



Research Submissions

Types of Triggers in Migraine – Factor Structure of the Headache Triggers Sensitivity and Avoidance Questionnaire and Development of a New Short Form (*HTSAQ-SF*)

Anna Caroli, Dipl.-Psych.; Timo Klan, PhD ; Charly Gaul, MD ; Sonja U. Kubik, MD ;
Paul R. Martin, PhD; Michael Witthöft, PhD

Objective.—To examine the factor structure of the *Headache Triggers Sensitivity and Avoidance Questionnaire (HTSAQ)* and its German version (*HTSAQ-G*), in order to identify potential different types of triggers. Furthermore, a short form of the questionnaire was developed.

Background.—The *HTSAQ* includes 24 of the most commonly reported headache triggers (eg, stress, odors, lack of sleep). Both the *HTSAQ* and *HTSAQ-G* appeared to be reliable and valid measures of sensitivity to and avoidance of headache triggers.

Methods.—In a cross-country collaboration, data from 2 cross-sectional studies including $N = 391$ individuals diagnosed with migraine from Australia ($n = 222$) and Germany ($n = 169$) were analyzed. The factor structure of the questionnaire was examined using exploratory and confirmatory factor analysis. Finally, a short form of the *HTSAQ* was constructed and evaluated regarding psychometric properties.

Results.—Factor analytic results showed a differentiation between internal and external headache triggers, and different patterns of strategies in coping with triggers. The scales of both the original questionnaire as well as the developed short form showed good reliability (Cronbach's $\alpha = 0.76$ to 0.96). As expected, negative correlations ($r = -0.10$ to -0.30 , $P = .006$ to $.044$) with acceptance of pain were observed. Participants with chronic migraine showed significantly higher triggers sensitivity and avoidance of triggers than those with episodic migraine ($t(389) = -9.12$, $P < .001$, Cohens $d = 0.93$).

Conclusions.—Both the long and short forms of the questionnaire appear to be reliable and valid measures. The development of the short form of the questionnaire simplifies the use of the *HTSAQ* in clinical practice. Further research should focus on other primary headache disorders, such as tension-type headache or cluster headache.

Abbreviations: *EASE* Experiment Avoid Stress Exposure, *HTSAQ* (German version: *HTSAQ-G*, short form: *HTSAQ-SF*) Headache Triggers Sensitivity and Avoidance Questionnaire, *LCT* Learning to Cope with Triggers, *S(O)* sensitivity to triggers compared with others, *S(T)* sensitivity to triggers compared with the time of least sensitivity, *TAMH* Trigger Avoidance Model of Headaches

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From the Department of Psychology, Johannes Gutenberg-University of Mainz, Mainz, Germany (A. Caroli, T. Klan, and M. Witthöft); Migraine and Headache Clinic Königstein, Königstein, Germany (C. Gaul); School of Applied Psychology, Griffith University, Brisbane, QLD, Australia (S.U. Kubik); Department of Psychiatry, Monash University, Melbourne, VIC, Australia (P.R. Martin); Department of Applied Psychology, Griffith University, Brisbane, QLD, Australia (P.R. Martin).

Address all correspondence to A. Caroli, Department of Psychology, Johannes Gutenberg-University of Mainz, Wallstraße 3, 55122 Mainz, Germany, email: ancaroli@uni-mainz.de

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INTRODUCTION

Headache triggers are defined as factors that alone or in combination provoke headache attacks in people prone to headaches.¹ In a meta-analysis on perceived triggers of primary headache disorders, 420 unique triggers were reported across 27,122 total participants.² The most frequently cited triggers were related to stress (eg, mental stress, conflict), sleep (eg, fatigue, too much sleep), and emotion (eg, anger, fear). In this meta-analysis, triggers were collapsed into 15 distinct categories via discussion and consensus among the various authors. Two sensitivity analyses have also aggregated triggers into less ($n = 4$; behavioral, environmental, consumption, physiological) and many more categories ($n = 30$). The authors found the utilization of 15 groups a satisfactory midpoint between broader and more precise approaches to grouping the various headache triggers. The question of the adequate grouping of triggers seems relevant in view of the large number of triggers mentioned and should be answered not only in the form of consensus, but also by means of a factor analysis. In addition, the question arises whether categories can also be found regarding the management options for the various types of triggers.

The *Trigger Avoidance Model of Headaches (TAMH)* postulates that trying to avoid triggers is an important factor in developing an aggravated or chronic headache disorder.³ According to the *TAMH*, avoidance behavior leads to reduced exposure to respective triggers, resulting in sensitization, and/or reduced tolerance for these triggers. The researchers further postulate that the mechanism of trigger sensitization is comparable to that of anxiety disorders. In the short-term, avoidance behavior leads to a relieved headache; however, in the long-term, avoidance behavior is believed to contribute to increased headache trigger sensitivity and subsequent activity. It is added that there are probably individual differences regarding the likelihood of developing a headache disorder in this manner.

Conventional recommendations regarding trigger management, in the context of psycho-educational methods, have mostly been aimed at the avoidance of potential triggers. However, this approach can be viewed critically for several reasons.⁴⁻⁹ Based on the idea that avoiding triggers is not always possible, and in line with the *TAMH*, researchers now suggest a more effective approach to the management of certain headache triggers may be *Learning to Cope with Triggers (LCT)*.³ In a randomized clinical trial with patients with migraine and/or tension headache, *LCT* (which uses a therapeutic approach to promote active handling of triggers and contains elements of exposure treatment) showed better treatment effects compared to traditional treatment methods such as trigger avoidance.¹⁰

Basically, 4 different options can be described when dealing with triggers (*EASE*).¹¹ Depending on the type of trigger, different strategies are recommended. *EASE* stands for *Experiment* (for triggers such as certain foods), *Avoid* (for potentially unhealthy triggers such as dehydration), *Stress* (stress management procedures for daily activities such as shopping), and *Exposure* (for sensory stimuli¹²⁻¹⁴).

In order to evaluate new therapeutic approaches such as *LCT*, and in particular, their effect on sensitivity to triggers, The Headache Triggers Sensitivity and Avoidance Questionnaire (*HTSAQ*) was developed.¹⁵ The *HTSAQ* lists 24 of the most commonly reported triggers for headaches and using a 5-point Likert-scale assesses respondents' sensitivity to these triggers, as well as their avoidance of these triggers. In an online survey of $N = 376$ participants, high reliability was shown using internal consistency ($\alpha > 0.80$) and test-retest reliability ($r = 0.81$ to 0.86 , $P < .01$). Furthermore, significant correlations with the Pain Sensitivity Questionnaire, the Pain Anxiety Symptoms Scale, and the Chronic Pain Acceptance Questionnaire showed evidence of good convergent validity of the *HTSAQ*.¹⁵ The German version of the *HTSAQ (HTSAQ-G)* showed good internal consistency ($\alpha = 0.96$) and

Conflict of Interest: Caroli: None; Klan: None; Charly Gaul received honoraria for consulting and lectures within the past 3 years from Allergan Pharma, Boehringer Ingelheim Pharma, Lilly, Novartis Pharma, Desitin Arzneimittel, Sanofi, Hormosan Pharma, electroCore, Grünenthal, Reckitt Benckiser, and TEVA. He does not hold any stocks of pharmaceutical companies or medical device companies. Kubik: None; Martin: None; Witthöft: None.

Table 1.—Demographic and Clinical Characteristics of the Sample

	Total Sample (N = 391)	Australian Sample (n = 222)	German Sample (n = 169)
Age in years, <i>M</i> (<i>SD</i>), range	37 (15), 18-83	31 (12), 18-63	45 (14), 18-83
Gender, female, n (%)	335 (85.7)	199 (89.6)	136 (80.5)
In stable partnership, n (%)	216 (55.2)	95 (42.8)	121 (71.6)
Headache diagnosis, n (%)			
Episodic migraine	208 (53.2)	160 (72.1)	48 (28.4)
Chronic migraine	183 (46.8)	62 (27.9)	121 (71.6)

test-retest reliability ($r = 0.88$, $P < .01$) and indications for validity.¹⁶

The results of these studies support the use of the *HTSAQ* or *HTSAQ-G* as reliable and valid measures of sensitivity to and avoidance of headache triggers. In therapeutic practice, the *HTSAQ(-G)* is able to reveal on a quantitative level how pronounced a person's sensitivity to triggers and avoidance behavior is. On a qualitative level, it is possible to systematically analyze which triggers are relevant for the respective person and to tailor trigger management individually. Because of the large number of items of the questionnaire and the limited sample size of each country sample, no factor analysis could be carried out within the 2 country-specific samples. However, combining the 2 datasets resulted in a sufficient sample size that allowed for the computation of factor analysis. The aims of this study are: (1) to examine the factor structure of the *HTSAQ* using exploratory and confirmatory factor analysis in order to identify possible different types of triggers as well as different categories in dealing with triggers; and (2) to develop a short form of the questionnaire (*HTSAQ-SF*) to make it more practicable for clinical use including an evaluation of its psychometric properties.

METHODS

Participants and Procedure.—In a cross-country collaboration, data from 2 cross-sectional studies from Australia and Germany were combined. This analysis is a secondary analysis of pooled data from 2 previous studies. In the first study, a convenience sample of $N = 222$ individuals diagnosed with migraine in an Australian online-survey completed the

HTSAQ.¹⁵ Participants provided consent by “opting-in” via a web link after reading the informed consent procedure. Data collection was completed between June and September 2015. In the second study, $N = 169$ consecutive patients diagnosed with migraine at a German headache clinic filled out the German version of the questionnaire (*HTSAQ-G*). Written informed consent was obtained from all participants. Data collection was completed between May 2016 and May 2017. In both studies, participants completed a battery of measures including other questionnaires, for example, the Chronic Pain Acceptance Questionnaire (*CPAQ*). Altogether, data from $N = 391$ individuals (85.7% female; age, $M = 37$) diagnosed with migraine (episodic migraine 53.2%, chronic migraine 46.8%) were analyzed. In the German study, diagnoses were made by clinicians according to the ICD-10 criteria. In the Australian study, the existence of a diagnosis was estimated using the Brief Headache Screen. From the Australian study, $n = 154$ participants were excluded because they did not have migraine according to the Brief Headache Screen. In the German study, $n = 35$ people were excluded as they did not have migraine as primary diagnosis according to the clinical judgment. The detailed demographic and clinical characteristics of the sample are shown in Table 1.

Ethics.—The German survey was approved by the Ethics Committee of the Psychological Institute of the Johannes Gutenberg University Mainz, Germany (application 2016-JGU-psychEK-010). Ethical clearance to conduct the Australian study was granted by the Human Research Ethics Committee of Griffith University, Australia.

Measures.—The *HTSAQ* assesses the sensitivity to triggers and the avoidance of triggers. The *HTSAQ* contains an instruction explaining the concept of headache triggers. The questionnaire contains 24 of the most frequently mentioned triggers (eg, stress, odors, lack of sleep) as well as 2 open questions for individual triggers that can be added. The triggers are each rated on 4 scales. For each trigger, it is recorded on a 5-point Likert scale: (1) how often the respondent experiences headaches because of the trigger (scale *Triggers*); (2) how sensitive the respondent is to the trigger compared with other people (scale *S(O)*); (3) how sensitive the respondent is to the trigger compared with the time of least sensitivity (scale *S(T)*); and (4) how hard the respondent tries to avoid the trigger (scale *Avoidance*). For the *Triggers* scale there are response options ranging from 1 = “Never” to 5 = “Always”, for the scale *S(O)* from 1 = “Not at all sensitive” to 5 = “Very highly sensitive”, for the scale *S(T)* from 1 = “Same” to 5 = “Very much more sensitive”, and for the scale *Avoidance* from 1 = “Do not try at all to avoid” to 5 = “Try to avoid at all costs”. The questionnaire is rather long with at least 88 items to answer. Using the questionnaire, a total score can be calculated over all scales or scores can be created for the respective scales or for specific triggers.

The Chronic Pain Acceptance Questionnaire (*CPAQ*) measures acceptance in dealing with chronic pain.¹⁷ The questionnaire consists of 20 items that can be assigned to 2 subscales. The *activity engagement* scale (11 items) refers to the continuation of daily tasks and leisure activities in the usual way, even when in pain. The *pain willingness* scale (9 items) captures the tendency to avoid or control pain. Cronbach’s α of the overall score and subscales is 0.78 to 0.82.¹⁷ The German version of the questionnaire (*CPAQ-D*) also shows good internal consistency of the overall score and subscales (Cronbach’s $\alpha = 0.84$ to 0.87) and there is evidence of good validity.¹⁸ Based on the conceptual differences between pain acceptance and avoidance behavior, a significant inverse relationship between the *CPAQ* and *HTSAQ* was expected.

Statistical Analysis.—Data were analyzed using SPSS statistical software, version 23.0 (SPSS Inc., Chicago, IL, USA) and Mplus 7.3.

Descriptive Statistics.—Descriptive Statistics (mean, *SD*, range, percentage) were obtained in order to describe the characteristics of the sample.

Factor Structure.—The structure of the questionnaire was examined using exploratory factor analyses. The factor analyses were performed separately for the subscales *Triggers* and *Avoidance*. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity were calculated. Principal axis analysis was used for factor extraction. A promax rotation was used due to expected substantial correlations between obtained factors. Horn’s Parallel Analysis¹⁹ was used to determine the number of factors.

The short form of the *HTSAQ*, the *HTSAQ-SF*, was created from data gathered on the full version of the questionnaire. Since an analysis of the relevance of the different scales found no added value of the individual scales¹⁶ and because of repeated critical comments on understanding scales *S(O)* and *S(T)*, those scales were omitted in the short form of the questionnaire. Furthermore, the instructions for the questionnaire were substantially reduced. Items in the long form were excluded according to the following criteria: (1) low item selectivity (<0.50) if the trigger is also rarely reported, that is, low means (<2.0) in scale *Triggers*; (2) factor loadings <0.30 ; (3) small difference (<0.1) between factor loadings and side loadings; and (4) high overlap of item content with other items.

Confirmatory factor analysis containing the triggers of the short form was conducted to test whether the shortened questionnaire fits to the factor structure of the original questionnaire. Confirmatory factor analysis models were conducted using weighted least squares mean and variance adjusted (WLSMV) estimation and goodness of fit was assessed based on the comparative fit index (CFI) and root mean square error of approximation (RMSEA).

Reliability.—Regarding the reliability of the questionnaire and its short form, Cronbach’s α was calculated to assess the internal consistency.

Validity.—Convergent validity was determined by Pearson’s product-moment correlations between the *HTSAQ/HTSAQ-SF* and the *CPAQ*. Furthermore, significant differences between chronic migraine and episodic migraine were expected. Independent samples

t-tests and Cohen's *d* were used to compare the mean *HTSAQ/HTSAQ-SF* total scores between these groups.

Interpretation for Clinical Use.—Percentile ranks were calculated to enable the clinical interpretation of the raw scores.

RESULTS

Factor Structure.—For the scale *Triggers*, removing the items *smoking cigarettes* and *menstrual cycle*, the KMO measure confirmed sampling adequacy (KMO = 0.87) suggesting that the proposed factor analysis was appropriate for factor extraction. Also, Bartlett's test of sphericity was significant ($\chi^2 = 2071.97$, $df = 231$, $P < .001$), suggesting that there are correlations present in the data that are appropriate for factor analysis. Horn's parallel analysis suggested a 2-factor solution. Factor 1 was labeled *internal triggers* (eg, anxiety, fatigue); factor 2 was labeled *external triggers* (eg, odors, travel). The loadings of all 22 items across the 2 extracted factors are presented in Table 2. Both factors showed a correlation of $r = 0.51$.

For the scale *Avoidance*, removing the items *smoking cigarettes* and *menstrual cycle*, the KMO measure confirmed sampling adequacy (KMO = 0.83) suggesting that the proposed factor analysis was appropriate for factor extraction. Also, Bartlett's test of sphericity was significant ($\chi^2 = 1977.12$, $df = 231$, $P < .001$), suggesting that there are correlations present in the data that are appropriate for factor analysis. Horn's parallel analysis suggested a 3-factor solution. Factor 1 was labeled *hardly or reluctantly avoidable triggers* (eg, flicker, travel/trips/driving); factor 2 was labeled *internal triggers* (eg, depression, stress); factor 3 was labeled *avoidable triggers* (eg, dehydration, hunger). The loadings of all 22 items across the 3 extracted factors are presented in Table 3. The factors showed a correlation ranging from $r = 0.08$ to 0.35.

When developing the short form, 4 items (coughing/sneezing, excess of sleep, low temperature, smoking cigarettes) were excluded because of low item selectivity (<0.50) and low occurrence (mean <2.0) at the same time. One item (head and neck movements) was excluded because of low factor loadings (<0.30). One item (high humidity) was excluded because of a small difference (<0.1) between factor loadings and side loadings. Another item (glare) was excluded because

Table 2.—Pattern Matrix of the *HTSAQ* (Scale *Triggers*)

Item	Factor 1	Factor 2
Anxiety	0.84	-0.30
Stress	0.82	-0.21
Fatigue/tiredness	0.65	
Lack of sleep	0.56	
Depression	0.55	
Eyestrain	0.46	
Dehydration/lack of water	0.43	
Anger	0.37	0.22
Excess of sleep	0.30	0.26
Coughing/sneezing	0.28	
Head and neck movements	0.26	
Odors/smells/fragrances	-0.21	0.73
Flicker		0.70
Low temperature		0.59
Travel/trips/driving		0.58
High temperature		0.58
Eating "headache foods"		0.56
Noise	0.28	0.48
High humidity	0.23	0.41
Glare	0.21	0.38
Drinking alcohol		0.38
Hunger/not eating		0.37

Promax rotation, factor loadings <0.20 are not reported; Bold: Items of the short version.

of a high overlap of item content with the items flicker and eyestrain. One item (lack of sleep) was excluded because of a high overlap of item content with the item fatigue/tiredness. In sum, 8 items were excluded. Furthermore, the questionnaire was shortened by omitting the scales *S(O)* and *S(T)* and by abbreviating the instructions.

A confirmatory factor analysis containing the triggers of the short form (trigger 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, 19, 22), except for the trigger *menstrual cycle*, showed an adequate model fit to the 2-factor solution for the scale *Triggers* (CFI = 0.92; RMSEA = 0.069) with an intercorrelation of $r = 0.70$ between the 2 factors. For the scale *Avoidance*, an adequate model fit to the 3-factor solution was shown (CFI = 0.90; RMSEA = 0.07) with intercorrelations of $r = 0.50$ to 0.60 between the 3 factors.

Reliability.—The total score of the *HTSAQ* showed high internal consistency ($\alpha = 0.96$). The reliability of the *Triggers* scale was 0.86, of the *S(O)* scale 0.88, of the *S(T)* scale 0.91, and of the *Avoidance* scale 0.84. The short form of the *HTSAQ* showed a smaller

Table 3.—Pattern Matrix of the HTSAQ (Scale Avoidance)

Item	Factor 1	Factor 2	Factor 3
Flicker	0.70		
Noise	0.68		
Odors/smells/fragrances	0.67		
High temperature	0.60		
Drinking alcohol	0.57	-0.29	0.23
Travel/trips/driving	0.55		
Low temperature	0.52		-0.20
Eating “headache foods”	0.48	0.23	0.25
High humidity	0.45	0.36	
Glare	0.44		
Excess of sleep	0.43		
Head and neck movements	0.42		
Coughing/sneezing	0.34	0.23	-0.42
Depression		0.76	
Anxiety		0.71	
Anger		0.58	0.30
Eyestrain	0.20	0.44	
Stress		0.42	0.27
Dehydration/lack of water			0.71
Hunger/not eating			0.65
Lack of sleep	0.29		0.57
Fatigue/tiredness	0.28		0.44

Promax rotation, factor loadings <0.20 are not reported; Bold: Items of the short version.

internal consistency compared to the full version. The total score of the *HTSAQ-SF* showed good internal consistency ($\alpha = 0.83$). The reliability of the *Triggers* scale was 0.77 and of the *Avoidance* scale 0.76.

Validity.—The scales of the *HTSAQ* showed negative correlations with the *CPAQ* ($r = -0.10$ to -0.24 , $P = .007$ to $.044$, 2-tailed). This indicates that higher trigger sensitivity and more avoidance behavior are associated with a lower level of pain acceptance. These medium correlations can be considered as the indications of the convergent validity of the *HTSAQ*. The scales of the *HTSAQ-SF* showed very similar validity coefficients ($r = -0.23$ to -0.30 , $P = .006$ to $.008$, 2-tailed).

Patients with chronic migraine ($M = 2.62$, $SD = 0.52$) and patients with episodic migraine ($M = 2.16$, $SD = 0.47$) showed a significant difference (*HTSAQ* total score) via independent samples *t*-tests ($t(389) = -9.12$, $P < .001$, 2-tailed, Cohen’s $d = 0.93$). The short form of the questionnaire showed very

similar results regarding the headache diagnoses. Patients with chronic migraine ($M = 2.83$, $SD = 0.49$) and patients with episodic migraine ($M = 2.45$, $SD = 0.49$) showed a significant difference (*HTSAQ-SF* total score) via independent samples *t*-tests ($t(389) = -7.62$, $P < .001$, 2-tailed, Cohen’s $d = 0.77$).

Interpretation for Clinical Use.—Percentile ranks for the *HTSAQ* and *HTSAQ-SF* are presented in Tables 4 and 5. Raw scores can be calculated via sum values. Percentile ranks were calculated for the total sample, for patients with chronic migraine and patients with episodic migraine.

DISCUSSION

The purpose of this study was to examine the factor structure of the *HTSAQ* in order to identify possible different types of triggers and different strategies in coping with triggers. Furthermore, a short form of the questionnaire was developed.

Regarding the descriptive characteristics of the 2 samples, differences between the samples become apparent. In the German study, the average age is slightly higher and the proportion of people living in a stable partnership is higher. The proportion of participants with chronic migraine compared to episodic migraine is higher. The higher degree of chronic conditions can be explained by the setting of the study (inpatient therapy in a headache clinic vs. online survey).

The exploratory factor analysis of the scale *Triggers* suggested a 2-factor solution that seemed plausible in terms of content on closer examination. Triggers such as anxiety, fatigue, dehydration showed high loadings on factor 1. Triggers such as odors, travel, noise showed high loadings on factor 2. This pattern suggested a difference in the origin of triggers. Therefore, we labeled factor 1 *internal triggers* and factor 2 *external triggers*. Of course, the origin of a headache provoking stimulus is sometimes not clearly assignable. For example, dehydration and hunger seem to be quite similar triggers, which both represent *internal* states due to the lack of *external* supply with drinks and food. Nevertheless, they are assigned to different factors. This suggests that these triggers could be described as both internal and external factors. The correlation between the 2 factors also suggests that they are not completely independent factors.

Table 4.—Percentile Ranks of Raw Scores of HTSAQ, Divided by Headache Diagnosis

Scale	Range	Percentile																										
		Total Sample									Chronic Migraine									Episodic Migraine								
		10	16	25	50	75	84	90	10	16	25	50	75	84	90	10	16	25	50	75	84	90						
Triggers	22-110	39	42	46	54	63	67	70	46	50	51	60	67	70	72.8	36	39	42	50	56	60	64						
S(O)	22-110	35	38	42	51	60	67	70	40.2	47	50	56	66.5	70	76	33	35.3	38	45	54	58	61.2						
S(T)	22-110	28	30	34	43	56	63.8	69	33	36	40	52	63	69	75	26	28	30	37	46	54	60						
Avoidance	22-110	41	44	47	55	64	68	72	45	47	50.5	59	67	71	75	39	41	44	52	60	66	69						
Total Score	88-440	151.7	157	171	201.5	240	260	277.3	169	186.4	199	221	260	278.6	290	146.6	151	157	184	216	234.2	249.8						

Raw scores are calculated via sum values.

Table 5.—Percentile Ranks of Raw Scores of HTSAQ-SF, Divided by Headache Diagnosis

Scale	Range	Percentile																										
		Total Sample									Chronic Migraine									Episodic Migraine								
		10	16	25	50	75	84	90	10	16	25	50	75	84	90	10	16	25	50	75	84	90						
Triggers	15-75	27	30	33	38	45	47	50	32.2	34	37	43	48	50	52	25	27	30	35	40	43	45.2						
Avoidance	15-75	29	31	34	40	46	49	52	31	33	36.5	42	47.5	50	54.8	27	29.1	32	37	43.3	46.9	49.3						
Total Score	30-150	59	63	67	78	89	94	98	64.2	68.7	72	84	94	98	103.6	55	58.1	63	72	82	89	93						

Raw scores are calculated via sum values.

The exploratory factor analysis of the scale *Avoidance* suggested a 3-factor solution which also seemed plausible in terms of content. Triggers such as flicker, noise, travel/trips/driving showed high loadings on factor 1 (labeled *hardly or reluctantly avoidable triggers*). Triggers such as depression, anxiety, stress showed high loadings on factor 2 (labeled *internal triggers*). Triggers such as dehydration, hunger, fatigue showed high loadings on factor 3 (labeled *avoidable triggers*). This pattern is similar to the one of the scale *Triggers*. Regarding the different coping strategies addressing triggers (Experiment, Avoid, Stress, and Exposure),¹¹ this pattern could reflect the different strategies, at least in part. Factor 1 (*hardly or reluctantly avoidable triggers*) could suggest the strategies Experiment and Exposure, for example, graduated exposure to noise can reduce the sensitivity to noise and behavioral experiments with “headache foods” can disprove erroneous beliefs about their ability to precipitate a headache. It should be noted that experiments could be considered potentially applicable to all triggers. Factor 2 (*internal triggers*) could be suitable for the strategy Stress, for example, stress management can help to cope with anger. Factor 3 (*avoidable triggers*) could be suitable for the strategy Avoidance, for example, it seems reasonable to avoid unhealthy triggers such as dehydration and lack of sleep. Again, correlations between the 3 factors suggest that they are not completely independent factors.

Due to the time involved in completing the original questionnaire, our aim was to develop a shorter version of the questionnaire. This was achieved by abbreviating the instructions, eliminating 2 scales, and eliminating various triggers. Criteria were low item selectivity and low occurrence at the same time, low factor loadings, small difference between factor loadings and side loadings, and high overlap of item content with other items. With regard to the first criterion, we decided to eliminate triggers not only because of low item selectivity, because this would have affected frequently mentioned triggers such as drinking alcohol, hunger, anxiety, and stress. Therefore, we opted for a combined criterion that also respects the frequency of triggers. Even though the shorter version of the questionnaire excluded some triggers, these are covered by the 2 open response options. Since 2 of the 3 weather-related triggers were excluded, but *change in the*

weather was mentioned repeatedly in the open answer options,¹⁶ it should be considered that the remaining weather-related trigger *high temperature* is formulated in an unsuitable or in a too specific way. So it could be an option to establish an alternative item to *high temperature*, such as *certain weather aspects* or *weather-related factors*.

Statistical analysis of the *HTSAQ-SF* using confirmatory factor analysis showed an adequate fit to the 2-factor solution for the scale *Triggers* and the 3-factor solution for the scale *Avoidance*. This indicates that the shortened version of the questionnaire is comparable to the original version in terms of the factor structure.

The *HTSAQ* showed good reliability, assessed via internal consistency, regarding the total score and the individual scales. In light of already known results of this data,^{15,16} these were expected results. The *HTSAQ-SF* showed a slightly lower internal consistency to the full version, but was still at a satisfactory level.

The validity of both questionnaires is supported by negative correlations between pain acceptance and both trigger sensitivity and avoidance behavior. Since these correlations were already observed in the origin samples, this finding is not novel.^{15,16} Construct validity was further confirmed with results showing that the *HTSAQ* and *HTSAQ-SF* scale scores differed significantly between patients suffering from chronic migraine and episodic migraine. It seems plausible that increased chronicity is accompanied by increased trigger sensitivity and avoidance behavior which is in line with the *TAMH*.³ High sensitivity and high avoidance tend to lead to more frequent headaches. Also, chronic headaches lead to high sensitivity and high avoidance.

The results of this study make a statistically substantiated contribution to research on the adequate grouping of triggers and on the different strategies in coping with triggers. This seems useful given the large number of reported headache triggers² as well as concepts such as *EASE*.¹¹ The *HTSAQ* is an important tool for evaluating the relationship between headache triggers sensitivity and avoidance behavior, for evaluating treatment concepts such as *LCT*³ and to support the planning and evaluation of therapy with headache patients. The construction of a short form of the *HTSAQ* that is psychometrically robust is a useful and economic derivative.

With regard to the benefits of this questionnaire for individualizing/personalizing therapy and prognosis, future studies should examine whether the use of the *HTSAQ* is useful compared to other diagnostic instruments (eg, questionnaires to measure pain anxiety and pain acceptance). In a current randomized-controlled study on the effectiveness of a specific cognitive behavioral therapy treatment program for migraine, various psychometric questionnaires, including the *HTSAQ-G*, are being used (German Register of Clinical Trials, DRKS-ID 00011111), so such evaluations can be conducted. Since measurements are carried out at different times, it will also be possible to verify whether the questionnaire captures sensitivity to change.

Several limitations need to be acknowledged. First, the results presented are limited to migraine. Further research should focus on other primary headache disorders such as tension-type headache or cluster headache. Second, the reliability and validity analyses have only a limited new value, since there are high correlations with the analyses of the previous 2 studies. An independent replication study with another evaluation of the psychometric properties of the *HTSAQ(-SF)* with new data is needed. Third, the participants' diagnoses were made in different ways. In the Australian study, the existence of diagnosis was estimated using the Brief Headache Screen, which is not as reliable as a clinical assessment and therefore a major limitation.

In conclusion, the factor analyses of the *HTSAQ/HTSAQ-SF* showed a pattern of different types of headache triggers (internal and external triggers) as well as different strategies in coping with triggers. Moreover, it can be stated that both the *HTSAQ* and its short form, the *HTSAQ-SF*, are reliable measures and show indications of validity.

STATEMENT OF AUTHORSHIP

Category 1

(a) Conception and Design

Anna Caroli, Timo Klan, Michael Witthöft

(b) Acquisition of Data

Anna Caroli, Sonja U. Kubik

(c) Analysis and Interpretation of Data

Anna Caroli, Michael Witthöft, Timo Klan, Charly Gaul, Sonja U. Kubik, Paul R. Martin

Category 2

(a) Drafting the Manuscript

Anna Caroli

(b) Revising It for Intellectual Content

Anna Caroli, Timo Klan, Charly Gaul, Sonja U. Kubik, Paul R. Martin, Michael Witthöft

Category 3

(a) Final Approval of the Completed Manuscript

Anna Caroli, Timo Klan, Charly Gaul, Sonja U. Kubik, Paul R. Martin, Michael Witthöft

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