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## Research Submission

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### Daily Frustration, Cognitive Coping and Coping Efficacy in Adolescent Headache: A Daily Diary Study

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**Objective.**—To investigate both concurrent and prospective relationships between daily frustration, cognitive coping and coping efficacy on the one hand and daily headache occurrence on the other.

**Methods.**—Eighty-nine adolescents aged 13-21 completed an online daily diary for 3 weeks. Data were analyzed using multilevel modeling.

**Results.**—Daily frustration of goal pursuits was significantly related to both same day and next day headache occurrence. Coping efficacy beliefs were significantly related to lower next day headache occurrence (no same day relationship was found). None of the cognitive coping strategies used in response to daily frustration were related to headache occurrence on the same or next day.

**Conclusions.**—Daily frustration to goal pursuit is suggested to be an important stressor contributing to concurrent and prospective headache occurrence. Furthermore, the extent to which adolescents believe in their ability to cope also appears to influence experience of subsequent headache. Further prospective studies are necessary to confirm these findings and to further unravel the possibly reciprocal relations between these factors. These findings offer useful insights into the dynamic interplay between daily stressful experiences and headache in youths.

**Key words:** adolescents, goal disturbance, cognitive coping, personal goals, coping efficacy

(*Headache* 2009;●●:●●-●●)

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Headache is one of the most commonly reported physical complaints in adolescence<sup>1</sup> reported on a weekly basis by approximately 1-in-7 boys and 1-in-4 girls.<sup>2</sup> Adolescents with frequent headache typically report significantly lowered well-being and quality of life compared with their headache-free peers.<sup>3-6</sup> Headache prevalence increases significantly during the early teen years<sup>7</sup> and these complaints can often be enduring into adulthood.<sup>8,9</sup> An important question

therefore is which psychological factors, which might be amenable to intervention, influence the occurrence of headache in adolescence?

In this study we employed the extended stress-coping model<sup>10</sup> to investigate the contribution of daily frustration and cognitive coping strategies to the occurrence of headache. Daily frustrations are defined as stress caused by daily internal or external demands that create disruption to personal goal pursuit. Cognitive coping strategies are defined as the thoughts (rather than the behaviors) employed to deal with the daily frustration or associated negative emotions.<sup>11</sup> In addition, we also investigated the importance of coping efficacy for the experience of headache in adolescence. Coping efficacy refers to the

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*Conflict of Interest:* None

belief that coping efforts are or have been effective, which can be seen as an internal resource.<sup>10</sup>

Previous research has highlighted the possible role of stress in the precipitation and chronification of headache.<sup>12-16</sup> These studies have particularly emphasized the role of proximal daily stressors rather than major life events.<sup>17,18</sup> Similarly, among high school students with headache the most commonly reported cause of headache was stress, reported by 40% of the adolescents.<sup>19</sup> Studies with adolescents have indicated that (daily) stress is related to higher levels of pain and somatic complaints.<sup>20,21,22</sup> Studies that have investigated the prospective relationship however are inconclusive. A number of prospective studies have failed to find evidence for a predictive relationship between psychosocial stress and pain, although these factors were found to covary.<sup>23,24</sup> Moreover, the prospective impact of daily frustration on headache in adolescence has yet to be investigated.

According to the expanded stress-coping model, the ways in which an individual copes with stressors are likely to impact upon physical outcomes. We suggest therefore that cognitive strategies used to cope with daily frustrations are likely to be related to headache complaints. Research on the impact of stress-coping strategies on pain in adolescents, however, is scarce. In male adolescents, use of depressive, palliative, and avoidant coping strategies has been related cross-sectionally to greater headache intensity.<sup>25</sup> Furthermore, among female undergraduates, 1-in-20 participants demonstrated a significant negative relationship between approach-coping and subsequent migraine.<sup>12</sup> With regards to specific cognitive coping strategies, various recent studies have suggested a relationship between rumination and physical health complaints.<sup>26,27</sup> Another cognitive coping strategy extensively investigated and associated with pain is that of catastrophizing.<sup>28</sup> This strategy is, however, typically measured as a response to pain. The extent to which catastrophizing in response to stress is related to headache has yet to be investigated. In addition, evidence suggests that perceptions of coping efficacy may be predictive of pain over and above the explanatory value of actual coping strategies employed.<sup>29</sup>

In summary, much of the evidence points to concurrent relationships between stress, coping, and

headache. However, the limited prospective evidence is mixed. This is the first study to employ a daily diary approach to investigate the role of self-regulatory factors in headache in the general population of adolescents. Daily diaries allow assessment of proximal stressors and associated coping efforts, capture daily fluctuations in pain, and reduce error associated with retrospective methods.<sup>30</sup> We therefore employed this approach to investigate the following research questions: To what extent is daily frustration to goal pursuit related both concurrently and prospectively to headache occurrence? When daily frustration is experienced, to what extent are cognitive coping strategies used in response to the stress and coping efficacy related to headache occurrence? In line with previous findings and the extended stress-coping model,<sup>10</sup> we hypothesized that higher daily frustration would be related to greater concurrent and prospective headache occurrence. Furthermore, strategies such as catastrophizing, self-blame and rumination, and low coping efficacy were expected to be related to higher headache occurrence. Conversely, strategies such as positive refocus and positive reappraisal and high coping efficacy were expected to be related to lower headache occurrence.

## METHODS

**Participants.**—Ninety-three adolescents participated in the daily diary study, of whom 4 were excluded from the analyses as they reported neurological illnesses (epilepsy and brain damage). Of the 89 participants included, 66 (74%) were girls and the age range was 13-21 years ( $M = 15.8$ ,  $SD = 1.3$ ).

**Procedure.**—Participants of a previous study among secondary school students who had given permission to be approached for a related study ( $n = 542$ ) were invited to participate via post. Interested parties were directed to the study website for more information on the aims and procedures and registration for the study. Adolescents were requested to complete an informed consent form online as part of registration, and parents/guardians of those under the age of 16 were also required to complete a separate consent form before their child commenced participation. Registered participants chose a log-in name and received a password in order to access the online

diary. Before commencing the main study, the diary was piloted among 8 adolescents for ease of use, acceptability by the target population, and to iron out any technical difficulties. Refinements of the measures, structure, and procedures were made based on the feedback from the pilot participants.

Participants completed a brief diary entry at the end of every day for 3 weeks. This took no longer than 10 minutes to complete. Reminder emails were sent to participants who missed an entry on the previous day(s). It was possible to complete entries retrospectively; however, this occurred in only 48 (4.5%) cases. All data entries were included in the analyses. Incentives were offered in form of a weekly raffle of a 25-Euro gift voucher (contingent on completion of 6 diary entries per week), plus a final prize draw (contingent on completing a minimum of 15 diary entries). Use of incentives is often used in diary studies<sup>29</sup> to motivate continued effort and minimize missing values. After completion of the study, participants were sent a brief report documenting the general findings of the study. The study was approved by the university faculty of social sciences ethics committee. In another publication, the influence of headache, daily frustration, and cognitive coping on affect are explored.<sup>31</sup>

**Measures.—Headache.**—Headache occurrence was indicated by the presence or absence of headache each day (0 = no headache, 1 = headache). When headache was reported, additional questions on headache characteristics were presented, such as severity, use of medication, and school attendance.

**Daily Frustration.**—Participants were asked to what extent things had gone the way they wanted them to go or not in 4 goal areas: school, at home, social life, and leisure. Answers ranged from 1 (went completely the way I wanted) to 7 (didn't go at all the way I wanted). Due to the similarity in findings across the goal domains, scores were averaged over the four domains to give a global indicator of goal frustration for that day ( $\alpha = 0.73$ ). Based on the premise that a coping response is stimulated when an event is appraised as stressful, when high frustration was reported (a score of  $\geq 5$ ) on any of the goal domains, adolescents were presented with questions on cognitive coping strategies and coping efficacy. If no

frustration was experienced on a given day (a score of  $\leq 4$ ), these questions were not presented.

**Cognitive Coping Strategies.**—Cognitive coping strategies used in response to high daily frustration were measured by means of the Cognitive Emotion Regulation Questionnaire<sup>32</sup> (CERQ, see also [www.cerq.leidenuniv.nl](http://www.cerq.leidenuniv.nl)). The original questionnaire consisted of 9 subscales comprised of 4 items each. As 36 items would be too lengthy to complete on a daily basis, one item per subscale was selected based on a high factor loading or conceptual representativeness of the item. The items used per subscale were as follows: acceptance: "I think that I can't do anything about it"; catastrophizing: "Again and again, I think about how terrible it all is"; other blame: "I think that others are to blame"; positive reappraisal: "I think that I can learn from it"; positive refocus: "I think about nicer things that have nothing to do with it"; putting into perspective: "I think that worse things can happen"; refocus on planning: "I think of how I can best cope with it"; rumination: "Again and again, I think about how I feel about it"; and self-blame: "I think that it's my own fault."<sup>33</sup> Participants were required to indicate to what extent they had used this strategy in response to the experience of frustration that day, ranging from 1 (not at all) to 5 (a lot). Acceptable reliability and validity of the CERQ have previously been demonstrated.<sup>32</sup>

**Coping Efficacy.**—Based on Aldwin and Revenson,<sup>34</sup> 2 items were developed to assess coping efficacy: "I feel that I dealt well with what happened today" and "I feel that I dealt well with my emotions today." The response scale ranged from 1 (completely disagree) to 5 (completely agree). Cronbach's alpha was 0.82.

**Statistical Analysis.**—A diary design generates data whereby daily entries (level 1) are nested within each individual (level 2). In order to take the dependence of the nested observations into consideration, multilevel logistic regression analyses were conducted using the program MLwiN version 2.02.<sup>35</sup> Marginal quasi-likelihood approximation was employed. Fixed effects of predictor variables were tested by comparing *t*-values (estimate/SE). A joint chi-square test was conducted to assess the significance of added variance components to the new model. All

independent variables were grand mean centered to reduce problems of multicollinearity. In order to assess the time-lagged associations, next day outcome(s) were regressed on present day independent variable(s). First, headache occurrence was regressed on daily frustration, controlling for age and gender. Second, on days when frustration was high ( $\geq 5$ ), headache occurrence was regressed on cognitive coping strategies and coping efficacy, controlling for age, gender, and variability in daily frustration.

## RESULTS

**Descriptive Statistics.**—A total of 1062 diary entries were completed out of a possible 1869, representing a completion rate of 57%. Headache was recorded on 250 of the 1062 entries (23.5%) by 71 participants (range 1-14 days). Average headache severity on days that headache was reported was 4.4 (SD = 2.2, range 1-10). Eight participants (9%) reported missing school in 11 (4.4%) of the headache cases. Thirty participants (34%) reported taking medication in 53 (21.2%) of the headache cases. High daily frustration ( $\geq 5$ ) was reported on 175 of the 1062 entries (16.5%); therefore, cognitive coping and coping efficacy data are available for 175 days.

**Multilevel Analyses.**—*Same day Analyses.*—First, headache occurrence was regressed on daily frustration, controlling for age and gender (see Table 1: same day headache). Age was negatively related to headache occurrence ( $B = -0.21$ ,  $t = 2.02$ ,  $P < .05$ ) indicating that headache was higher among younger adolescents. Furthermore, daily frustration ( $B = 0.45$ ,

$t = 5.34$ ,  $P < .001$ ) was significantly positively related to headache occurrence. In other words, greater daily frustration was related to a higher incidence of headache on the same day. Addition of daily frustration significantly improved the model ( $\chi^2 = 28.46$ , d.f. = 1,  $P < .001$ ).

Second, for days when daily frustration was high ( $\geq 5$ ), headache occurrence was regressed on cognitive coping strategies and coping efficacy, controlling for age, gender, and daily frustration (see Table 2: same day headache). None of the cognitive coping strategies or coping efficacy were found to be related to headache occurrence.

*Time-Lagged Analyses.*—First, next day headache occurrence was regressed on daily frustration, controlling for age and gender (see Table 1: next day headache). After controlling for age and gender, daily frustration was significantly related to next day headache occurrence ( $B = 0.20$ ,  $t = 1.94$ ,  $P < .05$ ). Addition of this variable significantly improved of the model ( $\chi^2 = 3.79$ , d.f. = 1,  $P = .05$ ).

Second, for days when daily frustration was high ( $\geq 5$ ), headache occurrence was regressed on cognitive coping strategies and coping efficacy, controlling for age and gender (see Table 2: next day headache). Cognitive coping strategies were unrelated to next day headache occurrence. However, greater coping efficacy was negatively related to next day headache occurrence ( $B = -0.32$ ,  $t = 2.22$ ,  $P < .05$ ). In other words, a greater belief in one's ability to cope was related to lower subsequent headache. Addition of coping efficacy significantly improved the model, ( $\chi^2 = 4.91$ , d.f. = 1,  $P < .05$ ).

**Table 1.—Same Day and Next Day Headache Occurrence Regressed on Daily Frustration Controlling for Age and Gender (n = 1062)**

	Same day headache occurrence			Next day headache occurrence		
	Estimate	SE	<i>t</i>	Estimate	SE	<i>t</i>
Age	-0.21	0.11	2.02*	-0.20	0.12	1.60
Gender	0.31	0.31	1.00	0.45	0.36	1.24
Daily frustration	0.45	0.09	5.34***	0.20	0.10	1.94*

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$ .

**Table 2.—Same Day and Next Day Headache Occurrence Regressed on Cognitive Coping and Coping Efficacy in Response to High Daily Frustration ( $\geq 5$ ) Controlling for Age, Gender, and Daily Frustration (n = 175)**

	Same day headache occurrence			Next day headache occurrence		
	Estimate	SE	<i>t</i>	Estimate	SE	<i>t</i>
Age	0.03	0.14	0.18	-0.39	0.21	1.84*
Gender	0.69	0.48	1.44	1.16	0.65	1.78*
Daily frustration	0.74	0.22	3.46***	0.44	0.26	1.68*
Acceptance	0.05	0.15	0.35	0.05	0.19	0.24
Catastrophizing	0.21	0.19	1.07	0.25	0.26	0.94
Other blame	-0.16	0.16	0.99	-0.24	0.19	1.24
Positive reappraisal	0.19	0.19	0.98	-0.09	0.25	0.37
Positive refocus	-0.14	0.16	0.92	-0.14	0.20	0.67
Putting into perspective	-0.06	0.15	0.39	0.18	0.20	0.88
Refocus on planning	-0.12	0.19	0.62	0.39	0.26	1.49
Rumination	-0.04	0.19	0.20	-0.36	0.25	1.42
Self-blame	-0.10	0.15	0.64	-0.34	0.21	1.63
Coping efficacy	-0.02	0.11	0.13	-0.32	0.14	2.22*

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$ .

## DISCUSSION

This is the first study to take a daily process approach to investigate the relationship between self-regulatory factors and headache among adolescents. Specifically, the concurrent and prospective relations between daily frustration, cognitive coping, coping efficacy, and headache occurrence were explored. Greater daily frustration was found to be related to greater headache occurrence, both on the same and next day. This supports previous studies among pediatric populations that have demonstrated covariance between (daily) stress and headache<sup>31,36</sup> or pain.<sup>23</sup> Moreover, these findings extend those of previous studies demonstrating a prospective effect of frustration to personal goal pursuit on subsequent headache occurrence. Based on these findings, we suggest that stress generated by impediment to pursuit of personal goals may be one mechanism by which headache is maintained.

In response to daily frustration, we investigated the importance of cognitive coping strategies and coping efficacy for the experience of headache. Contrary to expectations none of the cognitive coping strategies investigated were related to headache occurrence. The lack of relationship between strategies such as rumination and catastrophizing is contrary

to evidence from previous studies.<sup>26</sup> Speculating as to the reason for these results, it may be that the effect of cognitive coping strategies used in response to daily frustration on physical symptoms does not emerge until 2 or 3 days later. We also note that the focus in this study was on *cognitive* coping strategies however other coping strategies such as those of a *behavioral* nature may have demonstrated different results. For example, coping strategies such as behavioral distraction or emotional expression may have differential effects on headache. This may be particularly pertinent among adolescents who may be at greater risk of employing risky behaviors such as substance use as coping mechanisms. An alternative explanation for these findings is that pain-coping as opposed to stress-coping may have a more direct impact on concurrent and subsequent pain complaints.<sup>37</sup> Coping with daily stressors may be likely to have a more direct effect on affective state<sup>24</sup> which, in turn, has been shown to be related to pain.<sup>16</sup> Finally, we note that the 9 coping strategies were each measured by single items that were previously untested and not validated.

Our findings did however suggest that coping efficacy is related to lower next day headache occurrence. In other words, it may not so much be the way in which an adolescent copes with daily stressors but the belief

in one's ability to cope with them that is important for the experience of (subsequent) headache. This is in line with findings from previous studies that have found evidence for the importance of coping efficacy beliefs over and above the impact of actual coping strategies.<sup>29</sup> Questions remain as to why coping efficacy was not related to same day headache. It may be that evaluation of the effectiveness of coping efforts is an appraisal process that follows stress and as such exerts a delayed rather than immediate effect.

Some limitations to this study should be noted. First, we relied solely on self-reported measures while data from other sources such as parents or medical professionals may have been insightful. For example, ascertaining a headache diagnosis is recommended in future. Second, all measures were completed at the end of the day; therefore, fluctuations over each day were not captured. Also, collecting data for a longer period of time to include the menstrual cycle for girls would be preferable. In the future, we therefore suggest that multiple measurements throughout the day over a month may be advantageous, for example by means of the experience sampling method. Third, the low response rate of those invited to participate may limit the generalizability therefore we urge caution in interpretation of these findings due to possible selection effects. The finding that age was negatively related to headache is a possible indication of a selection bias as headache frequency more commonly increases with age.<sup>38</sup> Similarly, the completion rate was also relatively low. This reflects the trade-off between a naturalistic diary method and control over the environment and input of the participants. Finally, as is common in diary studies, many of the measures were adapted from questionnaires not specifically designed for daily use. The 9 coping strategies in particular were measured by 1 item as opposed to the 4 items of the original scales. Use of more refined and validated measures in the future may help shed further light on the relationships tested here.

In conclusion, we suggest that given the findings, daily frustration and beliefs regarding ability to cope with daily stressors may offer important targets for intervention with adolescents with headache. In particular, teaching self-regulatory skills that promote flexible goal pursuit so as to avoid frustration may be

beneficial. Examples include seeking alternative routes to goal achievement, modification of goals to fit the opportunities for goal pursuit, and consideration of goal disengagement when opportunities for goal attainment are less optimal. Such self-regulatory strategies may assist adolescents to avoid daily frustrations that may contribute or exacerbate headache pain. As the focus here was on headache in the general population of adolescents, an interesting expansion of this line of research would be to investigate these relationships in adolescents with a clinical headache diagnosis. Additionally, the extent to which greater daily frustration exacerbates other headache characteristics such as severity and duration of headache is also an interesting research question for the future. In this study we did not consider type of headache experienced, such as tension headache or migraine. Exploring the importance of stress and coping for these different types of headache will be an important continuation of this line of enquiry. Finally, exploring the role of coping efficacy in the establishment and maintenance of headache complaints is an important topic for future research.

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### Category 1

#### (a) Conception and Design

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#### (b) Acquisition of Data

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### Category 3

#### (a) Final Approval of the Completed Manuscript

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