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Appraisal of Headache Trigger Patterns Using Calendars

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Abstract

Objective: Using experimental, yet realistic, headache calendars, this laboratory study evaluated the ability of individuals to identify the degree of association between triggers and headaches.

Background: Individuals with headache often record daily diaries or calendars to identify their patterns of triggers.

Methods: This cross-sectional, observational study included adults with migraine, tension-type, or cluster headache who had ever experienced more than five attacks. Participants ($N = 300$) were presented with headache calendars and asked to rate the strength of the relationship (how strongly one causes the other) between three experimental triggers (high stress, poor sleep, and cinnamon) and headache using a 0 (“no relationship”) to 10 (“perfect relationship”) scale for each calendar.

Results: Calendars with a high positive correlation between trigger and headache had higher participant ratings than those with low correlations. The median [25th, 75th] of ratings for each correlation level were low correlation: 1 [0, 4], medium: 4 [2, 5], and high: 5 [4, 8], $p < 0.0001$. However, participants appeared to ignore negative associations (i.e., trigger present with no headache) and rated calendars with more headache days as having higher associations, regardless of the true relationship. The ratings for 2, 6, and 26 headache days were 1 [0, 3], 4 [1, 6], and 8 [0, 10], respectively ($p < 0.0001$). Participants’ previous beliefs about the triggers also affected their ratings (average correlation across triggers: $r = 0.25$, $p < 0.0001$).

Conclusions: This laboratory task supports the notion that individuals with headache are able to identify the association between headaches and triggers using headache calendars. However, these judgments can be biased by the individuals’ previous beliefs about the trigger and by the degree of headache activity.

Keywords

Covariation Assessment; Daily Diary; Bayesian

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Introduction

Individuals who experience headache routinely utilize some elements of covariation assessment when they evaluate the relationship between their headache attacks and the preceding events that may cause or “trigger” them.^{1,2} Covariation assessment is an essential cognitive task used when evaluating the relationship between two variables or events.^{3,4} In its simplest form, this task involves judging the extent to which the presence of variable A is likely to lead to the presence of variable B. Successfully judging this relationship is crucial for many human endeavors including learning,⁵ assignment of causality,⁶ and general categorization.⁷ Given its vast importance, the process through which humans perform covariation assessment has received considerable attention in both laboratory and naturalistic settings.^{8,9} This work has led to a mixed and sometimes controversial understanding of how adept people are at accurately assessing the degree of covariation between two variables.⁴

Individuals can approach a covariation task using either a *descriptive* or an *inferential* perspective.^{4,10} If a descriptive approach is used, an individual will focus on the direction and strength of the relationship between two variables. In this approach, individuals estimate a relationship using only the immediately available data in a machine-like computation (e.g., a correlation coefficient). Alternatively, an inferential perspective focuses on identifying the presence or absence of a relationship between two variables. In this approach, the perceiver could rely on previous learning or prior beliefs to help inform the judgment. This approach is consistent with a Bayesian perspective about judgment in which two individuals can evaluate the same evidence for a relationship (i.e., likelihood), but because they have differing levels of prior belief (i.e., prior probability) about the relationship, their rendered judgments (i.e., posterior probability) could differ remarkably. Although similar, the two approaches have different consequences when extracting information from a task. In essence, a descriptive perspective aims to answer the more nuanced question “How related are A and B?” while an inferential perspective aims to answer “Are A and B related?”⁴

How individuals come to believe that certain variables might trigger a headache is not known, but 80% of individuals with headache report that they have identified at least one trigger.¹¹ Because of the large number of headache trigger candidates¹¹ and the delay between exposure and attack for some triggers like stress,^{12–14} it is extremely difficult for an individual with headache to conduct covariation assessments using only naturalistic observation.^{1,15} For this reason, individuals are often instructed to record a headache calendar or diary in which they note the presence or absence of headaches along with the presence or absence of trigger candidates.¹⁵ Although such recordings are widely recommended, information about how adept individuals might be in conducting formal covariation assessments on these headache calendars or diaries is not known.

The aim of the present study was to evaluate the process of covariation assessment by individuals with headache using experimental, yet realistic, headache calendars. We hypothesized that individuals would utilize elements of both descriptive and inferential approaches in reporting a correspondence between perceived trigger and headache association strength and actual statistical covariation (i.e., a descriptive approach), but these

judgments would also be influenced by prior beliefs about the triggers (i.e., an inferential approach).

Methods

This was one of the four sub-studies that made up the Headache and Cognition Study (HACOGS), a cross-sectional, observational study conducted via a customized computer assessment program. The HACOGS was designed to assess cognitions associated with headache experiences and treatment. Data collection occurred in a single visit at a single site during the time period of May 2012 to May 2014. The study was approved by the Institutional Review Board of Wake Forest School of Medicine, and each participant was required to provide written informed consent. All participants were compensated with a gift card for their participation in the study. Two of the HACOGS sub-studies have previously been published.^{16,17} The authors had full access to all study data.

Recruitment of Participants

Participants were recruited through television advertisements and local headache specialists. Individuals who experienced migraine, tension-type, or cluster headaches and were ages 18 and over were eligible. These individuals must have experienced five or more headache attacks in their lifetimes. Because the questionnaires were only available in English, participants were required to be able to read and write in English. Individuals must have had no disability from visual impairment to be able to participate in this computer-based study. Additionally, participants must have been able to give written informed consent and complete all involved study tasks (e.g., those in a state of inebriation or florid psychosis were not eligible to participate).

Headache and Background Psychological Information

Participants answered questions about their monthly headache activity, most recent headache, degree of current headache pain, and use of preventive and abortive medications using the computer assessment tool. Participants completed additional questionnaires using the REDCap (Research Electronic Data Capture)¹⁸ data collection system or a paper version of the questionnaires, if they preferred. The included questionnaires were the Migraine Disability Assessment (MIDAS),¹⁹ the Weekly Stress Inventory Short Form (WSI-SF),²⁰ the Center for Epidemiologic Studies Depression Scale (CES-D),²¹ and the State-Trait Anxiety Inventory-Trait (STAI-T).²² As described previously,^{16,17} we collected as little protected health information as possible to minimize participant burden, and, therefore, did not differentiate among headache diagnoses in this laboratory study.

Calendar Task

The headache calendar task was conducted using E-Prime 2.0 software.²³ Participants were presented with instructions and examples of the calendar assessment task. The participants were informed that they would be presented with one-month grid-style calendars in which someone had recorded headache attacks and the days they encountered certain headache triggers. Their task would be to rate the strength of the relationship between the trigger and the headache.

Participants then were presented with headache and trigger one-month activity calendars for three headache triggers: high stress, poor sleep, and cinnamon (Figure 1). These triggers were chosen based on their a priori associations with headache. For example, we expected that participants would perceive cinnamon as inert, poor sleep as modestly related to headache activity, and high stress as highly related to headache activity.¹¹ The order of trigger presentation varied randomly for participants to prevent presentation bias. Each headache calendar contained three variable elements: 1) number of headache days per month, 2) number of headache and trigger pairings (i.e., when a trigger and headache occurred on the same day), and 3) number of extraneous triggers (i.e., triggers that occurred without a headache occurring on the same day) (Table 1). The calendars each contained one of three possible frequencies of headache days per month: two, six, or 26 headache days. Each possible number of headache days was paired with one of three possible headache and trigger pairing levels. The pairing levels represented zero headache and trigger pairings, pairings on 50% of the headache days, and pairings on 100% of the headache days. For example, calendars containing two headache days had zero, one (50%), or two trigger pairings (100%). Each combination of headache days and headache-trigger pairings was presented with low, medium, and high frequencies of extraneous triggers (i.e., triggers occurring on days when a headache did not occur). For calendars containing two or six headache days, a low level of extraneous triggers was equal to two, a medium level was equal to six, and a high level was equal to eight triggers. For calendars containing 26 headache days, a low level of extraneous triggers was equal to one, a medium level was equal to two, and a high level was equal to three triggers. All participants were presented with calendars containing all possible combinations (i.e., fully-crossed) of headache days (3), headache-trigger pairings (3), and extraneous triggers (3) for a total of 27 calendars per trigger and 81 total calendars. Participants were able to view each calendar for two seconds. This length of time was used to allow a large number of calendar presentations and to prevent participants from performing mathematical calculations on the observed calendars.

Before beginning the calendar task, participants were asked to rate the perceived potency of the included triggers (high stress, poor sleep, and cinnamon) by indicating the chances (from 0% to 100%.) they would experience a headache if they were to encounter that specific trigger. These ratings were used as the participant's a priori strength of belief in the potency of the triggers.

Primary Outcome Measure

After viewing each calendar, participants were asked to rate the strength of the relationship (how strongly one causes the other) between the trigger and the headache. They were instructed to use a zero to 10 scale where a rating of zero meant "no relationship" and a rating of 10 meant a "perfect relationship". Participants continued the process of viewing and rating calendars until they had viewed all possible combinations of headache and trigger patterns.

Statistical Analysis

The sample size for the HACOGS study was based on obtaining acceptable precision of a 95% CI for proportions.^{16,17} Because many variables were skewed, the questionnaire data

and data from association strength ratings are reported using median [25th, 75th percentile]. To examine the primary hypotheses, the association strength ratings were regressed onto a full factorial set of fixed effects including trigger (high stress, poor sleep, cinnamon), trigger pairings (0%, 50%, 100%), extraneous triggers (low, medium, high), and headache frequency (2, 6, 26 days/month). This model included all of the main effects and higher order interactions. A linear mixed-effects model with an identity link and a random intercept for participant was used to account for the fact that each participant contributed multiple ratings. A sensitivity model was also conducted to examine each participant's mean ratings of each trigger in relation to how others rated the trigger. This model specified both participant and headache trigger as random effects to examine the degree of "bias" in the ratings that existed after adjusting for the fixed effects. This model allowed estimation of the participant's rating for each trigger after accounting for characteristics of each calendar. The assumptions required to interpret the statistical models were closely evaluated during the analysis (e.g., checking of residuals). The distributions of the underlying data were evaluated, and no values were deemed outliers. To assist in the graphical display of the ratings, a continuously scaled phi correlation coefficient was estimated to index the "true" association depicted in each calendar (i.e., the actual correlation of triggers and headaches in any particular calendar), and this was entered into the model as a continuous linear predictor. All analyses were conducted in R 3.4 using R Studio 1.1. Where appropriate, all inferences are two-tailed with $p < 0.05$ interpreted as statistically significant.

Results

Demographics

$N = 300$ participants completed the questionnaires and the calendar task. Of these participants, 83% were female (248/300). Each participant rated the strength of association between a single trigger and headache activity for 81 calendars ($300 \times 81 = 24,300$ ratings). However, 680/24,300 (2.8%) of the calendar ratings were missing due to omissions or technical problems, and these were excluded from analysis.

The participants reported experiencing a range of headache frequencies with a median [25th, 75th] headache frequency of 7 [4, 13] days/month. The median MIDAS score was 19.5 [9, 44.25]. For further characterization of participants, other median scores were calculated as 13 [6, 23] for the CES-D, 37 [30, 49] for the STAI-T, and 37 [20, 60] for the WSI. The participants were taking a range of medications for their headaches with 58/300 (19.3%) currently taking a prophylactic treatment (e.g., topiramate, propranolol, etc.), 132/300 (44%) taking a triptan medication, and 159/300 (53%) taking a nonsteroidal anti-inflammatory drug (NSAID).

Calendar Ratings by Experimental Conditions

The association strength ratings within individual experimental conditions exhibited substantial variation with a full range of scores observed for each of the 81 conditions (range: 0 to 10 within each condition). There was also substantial variation across individuals with the variance components for subject-level intercepts, defined as each subject's average association rating, of 1.08 with residual variance of 6.05 (i.e.,

approximately 15% of total variance in ratings was observed across subject intercepts). Meaningful differences in ratings were observed for each of the main experimental effects on association ratings: triggers ($F[2, 23,556] = 130.0, p < 0.0001$), pairings ($F[2, 23,550] = 6179.5, p < 0.0001$), extraneous triggers ($F[2, 23,549] = 6.7, p = 0.001$), and headache frequency ($F[2, 23,550] = 4525.6, p < 0.0001$). Several higher order interactions among conditions also occurred including headache frequency $\times$ extraneous ($F[4, 23,550] = 25.1, p < 0.0001$) and pairing $\times$ extraneous ($F[4, 23,549] = 72.5, p < 0.0001$). To illustrate these effects, Figure 2 displays the means of each of the headache frequency and pairing conditions, averaging across trigger and extraneous values. As can be seen from the plot, increasing headache frequency and pairings led to increasing ratings of perceived association strength between the trigger and headache. This effect is isolated in Figure 3 where the predicted ratings from the model can be seen to be associated with increasing levels of extraneous headache triggers and increasing headache frequency. As both triggers and headache frequency increase on the calendar, association strength ratings increase, even though the actual relationship was not different across conditions. For example, the median [25th, 75th] ratings for 2, 6, and 26 headache days were 1 [0, 3], 4 [1, 6], and 8 [0, 10], respectively ($p < 0.0001$).

Evidence for Descriptive View

The actual strength of the association between the headache and the trigger displayed on the calendar was summarized using the phi coefficient for each calendar. Figure 4 (left) displays the observed association between the actual trigger and headache association and the participant's rating of the association after controlling for all other factors. Calendars with higher direct relationships (i.e., a greater positive correlation between trigger and headache) had greater ratings than calendars with negative correlations or no correlations, $p < 0.0001$ (Figure 4, left). For example, the ratings for all trigger calendars with 20% headache days and 6 extraneous trigger days with observed correlations (i.e., arising from the combination of factors) of $-0.25, 0.22$, and 0.61 were median [25th, 75th]: 1 [0, 4], 4 [2, 5], and 5 [4, 8], respectively.

By rating a consistent increase in association strength across all levels of actual association between the triggers and headache, participants appeared to be using the descriptive approach (e.g., How related are these two variables?). Figure 4 (left) displays how these participants actually rated the associations versus how participants would if they were using a purely descriptive approach (Figure 4, right). In the task, inverse associations (i.e., a negative correlation between trigger and headache), were given low ratings, even when the association was actually quite strong (e.g., $r = -0.9$). In such instances, the presence of a trigger would correspond to the *absence* of a headache. A purely descriptive approach would rate these inverse associations using the same magnitude for positive and negative correlations. Thus, the ratings from the positive associations were consistent with a descriptive approach, while the ratings for calendars with inverse associations were not.

Evidence for Inferential View

To examine the strength of evidence that participants used an inferential perspective (e.g., seeking to answer "Is this trigger related to headache?"), the differences between triggers

were evaluated. Because each headache trigger was displayed using identical conditions, any systematic differences in the ratings between triggers reflects a likelihood that participants interpreted the calendars using considerations beyond the evidence presented in the calendar, which is consistent with an inferential approach.

Averaging across all calendar conditions, cinnamon had a median [25th, 75th] of 2 [0, 7], poor sleep had a rating of 3 [0, 7], and high stress had a rating of 4 [1, 8]. The difference between cinnamon and poor sleep was 0.35 (95% CI: 0.24 to 0.46), $p < 0.0001$, and the difference between cinnamon and stress was 0.63 (95% CI: 0.52 to 0.75), $p < 0.0001$. Thus, given the same “true” relationship depicted on the calendars, participants reliably rated high stress > poor sleep > cinnamon.

These differences in ratings were in accordance with participants’ a priori beliefs about the triggers (collected before completing the calendars). On a 0% to 100% scale reflecting perceived chance of getting a headache if exposed to these triggers, the median [25th, 75th] rating was 0% [0, 0] for cinnamon, 50% [30, 80] for poor sleep, and 75% [50, 90] for high stress, all $p < 0.0001$. Additionally, association strength ratings within each trigger were associated with strength of a priori beliefs. Figure 5 displays the positive association between a priori beliefs and degree of bias in a participant’s rating. The average correlation across triggers was $r = 0.25$, $p < 0.0001$. After adjusting for prior beliefs, the variance component for triggers was reduced by 6.8%. This indicates that the degree to which two individuals rated the same trigger when presented with the calendar was modestly related to their prior beliefs about the trigger in the calendar.

Discussion

The present study examined the process of covariation assessment used by individuals with headache when evaluating headache calendars. In clinical practice, individuals with headache often record the data for these calendars over one or more months using daily diaries, often with a paper-pencil calendar grid. These calendars are then used to evaluate patterns in headache activity and to examine the relationship between suspected triggering factors and attacks. To glean information from these calendars or diaries, an individual must conduct a formal or informal covariation assessment using the patterns of the presence/absence of a trigger in conjunction with the presence/absence of a headache. This information can then be used by the care provider and patient to craft a management plan based on the frequency of headache attacks and the potency of the triggering factor(s). However, the means by which individuals process this information and how accurate these interpretations actually are have not previously been known. Using a controlled laboratory setting, this study examined the accuracy of informal judgments stemming from headache trigger calendars and several elements of the process through which individuals evaluate this information.

The results support the hypothesis that individuals are able to estimate positive (i.e., direct) relationships that are in concordance with the actual relationships depicted in a calendar. This was evidenced by the fact that as the true correlation increased on the calendar, subjective ratings of this relationship also increased in a linear fashion. However,

participants appeared to give negative relationships differential weight when making ratings. When a trigger was associated with the absence of headache attacks in the calendars (i.e., negative correlation), the ratings were uniformly lower in a linear fashion. Thus, participants were effectively evaluating direct relationships (more trigger, more headaches) and ignoring inverse relationships (more trigger, less headaches). This finding is indicative of a mixed descriptive and inferential cognitive style that is complicated by additional findings related to the particular triggers.

Participants in the study appeared to rate triggers differently depending on their prior beliefs about these triggers. Given the same strength of evidence depicted in the calendar, stronger prior beliefs about the importance of a trigger were uniquely associated with higher subjective ratings. For example, the ratings for calendars depicting stress were higher than those for poor sleep, and this effect was in proportion to the differences in the participants' prior beliefs about the potency of these triggers in causing headaches. This finding supports the hypothesis that, in this laboratory setting, individuals were not simply evaluating the pattern of triggers and headaches on the calendar when conducting the covariation assessment. They also were modestly influenced (i.e., ~ 7% of the variance) by prior beliefs about the items on the calendar when forming a judgment about the relationship between headaches and triggers. The use of prior beliefs when incorporating new evidence is the hallmark of a Bayesian inferential approach to covariation assessment.

Taken together, the pattern of evidence supports the notion that participants appear to have used elements of both a descriptive and inferential approach when evaluating the calendars. For the descriptive approach, participants appeared to be answering a modification of the original question, "How related are A and B?" with a more specific question, "How *positively* related are A and B?". Further, participants similarly modified the inferential question to "Are A and B *positively* related?". Unfortunately, teasing apart which of these strategies was more important in rendering a judgment could not be attempted given that there was no trigger for which patients exhibited a *negative* belief. When prior beliefs are all in the same direction (i.e., all beliefs entail direct correlations), the predictions from the descriptive and inferential models are overlapping. Additionally, the instructions presented to participants might have inadvertently focused participants' appraisals on *only* the positive aspect of any association (e.g., "how strongly one causes the other"). Rating the strength of an association involves theoretically evaluating all forms of covariation, both positive and negative, but evaluating the strength of a causal relationship might encourage a focus on only direct associations between two variables. Thus, future studies could further examine the role of diverse beliefs (i.e., both positive and negative) about triggers in interacting with strength of evidence depicted on the calendars and could assess the association strengths using modified instructions to better ensure that a participant is considering covariation in both directions.

This study utilized a controlled laboratory session that forced participants to make quick judgments about the evidence shown on the calendars. As a result, the generalizability of these ratings to real-world settings is unknown. In real-world settings, individuals would have more time to consider the calendars or even perform formal analysis when forming judgments. Furthermore, individuals are often encouraged to track more than one headache

trigger (making the covariation task more complex),^{1,15} and adherence to data collection can often be poor (making the information less reliable). Additionally, we did not examine differences related to headache diagnosis in this laboratory study. This limitation prevents understanding calendar appraisal by diagnostic groups, which could be informative. This is important because much of the existing literature on headache triggers has been conducted in individuals with migraine.¹¹ However, we did not seek to investigate the influence of diagnosis on these perceptions in the current study.

This study has additional limitations that should be considered. Several headache triggers are postulated to have complex temporal and dose-response associations, such as the delayed reaction from exposure to high levels of stress,^{1,12,14} and it is not clear if participants utilized temporal considerations in their ratings (e.g., stress today, headache tomorrow) or would have benefited from more specific “dosing” information about the triggers (i.e., more than presence/absence information). Worthy of note is that only synchronous relationships were instilled in the calendars and that temporal relationships existed only by chance and were not systematically present across calendars.

Although the rating scale used to index the degree of associations depicted on the calendars was easy to use, it has not been validated against other known concepts. It is possible that the finding that negative associations were ignored was due to participants’ misunderstanding of the nature of the item. Perhaps individuals recognized negative associations as important but intuited that only positive associations should be rated highly on this scale. Alternatively, individuals may hold sophisticated causal structure beliefs that suppose that a single trigger is not sufficient to induce a headache by itself (e.g., triggers may need to cascade to produce an effect). Additionally, it is difficult to identify what a clinically significant degree of differences is for this measurement scale. Future studies should consider using more nuanced measurements when attempting to distinguish between the descriptive and inferential approaches to covariation in this setting.

This laboratory task supports the notion that individuals with headache are able to identify the association between triggers and headaches using headache calendars. The data supports the use of calendar diaries as a helpful tool to isolate the degree of same-day association between candidate triggers and headache activity. The advanced use of electronic diary capture systems will make the task of collecting and analyzing such data easier. Further, several aspects of the covariation assessment process elucidated in this study should be considered by clinicians when working with their patients to interpret the data collected in headache calendars. First, inverse associations, or any associations that are surprising, are unlikely to be recognized by the patient. Second, high levels of headache activity or frequent trigger encounters are likely to bias patients’ perceptions of the underlying association. Finally, patients’ previous beliefs about triggers are likely to play a large role in how they interpret the data. These findings underscore the need for clinicians to review calendars with their patients and for all parties to consider pre-conceived beliefs about the nature of the relationships when forming a care plan. Although headache calendars can be very useful in assisting individuals when identifying headache triggers, being aware of these influences can better ensure that useful information is obtained from these important tools.

Conclusions

This laboratory study supports the idea that individuals with headache are able to identify headache-trigger associations from headache calendars using elements of covariation assessment. However, these judgments can be biased by the individuals' previous trigger beliefs and by the degree of headache activity. Further, it is not clear if individuals are able to utilize the calendars to evaluate protective factors when the presence of a factor is associated with less headache activity. Formal statistical analysis of the associations between triggers and headaches could be conducted to ensure that this information is best evaluated without bias.

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Abbreviations:

HACOGS	Headache and Cognition Study
REDCap	Research Electronic Data Capture
MIDAS	Migraine Disability Assessment
WSI-SF	Weekly Stress Inventory Short Form
CES-D	Center for Epidemiologic Studies Depression Scale
STAI-T	State-Trait Anxiety Inventory-Trait
NSAID	Nonsteroidal Anti-Inflammatory Drug

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Figure 1.

An example of a headache trigger calendar used in the study. The calendar displays a month with six headache days, three trigger and headache pairings, and a medium level of extraneous trigger occurrences (six). Yellow bursts represent headache days. Purple bars represent trigger occurrences. In the study, participants rated 81 calendars in which the headache triggers were clearly labeled as being either high stress, poor sleep, or eating cinnamon.

Figure 2.

The conditional means with error bars representing SD, for combinations of headache frequency (2, 6, and 26 days/month) and trigger pairings (0, 50, and 100% pairings). As headache frequency increases, the average ratings increase ($p < 0.0001$), and as the number of pairings increases, the average ratings increase ($p < 0.0001$). However, a frequency $\times$ pairings interaction ($p < 0.0001$) indicates that differences between the frequency conditions are not constant for pairing levels.

Figure 3.

Theoretical predictions from the linear mixed effects model (shaded area represents 95% prediction intervals) for the median patient when the true association is $r = 0$ (i.e., no correlation among the trigger and headache). As both trigger and headache frequency increase on the calendar, association strength ratings increase ($p < 0.001$ for each), even when the actual relationship does not change. Across all degrees of relationships, simply having a greater number of headache and/or trigger days was associated with higher ratings.

Figure 4.

The relationship between the true correlations depicted on the calendars and association strength ratings (left panel). The right panel depicts the theoretical association strength ratings if both direct and indirect relationships were given equal weight when forming association strength judgments. The left panel depicts the actually observed association ratings, while the right panel depicts what a purely descriptive approach to covariation assessment should resemble.

Figure 5.

The degree of “bias” across all ratings for each participant is plotted as a function of previous beliefs about each trigger. The bias was estimated as the random effects variance for each participant for each trigger after adjusting for the true association depicted on the calendars. Individuals tended to rate the association strength on the calendars higher when they had greater degrees of prior beliefs about the association strength of the triggers.

Table 1.

Variable elements included in headache calendars.

Level	Variable Elements		
	Headache days per month	Proportion of days when headache attack and trigger are paired	Extraneous triggers not paired with a headache attack
Low	2	0%	2 when headache days = 2
			2 when headache days = 6
			1 when headache days = 26
Medium	6	50%	6 when headache days = 2
			6 when headache days = 6
			2 when headache days = 26
High	26	100%	8 when headache days = 2
			8 when headache days = 6
			3 when headache days = 26

Note: Participants were presented with a series of calendars containing all combinations of low, medium, and high levels of headache days, headache and trigger pairings, and extraneous triggers (i.e., fully-crossed, 27 calendars for each of the 3 triggers, 81 total calendars).