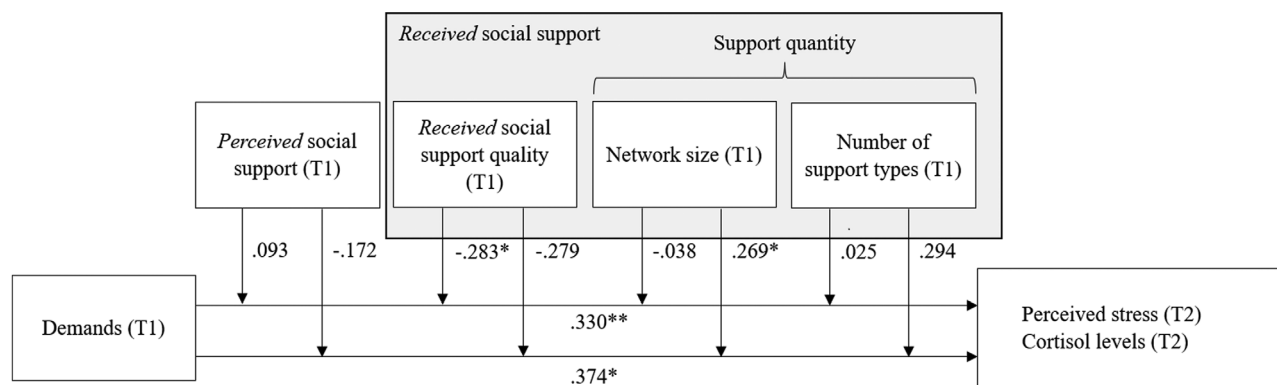


Figure 1. Research model of the relationship between demands, perceived and received social support, stress and cortisol levels. * $p < .05$; ** $p < .01$.

Data were collected from $N = 125$ students, of whom 63 participants also provided saliva samples. Seven participants did not complete all questionnaires, and five participants from whom saliva samples were collected additionally reported disease or taking medication that could influence their cortisol levels. Thus, 12 participants were completely excluded from further analyses. The final data sample consisted of $N = 113$ students. The mean age was 25.52 years ($SD = 2.46$). Of the total participants, 46.3% were female and 50.4% were male (3.3% missing data).

Measures

Perceived Social Support

Perceived social support was assessed using the German version of the Interpersonal Support Evaluation List (ISEL; Cohen & Hoberman, 1983; Laireiter, 1996). The ISEL measures perceived social support, including appraisal, belonging, self-esteem, and tangible (example item for tangible: “If I got stranded 10 miles out of town, there is someone I could call to come get me”). All 40 items were rated on a 4-point Likert scale (1 = *not true at all*; 4 = *exactly true*). Cronbach’s α was .94.

Received Social Support/Social Network Analysis

Participants were asked to think about their social support network and list up to 20 people who supported them in any way (e.g., emotional, instrumental). To facilitate name generation, we gave a brief definition of what was meant by *social support network* in this study (persons in their environment who support the participant, e.g., in stressful times or situations).

Measuring received support quality involved asking the participants to specify whether they felt optimally supported by the persons reported in their social support network on a 6-point Likert scale using a single-item measure (1 = *I do*

not agree at all; 6 = *I agree entirely*). This approach allowed us to assess the received support quality of their actual support network rather than capturing only the overall perceived social support.

To measure the received support quantity, we calculated two different indicators. First, we used network size, that is, the number of contacts the participants reported in their network. The mean network size was 7.19 ($SD = 3.79$). Because every person listed in the network might provide not only one but several different types of support, the network size alone might not suffice to reflect the actual support quantity (e.g., Bavik et al., 2020). Therefore, second, participants were asked to report which different types of support each person in their network provided by selecting the applicable types from a list (e.g., financial, emotional, not at all), answering the question “In what ways are you supported by the person?” (adapted from Östberg & Lennartsson, 2007). We calculated the mean number of provided types of support over all persons in the network relative to the network size as the second indicator for support quantity. Persons (1.1%) who did not provide any kind of support were excluded from this analysis. The mean was 2.51 ($SD = 0.89$).

Demands

Demands were measured using the Resources and Demands questionnaire by Schulte et al. (2021). For this study, we chose the scales assessing pressure to perform, private stress, and time pressure (example item for time pressure: “I have to do a large amount of work in a short time”) to calculate an overall demands measure because they are highly relevant in the student context (e.g., Weber et al., 2019). All nine items were rated on a 6-point Likert scale (1 = *strongly disagree*; 6 = *strongly agree*). Cronbach’s α was .82.

Cortisol Analysis

Following the procedure suggested by Pruessner et al. (1999), the participants were asked to collect their saliva samples in three numbered Salivettes (Sarstedt, Nümbrecht, Germany) immediately after waking up, 30 min after and 1 hr after waking up. Since some of the participants did not return all Salivettes, a total of 149 saliva samples (out of 174 possible) was sent to the biochemical laboratory at Trier University, Germany, for analysis. Cortisol levels were determined by a competitive solid-phase time-resolved fluorescence immunoassay (Dressendorfer et al., 1992). The participants who did not provide the complete set of three Salivettes were excluded from the cortisol analysis but still were considered in the analysis of the questionnaires.

We analyzed the area under the curve with respect to increase (AUCI) as well as the area under the curve with respect to ground (AUCG) as suggested by Pruessner et al. (2003) for the CAR at T2.

Perceived Stress

Perceived stress was measured by two established instruments. First, the Trier Inventory for Chronic Stress (TICS; Schulz & Schlotz, 1999), which was developed to measure sustained stress. Attendees answered the question “How often have you experienced this in the last 3–4 weeks?” for 25 items (e.g., “Too many obligations I have to fulfil”) on a 5-point Likert scale (1 = *not at all*; 5 = *very often*). Cronbach’s α was .93. Second, the Irritation Scale (IS; Mohr et al., 2005) includes momentary emotional irritation and cognitive irritation (e.g., “It’s hard for me to shut down after work/university”). Each of the eight items was rated on a 6-point Likert scale (1 = *strongly disagree*; 6 = *strongly agree*). Cronbach’s α was .85. We wished to include aspects of sustained stress as well as momentary irritation with minimal information loss. Therefore, to obtain an overall measure of *perceived stress*, we calculated a latent variable of TICS and IS.

Results

Table 1 shows descriptive statistics and correlations between the study variables. To test our hypotheses, we conducted regression analysis (H1), moderation (H2), and multiple moderation analysis (H3 and H4) using MPlus Version 7.4 (Muthén & Muthén, 1998–2017). Demands were included as a predictor in every model. We tested two models for each analysis (separate models for perceived stress and cortisol levels as criteria) because of the different sample sizes for each criterion. For moderation analysis (H2), perceived support was included as the moderator. For multiple moderation analyses (H3 and H4), perceived support, received

support quality, network size, and the number of provided support types were included as moderators. For multiple moderation, we used Stride et al.’s (2015) approach. All variables in the model were *z*-standardized for further analysis. We controlled for age in all analyses.

Demands and Stress: Regression Analyses

Demands were positively related to perceived stress ($\beta = .45$, $p < .001$) and AUCI ($\beta = .24$, $p = .023$), but not to AUCG. Therefore, H1 can be supported for perceived stress and AUCI, but not for AUCG.

Perceived Support: Moderation Analyses

The results of moderation analysis indicated a significant moderator effect of perceived social support on the effect of demands on perceived stress ($\beta = .237$, $p = .018$) with an R^2 of .46 ($p < .001$; see Table 2). Figure 2 displays the significant interaction effects. Participants with high perceived support (sample average perceived support +1 *SD*) showed a lower perceived stress level compared to participants with low perceived support (sample average perceived support –1 *SD*) when demands were low to medium but not when demands were high. Interestingly – but contrary to our assumptions – participants with low perceived support showed an overall high level of perceived stress while demonstrating only a slightly higher perceived stress level when demands were high. Therefore, high perceived support also displayed a stronger relationship between demands and perceived stress than low perceived support. Consequently, a buffering effect of perceived support was only evident for low to medium demands. Thus, H2a could not be supported.

Regarding the effect of demands on cortisol levels, the results also revealed a significant moderator effect of perceived social support for AUCI ($\beta = -.296$, $p = .011$) with an R^2 of .19 ($p = .040$), but not for AUCG (see Table 2). Participants with high perceived support demonstrated a weaker relationship between demands and AUCI compared to participants with low perceived support (see Figure 2 for the interaction effects). Perceived social support appeared to buffer the effect of demands on cortisol levels in terms of AUCI, partially supporting H2b.

Perceived and Received Support: Multiple Moderation Analyses

After including received social support quality and quantity in the analysis, perceived social support did no longer moderate the effect of demands on perceived stress or cortisol levels.

Table 1. Means, standard deviations, and intercorrelations among the study variables

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
Age	25.52	2.46										
Sex	1.52	0.50	-.01									
Demands	3.59	0.76	.21*	.13								
Perceived social support	3.35	0.44	-.13	-.05	-.14							
Perceived stress (IS)	2.97	0.94	.07	.04	.35**	-.39**						
Perceived stress (TICS)	2.63	0.68	.18	.05	.41**	-.40**	.63**					
Cortisol level (AUCI)	77.48	358.81	-.28	.16	.28	.14	-.03	.05				
Cortisol level (AUCG)	776.95	274.23	-.02	.11	-.02	.17	.02	.16	.25			
Received support quality	4.94	1.15	-.20	-.09	-.14	.34**	-.32**	-.34**	-.30*	-.02		
Support quantity (network size)	7.19	3.79	-.16	-.05	-.28**	.14	-.11	-.13	.02	-.24	.04	
Support quantity (number of support types)	2.51	0.89	-.24*	-.02	-.01	.32**	-.18	-.26*	-.21	-.04	.30**	-.25**

Note. *M* = mean; *SD* = standard deviation; IS = Irritation Scale; TICS = Trier Inventory for Chronic Stress; AUCI = area under the curve with respect to increase; AUCG = area under the curve with respect to ground. * $p < .05$; ** $p < .01$ (two-tailed).

Table 2. Results of moderation analyses with demands as independent variable, perceived social support as moderator, and perceived stress/cortisol levels as dependent variables

Predictor	Perceived stress ¹		Cortisol levels (AUCI) ²		Cortisol levels (AUCG) ²	
	β	p	β	p	β	p
Demands	.379	.002	.277	.008	-.063	.320
Perceived Social Support	-.496	<.001	-.301	.007	-.200	.182
Demands $\times$ Perceived Social Support	.237	.018	-.296	.011	-.005	.486

Note. ¹ $N = 109$; ² $N = 51$. One-tailed analyses. AUCI = area under the curve with respect to increase; AUCG = area under the curve with respect to ground.

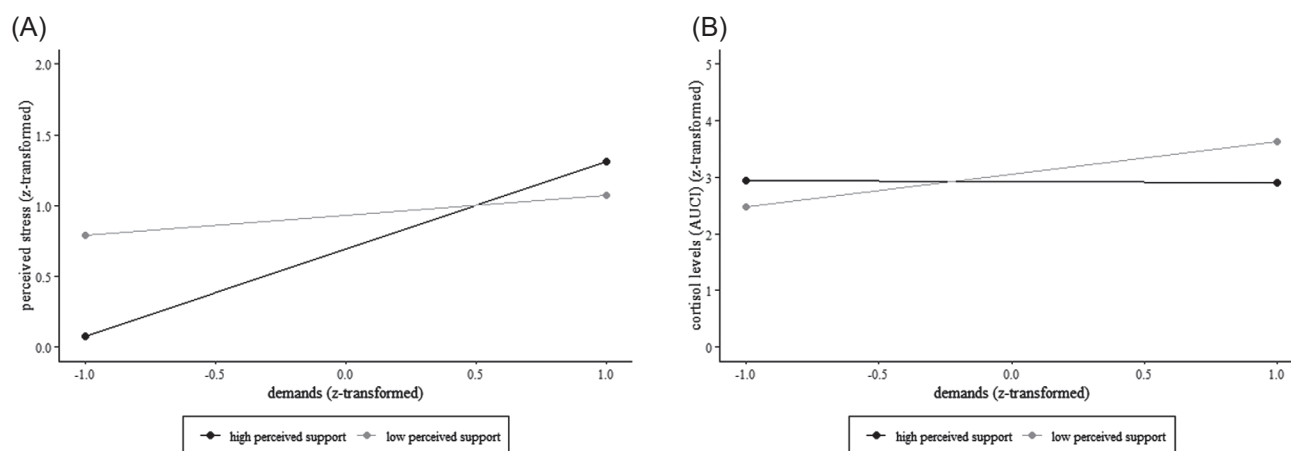


Figure 2. Moderating effect of perceived support on the relationship between demands and stress/cortisol levels. (A) Moderating effect of perceived support on the relationship between demands and perceived stress. (B) Moderating effect of perceived support on the relationship between demands and cortisol levels (AUCI).

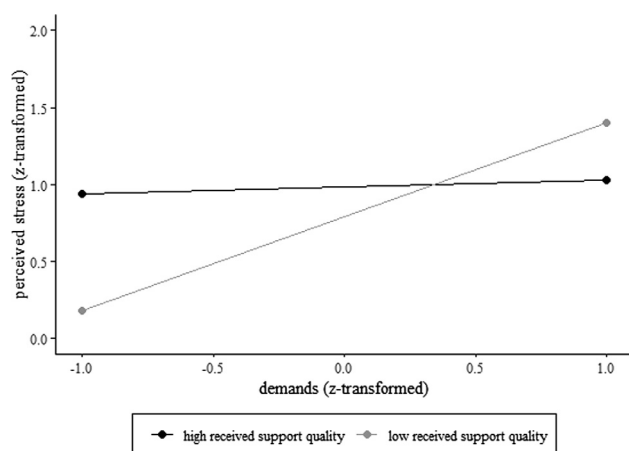
The received support quality moderated the effect of demands on perceived stress ($\beta = -.283$, $p = .033$) with $R^2 = .54$ ($p < .001$; see Table 3). Participants with low received support quality showed a lower perceived stress level compared to participants with high received support quality when demands were low to medium but not when

demands were high (see Figure 3). Participants with low received support quality revealed a stronger relationship between demands and perceived stress than participants with high received support quality. For participants with high received support quality, the perceived stress level remained relatively stable, while it was higher for

Table 3. Results of multiple moderation analyses with demands as independent variable, perceived social support, received social support quality, network size and number of provided support types as moderators and perceived stress/cortisol levels as dependent variables

Predictor	Perceived stress ¹		Cortisol levels (AUCI) ²		Cortisol levels (AUCG) ²	
	β	p	β	p	β	p
Demands	.330	.002	.374	.037	-.193	.199
Perceived Social Support	-.269	.007	-.191	.036	-.164	.153
Demands $\times$ Perceived Social Support	.093	.200	-.172	.114	.267	.109
Received Social Support Quality	-.342	.001	-.420	.018	.176	.131
Demands $\times$ Received Social Support Quality	-.283	.033	-.279	.056	-.275	.104
Network Size	-.033	.376	-.010	.480	-.253	.125
Demands $\times$ Network Size	-.038	.314	.269	.036	.137	.260
Number of Provided Support Types	-.149	.076	-.061	.366	.058	.343
Demands $\times$ Number of Provided Support Types	.025	.416	.294	.064	-.035	.439

Notes. ¹ $N = 109$; ² $N = 51$. One-tailed analyses. AUCI = area under the curve with respect to increase; AUCG = area under the curve with respect to ground.

**Figure 3.** Moderating effect of received support quality on the relationship between demands and perceived stress

participants with low received support quality with higher demands. Thus, received support quality seemed to have a buffering effect on the relationship between demands and perceived stress above and beyond the effect of perceived support, supporting H4a. Since no moderating effects were found for received support quantity, we had to reject H3a.

Although the analysis revealed that the moderating effect of received support quality on the relationship between demands and AUCI ($\beta = -.279$, $p = .056$) is statistically insignificant at the α level of .05, it is worthy of discussion. Regarding received support quantity, network size moderated the relationship between demands and AUCI ($\beta = .269$, $p = .036$). Also, the number of provided support types showed a marginal significant moderating effect ($\beta = .294$, $p = .064$). R^2 was .30 ($p = .001$) for this model. For AUCG, no moderating effects for either received support quality or quantity were found (see Table 3). Figure 4 displays the

interaction effects. For received support quality, the interaction effects regarding AUCI are similar to those for perceived stress. Received support quality tended to have a buffering effect on the relationship between demands and AUCI, but not AUCG, above and beyond the effect of perceived support, which partially supported H4b.

Participants with high received support quantity showed a stronger relationship between demands and AUCI than participants with low received support quantity (see Figure 4). Interestingly, but contrary to our hypotheses, for participants with high received support quantity, the cortisol levels in terms of AUCI were high when demands were high, while it remained relatively stable for participants with low received support quantity, requiring us to reject H3b.

Discussion

This study sought to extend research on social support in the relationship between demands and stress to obtain a better understanding of the effects and mechanisms behind this relationship. Accordingly, we examined different characteristics of social support (perceived vs. received support and quality vs. quantity) and their impact on the effect of demands on perceived stress and cortisol levels in a joint research approach.

As expected, we found demands to be positively linked to perceived stress and to cortisol levels. Concerning the assumed buffering effect of social support, perceived social support seems to buffer the effect of demands on AUCI, which is consistent with the framework of the JD-R model. These findings are especially interesting because of the lack of research on stress biomarkers within the JD-R framework. Surprisingly, however, perceived social support seems to be only beneficial for perceived stress if demands are low

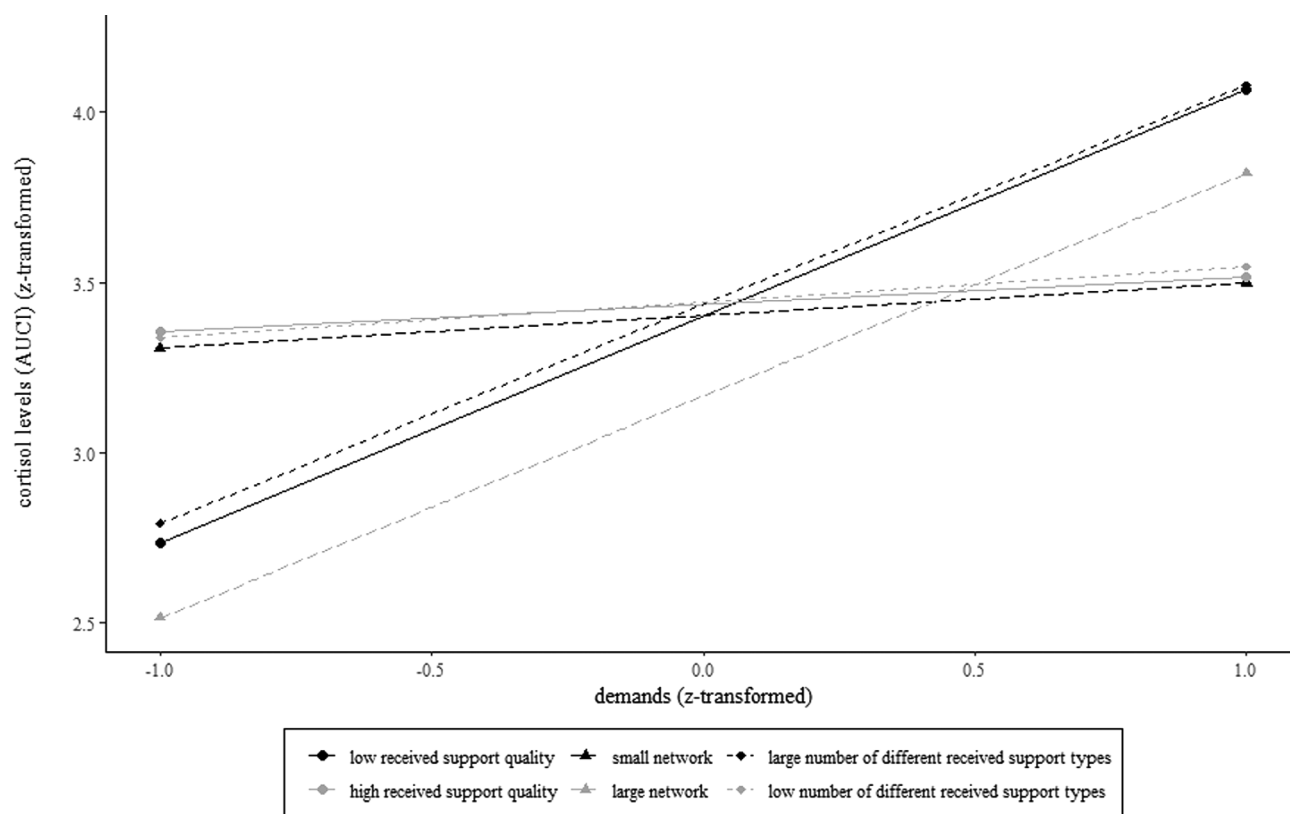


Figure 4. Moderating effect of received support quality, network size, and number of received support types on the relationship between demands and cortisol levels (AUCI).

to medium. This outcome is contrary to our assumptions as well as to previous studies on the buffering effect (Viswesvaran et al., 1999) and leads to the question of why perceived social support does not show a buffering effect anymore once demands are high. A potential explanation could be that when experiencing high demands, the perception of having support in the background becomes insufficient for coping with the demands, making actually receiving support necessary in those situations. This suggestion is supported by Rees and Freeman's (2007) findings, which showed a higher stress-buffering effect of received than perceived support in a situation with potentially higher demands than usual (i.e., a sport game). In further support of this explanation, our results revealed that the moderating effect of perceived support on the effect of demands on both of the measured outcomes was no longer significant if received support was added into the model. Instead, we found support for a moderating role of received support. In detail, received support quality buffered the relationship between demands and perceived stress in this model, as expected. However, persons with high received support quality showed a higher level of perceived stress for low and medium demands than persons with low received support quality. Similar patterns appeared for the buffering effect of received support quality on the

effect of demands on AUCI. What we can derive from these results is that received support quality is beneficial when demands are high because the stress level seems to be stabilized by the received support quality. More precisely, stress seemed not to depend on demands for persons with high received support quality. However, the level of stress in these persons was higher than for those with low received support quality and additionally low demands. A possible explanation might be that individuals having a supporting network may experience pressure or intention to provide excellent support quality to their network due to reciprocity norms (Abbott & Freeth, 2008). Especially in times of low demands, persons might feel obliged to provide support, which could lead to a higher perceived stress level even in times of low to medium demands. To examine this assumption, we made an exploratory correlation analysis between provided support and received support quality. That descriptive analysis indeed showed a positive correlation between provided support and received support quality ($r = .23$, $p = .048$), supporting this assumption. Another explanation that follows along with reciprocity norms is the effect of receiving social support on self-efficacy beliefs. Especially when over-benefitting, self-efficacy beliefs may be lowered (Jaekel et al., 2012), potentially leading to higher stress.

Contrary to our hypotheses on received support, support quantity did not show the expected moderating effects. While network size did not have any moderating effect on the relationship between demands and perceived stress, it seemed to have had the opposite effect to what we expected on AUCI. For those participants with a large network of supporters, the AUCI was high when demands were high, while it remained stable for participants with a small network of supporters. In this case, a large network may even be contraindicated in terms of the CAR. Similar patterns were shown for received support quantity in terms of the number of provided support types, albeit only marginally significant. A possible explanation for these results could be that because the received support failed to match the needs of the participants, it was not effective. For example, the social support effectiveness model (Rini & Dunkel-Schetter, 2010) states that the degree to which received support fits the need decides whether the received support is effective and if it is helpful or harmful. Furthermore, Melrose et al. (2015) suggested that a support overload (receiving more support than needed) also negatively affects the relationship between received support and mental health. Therefore, while social support should be measured as a multidimensional construct, the degree of need-matching supportive behaviors should also be considered (e.g., by including a needed-received-support proportion measure). From a social network perspective, another possible reason could be that a large network may offer more support providers but may also involve more support-receivers than a small network. For example, imbalances in reciprocity could be detrimental to health (Liang et al., 2001). Beyond reciprocity norms, Ellwardt and colleagues (2019) stated that measures of network size are unable to detect the negative effects of social networks on stress if the affective component of the network ties (i.e., the closeness and positiveness) is neglected. Furthermore, it could be hard to choose the right support provider for a specific case when faced with a wide selection, also raising the risk of missing the stress-support match.

Theoretical and Practical Implications

This study contributes to a better understanding of the mechanisms of social support and its buffering effects. We extend research on the JD-R model by showing how social support works as a personal resource and that its buffering effect is not always present but depends on the amount of demands, how stress is measured and whether support is perceived or received. In addition, we contribute to research on social support and stress mechanisms in the student context. Explicitly developed for the university context, the study demands-resources (SD-R) framework transfers the postulated direct interactions from the JD-R model

into the context of studying (Lesener et al., 2020). The results of this study underline the postulated direct effect of demands on stress within the SD-R framework and extend research on this framework by examining the moderating effects of resources in this context. Furthermore, by differentiating between perceived and received support, we contribute to social support theory. For example, our results feed the theoretical postulations of Uchino (2009) and others that perceived and received support work as distinct mechanisms, necessitating a more differentiated look at the overall construct of social support. In addition, our findings offer a contribution to the theory that received support also should be viewed as a multidimensional construct (Cohen & Wills, 1985; Schwarzer et al., 1994) because various facets of received support work differently toward stress.

One essential practical implication of this study is that it is crucial to review the quality of the individual's support network to benefit from it in stressful times. Moreover, the study results reveal that a high received support quantity is not always beneficial. Although a large network is helpful in its potential to provide good-quality support in stressful times, being part of a large network and providing support to others in the network can require a lot of one's own resources. Therefore, it might be more beneficial or less demanding for students to maintain a few high-quality relationships than many low-quality relationships. Furthermore, a higher focus on the individual's personal resources is needed. This requirement also applies to times characterized by a lower stress level; specifically, according to this study, stress peaks may be compensated via social support, though the general stress level was not that much influenced. In terms of psychological and healthcare practice, stress management and coping interventions should include a focus on both personal resources and the personal support network. Using network maps in coaching might help to reflect which social contacts are more or less helpful or harmful (Wittner et al., 2020). Furthermore, participants should learn to balance the amount of support they provide with the support they receive in turn, preventing the scales from tipping toward the negative side for their stress level.

Limitations, Directions, and Conclusions

Despite this study's contributions, the results lead to further research questions. Since our results reveal a positive relationship of network size with AUCI, more research is needed on circumstances under which social support is more harmful than beneficial in reducing stress. Despite the first studies examining that topic (e.g., Morin-Major et al., 2016), it remains unclear which aspects of support (e.g., network parameters) lead to such undesirable effects and why. Furthermore, social network analysis is still in its

infancy concerning the link between network parameters and stress biomarkers.

Even though we followed an approach with multiple measurement points, each participant's stress level reflects only a momentary snapshot at a particular measurement point, leading to the question of how the stress level changes over time. Furthermore, our approach does not allow conclusions on causal effects of the link between demands and social support on increases or decreases in stress. Therefore, future research should assess both demands and stress at all timepoints to allow cross-lagged analyses. Future research should also seek to assess when demands are really stress-inducing by taking the general demands and stress level of the participants into account, for example, by using daily measures in an event-based diary study format combined with daily measures of cortisol levels. Such an approach could help future research shed light on the impact of social support in a particular situation and on support-seeking behavior in demanding situations.

Even if received support was measured by using the social network approach, it still involves subjectivity. Assuring a more objective assessment of the social network (and, e.g., the contact frequency within the network) might involve using such options as a technology-based solution like Bluetooth or NFC/RFID interfaces (Thiele et al., 2018). Since such an approach neglects the quality of the received support, a possible compromise could be to assess received support with a more event-based approach by referring network support to specific stress situations. Additionally, received support quality was measured via a single item per listed person in the network. Despite being a common procedure in social network analysis (e.g., Powazny & Kauffeld, 2020), and although single-item measures have been proven to fulfill test criteria (e.g., Wanous & Hudy, 2001), this technique may underestimate the relationship of support quality and stress by neglecting potential effects of different aspects of received support quality.

Due to the study originating from a larger research project, we were not able to calculate an a priori power analysis, which is clearly a limitation. Along similar lines, the smaller sample size for the saliva measures than for perceived stress constricts the comparability of the results for both outcomes. Further testing of the model with larger and diverse samples is recommended to achieve more generalizability and to extend the research beyond the student context.

Nevertheless, to conclude, this study yielded striking findings. When experiencing demands, received support appears to be more relevant than perceived support in terms of buffering the relationship between demands and stress. More precisely, the received support quality seems the most beneficial factor. In contrast, received support quantity may even exert detrimental effects. Furthermore,

perceived stress differs from AUCI in the affectability through perceived and received social support.

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History

Received June 7, 2021

Revision received January 29, 2022

Accepted January 31, 2022

Published online March 28, 2022

Publication Ethics

The responsible ethics committee (ethics committee of Faculty 2, TU Braunschweig) granted approval for this study (FV-2016-14).

Funding

Open access publication enabled by TU Braunschweig.

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