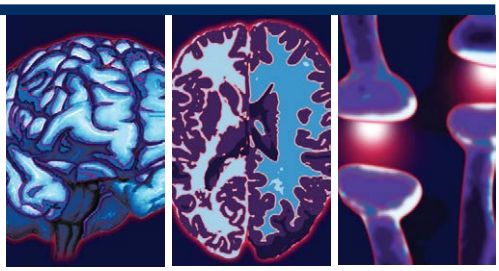

Daily Hassles, Coping and Well-Being: The Moderating Role of Hemispheric Lateralization

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ABSTRACT

Background: Daily hassles (DH) correlate positively with physical and psychological outcomes. Hemispheric lateralization (HL) is the tendency to activate or utilize functions associated with one hemisphere versus parallel regions in the other side. Right-HL is related to longer stress responses and left-HL was found to moderate relationships between DH and mental health. The purpose of this study was to investigate whether coping styles can explain the protective role of Left HL.

Methods: In this study, 76 participants completed a daily stressor scale, a physical symptoms scale (PHQ-15), anxiety and depression scales (HADS) and brief scales of coping. HL was measured by the neuropsychological line bisection task, previously validated by electroencephalography.

Results: DH was positively correlated with anxiety and physical outcomes in the full sample, and with anxiety only among right-HL people. Furthermore, while in the right HL group, emotion focused coping correlated with both DH and anxiety, in the left HL group, problem focused coping correlated with DH and anxiety. A formal mediation-moderation analysis confirmed this pattern only for denial, which was associated with both DH and anxiety, only in right-HL people.

Conclusions: The different coping correlates of right and left HL people may be the mechanism which explains the protective role of left HL in the association between DH and mental health. Limitations and additional neurophysiological mechanisms are discussed.

Keywords

Daily Hassels, Coping, Health, Hemispheric Lateralization, Mediation, Moderation

Introduction

Everyday individuals have experiences of daily hassles (DH) such as traffic jams, arguments with one's spouse or friends, or many tasks to do at work or at home. Hassles are the irritating, frustrating and distressing demands that, to some degree, characterize everyday transactions with the environment [1]. Lazarus conceptualizes hassles as "experiences and conditions of daily living that have been appraised as salient and harmful or threatening to the endorser's well-being". These stressors may be more predictive of mental and physical outcomes than major life events. Indeed, DH are associated with anxiety [2], depression [3] increased cortisol levels [4,5] having a cold, the flu, headaches and backaches [6] chronic diseases [7] as well as with inflammation [8,9]. According to the transactional model of stress and coping, stress responses result from the appraisal of the events [1]. The primary appraisal is an interpretation of the stressor's severity and the secondary

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appraisal concerns one's available resource to deal with the situation. In addition, external and internal resources [10] moderate the relationship between daily hassles and physical and mental outcomes. This association is moderated by the social support [11] hardiness and one's typical coping strategies [12,13], For example, one study showed that problem focused coping was negatively associated with depression whereas emotion focus coping increased the association between DH and depression among French students.

However, are there neuropsychological internal resource factors, which moderate the effects of stress on well-being? An emerging neuropsychological internal resource variable, which has received preliminary attention and plays a role in stress responses, is hemispheric lateralization (HL). HL refers to inter-individual differences in the activation of the left versus the right hemisphere or some specific regions in each hemisphere, also termed cerebral asymmetry. HL is associated with trait-like characteristics such as temperament and psychopathology, emotional processes and motivation [14]. Tomarken, Davidson, Wheeler and Doss [15] found an association between the right hemisphere and negative affect and between the left hemisphere and positive affect. According to Davidson [16], the right hemisphere is associated with avoidance behavior while the left hemisphere is related to approach behavior. Harmon-Jones [17], then constructed a motivational-direction model including dimensions of approach and withdrawal related to prefrontal asymmetry and their model better accounted for various empirical findings. Anger, an approach emotion, together with positive effect, are associated with increased left hemisphere activation and decreased activation of the right hemisphere [17], In contrast, the right hemisphere is associated with sad mood and anxiety and with withdrawal behavior. Interestingly, when individuals with social phobia anticipated giving a public speech, they exhibited greater right hemispheric activation than controls [18]. In addition, infants undergoing the 'stranger situation' (used to assess attachment styles) recover more slowly if they have more right-HL than left-HL [16].

Indeed, one study investigated the role of HL in the relationship between stressors including DH and psychological outcome. Herzog et al. [19] showed that HL moderated the relationship between DH and psychological distress: A positive and significant correlation between DH and distress was only seen for people with right HL. This was supported experimentally, where following an acute stressor, people with right-HL responded with stronger increases in reported stress than those with left-HL [19] In a following study, Herzog, et al. [20] showed that the association between self-reported missile exposure and PTSD symptoms was positive only for people with relatively right-HL but not left-HL, using either a self-reported or a neuropsychological test of HL. These findings suggest that the left hemisphere could be a protector against the adverse effects of threatening events.

Nevertheless, the mechanisms by which left-HL may be a protective factor in the effects of DH on well-being have not been revealed. The purpose of this study was to investigate the role of coping strategies in the mechanism, which explains difference between people with right and left HL in the correlations between DH and well-being. According to the approach-withdrawal motivation model of frontal asymmetry [17], we considered two kinds of coping, namely approach and avoidance coping strategies [21]. Left-HL involves approach-related motivation whereas right-HL islinked to avoidance motivation. Furthermore, these motivational styles are related to both types of coping – problem focused coping (PFC) and emotion focused coping (EFC), strategies thought to be crucial according to the theory of stress, coping and adaptation [6], PFC strategies such as analyzing and solving a problem are analytical efforts towards a problem, while EFC such as denial or avoidance reflect withdrawal from a problem. Therefore, it appeared relevant to investigate the link between HL and coping. Our first hypothesis was that DH would be positively associated with physical and mental symptoms. Second, testing the moderating role of HL, we expected that the association between DH and symptoms would be stronger for people with right-HL than for people with left-HL, in line with previous findings [19,20]. Finally, in line with psychological correlates of HL [16,17] we hypothesized that the coping correlates would differ between right and left HL groups. Specifically, we hypothesized that in right-HL, EFC strategies would be related to DH and to symptoms, while in left-HL, PFC strategies would be related to DH and to symptoms.

Materials and Methods

■ Participants

The participants were 76 right-handed adults. The mean age was 25.66 years (range: 17-56 years, SD=6.34). Participants were recruited from the social media on the internet in France. The majority of the participants was female (n=54.71%) and male represented 28.9% (n=22) of the sample. This sample was characterized by high educational attainment, as most were students (65.8%) and other was employees (30.3%) or unemployed (3.9%). Half of the sample was in couple (50%) or married (5.3%) and the other was single (44.7%). Six of the participants declared having a chronic disease. All participants were informed of the nature of the study procedures and provided online written informed consent prior to participation.

■ Materials

Background information: This included participants' age, gender, handedness, and years of education, working status, relationship status and number of children. Handedness was assessed by asking whether a participant's dominant hand was left or right and left-handed people were excluded from the study.

Daily stress: To assess this construct we used the *Daily Stress Scale* [22]. This is a 21 items questionnaire including prevalent daily stressors, divided into ten categories. The 10 stressor categories were (a) overload at home, (b) overload at work or school, (c) family demand, (d) other demand, (e) transportation problem, (f) financial problem, (g) argument with spouse, (h) argument with child, (i) argument with single other person (not a spouse or child) and (j) with multiple other persons on the same day. We changed the original dichotomous response option to a Likert scale, to increase the scale's sensitivity. Participants had to evaluate "At which point each of the following situations seemed stressful to you during the last week?" on a Likert scale (0=not at all; 1=a little; 2=somewhat; 3=to a great extent). In the present study, the scale's internal reliability was strong (Cronbach alpha of 0.89). For the present study, we only considered the total score of this scale, with higher scores reflecting more DH.

Hemispheric lateralization: This main study construct was measured by non-pre-bisected line test, where participants received 14 horizontal lines, in which they had to mark the perceived middle on each one. The lines were 20 ± 1 cm long. The computer marked the distance between the real middle and the participant has marked middle. A tendency for a deviation towards the left of the real middle reflected right-HL, while a tendency for a deviation towards the right of the real middle reflected left-HL. Deviations right from the middle were positively scored and deviations left from the middle were negatively scored. Participants' HL score was the mean of their deviation across the 14 lines, with higher scores reflecting left-HL. A highly similar test was validated against an electroencephalography measure of HL [23]. In the present study, the internal reliability of this test was high (Cronbach's alpha=0.87). The test was performed online, coded on JavaScript. However, this program did not take into account the resolution of participants' screen, which posed a problem for standardizing the size of all lines in the line bisection test. For this reason, participants had to adjust a square with their credit card (without providing any information about it), to certify the real resolution of their computer.

Coping: This construct was assessed by the Brief Cope [24]. This scale originally consists of 14 subscales with two items per subscale. For the present study, we used four categories of coping, two reflecting approach (problem focused) coping and two reflecting avoidance (emotion focused) coping, according to Suls and Fletcher [25]. The subscales were selected in concordance with studies showing left/right HL correlations with the four relevant coping concepts (planning and active coping reflecting approach, while denial and self-blame reflecting avoidance [17,26,27]. We selected active coping and planning as approach coping strategies with questions such as "I've been concentrating my efforts on doing something about the situation I'm in" or "I've been trying to come up with a strategy about what to do." respectively. For avoidance coping, we used denial and self-blame with questions such as "I've been saying to myself "this isn't real" or "I've been criticizing myself.", respectively. Participants answered each question on a likert scale (1=not at all to 4=totally agree). The Cronbach's alpha coefficients (internal reliability) of Self-blame was 0.87, of Denial was 0.79, of active coping was 0.55 and of planning, was 0.79. Thus, except for active coping, these were adequate to strong reliability coefficients, and were considered adequate given that each subscale included only two items.

Anxiety and depression these constructs were assessed by the hospital anxiety and depression scale (HADS) [28]. This scale assesses intensity of anxiety and depressive symptoms. The questionnaire was validated in French [29]. It includes two subscales, 7 items for depression and 7 items for anxiety. The participant has to answer each item on a 0 to 3 scale for each item, while some items require to be reversed. The Cronbach's alpha internal reliability coefficients were for anxiety 0.80 and for depression 0.68.

Physical symptoms this construct was assessed by the physical health questionnaire (PHQ-15) [30]. This scale evaluated patients' physical health symptoms and included 15 items (e.g., chest pain, headaches, back pain, shortness of breath). The participants had to indicate the extent to which they were bothered by each symptom from not bothered (0) to very bothered (2). We changed the reference point from the past week to the past month in the present study, to have a more general representation of participants' physical health. The scale's internal reliability in the present study was good (Cronbach's alpha=0.79).

■ Procedure

We entered all questionnaires on a Limesurvey website. The link was shared on social network such as Facebook and Twitter. The first page contained the letter of information and the informed consent. Consent was provided electronically, by agreeing to participate in the study. Once accepted, participants filled out the sociodemographic questions. The next test was the line bisection test. Thereafter, participants filled in the brief cope, daily stress scale, HADS and the PHQ-15. All the data were recorded in Limesurvey, anonymously. The time for completion of the study was between 10 to 15 minutes.

■ Statistical analysis

We used Pearson correlations to test the relationships between DH and physical and mental health. To test the moderating effect of HL, we split the sample into two groups according to the line bisection score. Participants in the upper 40% percentile were considered as left HL and those in the lower 40% percentile were considered as right HL. Such an analysis was performed in previous studies as well [19,20] to enable to create more distinguished HL subgroups. We used Pearson correlations to test the correlations between DH, coping, physical, and mental symptoms, within each HL group separately. Finally, we additionally applied a more rigorous mediation-moderation analysis of coping style (as mediator) and HL (a moderator) in the associations between DH and symptoms, as described in detail below. We used SPSS 24 to analyze the data.

Results

■ Descriptive analysis

Table 1 depicts the descriptive statistics of the main study variables in the full sample (n=76). The mean HL score showed a slight tendency towards right-HL and the standard deviation (SD) revealed large individual differences on the HL variable. The mean anxiety level reflects mild anxiety while the mean depression level is below the mild cut-off.

■ Relationship between daily hassles and physical and mental health

Table 2 shows the correlations between DH and physical and mental symptoms in the full sample. Positive correlations between DH and physical symptoms ($r=0.21$; $p<0.05$) and between DH and anxiety ($r=0.34$; $p<0.001$) were found. In contrast, there was no correlation between DH and depression ($r=0.13$; $p=0.12$).

■ The effects of daily hassles and hemispheric lateralization on symptoms

Since HL is construed as a categorical rather than a continuous variable [20]. we analyzed the relationship between DH and health outcomes separately for participants with right-HL and left-HL. To perform this analysis, we examined people with the lower 40% HL percentile (right-HL, n=31) and higher 40% percentile of HL scorers (left-HL, n=30), as described above. As shown in **Table 3**, a clear difference in the pattern between the left and right HL groups in the DH-health relationships emerged. There was a positive and significant correlation between DH and anxiety among right-HL participants ($r=0.33$; $p=0.03$) but non-significant relationships with depression ($r=0.06$; $p=0.37$) and physical symptoms ($r=0.23$, $p=0.11$). In contrast, all three correlations were non-significant among left- HL participants (for DH and physical symptoms: $r=0.08$, $p=0.33$, for anxiety: $r=0.16$, $p=0.19$ and for depression: $r=0.33$, $p=0.43$). In this case, HL seems to moderate only the relationship between DH and anxiety because the correlation is null among left HL and significant for right HL participants. This is graphically depicted in **Figure 1**.

Table 1: Descriptive statistics of main study variables (n=76).		
Variable	**Mean**	**SD**
Daily hassles	17.57	13.24
HL-Line bisection score	-0.07	2.93
Physical symptoms	8.30	4.41
Anxiety	9.01	4.16
Depression	4.45	3.02
ABB: SD: Standard Deviation; HL: Hemispheric Lateralization		

Table 2: Correlations between daily hassles and physical and mental symptoms: full sample (n=76).				
		Physical S.	**Anxiety**	**Depression**
DH	Pearson Correlation	0.21*	0.34**	0.13
Note: DH: Daily Hassles; Physical S.: Physical Symptoms; * p<.05; **. p<.01 (1-tailed)				

Table 3: Correlations between Daily hassles (DH), coping style and anxiety, as function of hemispheric lateralization (HL).					
Groups		**Active**	**Plan**	**Blame**	**Denial**
Right-HL n=30	DH	-0.22	-0.20	0.04	0.41*
	Anxiety	0.07	-0.02	0.43**	0.65***
Left-HL n=31	DH	-0.21	-0.40*	-0.16	0.07
	Anxiety	-0.30*	-0.45**	-0.05	0.24
Note: * p ≤ 0.05; ** p<0.01; *** p<0.001 (1-tailed)					

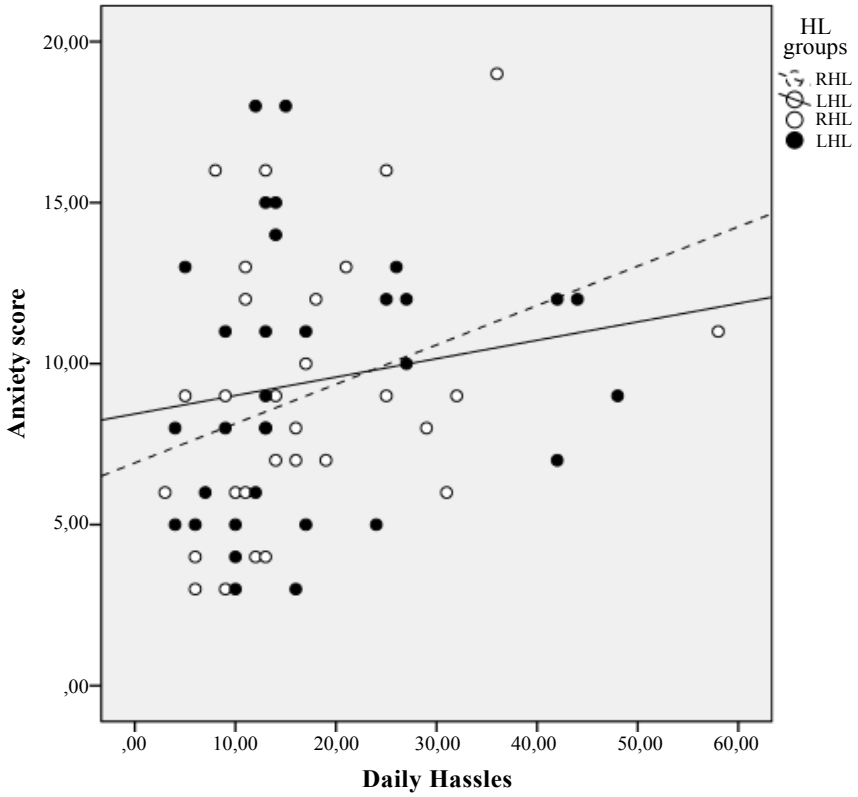

Figure 1: Correlations between anxiety and daily hassles as function of hemispheric lateralization.

■ The relationship between daily hassles, coping and health symptoms as function of hemisphere lateralization

We now turn to our main research question: Do the coping correlates of both DH and health differ as a function of HL? We first used Pearson correlations to test the relationship between coping strategies and DH, physical symptoms, anxiety and depression, as a function

of HL. For right-HL participants, there was a positive correlation between DH and denial coping. Furthermore, blame coping and denial coping, both types of EFC, were positively correlated with anxiety. In contrast, there were no correlations between DH and active coping or planning coping, both types of PFC, in the right HL participants. On the other hand, in the left HL participants, there was a negative correlation between DH and planning coping, but DH was unrelated to blame coping or denial, both forms of EFC. However, DH was also unrelated to active coping, a form of PFC. Planning coping and active coping, both types of PFC, were negatively associated with anxiety, in left-HL participants. Finally, anxiety levels were significantly and inversely related to both planning and active coping in left-HL participants. **Table 3** depicts these results, which clearly show a different and unique pattern of correlations between coping strategies and DH and outcomes, as a function of HL.

■ A formal moderated mediation analysis in the associations between daily hassles, coping, and physical and mental health, as function of hemispheric lateralization

In this last analysis, we combined a theoretical and an empirical approach in selecting the coping strategies for this rigorous analysis. Theoretically, we wished to consider both types of coping (i.e. PFC, EFC) according to the theories of stress, coping and adaptation [6] because both types are effective, depending on the context in which they are used (e.g., controllability) [31]. However our previous results **(Table 3)** revealed that only two of the four coping strategies might be candidates for serving as mediators. Indeed, only denial (an EFC) and planning coping (a PFC) were each related both to DH (the predictor) and anxiety (the outcome), separately in right HL (denial) and in left HL (planning). Thus, the following analysis enabled us to test the meditating role of these two coping strategies together in the same model while considering the moderator HL, using model 59 of Hundt' procedure on SPSS version 21 [32].

In step 1, denial served as an outcome, and DH was significantly associated with denial (p=0.02; 95% CI: .0.01 - 0.17) and the interaction of DH x HL tended to be significant (p=0.08; 95% CI: -0.09–0.01). Similarly, in step 1, also planning served as an outcome, however, neither DH was significantly associated with planning (p=0.82; 95% CI: -.0.16 - 0.13) nor was the interaction of DH x HL related to planning (p=0.80; 95% CI: -0.10–0.01).

In Step 2, we examined the direct effects of DH and its indirect effects (via coping) on anxiety, moderated by HL. This reflected the main moderated mediation analysis. DH had no direct effects on anxiety in either people with right HL (p=0.26, 95%CI: -0.06–0.20) or with left HL (p=0.73, 95%CI: -0.10–0.14). Concerning the indirect effects, denial emerged as a significant *mediator* in the association between DH and anxiety, in people with right HL (95%CI: 0.01 – 0.19) but not in people with left HL (95%CI: -0.03–0.03). Thus, HL moderated the mediating role of denial in the DH-anxiety relationship. In contrast, planning coping was not a mediator between DH and anxiety either in people with right HL (95%CI: -0.02–0.07) or in those with left HL (95%CI: -0.01-0.19).

Finally, in Step 3, we discovered that only the path containing denial met the criterion of a moderated mediator (moderated mediation index = -0.09; 95%CI: -0.19- -0.007) but not planning coping (moderated mediation index=0.04; 95%CI: -0.03 – 0.18).

This analysis clearly showed that denial coping mediated the association between DH and anxiety, moderated by HL: Denial was a mediator between DH and anxiety only in people with right-HL, not left-HL. **Figure 2** depicts all paths' coefficients of this analysis.

Discussion

The purpose of this study was to investigate the mechanisms which explain the moderating role of HL in stress responses and specifically in the relationship between daily hassles (DH) and health outcomes. Our main hypothesis was that different coping styles associated with right- versus left-HL may explain the moderator effect of HL in the association between DH and health outcomes.

The first result shows that there is a positive relationship between DH and anxiety. This result is congruent with the literature [6,13,33,34]. The second main result was a positive relationship between DH and physical symptoms. This is in line with studies showing that emotional reactivity to daily hassles is associated with chronic diseases [7], with studies showing that stressors are related to myocardial infarctions [35], and to other physical conditions such as colds [14] and headaches [36]. Some

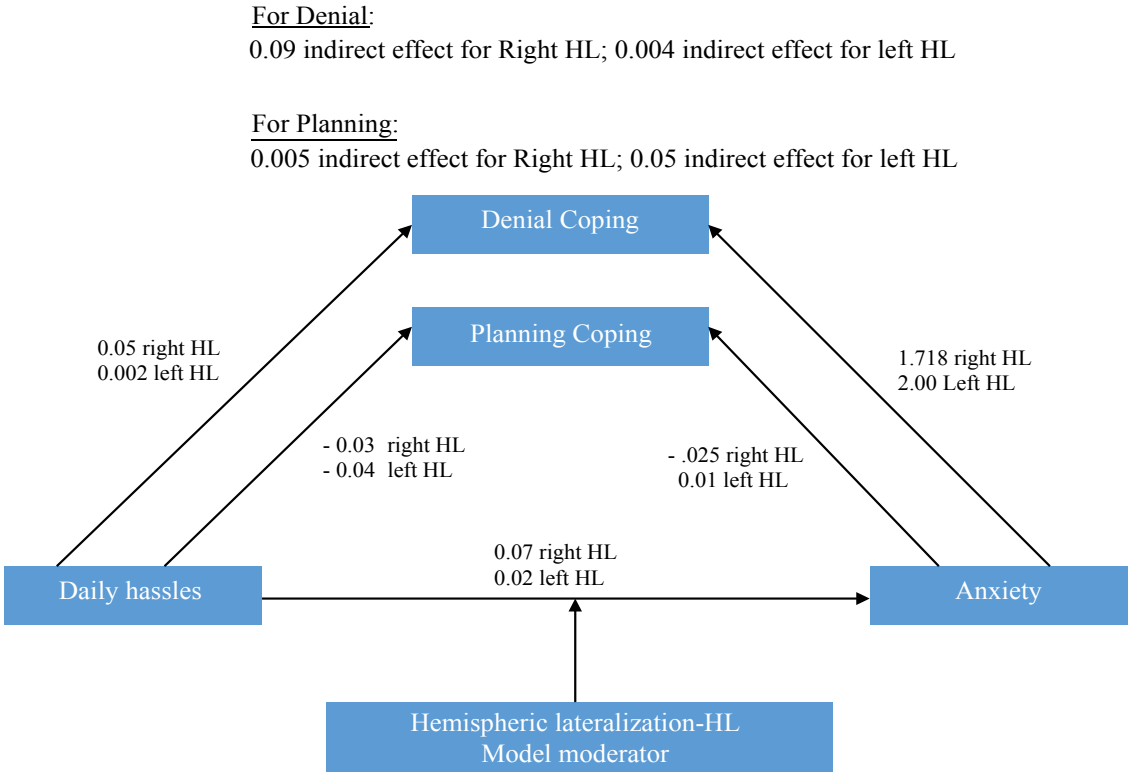

Figure 2: Path analysis of mediator-moderator analysis concerning daily hassles, coping and anxiety, as function of hemispheric lateralization (HL).

of the biological mechanisms underlying such associations could include an increase of cortisol among older persons with stress and an increase of the inflammatory marker C-reactive protein [9].

One of the main objectives of this study was to test HL as a moderator variable. We found that the relationship between DH and anxiety differed as function of HL. The association between DH and anxiety was not significant among left-HL participants but was positive and significant among participants in the right-HL group. This result is congruent with Herzog al [19] and with the protective role of left-HL in the relationship between life threatening stress and post-traumatic stress symptoms found in a real life context of war in Israel [20].

The main question is why does the left hemisphere play such a protective role. Various findings from cognitive neurosciences and psychophysiology could explain the protective role of the left hemisphere. First, people with left-HL recover faster from stress than those with right-HL [16]. In addition, there is a relationship between HL and the autonomic nervous system. According to Wittling et al. [37] the left hemisphere drives the parasympathetic system, whereas the right hemisphere controls the sympathetic system. Indeed, repetitive transcranial magnetic stimulation of the left, but not the right, dorsolateral prefrontal cortex, led to increases in the vagal parasympathetic index of heart rate variability (HRV). Furthermore, people with high vagal activity recover faster from stressors in multiple physiological systems [38]. HRV correlates with emotional regulation [39], a key ability for terminating one's stress response and possibly the effects of DH on health. Of relevance to this issue, children who exhibit right-HL had poor emotional regulation and low HRV four years later, during an emotional task [40]. Thus, though not measured in the present study, it is possible that the protective role of left-HL partly results from its ability to mediate the vagal parasympathetic stress response which regulates emotional and physiological responses to adversity.

However, in the present study, we examined the role of a psychological construct, namely coping, as an explanatory variable for the moderating effects of HL in the DH-health relationship. The impact of DH on health may depend on the appraisal of DH and on the coping strategies used. For example, Lu [13] showed that

suppression coping was not adaptive whereas planning coping was associated with better mental health. Similar results were found in a meta-analysis on the role of coping strategies and health [41]. The main novel finding of the present study concerns the role of coping style as function of HL. We found different coping correlates of both DH and of anxiety, as function of HL, in two different analyses. Using the more simple but straightforward statistical analysis, we observed that in people with right HL, positive correlations between DH and denial, and between anxiety and both denial and blame coping, were found. This is in line with the right-HL reflecting the behavior inhibition system, which reflects an avoidance orientation. In contrast, in people with left-HL, we observed an inverse correlation between DH and planning coping and between anxiety and both active and planning coping. This is in line with left-HL reflecting the behavior activation system and an approach orientation, thus approaching problems [14,42-44]. In other words, astonishingly different coping strategies were associated with both the stressor (DH) and the outcome (anxiety), depending on one's HL, with right-HL being EFC strategy oriented and left-HL being PFC strategy oriented. These results were then replicated in the more rigorous statistical analysis which enabled denial and planning coping to "compete". In that rigorous analysis, denial coping emerged as mediator in explaining the moderating role of HL in the relationship between DH and anxiety. These patterns can explain why stressors are more strongly associated with stress outcomes in right-HL but not in left-HL people [19,20] since routinely using emotion focused coping strategies such as avoidance or denial may not solve the stressors, especially if controllable. In contrast, using PFC, mostly in controllable situations, helps to terminate and resolve stressors, and thus reduce their long-term impact. Thus, approach coping, associated with left-HL, and associated with less distress in the present study, seems to be more adaptive for coping with DH and this is perhaps why left-HL could be protector. In contrast, avoidance coping, particularly denial, associated with right HL and with more distress in the present study, seems to be less adaptive to cope with DH, and is perhaps the reason for right-HL being a vulnerability factor. Future studies may need to examine both psychological (coping) and neurophysiological factors (e.g., HRV) together and test which dimension is more important in mediating and explaining the moderating (protective) role of left-HL.

Our study included several limitations. First, the sample was reduced because of exclusion of people falling between clear right- and left-HL groups. However, this was deliberately done in order to create more distinguished right-HL and left-HL groups. Second, most of our sample included students close to exams. Lewis et al. [45] showed a switch in right HL when students were taking exams. This could have affected participants' HL and health outcomes. Third, we did not include neurological measures of HL such as EEG or brain imagery. However, our neuropsychological measure of HL, the line bisection test, was validated against an EEG measure [23]. Finally, we did not use objective measures of physical health which may have contributed to the null results on this outcome. Future studies need to include more participants from various age groups, and measure health and EEG by more objective measures as well.

Conclusion

In summary, our study showed that HL moderated the relationship between DH and anxiety. Moreover, the coping style correlates of both DH and anxiety differed as function of HL, and this could explain the protective role of left-HL seen in recent and in the present study. Our results echoed the fact that approach coping (planning) is related to left HL, whereas avoidance coping (denial) is related to right-HL, and these differences could explain the protective role of left-HL in the stress-health association. Other neurophysiological mechanisms may also need to be tested for explaining the observed pattern of results. For example, the vagus nerve could underlie some of these results because left hemispheric activation in the dorsolateral prefrontal cortex increases vagal activity, indexed by heart-rate variability (HRV) and high HRV is related to faster recovery from stress [38]. Whether the associations between left-HL and HRV are bidirectional and whether HRV-biofeedback, can increase left-HL in the service of coping more adaptively with stress, need to be investigated in future studies.

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