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Perceptions of Headache Trigger Potency

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PERCEPTIONS OF HEADACHE TRIGGER POTENCY

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ABSTRACT

Various endogenous and exogenous stimuli are thought to trigger headache attacks (Lipton et al., 2014; Park, Chu, Kim, Park, & Cho, 2016). Regardless of potency, headache precipitants rarely induce headache each time a susceptible individual encounters their trigger (Rothrock, 2008). Due to the inconsistent nature of headache triggers, individuals may have inaccurate beliefs about their headache triggers and how likely they are to induce a headache (Kelman, 2007). The purpose of the present study is to examine estimates of trigger potency among individuals with migraine or tension-type headache (TTH) and assess congruence between potency estimates and reported headache frequency.

2,482 undergraduate students, who met ICHD-3 diagnostic criteria for migraine or TTH, participated in an online survey battery that included questions concerning headache symptoms, susceptibility to common headache triggers, and various probabilities regarding the onset of headache when encountering (and not encountering) their most potent trigger.

A mean of 4.09 ($SD = 2.07$) triggers were reported across all headache diagnoses, with the most potent trigger being stress. Separate linear regression showed that headache frequency and disability were significant “predictors” of trigger potency, such that frequency ($R\text{-squared} = 14.6\%$; $B = 1.72$, $p < .001$) and disability ($R\text{-squared} = 17.7\%$; $B = 1.26$, $p < .001$) each accounted for considerable variance in estimates of trigger potency. A paired-samples t-test comparing expected versus reported headache frequency

yielded a statistically significant difference, such that the former was on average 1.21 (5.59) days less than the latter, $t(2364) = 10.49$, $p < .001$. Nearly one-thirds of the sample evidenced bias in their potency estimates.

The current study found that young adults who experience headache report stress as the most potent trigger for all headache groups. Perceptions of headache trigger potency were associated with headache frequency, disability, and subtype such that those with more frequent and disabling migraine perceived triggers as more likely to cause headache upon exposure than those with less frequent/disabling TTH. A significant minority overestimated the potency of their most important trigger, and future studies considering all reported triggers may reveal even further overestimations.

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INTRODUCTION

Primary Headache Diagnoses

Headache disorders affect almost half of the world's population. Forty-six percent of adults globally meet criteria for diagnosis of a primary headache disorder (Stovner et al., 2007), which are diagnosed if symptoms are not attributed to any other disorder or illness. The International Classification of Headache Disorders, 3rd edition (ICHD-3; Headache Classification Committee of the International Headache Society, 2013) designates the four types of primary headache diagnoses: migraine with and without aura, tension-type headache (TTH), cluster headache, and other primary headaches. The characterization of these primary headache types is based primarily on symptomatology of the headache attack.

Diagnoses of migraine with and without aura are determined by the diagnostic criteria set by the International Headache Society (ICHD-3, 2013). Migraineurs must experience a headache attack lasting 4-72 hours if untreated or unsuccessfully treated. Two of the following characteristics are also required: unilateral location, pulsating/throbbing pain quality, moderate to severe pain intensity, and aggravation by and/or avoidance of regular physical activity. In addition, migraineurs must experience at least one of the following: nausea, vomiting, or *both* photophobia (sensitivity to normal levels of light) and phonophobia (sensitivity to normal levels of noise). If 5 or more attacks have occurred that fulfill these criteria without being attributed to another disorder, a diagnosis of migraine is appropriate. Migraine has a lifetime prevalence rate

of 11% (Stovner et al., 2007) and is three times more common in women as men (Bigal & Lipton, 2009; Lipton et al., 2007).

Aura, which affects a minority of migraineurs, is characterized by the presence of visual, motor, aphasic, and/or sensory symptoms that usually precede headache and subside before pain begins (ICHD-3, 2013). Diagnostic criteria for migraine with aura consist of migraine with at least one the following characteristics: one or more aura symptoms that gradually develop and occur before the onset of the headache attack, symptom(s) must be present between 5 to 60 minutes, and a headache must follow the aura symptoms within an hour (ICHD-3, 2013).

Tension-type headache (TTH) is the most common headache disorder, with a lifetime prevalence rate of 42% (Stovner et al., 2007). The duration of TTH is between 30 minutes to 7 days, and aura symptoms are absent (ICHD-3, 2013). In comparison to migraine, diagnostic criteria for TTH include two of the following characteristics: bilateral location, nonpulsating/tightening pain quality, mild or moderate pain intensity, and no aggravation by or avoidance of regular physical activity (ICHD-3, 2013). Other characteristics typical of migraine (photophobia, phonophobia, nausea, vomiting) usually do not occur in TTH (Crystal & Robbins, 2010).

Both migraine and TTH are each categorized into episodic and chronic subtypes: episodic migraine (EM), chronic migraine (CM), episodic tension-type headache (ETTH) and chronic tension-type headache (CTTH). Symptomatology between episodic and chronic headache are similar, with attack frequency being the determinant of subtype. If the headache meets migraine or TTH diagnostic criteria and occurs on less than 15 days a month, it is classified as episodic. If the headache occurs on 15 days or more, it is

classified as chronic (ICHD-3, 2013). Chronic headache is typically more disabling than episodic because of higher headache frequency, but both may cause acute disability.

Impact of Headache

According to the World Health Organization (WHO), headache is ranked as one of the top 10 most disabling medical conditions worldwide (Stovner et al., 2007). In the 2013 Global Burden of Disease (GBD) study, headache disorders ranked third in years of life lost to disability (Steiner et al., 2015). Headache disorders cause more disability-adjusted life years (DALYs), a measure of disease burden, than all other neurological disorders combined (Steiner, Stovner, & Vos, 2016). The disabling nature of headache causes many disruptions in affected individuals' daily lives, and some evidence suggests that individuals with headache lose more productive time at their place of employment than do those with other prominent pain conditions (e.g., back pain, arthritis; Stewart, Ricci, Chee, Morganstein, & Lipton, 2003).

Migraine in particular is among the leading causes of disability worldwide, and the 2013 GBD study ranked migraine as the sixth leading cause of disability (Steiner et al., 2015). Emerging data from the 2015 GBD study indicates that migraine is now considered the third highest cause of disability in individuals under the age of 50 (Steiner et al., 2016). In contrast, TTH is not regarded as a highly disabling disorder for most individuals, but its high prevalence confers substantial burden at a societal level.

At an individual level, 53.7% of migraineurs report experiencing severe impairment and disability during headache attacks (Bigal & Lipton, 2009). Of female migraineurs in the United States, 35% report having one to four severe migraine attacks

per month, and 25% experience four or more; males with migraine reported similar frequencies (Bigal & Lipton, 2009). Almost half of migraineurs also experience absences from familial and social gatherings due to migraine, and 32% avoid planning and attending future engagements for fear of migraine-related cancellations (Bigal & Lipton, 2009).

Headache Precipitants

The disabling nature of headache causes individuals to fear future headache attacks, and many sufferers seek to identify the putative causes of their attacks with the intention of reducing headache frequency. Various endogenous and exogenous stimuli are thought to “trigger” headache attacks (Lipton et al., 2014; Park, Chu, Kim, Park, & Cho, 2016), such that contact with these precipitants increases the probability of a subsequent headache occurring (Lipton et al., 2014). Individuals with headache experience heightened sensory sensitivity in the brain interictally compared to unaffected individuals (Lipton, Pavlovic, Haut, Grosberg, & Buse, 2014). This central nervous system sensitivity contributes to more frequent headaches (Kelman, 2007) by increasing the susceptible individual’s threshold to trigger stimuli (Lipton et al., 2014). Three-quarters of those with headache report the presence of at least one trigger (Kelman, 2007), the most common of which are stress, hormones (in women), not eating, weather changes, disturbed sleep, various odors, neck pain, lights, various foods, and exercise (Kelman, 2007; Rothrock, 2008).

Triggers are not uniformly consistent among those affected by headache (Rothrock, 2008). No single precipitant is present in all headache sufferers (Rothrock,

2008), and individuals vulnerable to headache experience varying numbers and types of triggers (Kelman, 2007). Regardless of potency, headache precipitants rarely induce headache every time they are encountered (Rothrock, 2008). Rather, the probability of developing a headache after encountering a trigger is determined by a variety of factors including the amount of trigger encountered, the duration of exposure, and contact with other possible precipitants (Kelman, 2007; Rothrock, 2008).

Successful prevention of headache attacks thus relies on the identification of possible headache triggers and engaging in protective factors such as practicing trigger avoidance, taking preventive medication, managing stress, and keeping regular sleep and eating habits. Utilizing these protective measures decreases probability of headache (Lipton et al., 2014), but trigger avoidance is difficult and occasionally impossible (Kelman, 2007). Excessive dietary and daily life changes can impose severe restrictions on an individual avoiding potential triggers (Kelman, 2007). Furthermore, avoidance of triggers promotes central sensitization, so an individual is unlikely to habituate to that trigger if it is consistently avoided (Martin & MacLeod, 2009).

Limitations of Trigger Literature

Due to the inconsistencies associated with the manifestation and causality of headache precipitants, individuals who alter their trigger exposure may not experience a decrease in the frequency of headache attacks. Migraineurs have poor awareness about their headache triggers (Baldacci et al., 2013), so mistakenly identifying or failing to notice a trigger may not alter headache attack frequency. Further, it can be difficult to

recognize triggers, as susceptible individuals may view their trigger as a symptom of headache instead of the cause (e.g., high stress, photophobia) (Kelman, 2007).

Although identifying triggers is difficult, individuals vulnerable to headache are routinely encouraged to maintain daily headache journals to assist in identifying causality (Lipton et al., 2014). To assign causality to suspected headache triggers, three basic conditions must be met: consistency of the sufferer, consistency of the triggers' effects, and consistent trigger presentation, and these conditions are very difficult to establish in experimental research manipulations (Turner, Smitherman, Martin, Penzien, & Houle, 2013). To facilitate discovery of trigger causality, individuals keeping a daily headache diary are instructed to self-monitor headache variables, medication use, mood and stress symptoms, sleep, and other pertinent information (Lipton et al., 2014). This process provides vast amounts of useful information about an individual's triggers (Kelman, 2007; Lipton et al., 2004). Working together with his/her health care provider, they can use this information to develop behavioral interventions to decrease trigger impact (Lipton et al., 2004).

While helpful, this self-report method of detecting triggers has limitations. Both paper and electronic journals are burdensome to clients, as they must record all observations of and contact with a multitude of common triggers (Lipton et al., 2014). Retrospective completion of daily diaries is influenced by recall bias, and recalling past events leads to inaccurate information (Lipton et al., 2014). Further, uncommon or infrequent triggers may be overlooked or difficult to identify. Direct causality also cannot be determined when utilizing diary methods, as observed data only confirms correlations between the headache and trigger relationships (Park et al., 2016; Lipton et al., 2014).

Other methods to determine headache/trigger relationships are also flawed and limited. Surveys are influenced by recall bias, personal beliefs, and reverse causality (Lipton et al., 2014). Case cross-over studies are affected by similar problems, and repeated measures retrospective cohort studies are limited to linking headache triggers to exposure data from independent sources (e.g. comparing headache trigger diaries to local weather reports; Lipton et al., 2014). Clinical trials to determine headache causality are expensive, time-consuming, susceptible to selection bias, and only relevant to suspected triggers (Lipton et al., 2014, Park et al., 2016). During clinical trials, only one trigger can be studied at a time, and some suspected triggers cannot be manipulated or even studied at all (Lipton et al., 2014). While each has limitations, conducting experimental studies and analyzing retrospective diaries using advanced statistics remain the mainstay for studying headache triggers (Turner et al., 2013).

Cognitive Biases in Perceptions of Headache Triggers

When considering the limitations present in headache precipitant research, an additional challenge is the cognitive biases that headache sufferers likely have about their triggers. Due to the inconsistent nature of headache triggers, individuals may have inaccurate beliefs about their headache triggers and how likely their assumed triggers will induce a headache (Kelman, 2007). Individuals readily attribute causality to relationships (Tenenbaum, Kemp, Griffiths, & Goodman, 2011), so their conclusions and reflections on relationships are reliant on subjective beliefs and assumptions (Barbey & Sloman, 2007), as well as common cognitive heuristics.

When considering events, individuals commonly ignore base rates and rely on intuitive probability to construct their assumptions (Barbey & Sloman, 2007). Base rate neglect stems from favoring stereotypical and diagnostic heuristics over careful consideration of base-rate probability (Pennycook, Trippas, Handley, & Thompson, 2014). People seem to disregard the statistical methodology of prediction when making judgments; instead, they are guided by intuitive, subjective conclusions that differ from statistical probability (Barbey & Sloman, 2007). Making statistically sound judgments requires effortful assessment and consideration of base rates (Type 2 processing), but individuals consistently prefer to utilize quick, spontaneous thinking (Type 1 processing) when presented with problems that requires an estimate of frequency (Pennycook et al., 2014; Kahneman, 2011).

In addition to base-rate neglect, individuals are guided by simplifying heuristics and mental shortcuts that can lead to errors in judgment (Kahneman & Tversky, 1973). Heuristics refer to an overestimation of an event occurring based on prior experience and existing ideas (Kahneman & Tversky, 1973), as the individual ignores prior experiences that run contrary to the expected outcome (Kahneman & Tversky, 1973). This study proposes that people rely on heuristics when considering the impact and potency of their headache triggers. Two such heuristics that may be at play are the representativeness and availability heuristics.

The representativeness heuristic causes errors in reporting numerical predictions and estimating probability (Tversky & Kahneman, 1974). Individuals are likely to engage in the representativeness heuristic when asked how certain events and/or processes are related, such that one event is representative of, or resembles, the process by which it

occurs (Tversky & Kahneman, 1974). For example, individuals provided a favorable description of a company will likely state that the company will be successful in the future. Likewise, a company with an inferior description is assumed to perform unsuccessfully (Tversky & Kahneman, 1974). This suggests that individuals use descriptions or characteristics to make judgments that are most representative of the given information. In the present study, this mode of judgment may have an influence on individuals with headache, such that those with more frequent or disabling headache may perceive their headache triggers to be more potent (i.e., likely to cause headache) than those with less frequent headache. If an individual perceives his headache as exceptionally disabling, he is likely to report a greater trigger potency due to representativeness.

Another heuristic that may affect participants' judgment is the availability heuristic. Individuals use this heuristic when determining probability or frequency by the ease with which an instance comes to mind (Tversky & Kahneman, 1974). Large collections of items are usually recalled easier and faster than less frequent instances, but this can lead to an overestimation of probability or frequency. The greater ease by which an instance is retrievable from memory and experience, the more likely the prediction is affected by the availability heuristic (Tversky & Kahneman, 1974). For example, when individuals are asked whether there are more English words that begin with *r* or more English words that contain *r* as the third letter, most may determine that there are more words that begin with the letter *r*, as these words more easily come to mind (Tversky & Kahneman, 1974). (In actuality there are far more words that have *r* as the third letter.) As applied to headache triggers, the availability heuristic may affect perceptions of

triggers such that the potency of headache triggers that one is exposed to most frequently may be overestimated in comparison to those to which one is exposed to less frequently.

Purpose of the Present Study

The net effect of these cognitive biases is that base rates of both headache frequency and trigger exposure may be neglected and trigger potency overestimated. The purpose of the present study thus was to examine reported trigger stimuli, trigger perceptions, and whether individuals with migraine or TTH accurately estimate the probability of headache when exposed to perceived headache triggers. The proposed hypotheses were as follows:

Study Goal #1: To assess the extent to which headache variables (diagnosis, frequency, and disability) “predict” number of reported triggers and trigger potency estimates.

Hypothesis 1a: Individuals with CM will report a higher number of triggers than all other headache diagnoses.

Hypothesis 1b: Headache frequency and disability will be positively associated with total number of reported triggers and trigger potency estimates.

Study Goal 2: To examine the accuracy of perceptions of headache probability when exposed to perceived triggers (i.e., trigger potency).

Hypothesis 2: Individuals will overestimate the potency of their headache triggers.

METHODS

Participants

The sample was drawn from 7,551 undergraduate students who provided informed consent and participated in an online survey battery for psychology course credit from Fall 2012 through Fall 2016. Participants with missing data or suspect effort (e.g., completing the extensive battery in under 30 minutes) were omitted from the study. Within a large online battery of other measures, individuals answered questions concerning headache symptoms, susceptibility to common headache triggers, and various probabilities regarding the onset of headache. Of the 7,551 participants who completed the online battery, 2,482 met ICHD-3 classification criteria for migraine or TTH and were retained for the present study; participants without headache or with another headache diagnosis were excluded.

Measures and Procedure

A revised version of the computerized *Structured Diagnostic Interview for Headache (SDIH-R)* was administered in computerized form to generate headache diagnoses adhering to ICHD headache diagnostic criteria (Andrew, Penzien, Rains, Knowlton, & McAnulty, 1992). This measure consists of numerous questions regarding headache symptoms, frequency, duration, and possible secondary causes of headache. In the present study, the required duration criterion for migraine was reduced from at least 4 hours to 2 hours as young adults often experience otherwise typical migraine attacks of

shorter duration than older adults (Rains, Penzien, Lipchik, & Ramadan, 2001).

Approximately 600 participants in the present study reported a migraine duration between 2 and 4 hours.

After responding to the SDIH-R, participants completed the Headache Impact Test (HIT-6), a measure of headache-related disability (Kosinski et al., 2003). They were then presented with a list of 12 common headache precipitants: stress, menstruation, noise, odors/smells, not eating, alcohol, weather changes, too little sleep, too much sleep, exercise, sexual activity, and smoking. Participants were asked to indicate all stimuli that triggered their headache attacks and then to select the trigger that was the “most important in causing [their] headaches.” Considering their most important trigger, participants were then asked to estimate the likelihood (0-100%) of developing a headache if *exposed* to this trigger (positive predictive value, or PPV) and of developing a headache if *not exposed* to this trigger (negative predictive value, or NPV) and then to estimate the number of days this trigger was encountered each month (i.e., 0-30 days).

Statistical Analyses

Data were analyzed using SPSS, and the criterion for statistical significance was set at $p < .05$. Distributions were examined and descriptive statistics reported. The frequencies of the most potent triggers were reported as a function of headache diagnosis. To assess diagnostic differences in total triggers, a one-way analysis of variance (ANOVA) was performed using headache diagnosis as the independent variable and the total number of triggers reported as the dependent variable. Bonferroni post-hoc tests were used to identify specific differences between headache groups.

For the purposes of examining variables associated with perceptions of trigger potency, estimates of headache likelihood upon exposure (PPV) were considered proxies of trigger potency and the main variable of interest. A one-way ANOVA was conducted using headache diagnosis as the independent variable and PPV as the dependent variable. Bonferroni post-hoc tests were then performed to reveal significant differences between headache groups and PPV estimates. Linear regressions (using frequency and disability as predictors) were used to identify headache variables related to potency perceptions; perceptions were compared between headache diagnostic groups using an independent samples t-test.

To examine the accuracy of perceived trigger potency estimates, PPV was multiplied by the reported frequency of exposure to derive an expected headache frequency (as a function of exposure to this trigger), which was then compared to the participant's reported monthly headache frequency from earlier in the survey via paired samples t-test.

RESULTS

Sample Descriptives

The analyzed sample ($n = 2,482$) was largely female (73.4%) with a mean age of 19.1 years ($SD=2.4$; range 18 to 54). The majority of participants were Caucasian (78%) followed by African American (15.2%), Multiracial (2.5%), Asian (2.3%), Hispanic/Latino (1.5%), Native American/Alaskan Native (0.3%), and Native Hawaiian/Pacific Islander (0.1%). Demographic descriptive statistics are presented in Table 1.

Based on SDIH-R responses, 269 (10.8%) participants met criteria for chronic migraine, 1,067 (43%) for episodic migraine (333 [13.4%] with aura and 743 [29.6%] without aura), 91 (3.7%) for chronic TTH, and 1,055 (42.5%) for episodic TTH. The average headache frequency is 7.44 (5.87) days per month, and the average HIT-6 score of headache disability is 54.03 (8.87).

Endorsed Triggers

A mean of 4.09 (2.07) triggers were reported across all headache diagnoses. Mean triggers by diagnostic status are presented in Table 2. One-way ANOVA comparing the 5 headache diagnostic groups revealed a significant between-group difference in number of total triggers ($F [4, 2477] = 93.19, p < .0001$). Bonferroni post-hoc tests results revealed that those with chronic migraine endorsed a significantly higher mean number of triggers than all other groups ($M = 5.55, ps < .0001$). Those with episodic TTH endorsed fewer

triggers than those with any form of migraine ($M = 3.32$, $ps < .0001$) but did not differ significantly from those with chronic TTH.

From the list of the 12 most common triggers, participants selected their most potent trigger. Participants that did not endorse any of the queried triggers ($n = 117$) were excluded from further data analyses. Of those with migraine or TTH, the most commonly reported “most important” trigger was stress (CM = 49.0%; EM with aura = 43.9%; EM without aura = 38.0%; CTTH = 50.0%; ETTH = 34.5%). Other notable important triggers selected were not eating (CM = 14.6%; EM with aura = 11.9%; EM without aura = 17.7%; CTTH = 14.3%; ETTH = 15.4%), low sleep (CM = 12.6%; EM with aura = 12.5%; EM without aura = 12.8%; CTTH = 15.5%; ETTH = 15.4%), and menstruation (CM = 7.7%; EM with aura = 11.0%; EM without aura = 8.8%; CTTH = 2.4%; ETTH = 7.7%). Table 2 summarizes the most important triggers of each headache diagnosis.

Variables Associated with Trigger Potency

On average, participants reported a 60.1% (26.3%) chance of a headache upon exposure to their most important trigger (CM = 78.4%; EM with aura = 67.4%; EM without aura = 62.9%; CTTH = 72.3%; ETTH = 49.9%), with potency estimates ranging from 0% to 100%. A one-way ANOVA showed a significant difference between headache diagnoses and PPV estimates ($F [4, 2360] = 94.3$, $p < .0001$), and Bonferroni post-hoc tests revealed that those with CM reported a significantly higher PPV estimate than the other headache groups excluding CTTH, suggesting that headache frequency is associated with higher trigger potency estimates. When collapsing all headache diagnoses

into migraine and TTH, migraineurs perceived triggers to be more potent than those with TTH (67.1% [24.5] vs. 51.7 [25.9]; $p < .001$). On average both groups believed that they were more likely to have a headache than not when exposed to their most important trigger.

A series of linear regressions were used to identify headache frequency and headache disability as significant “predictors” of trigger potency. Separate linear regression showed that headache frequency and disability were each related to trigger potency, such that both frequency (R-squared = 14.6%; $B = 1.72$, $p < .001$) and disability (R-squared = 17.7%; $B = 1.26$, $p < .001$) accounted for considerable variance in potency estimates (PPV).

Accuracy of Trigger Potency Estimates

Expected monthly headache frequency was calculated by multiplying PPV by the reported monthly frequency of exposure to that trigger. Expected headache frequency was compared with reported monthly headache frequency. A paired-samples t-test comparing expected versus reported headache frequency yielded a statistically significant difference, such that the former was on average 1.21 (5.59) days less than the latter, $t(2364) = 10.49$, $p < .001$.

These data are shown via scatter plot in Figure 1. The reference line at 0 depicts the point at which no difference between expected and reported frequencies would manifest. Each data point above this line represents one individual who presumably overestimated the potency of their most important trigger (i.e., their expected frequency based on potency estimates of one trigger was mathematically greater than their reported

overall monthly headache frequency); these individuals represented 31.4% of the entire sample. As is evident from the fitted line, this occurred most commonly at the lower headache frequencies.

DISCUSSION

The present study sought to assess the extent to which headache variables (diagnosis, frequency, and disability) “predict” headache triggers and trigger potency estimates. In addition, the accuracy of individuals’ perceptions of headache probability when exposed to perceived triggers was examined.

Hypothesis 1a stated that those with chronic migraine would endorse a higher number of triggers than all other headache diagnoses. Consistent with Hypothesis 1a, the mean number of triggers reported by those with chronic migraine was significantly greater than the mean of other headache diagnoses. This suggests that those with more frequent (chronic ≥ 15 headache days per month; ICHD-3, 2013) and disabling (migraine is more disabling than TTH; Steiner et al., 2015) headache perceive themselves to be more sensitive to a greater number of stimuli that can precipitate headache.

Participants in the current study reported stress, not eating, lack of sleep, and menstruation as important headache triggers. These data are consistent with previous research in which these stimuli were also identified as common headache triggers among older adults (Kelman, 2007; Wöber, Holzhammer, Zeitlhofer, Wessely, & Wöber-Bingöl, 2006; Houle et al., 2012), indicating that younger headache sufferers experience similar triggers. Stress was reported as the most important trigger across all headache groups. Participants viewed stress as the most potent of their triggers, and this finding is generally consistent with that of others studies, though some have found menstruation is the most impactful among women (Kelman, 2007; Wöber et al., 2007).

Consistent with Hypothesis 1b, headache frequency and disability were associated with trigger potency estimates, such that each accounted for considerable variance in participants' trigger potency estimates. Both headache frequency and disability influence participants' PPVs, suggesting that those with more frequent and disabling headache perceive a given trigger to be more likely to induce headache than those with less frequent or disabling headache. Headache diagnosis, independent of headache frequency, also affected estimates of PPV. Migraineurs perceive their triggers to be more potent than those with TTH, though both groups regarded their headache triggers as likely to induce a headache upon exposure. Because migraine is more disabling than TTH at the individual level (Steiner et al., 2015), disability may be influencing the observed difference between headache diagnoses.

Hypothesis 2 assumed that individuals would overestimate the potency of their headache attacks, thus resulting in inaccurate headache probability estimations potentially due to base-rate neglect or the aforementioned heuristics. At a minimum, nearly one-third of participants exhibited considerable biases when providing estimations. This is likely an underestimate of the proportion of participants who overestimate trigger potency, as this reflects those whose estimates are inaccurate based on potency of one trigger only. Had we queried more than one trigger we likely would have identified an even greater number of participants overestimating the potency of triggers, as participants reported on average four triggers. The equiprobability hypothesis is also a probable influence on the inaccurate PPV estimations given by the participants. The equiprobability hypothesis states that individuals often view the likelihood of an event occurring as equal to the likelihood of it not occurring (Hattori & Nishida, 2009). Rather than providing accurate

estimations by recalling experiences, participants may be viewing the probability of headache as a fifty-fifty chance. We are exploring this possibility in future analyses.

The implications of the present study extend to our understanding of the way headache triggers are viewed and researched, as these findings suggest there exists considerable inaccuracy regarding perceptions of headache triggers. In future research, researchers must account for this phenomenon in designing studies of headache triggers and work to identify the sources of biases.

The present study exhibits multiple strengths that include a large sample size of young adults that meet ICHD-3 diagnostic criteria for migraine or TTH, a variety of statistical methodology to answer a novel question in the field of headache, and the utilization of a validated measure for headache disability.

Limitations of the present study exist, and thus caution is warranted when interpreting results. First, self-report information was collected using retrospective questionnaires regarding headache history and headache trigger perceptions. The retrospective nature of the obtained data and associated reliability issues could have influenced study results. Second, accuracy analyses were conducted assuming direct (but retrospective) reports of monthly headache frequency are accurate reflections of reality, but the overestimation of trigger potency could reflect inaccuracy in estimating headache frequency instead of in quantifying trigger potency (or in estimating trigger exposure). Third, despite commonalities in trigger between our sample and those of prior studies, the extent to which these results generalize well to other populations is unknown. The present sample lacks diversity in that it is mostly composed of young, white, female headache sufferers without long histories of headache chronification or medication use. With that

in mind, however, the pattern of results regarding common triggers parallels that of older samples.

Future studies on the perception of headache trigger potency would address many of the limitations in the present study by utilizing long-term headache diaries, as this remains the most accurate way to study headache (Turner et al., 2013). Using this method would decrease the unreliability associated with participants' answers regarding headache history and frequency, as well as provide exposure information regarding other suspected headache triggers that the present study lacked. Headache diaries can also address the possible influence of the equiprobability hypothesis, as data from daily diaries could be compared with potency estimates to more conclusively demonstrate biases pertaining to headache triggers.

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TABLES AND FIGURES

Table 1*Demographic Characteristics of the Sample (n = 2,482)*

Variable	% or Mean (SD)
Gender (% Female)	73.4
Mean Age (SD)	19.1 (2.4)
Race (% Caucasian)	78
Marital Status (% Never Married)	97.4
Education (% Some college)	58.7
Employment (% Unemployed)	72.9
Income (% >\$50,000)	38.4
Greek (% Greek)	35.1
Mean Headache Frequency (SD)	7.44 (5.87)
Mean HIT-6 Score (SD)	54.03 (8.87)

Table 2

Mean of Total Triggers and Most Potent Triggers of Each Headache Diagnosis (Percent of sample [N = 2365] reporting each trigger as their “most important in causing headaches”)

	Chronic Migraine	Episodic Migraine w/out Aura	Episodic Migraine w/ Aura	Chronic TTH	Episodic TTH
Mean of Total Triggers (SD)	5.55 (2.11)	4.44 (1.99)	4.61 (2.09)	3.92 (2.04)	3.32 (1.76)
Percent of Sample Reporting Most Potent Trigger					
Stress	49.0	38.0	43.9	50.0	34.5
Menstruation	7.7	8.8	11.0	2.4	7.7
Noise	2.7	2.8	2.2	1.2	3.0
Odors/Smells	3.4	2.4	3.1	2.4	1.6
Not Eating	14.6	17.7	11.9	14.3	15.4
Alcohol	0.8	3.9	1.9	1.2	6.6
Weather Changes	6.1	8.7	10.0	7.1	10.8
Low Sleep	12.6	12.8	12.5	15.5	15.4
High Sleep	1.1	3.2	1.3	3.6	2.7
Exercise	0.4	0.7	1.3	2.4	1.3
Smoking	0	0.3	0.3	0	0.1
Sexual Activity	0	0	0.3	0	0.1

Figure 1

Discrepancies between Expected and Reported Headache Frequencies

