Automatic Effects of Illness Schema Activation on Behavioral Manifestations of Illness

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Abstract

Objective*:** Relatively little research has directly evaluated the schematic nature of illness representations proposed by the common sense model of illness. Four studies tested the hypothesis that illness schema activation leads directly and automatically to behavioral manifestations of illness. ***Methods**:* Study 1 was a survey ($N = 970$) that evaluated the proposition that the mental representation of common cold symptom experience includes functional deviation from the usual prototypical self. Studies 2 and 3 were experiments that tested effects of cold schema activation using a subliminal priming paradigm on walking speed (Study 2, $N = 53$) and free recall in a memory task (Study 3, $N = 30$). Study 4 ($N = 65$) used a 2 (cold prime vs. control) X 2 (alternate self vs. control) experimental design to investigate attenuation of the effect of the cold prime on free recall. ***Results: Study 1 confirmed the multifactorial nature of functional self-deviations representing the common cold symptomology. Studies 2 and 3 showed that participants primed with the common cold schema walked more slowly and performed worse on a memory recall task relative to controls in whom the schema was not activated. These effects were automatic in the sense that participants were not aware of the prime or of this influence. In Study 4, priming an alternative self-identity overcame the deleterious effect of automatic common cold schema activation on free recall in a memory task. ***Conclusions***: Subliminal activation of a schematic representation of illness automatically activates behavioral manifestations of illness.

Keywords: Common sense model, common cold, flu, automatic behavior, symptoms, illness, schema, priming, implicit

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The common sense model (CSM) of self-regulation describes the cognitive processes involved in the important process by which an individual may come to recognize that he or she is ill (Leventhal, Meyer & Nerenz, 1980; Leventhal, Weinman, Leventhal & Phillips, 2008; Leventhal, Breland, Mora & Leventhal, 2010; Leventhal, Leventhal & Breland, 2011). A key premise of the CSM is the relationship between the perception of stimuli relating to illness and the activation of organized knowledge structures ('schema') regarding illness. The central route to illness identification in the CSM involves the detection of somatic, physical or cognitive functional deviation that exceeds normally expected variability from the underlying prototype of the usual physical and functional self. The identification of illness follows from the activation and matching of the content of the illness schema to symptomatic experience (Martin, Rothrock, Leventhal & Leventhal, 2003; Leventhal et al., 2010).

Content Domains and Structure of Illness Representations in the CSM

Illness representations comprise five main content domains. Cognitive representations of *the identity of the condition*, the functional deviations from the prototypical self that comprise the symptoms and their label (what it is called) together identify an illness. Studies conducted in a range of illness contexts have evidenced the prototypical nature of the representation of illness symptoms, and shown that illness labels render symptom prototypes salient (Bishop & Converse, 1986; Cameron, Leventhal & Leventhal, 1993). Further domains relate to content concerning its perceived cause, timeline, perceived consequences and controllability. Illness threat is also represented emotionally, in parallel to cognitive representations (Leventhal, Diefenbach & Leventhal, 1992). The multidimensional content of explicit illness representations has received support in a range of illness contexts using qualitative and quantitative methodologies (e.g. Graham, Rose, Hankins, Chalder & Weinman, 2013; Hagger & Orbell, 2003, 2005; Heijmans & de Ridder, 1998; Meyer, Leventhal & Gutman, 1985;

Moss-Morris et al. 2002). In relation to structure, Leventhal proposes that illness representations are schematically organized knowledge structures. Although illness schema may often be consciously processed, recent studies have provided preliminary evidence that illnesses are represented as schemata that are specific, implicit and organized. Williams, Wasserman and Lotto (2003) suggested that a general illness schema might be activated in participants who wrote about their last illness experience. Participants subsequently presented with a modified Stroop color-naming task containing general illness related words (e.g. poorly) showed greater color naming latencies to words related to illness over neutral words. Henderson, Hagger & Orbell (2007) showed that an illness specific prime activated an illness specific knowledge structure. A common cold prime resulted in heightened perceptual awareness of words associated with the common cold, but not to words associated with cardiovascular disease, presented in a subsequent Stroop task. These data support an implicit association between an illness label and other concepts contained in an illness schema. Henderson, Orbell & Hagger (2009) further demonstrated that information about coping procedures is encoded with other aspects of an illness representation. Participants subliminally primed by the word "Flu" demonstrated greater responsiveness to words associated with previously-elicited typical means for coping with the illness (e.g. "lozenge") in a grammatical decision task, but only if they were habitual users of the strategy when experiencing a cold. Findings indicate that frequent co-activation of the illness schema and coping strategy results in the coping strategy being encoded and activated by a subliminal illness prime. Implicit illness schemata are dynamic structures, updated by past and ongoing experience and their operation does not require the employment of effortful resources.

Priming Behavioral Manifestations of Illness

The present research concerns the effect of subliminal illness priming on accessibility of functional deviation associated with illness. If, as a consequence of frequent co-activation in the past, illness labels (and associated information) are encoded with symptomatic deviations,

priming an illness should activate behavioral manifestations of illness. This possibility has not previously been investigated. Numerous studies have shown that the activation (by priming) of traits, goals, stereotypes and other constructs can influence individuals' behavior (e.g. academic performance, walking speed, helping behavior) without their intention or awareness (for reviews see e.g. Aarts 2007; Bargh, 2006; Molden, 2014) and recently research has turned to consideration of mechanisms that might explain these behavioral effects. Current research suggests that primes affect behavior via changes in the active self-concept. People possess a vast chronic self-concept, of which only a subset (the active self concept) can be active at any given moment. The active self-concept is an important guide to behavior and includes implicit automatic components (Markus & Wurf, 1987). The *active-self* account of priming effects (Wheeler, DeMarree & Petty, 2007; Smeester, Wheeler & Kay, 2010) proposes that, in general, primes induce changes within the active-self by making dominant those particular aspects of one's self knowledge that are associated with the respective prime. For example, Hundhammer & Mussweiler (2012; study 4) showed that a sex prime led men to act more assertively to interrupt an experimenter who had become distracted but led women to act more submissively and wait longer than controls. These opposite effects on behavior depended upon the gender stereotypical subset of self knowledge activated by the prime. The cognitive representation of illness proposed by the CSM is fundamentally a representation of the functionally deviant self (Leventhal et al., 2011). Priming an illness schema should therefore activate knowledge of the functionally deviant self that is associated with the prime and serve as a guide to behavior. We propose that an illness prime will lead people to manifest behavior consistent with illness, so long as a person possesses a mental representation of the symptoms and experiences associated with the primed illness.

The Present Research

Since it is important that a prime activates an existing symptomatic representation, the hypotheses were tested in the context of an illness with which participants might be expected to

have experience, the common cold. Most people experience between two and five common cold episodes each year (Johnstone & Holgate, 1996). Study 1 examined participants' representations of common cold symptoms in order to validate our assumption that functional aspects of the 'self with a cold' are encoded in the mental representation. To test the hypothesis that cold priming would lead people to behave in accordance with illness, two experiments (Studies 2 and 3) examined the effect of subliminally priming the common cold schema on subsequent behavioral responses. Specifically, it was hypothesized that participants presented with a subliminal common cold prime would exhibit impaired walking speed (Study 2) and cognitive performance (Study 3) relative to controls, and that these effects would occur automatically, without participants being aware of the prime, nor that it had influenced their behavior. The final study (Study 4) sought to shed light on the boundary conditions of illness priming. If the effect of illness priming depends upon temporary activation of the illness schema in the active self concept as proposed by Wheeler et al., 2007, then activating alternative self-knowledge before illness priming should eliminate these effects. It was hypothesized that the effect of a common cold prime on cognitive performance would be moderated by prior activation of alternate non-illness aspects of self-knowledge. In sum we sought to address two questions: First, are functional deviations associated with illness encoded in an illness representation so that illness priming influences behavior outside of conscious awareness? Second, is it possible to protect the individual against illness priming? The university ethical committee granted ethic approval and all experimental participants signed consent forms and were debriefed following participation.

Study 1

The purpose of Study 1 was to validate our assumption that the mental representation of common cold symptomology would include not only characteristic somatic symptoms but also functional deviation from the usual prototypical self. We expected that the common cold

experiential prototype would comprise multiple underlying factors representing behavioral, cognitive, social and emotional functionality.

Item Generation

An item pool that represented the domains of subjective experience of 'having a cold' was derived from a preliminary study in which forty student participant volunteers were asked: "Please write a short narrative about your most recent common cold experience. Please think about how it felt to have the common cold. You can be as descriptive and explanatory as you like". The narratives were inspected for content and all discrete self-referential statements (i.e. statements including the terms "I", "My", "Me") that described an experiential symptom state associated with having a cold were retained. Our strategy in generating these items was to represent all experiential domains elicited by the narratives and to retain the wording as closely as possible to that used by the participants. A questionnaire developed containing these items entitled "How I feel when I have a common cold" instructed participants to respond to each item on a on a 7-point scale anchored from 1 (This is not at all true of me when I have a common cold) to 7 (This is very true of me when I have a common cold).

Factor Structure

The questionnaire containing the 58 preliminary items was presented to an independent sample of 970 participants recruited either via notices posted around campus, classes, or from amongst visitors to university open days (63% female, *M* age = 27.81, *SD* = 12.03). Participants completed either a paper version (79%) of the questionnaire or were sent an electronic version by email (21%). Age and gender of participants did not vary by mode of distribution of the questionnaire (Age, t (968) = 1.42, p = .156; gender, χ^2 (1) = 2.96, p = .097).

Following Costello & Osborne's (2005) recommendations the resulting data were subjected to an exploratory factor analysis using maximum likelihood estimation with oblimin rotation. Results revealed 9 factors with eigenvalues greater than 1. Inspection of the pattern matrix suggested seven interpretable factors each with several high loading items. After

removal of free-standing items not associated with one of these seven factors, further analyses using maximum likelihood estimation with oblimin rotation with the number of factors to be retained for rotation set at 6, 7 and 8 suggested that the cleanest solution (items loadings above .30, no cross loadings and no factors with fewer than 5 items) was a 6 factor structure. Parallel analysis (Velicer & Jackson, 1990) with raw data permutation was performed in SPSS using O'Connor's (2000) RawPar script in order to confirm the optimum factor solution. A 95th percentile distribution and 1000 permutations were selected. Six of the observed eigenvalues were greater than the 95th percentile values of the randomly permuted data (factor 7 observed eigenvalue = 1.259 < 95th percentile value = 1.298) confirming that a 6-factor solution was appropriate. The six factors each comprised 5 or more items with item loadings ranging from 0.3 to .86. The six factors can be summarized as *cognitive symptoms* (e.g. "I have difficulty concentrating"; "I find it hard to put mental effort into anything"), *social identity* (e.g. "I feel other people look down on me"; "I feel unattractive"; "I feel different from other people"), *behavioral symptoms* (e.g. "I can't walk very far"; "I find it difficult to move about"), *respiratory symptoms* (e.g. "My nose is blocked"; "My sense of smell is decreased"), *systemic symptoms* (e.g. " I have a headache"; I feel shaky"; "I have nausea") and *negative mood* (e.g. " I feel annoyed"; "I feel upset"; "I feel irritated") (Appendix A).

Discussion

Results confirmed our assumption derived from the CSM that the symptom identity associated with the common cold would be characterized by self-perceptions of functional deviation from the usual prototypical self. Six facets were identified, representing cognitive, social, behavioral, systemic, respiratory and emotional components of common cold illness self-identity.

Study 2

Results of Study 1 indicated that lethargy may be a key symptom experienced when suffering from a common cold. Study 2 tested the hypothesis based on Leventhal et al.'s CSM

that activation of a common cold schema might also activate typical behavioral manifestations of illness. We hypothesized that the activation of the common cold illness schema using a subliminal prime would lead participants to walk more slowly than controls. We investigated this possibility using a subliminal prime and an electronic system to objectively and surreptitiously capture walking speed.

Method

Design and participants. A single independent variable between groups (cold prime vs. control) experimental design was employed to test the hypothesis. The prime was delivered subliminally. Participants were 53 volunteers from the university participant pool (men = 16, women = 37, *M*age = 27.83, *SD* = 10.93) who volunteered to participate in a study of "visual acuity". It was important that participants remained naïve to the study purpose throughout the experiment in order to test the hypothesized effects of activation of the schema outside of conscious awareness. The participants were native English speakers and were reimbursed £3 for their participation. Participants were randomly assigned to either the experimental or control condition. Participants currently suffering from a common cold were excluded following data collection.

Materials and equipment. The presentation of the subliminal prime was controlled by an Apple Macintosh computer and presented on a 14-inch color monitor. The experiment was generated using the "Superlab" version 4.0.6 computer program and comprised a subliminal prime embedded within an ostensible visual acuity task.

Subliminal prime. Because the word *cold* is semantically ambiguous, an alternate one-word prime was required to activate the common cold schema. Following Henderson et al. (2009) the word *flu* was adopted. Henderson et al. (2009) reported two pilot studies demonstrating that the word *flu* is highly associated with the common cold, unambiguous when spelled, and used synonymously with the "common cold' in everyday speech. The experimental prime consisted of the word 'FLU', presented subliminally, with a presentation

time of 17ms (Eimer & Schlaghecken, 1998; Henderson et al., 2009). In the control condition, participants were presented with the stimulus 'XXX' so that the length of the subliminal stimulus was matched in the experimental and control groups. The prime was presented using a backward and forward mask, containing a random letter string (XQFBZRMQBX) that covers a variety of letter patterns and is structurally similar to the letters contained in the stimulus word. (Bargh & Chartrand, 2014). The forward and backward masked prime appeared as a 'flash' on either the upper left, upper right, lower left or lower right (25 times in each corner) of the screen for 60ms. Participants were required to indicate whether the 'flash' had appeared on the left or right of the screen by pressing one of two keys on the keyboard (the keys 'a' and 'l, labeled "left" and "right", respectively).

Walking speed. Walking speed from the computer cubicle was recorded in seconds over a 10m distance using infra-red sensors (Brower Wireless Sprint System 2007™) covertly embedded in the corridor walls.

Procedure. A plausible scenario was developed requiring participants to walk the distance between the sensors embedded in the corridor wall after completing the computer task. Participants were tested individually. The participant was asked to attend a testing room and to complete a standard consent form. The experimenter explained that due to building works in the department it was necessary to use a different quieter experimental cubicle for the experiment. They were informed that the cubicle was small and they should leave any belongings in the original testing room before going to the cubicle and that the testing room door would be locked. This procedure ensured that all participants would walk back unencumbered by a coat or bag and reduce the likelihood of interference. Participants were then directed to the cubicle and asked to take a seat in front of a computer with "right" and "left" labels attached to the 'a' and 'l' keys on the keyboard. In order that the experimenter remained blind to condition, participants were asked to watch a video controlled by a simple Supercard® program that would explain how to run the experiment. The participant was told

that when the experimenter left the room, they were to watch the video and follow the instructions on the screen and once they had finished, return to the original testing room where the experimenter would meet them to complete a questionnaire. Once the participant was ready to begin, the experimenter left the cubicle and returned to the original testing room to avoid influencing the participant as he or she emerged from the cubicle to walk back to the testing room.

Prime and control participants were presented with identical on-screen instructions. Participants were instructed that they would see a fixation cross in the center of the screen that they were to look at, followed by a string of letters that would 'flash' briefly at the top right, top left, bottom right or bottom left of the screen. When the flash disappeared their task was to indicate whether the flash had appeared on the left or the right side of the screen by pressing either the 'l' key to indicate right, or the 'a' key to indicate left. Participants were instructed to keep looking at the center of the screen where the fixation cross would appear throughout the task, and to be as quick and accurate as possible. The final screen prompted participants to return to the previous testing room. As the participant walked from the cubicle to the testing room, their walking speed between the two points was automatically recorded via the infrared sensors embedded in the wall. On reaching the testing room, the experimenter conducted a funneled debriefing procedure (Bargh & Chartrand, 2014) to test for participants' awareness of the primes in an unobtrusive way. Participants answered a series of questions that varied in their specificity. Initial questions concerned awareness of the purpose of the study and subsequent questions checked for recognition of the subliminal priming stimuli and awareness of walking speed assessment. No participant reported being aware of the subliminally presented words, being aware that their walking speed had been measured, or suspicion about the purpose of the study. At this point demographic information was recorded and participants were asked if they were currently suffering from a common cold, before being fully debriefed about the purpose of the study and the surreptitious recording of walking speed and thanked.

Results and Discussion

Preliminary analyses. Data from four participants was excluded because they were suffering from a current cold (n=3) or the sensor failed to record walking time (n=1), leaving a final sample of 49 (men = 16, women = 33; *M* age = 28.18, *SD* = 11.19), 25 controls and 24 in the prime condition. Randomization checks confirmed that men and women were equally distributed across conditions, X^2 (1) = 1.25, p = .263, and there was no age difference between conditions, t (47) = -.14, p = .892. Walking speed data were moderately skewed and were log transformed prior to analysis.

Effect of the cold prime on walking speed. It was hypothesized that participants exposed to the subliminal cold prime would walk more slowly than controls after leaving the laboratory. Means and standard deviations and a t–test of the non-transformed walking speeds are shown in the upper portion of Table 1. Cold primed participants walked more slowly than controls, a moderate effect size according to Cohen's (1992) criteria.

Consistent with hypothesis, subliminal activation of the common cold resulted in participants walking slower relative to control participants. We viewed this as evidence that activation of the common cold schema led to activation of behavioral aspects of the common cold symptom prototype. Another experiment with a different dependent measure sought to replicate the finding with respect to a different component of common cold symptomology.

Study 3

Study 1 showed that the functional representation of a common cold includes a lack of mental energy and difficulties in concentrating. Study 3 tested the hypothesis that subliminal activation of a common cold schema might result in performance deficits on a memory task.

Method

Design and participants. A single independent variable between groups (cold prime vs. control) experimental design was employed to test the effect of a subliminally presented prime

on cognitive performance. Participants were students and staff from the university participant pool (N = 30, men = 13, women = 17; Mage = 33.00, SD = 12.64) who volunteered to participate in a study of cognitive processes. The participants were native English speakers and were reimbursed £3 for their participation. Participants were randomly assigned to either the experimental or control condition.

Materials and equipment.

Subliminal prime. The backward and forward masked experimental prime (FLU) and the control (XXX) were exactly as in study 2. However in this experiment, the prime and its masks were embedded in a free recall task and were presented at the beginning of each trial, immediately before the presentation of each word in the recall task.

Free recall memory task. A free-recall memory task served as a measure of cognitive performance (e.g. Murdock, 1962; Bhatarah, Ward & Tan, 2006). Participants are shown a list of words that they are required to consciously encode and subsequently retrieve from memory (i.e. remember and recall). Participants must use cognitive effort to remember the words, particularly when the words are unrelated to any salient concepts, making it an appropriate task to test diminished cognitive function when the illness schema is activated. Three, twenty-four word lists were created. The words were selected at random from the Toronto Word Pool (Friendly et al., 1982), and matched across the three lists for number of nouns, verbs and adjectives and for frequency and length using the Celex database (Baayen, Piepenbrock & van Rijn, 1993). Three psychology faculty also inspected the lists and excluded words related to illness, speed, accuracy or memory. The word lists were presented, one word at a time, in three blocks of 24 words each. The prime and its masks appeared for 60ms immediately before the presentation of each word. Each word was presented in lower case Arial font size 24 and appeared six millimeters high in the center of the screen. The words were presented for one second each, followed by a 500ms blank screen.

Procedure. Participants were tested individually. Each participant was shown to a testing cubicle where the experimenter asked him or her to complete a standard consent form before explaining the upcoming task. The experimenter placed a pen and three blank sheets of paper labeled List A, List B and List C on the desk beside the keyboard. In order that the experimenter remained blind to condition, participants were asked to watch a video controlled by a simple Supercard® program that would explain how to run the experiment. The participant was told that after the researcher left the room, they were to read the instructions on the computer screen and push any key to begin the task. The instructions were identical for the experimental prime and control conditions. Participants were instructed to look at the center of the screen throughout the task where they would see a string of letters 'flash' in the center of the screen followed by a word. Participants were asked to try to remember each word and told that they would be asked to write down as many as they could remember. The instructions informed participants that they would see three sets of words, 'List A', 'List B' and 'List C' and at the end of each list there would be a break and they would be given an opportunity to write down as many words from that list as they could remember. Following presentation of the first twenty four words, a beep sounded and a further instruction screen asked the participant to take the sheet of paper labeled 'List A' from the pile and to list as many words as they could following the sound of the next beep. After 60 seconds recall time, another beep sounded and a new instruction screen appeared informing participants that they should stop writing and put the list to one side. They were told they would now see List B words as soon as they pushed any key to continue. This procedure continued until the participant had listed the words from List C. After completing the free recall task, the final screen prompted participants to call the experimenter who conducted a funneled debriefing procedure (Bargh & Chartrand, 2014). Participants were asked a series of questions that varied in specificity from initial questions concerning the purpose of the study followed by questions checking for recognition of the prime stimuli. Data from 1 participant was subsequently excluded on the basis of

suspicion about the task. Finally, demographic data was collected and participants were asked if they were currently suffering from a common cold, before being fully debriefed and thanked.

Results and Discussion

Preliminary analyses. Data from six participants who reported currently having a common cold, and from one participant whose recall score was an outlier (>*M*+3*SD*s) was discarded, leaving a final sample of 22 (men = 9, women = 13; *M*age = 33.52, *SD* = 12.25), 11 controls and 11 in the prime group. Randomization checks confirmed that there was no age difference between conditions, t (20) = -.85, p = .408. However, men were over-represented in the prime group, X^2 (1) = 4.70, p = .030. Preliminary analysis of this possible source of systematic bias showed that gender was unrelated to word recall (*t* (20) = -.981, *p* = .338) so was not considered further. The mean number of recalled words from all three lists served as the dependent measure.

Effect of the prime on word recall. It was hypothesized that participants exposed to the subliminal cold prime would recall fewer words. Means and standard deviations of the recalled words are given in the lower portion of Table 1. A t-test confirmed that cold primed participants recalled fewer words than those in the control condition, a large effect size according to Cohen's (1992) criteria.

Consistent with hypotheses, subliminal activation of the common cold resulted in poorer word recall consistent with impaired cognitive performance. Studies 2 and 3 provide evidence of behavioral consequences of subliminal activation of a common cold illness schema.

Study 4

Studies two and three demonstrated that priming the common cold outside of conscious awareness led to behavioral and cognitive deficiency that is consistent with an active cold schema. Following Wheeler et al. (2007) it was theorized that the subliminal prime would exert behavioral effects because it temporarily activated specific knowledge including behavioral

schema associated with the prime. At the moment of priming, the association between the prime and knowledge about the functionally deviant self contained in the illness schema become the central component of the active self and guided behavior. The final experiment was designed to test the hypothesis that activating alternate aspects of the chronic self concept might help to protect participants against illness priming. We theorized that priming alternate aspects of the self-concept that are unrelated and antagonistic to illness schema content would reduce the effects of subsequent illness priming. It was hypothesized that priming alternate self knowledge prior to the illness prime would moderate the consequences of an illness prime on cognitive performance. This final study also included a measure of self-reported fatigue in completing the recall task as an additional check on the non conscious mediation of participant responses.

Method

Design and participants. A 2 (illness schema activation: common cold prime vs. control) X 2 (self-identity activation: positive self prime vs. control) between participant design was used to test the hypothesis. The common cold prime was subliminal, whereas the identity prime was supraliminal. Participants were 66 undergraduate students (19 men; 47 women; *M*age = 21.76, *SD* = 7.63) who volunteered to participate in two ostensibly unrelated studies that would run consecutively. The participants were native English speakers and were reimbursed £5 in advance for their participation. Participants were randomly assigned to either the experimental or control conditions.

Materials and equipment. The experiments were controlled by an Apple Macintosh computer and presented on a 14-inch color monitor. The experiment was generated using the "Superlab" version 4.0.6 computer program and comprised two ostensibly unrelated tasks; a supraliminal prime for an alternate sense of self followed by the free recall memory task with an embedded subliminal cold prime identical to that used in Study 3. Word recall from the second task served as the dependent variable.

Alternate self prime. To create a plausible but subtle procedure that would enable us to activate aspects of the self concept not related to illness, we adapted a procedure from the Klee-Kandinsky painting preference task (e.g. Gaertner & Insko, 2000) in which participants are given feedback based upon their ostensible artistic preferences. Participants were asked to rate a series of 20 art images presented in random order. Each image was presented on the screen together with a Likert scale anchored by 1 (*I don't like this image at all*) and 6 (*I like this image very much*) and remained on the screen until the participant made a response. These responses were recorded but were irrelevant to the feedback that followed. Following the assessment of the 20 images, the supraliminal prime (alternate self vs. control) was presented. Participants in the alternate self condition were told that their scores relating to the extent to which they liked the images had revealed that they stated preferences for "Taylor" art. Those people expressing preference for "Taylor" pictures were described in generally positively terms, as people who are relatively high achievers, find it easy to make friends, who are easy-going and tend to be successful. Another screen then appeared and participants were asked to agree/disagree with 5 statements about being a "Taylor" (e.g. "I like being considered a member of the Taylor group" I am pleased to be a 'Taylor'") on a Likert scale from 1 (*disagree*) to 5 (*agree*). Participants in the control condition saw a screen with a paragraph giving some information about art.

Subliminal cold prime. The subliminal common cold prime was embedded in a free recall task exactly as described in Study 3.

Procedure

Participants were tested individually. Participants were shown into a testing cubicle that housed a desk-mounted computer where they completed a standard consent form and the experimenter explained the upcoming task. A questionnaire measure of task related fatigue was placed face-down on the desk next to the computer and three sheets of paper labeled List A, List B and List C were presented to the participant on the desk before them. The participant

was told that after the researcher left the room, they were to begin the first computer task followed by the second, unrelated, task. Participants were asked to read the instructions on the computer screen and push any key to begin the task. The instruction screens were identical for both the experimental prime and control conditions. Instructions for the first task asked participants to rate their liking for a series of images. After rating the last image, participants assigned to the positive self-identity prime condition viewed the screens relating to being a 'Taylor', while control group participants read a screen displaying information about art. The next screen instructed all participants to press any key to continue to the second task, whereby the instruction screen for the free recall memory task appeared, as described in Study 3.

After completing the free recall task, the final screen prompted participants to complete the questionnaire that had been placed face down on the desk. The experimenter then conducted a funneled debriefing procedure (Bargh & Chartrand, 2014) to test for participants' awareness of the true purpose of the task, whether they perceived any connection between the two ostensibly unrelated tasks and whether they were able to report recognition of the subliminal prime stimuli. Data from one participant was subsequently excluded on the basis of suspicion about the task. Demographic information was then collected and the participant was asked if he or she was currently suffering from a common cold, before being fully debriefed and thanked.

Questionnaire measure

The questionnaire completed directly after the free recall task measured self-reported fatigue (α = .75). This scale included eight items (e.g. "How difficult did you find it to perform the task?" "How tiring was it to perform the task?"). Responses were made on seven point Likert scales with anchors 1 (*not at all*) to 7 (*extremely*).

Results and Discussion

Preliminary analyses. Data from 15 participants was excluded because they reported currently having a common cold, data from 3 participants whose word recall scores were

outliers was excluded[1], leaving 47 participants data for analysis (men = 15; women = 32; *M* age = 21.47, *SD* = 7.13) (Group sizes: 12,12,12,11). Randomization checks confirmed that men and women were equally distributed across the prime and control groups (alternate self prime vs. control group X^2 (1) = .045, *p* = .831; common cold prime vs. control X^2 (1) = .704, *p* = .401), and that there was no age difference across conditions (alternate self prime vs. control group *t* (45) = .193, *p* = .848; common cold prime vs. control group *t* (45) = .704, *p* = .401).

Inspection of the data concerning attitudes towards the art images presented in the first task showed that these ratings were unrelated to recall in the subsequent task (*r* (47) = -.002, *p* = .989). ANOVA confirmed that there were no differences in artistic attitudes across conditions; there were non-significant main effects of self-prime and cold prime and the interaction term (*F* (1,43) = 1.48, *p* = .231; .303, *p* = .585; .008, *p* = .929, respectively). Participants in the self-prime condition reported generally favorable views of being a 'Taylor' (*M* = 3.46, *SD* = 1.14). A 2 (Self-identity activation: alternate self prime vs. control) X 2 (illness schema activation: common cold prime vs. control) between participants ANOVA confirmed that fatigue did not differ by condition; there were non-significant main effects of self-prime and cold prime and the interaction term (*F* (1,43) = .07, *p* = .787; .135, *p* = .251; 1.50, *p* = .227, respectively).

Effect of common cold and positive self primes on word recall. The mean number of recalled words from all three lists served as the dependent measure. A 2 (self-identity activation: alternate self prime vs. control) X 2 (illness schema activation: common cold prime vs. control) between participants ANOVA revealed a significant effect of the common cold

[1] An alternative way to manage outliers is to conduct a nonparametric bootstrapping analysis of the data set including outliers (N = 50). This analysis revealed the same pattern of results. ANOVA revealed a significant main effect of cold prime (*F* (1, 46) = 4.90, *p* = .032), a non-significant main effect of alternate self prime (*F* (1,46) = .00, *p* = .996) and a significant interaction of cold prime and self prime (*F* (1,46) = 5.64, *p* = .022). Inspection of bootstrapped (1000 bootstrapping resamples) 95% confidence intervals (CI) of the mean recall scores showed that the confidence interval between cold primed and control participants did not include zero (95% CI [.165, 1.942]) so that the null hypothesis can be rejected at the 5% level. For the comparison of self primed participants with controls, the confidence interval included zero (95% CI [-.964, .971]) consistent with the non-significant result from the ANOVA. Bootstrapped comparisons of simple effects showed that for participants who were not primed with an alternate self, the cold prime was associated with lower recall (95% CI [1.149, 3.186) so that the null hypothesis can be rejected, consistent with the result from study 3. When primed with an alternate self, the cold prime no longer influenced recall (95% CI [-1.38, 1.22]). Participants primed with the cold after an alternate self prime recalled more words than those primed with the cold only (95% CI [-2.12, -.079]).

prime (F (1,43) = 4.53, p = .039, η_p^2 = .095) that was qualified by a significant interaction of cold prime and alternate self (F (1,43) = 6.74, p = .013, η_p^2 = .14). The main effect of the alternate self prime was non significant (F (1,43) = 0.52, p = .476, η_p^2 = .01). Means and standard deviations of the correctly recalled words are displayed in Table 2. Analyses of simple effects indicated that for participants who were not primed with an alternate self, priming with the common cold was associated with lower word recall as compared to controls (Table 2: bottom row). This finding replicates the observation from Study 3. More important for the current hypothesis, when participants were primed with an alternate self, the common cold prime no longer influenced word recall (Table 2: top row). Participants primed with the common cold after an alternate self prime recalled more words than those primed with the common cold only (Table 2: column 1).

Findings from Study 4 showed that an alternate self prime was effective in reducing the effect of common cold schema activation on behavioral manifestation of illness, specifically cognitive performance as measured by a free-recall memory task. The effect occurred without participants being aware of the cold prime, or of its influence.

General Discussion

The primary goal of the research was to test the hypothesis that functional components of symptom experience are encoded in implicit illness representations so that subliminal activation of an illness schema activates behavioral manifestations of illness. Findings from four studies reported in the current article lend support to this suggestion. After confirming that people represent common cold experience in functional terms (Study 1), significant effects of a subliminal prime on behavioral and cognitive functional deviations associated with the common cold were observed (Studies 2 and 3). Specifically, individuals in whom the common cold illness schema was temporarily activated demonstrated significantly slower walking speed and significantly poorer performance on a cognitively demanding task. These effects were

reliably observed across two different behavioral contexts using objective behavioral measures and replicated in Study 4. Moreover, these effects were observed without participants being aware that the illness schema had been activated, nor that their behavior had been influenced. Study 4 also showed that the effect of activating the illness schema on cognitive performance was moderated by the prior activation of alternate self-knowledge not associated with illness.

The present studies extend previous research concerning activation of implicit illness concepts by demonstrating that schema activation outside of conscious awareness can produce deficits in behavioral performance that are consistent with an illness prototype, in people who have no objective pathology. We theorized that an illness schema as described by the CSM is essentially a mental representation of the functionally deviant self. Following Wheeler et al's (2007) active self account, we propose that these behavioral effects were observed because the prime temporarily activated knowledge of the functionally deviant self contained in the illness schema associated with the prime. Since the active self is an important guide to current behavior, participants subsequently demonstrated behavioral manifestations of illness. Behavioral and cognitive slowness is consistent with the behavioral consequences of immune system activity in the body, and with the induced avoidance of exertion brought about by the immune system whilst fighting infection (Eccles, 2000). Since symptoms might therefore be considered a part of the self-regulation process associated with illness it is explicable that this active self-regulation process, implicitly represented by behavioral and cognitive lethargy, impacted upon the task of walking back to the experimenter's testing room, and engaging in a cognitively demanding task, even without participant awareness.

Might an illness prime also automatically activate self-regulatory behaviors such as medication use or seeking medical help? Henderson et al (2009) showed that subliminal priming activated coping strategy concepts (such as 'lozenge') associated with an illness prime, but only amongst habitual users of the strategy in that context (i.e. when suffering from a

common cold) in the past. It is therefore plausible that a prime might lead to self-management behavior (adaptive or maladaptive) that is encoded with an illness provided that an individual possesses a behavioral script for the strategy (cf. Leventhal et al., 2011). Mere knowledge of recommended action is unlikely to be sufficient for behavioral responses to occur automatically and without conscious intent. While present studies capitalized upon common misrepresentations of 'flu' as merely a 'bad cold' in order to overcome ambiguity in the meaning of the word 'cold', cold-specific versus flu-specific primes would be needed for subsequent research on priming behaviors such as flu vaccination (e.g. Chapman & Coups, 2006).

Present findings regarding an, albeit minor illness, support the view that symptomatic deviations from the prototype of the functional self are an important component of the cognitive representation of disease threat. The inclusion of loss of behavioral and cognitive functionality in the cognitive representation of illness is consistent with literature concerning self-assessed health. Self-assessments of health are powerful predictors of the future onset of major illnesses (Idler & Benyamini, 1997) and it is self-assessments of function, not of emotional states that contribute to, and drive changes in self-assessed health (Mora et al, 2008, Leventhal et al., 2011). Changes in functional health also drive change in accessibility of coping information (e.g. Schuz et al., 2011). Questionnaire instruments designed to assess explicit illness representations might benefit from the inclusion of functional performance in the identity domain.

The final study provides preliminary evidence of one process that might regulate the extent to which an illness prime is likely to result in behavioral manifestations of illness. We proposed that activation of alternate non-illness self knowledge might protect participants against illness priming and obtained findings in line with this proposal. Future research will want to explore specific types of self-knowledge and other paradigms such as self-affirmation

(e.g. Cohen & Sherman, 2014) that might provide insight into this protective mechanism. Present studies used asymptomatic samples to investigate priming effects without confounding by current illness or possible effects of actual illness on task performance. Nonetheless, a number of future research directions may be indicated by the findings. For example, it is possible that an active self-concept that opposes activation of an illness schema may interfere with or delay detecting and interpreting a deviation from the normal state of somatic functioning, leading to late or inappropriate self-management. Relatedly, findings raise interesting questions about the implications of chronic schema activation arising from incorporation of an illness label (identity) in the chronic self-concept (e.g. chronic fatigue syndrome, Moss-Morris & Petrie, 2001), and the possible role of active self-knowledge that is not associated with illness in protecting against adoption of a chronic illness identity. Other factors might also impact upon the likelihood of a prime leading directly to behavioral manifestations of illness. Priming behavior requires that people have experience of the primed category (Dijksterhuis et al., 2000). Priming a disease with which people have limited experience (and consequently no elaborated schema that has been repeatedly co-activated with symptoms) is unlikely to result in direct behavioral consequences. Another factor might be the specific content of the cognitive representation of illness. While illness representations are by their nature negatively valenced, nonetheless individual differences derived from experience, cultural knowledge and so on, may lead to differences in representation of consequences, causes, controllability and so on. For example, Henderson et al. (2007) showed that response latency to illness related words in a Stroop task following a prime were correlated with participants' explicit representations of illness.

As with any new area of research a number of limitations should be acknowledged. In the present studies, participants were tested individually and alone, with no other person present in the testing environment, conditions in which an illness prime is most likely to be attributed to

the self (Wheeler et al., 2007). Mediation by activation of self concepts associated with illness could not be tested in the present studies because it might have primed illness in the control groups. However, future research might additionally examine the self-perceptions activated by an illness prime to provide insight into the processes theoretically proposed to account for current findings. The sample sizes in the present study were relatively small, particularly in studies 3 and 4, although consistent effects were obtained across studies. Further research adopting illness priming techniques in larger populations is warranted.

In sum, the present investigation extends understanding of the schematic nature of illness representations in the CSM by showing that activation outside of awareness can lead to the simultaneous activation of behavioral manifestations of the illness prototype. While illness schema are most commonly activated by detection of deviations from the normal somatic self, and are often brought to conscious awareness, current evidence suggests that primes in the environment may also in some circumstances directly activate illness.

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Table 1.

Mean Walking Speed (Study 2) and Word Recall (Study 3) as a Function of Cold Prime

Dependent Measure	Prime Condition		Control Condition			
	M	*SD*	*M*	*SD*	*t (p)*	*d (CI)*
Walking speed (s)	8.19	1.27	7.58	0.51	-2.21 (.032)[a]	-0.63 (-1.21, -0.06)
Word recall	6.76	1.87	8.55	1.39	2.54 (0.02)	1.08 (0.19, 1.98)

Note: a. t value computed from log transformed walking speed. Non-transformed walking speeds are shown in the table for comprehensibility. Log transformed values were (Prime; M = 0.91, SD = .06: Control; M = 0.88, SD = .03).

Table 2.

Mean and Standard Deviation of Word Recall as a Function of Alternate Self Identity Prime Condition and Common Cold Prime Condition (Study 4)

Identity Prime Condition	Illness Prime Condition					
	Cold Prime		Control			
	M	*SD*	*M*	*SD*	*t(p)*	*d (CI)*
Alternate-Self	8.58	1.16	8.36	1.30	-.28 (.783)	-0.12 (-.094,0.702)
Control	7.06	1.12	9.22	1.37	4.24 (<0.001)	1.73 (0.79,2.67)
t (*p*)	-3.21 (.004)					
d	-1.34					
(CI)	(-2.25, -0.43)					