Heliyon 5 (2019) e01685

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.heliyon.com

Heliyon

Threat sensitivity is associated with the healthcare source used most often: doctor's office, emergency room, or none at all

Stephen Ristvedt [a,*], Kathryn Trinkaus [b], Erika Waters [c], Aimee James [c]

[a] Department of Anesthesiology, Washington University School of Medicine, USA
[b] Department of Surgery, Washington University School of Medicine, USA
[c] Surgery – Public Health Sciences, Washington University in St. Louis, USA

ARTICLE INFO

Keywords:
Psychology
Public health

ABSTRACT

A significant proportion of American adults do not have a regular source of healthcare and the reasons for this shortfall are not fully understood. The objective of this study was to examine the relationship between individual differences in threat sensitivity and healthcare utilization in a survey of 483 African American men. Demographics, psychological characteristics, and health behaviors were assessed. The primary outcomes were: 1) most frequent source of healthcare utilization (doctor's office or clinic vs. emergency room vs. no place), and 2) frequency of healthcare utilization (one or more vs. no healthcare visits in the previous year). Data were analyzed with multivariable logistic regression. Results showed that threat sensitivity, insurance status, and age were associated with the most frequent source of healthcare utilization. Compared to men who most commonly used a doctor's office or clinic, men who tended to use an emergency room had higher levels of threat sensitivity and those with no usual healthcare source had lower levels of threat sensitivity. These findings fit with leading neurobiological theories of personality regarding threat sensitivity. From a pragmatic standpoint, these findings may also lend insight to the tailoring of health marketing messages designed to optimize utilization of healthcare resources.

1. Introduction

Getting regular healthcare through a doctor's office or clinic is associated with better outcomes and lower costs (Friedberg et al., 2010; McWilliams et al., 2011; Starfield and Shi, 2004). Unfortunately, over 20% of Americans do not have a regular source of healthcare (Agency for Healthcare Research and Quality, 2017). Understanding the factors that contribute to suboptimal healthcare utilization (HCU) is therefore key to developing solutions to this problem. For instance, an obvious deterrent to regular HCU is insufficient insurance coverage (Agency for Healthcare Research and Quality, 2017), so encouraging coverage for more people could help to ameliorate this situation. However, the fact that 40–50% of uninsured adults have a usual source of care and 15–25% of insured adults do not suggests that other factors may also be important (Artiga et al., 2015). For example, psychosocial factors that might be associated with underutilization of healthcare resources include attitudes that could lead to distancing from the medical establishment (Courtenay, 2000; LaVeist et al., 2009).

Other factors that might influence HCU are individual differences in more deeply ingrained motivational characteristics that could predispose an individual to behave in certain ways in relation to health-related matters. How an individual responds to potentially threatening information, for example, could influence the pursuit of healthcare. That is, the decision to seek medical care is typically in response to symptoms, professional or lay advice, or public health messages, all of which carry an implicit element of threat. In fact, the concept of threat is central in many prominent models of health-related behaviors (Becker, 1974; Lazarus and Folkman, 1984; Leventhal et al., 1984; Rogers, 1975; Weinstein, 1988). Individual differences in sensitivity to threat could thus plausibly influence patterns of HCU, although this association has not previously been examined.

People vary widely in the degree to which they perceive and respond to threats. People on one end of the spectrum are dispositionally hypersensitive to possible threat and thus more prone to anxiety and avoidance. Those on the other end of the spectrum are relatively insensitive to threats and thus more likely to be generally unflustered and perhaps to take unnecessary risks. This trait dimension, hereinafter termed threat sensitivity (Corr and McNaughton, 2008), is included in

* Corresponding author.
E-mail address: ristvedt@wustl.edu (S. Ristvedt).

https://doi.org/10.1016/j.heliyon.2019.e01685
Received 4 December 2018; Received in revised form 2 April 2019; Accepted 3 May 2019

two of the more prominent personality theories that are rooted in neurobiology: Gray's Reinforcement Sensitivity Theory (RST; Gray, 1982; Gray and McNaughton, 2000) and Cloninger's tridimensional theory (Cloninger, 1987). The RST holds that the "primary colors" of emotional experience and expression are governed by three neurobiological systems, one of which is the Behavioral Inhibition System. In the original RST (Gray, 1982), the Behavioral Inhibition System was conceived as a neurologically-based module that oversees the perception of conditioned aversive stimuli as well as the emotional and motivational responses to such stimuli. In the revised RST (Gray and McNaughton, 2000), the Behavioral Inhibition System took on a different role, which was to mediate conflicts between the other two systems (the Fight-Flight-Freeze system and the Behavioral Approach System). In both versions of RST, however, the Behavioral Inhibition System is responsible for the process of risk assessment and the generation of the "watch out for danger" emotion of anxiety (Corr, 2008). Cloninger's theory includes the trait dimension termed "Harm Avoidance" (Cloninger, 1987), which is characterized by features very similar to Gray's Behavioral Inhibition System (Gray, 1982; Gray and McNaughton, 2000).

Both Gray's and Cloninger's theories have spawned multidimensional models of personality traits as well as several self-report instruments to measure those traits (Cloninger et al., 1994; Corr, 2016).

We investigated the association between threat sensitivity and HCU as part of a study of health behaviors among African American men, whose patterns of HCU are markedly different from other demographic groups in the U.S. Compared to Caucasians and African American women, African American men are less likely to go to a doctor's office for their healthcare needs and more likely to go to an emergency room (Blackwell and Villarroel, 2016). Even among adults with private insurance, African Americans are less likely than Caucasians to have a usual source of health care (Artiga et al., 2015). Other possible contributions to these disparities may be that African Americans are more likely than Caucasians to report racial discrimination in healthcare settings (Stepanikova and Oates, 2017) and to develop mistrust of healthcare organizations (Armstrong et al., 2013; Boulware et al., 2003; Musa et al., 2009). Along with individual differences in threat sensitivity, then, perceived discrimination and medical mistrust were also examined. We expected that higher levels of both perceived discrimination and medical mistrust would be associated with suboptimal healthcare utilization habits, either in the form of overreliance on the emergency room or underuse of available healthcare resources altogether.

2. Methods and materials

2.1. Participants and procedure

Participants were recruited through the Center for Community-Engaged Research, which included a storefront facility ("HealthStreet") located in a largely low-income urban neighborhood and a database of individuals interested in research participation. HealthStreet staff also posted fliers and engaged in community outreach. Eligibility was verified (i.e., male, Black or African American, age 21–85) and written informed consent was obtained. Surveys were administered at the HealthStreet facility or at community venues. Surveys generally took 30 min and participants received a $20 gift card. The study was approved by the Washington University Human Research Protection Office.

2.2. Outcome measures

2.2.1. Source of HCU

Two questions assessing HCU source were adopted from the National Health Interview Survey (National Center for Health Statistics, 2010): "Is there one place, or maybe more than one place, that you usually go when you are sick or need advice about your health? No, there is no place; Yes, there is one place; Yes, there is more than one place," and (If one place or more than one place) "What kind of place do you go to most often? Clinic or health center; Doctor's office; Hospital emergency room; Hospital outpatient department; Some other place."

2.2.2. Frequency of HCU

Frequency of HCU was adopted from the Health Information National Trends Survey (HINTS; Nelson et al., 2004): "In the past 12 months, not counting times you went to an emergency room for an emergency situation, how many times did you go to a doctor, nurse, or other health professional to get care for yourself?" Response options were: "None," "1 time, " "2 times," "3 times," "4 times," "5 to 9 times," and "10 or more times".

2.3. Predictor measures

2.3.1. Threat sensitivity

Participants completed the Behavioral Inhibition Scale (BIS; Carver and White, 1994), which was developed specifically to assess sensitivity of the Behavioral Inhibition System from Gray's original RST (Gray, 1982). The BIS requires participants to respond on a 1 to 4 scale ("very false for me'' to "very true for me'') to each of seven items (e.g., "If I think something unpleasant is going to happen, I usually get pretty 'worked up'''). Total scores can thus range from 7 to 28, with higher scores indicating greater levels of threat sensitivity. This instrument has demonstrated strong correlations with several other standardized measures of threat sensitivity, including Cloninger's Harm Avoidance scale (Cloninger et al., 1994) and a measure derived from the MMPI (Hathaway and McKinley, 1943) by MacAndrew and Steele (1991). However, the BIS scale has been the most widely used measure of threat sensitivity (Corr, 2016) and has been used extensively in studies of health behavior (Braddock et al., 2010; Dumitrescu et al., 2010; Hall et al., 2008; Ristvedt et al., 2014; Sherman et al., 2006), behavior genetics (Johnson et al., 2016; Takahashi et al., 2007; Whisman et al., 2011), and the neurobiological basis of behavior (Amodio et al., 2008; Cools et al., 2005; Shackman et al., 2009). Cronbach's alpha for this study was .62.

2.3.2. Perceived discrimination

Participants answered a question from the 2004 Behavioral Risk Factor Surveillance System that asks whether their healthcare experiences within the past 12 months have been "worse than, the same as, or better than people of other races" (Centers for Disease Control and Prevention (CDC), 2004). We also included two modifications of this question, which asked participants to compare their experiences with "people of other income levels" and "people with other insurance coverage". Participants were divided into two groups: those who endorsed "worse than" in response to least one of the three questions and those who did not endorse "worse than" in response to any of the three domains. Cronbach's alpha for this study was .89.

2.3.3. Medical mistrust

Participants completed the Medical Mistrust Index (MMI; LaVeist et al., 2009), which assesses level of agreement on each of seven statements (e.g., "You'd better be cautious when dealing with healthcare organizations"). For this study, the phrase "healthcare organizations" was replaced with "healthcare providers" to capture perceptions of more personal interactions. Cronbach's alpha for this study was .85.

2.3.4. Self-reliance

Participants completed the 22-item version of the Conformity to Masculine norms Inventory (CMNI-22), which measures adherence to traditional masculine attitudes and behaviors (Hamilton and Mahalik, 2009). The 2-item self-reliance subscale was examined for the current study (e.g., "It bothers me when I have to ask for help"). Cronbach's alpha for this study was .50

2.3.5. Health status

Presence of comorbid medical conditions was assessed using a self-report questionnaire (Katz et al., 1996) that was derived directly from

the Charlson index (Charlson et al., 1987). The Charlson index was developed from medical records to produce a single score that reflects the severity of medical comorbidity by counting up the number of common diseases, with each disease weighted by its relative seriousness (based on 1-year mortality rates). Possible scores on the self-report measure range from 0 to 37, with higher scores indicating more significant comorbidity. Self-rated health was also assessed by asking participants to rate their "health in general" as either excellent, very good, good, fair, or poor.

2.3.6. Insurance status

Participants indicated whether they were covered by health insurance or some other healthcare plan. Those who answered "yes" were asked to indicate the kind(s) of healthcare coverage that they had (private plans and/or government programs) and whether they had had any lapse in their insurance coverage in the previous 12 months.

2.3.7. Demographic Information

Age, education, employment status, marital status, and income were assessed.

2.4. Data analyses

Ordinary logistic regression analyses were used to compare groups of men with respect to both HCU source and HCU frequency. For HCU source, two models were used to estimate the odds of: 1) going most often to a doctor's office or medical clinic for health care vs. identifying no usual place; and 2) going most often to a doctor's office or medical clinic vs. going most often to an ER. For HCU frequency, one model was used to estimate the odds of having made any vs. no medical visits in the past year. The main predictor in all three models was threat sensitivity as measured by the BIS (Carver and White, 1994). Covariates were perceived discrimination (because of race, income, or insurance status), medical mistrust (MMI score), self-reliance (CMNI subscale score), medical comorbidities, self-assessed health, age, education, current health insurance, whether or not insured participants had had any lapse in their insurance in the previous 12 months, and income. Complete-case analyses were used, such that cases with missing values on any of the variables of interest were not included. It is likely that responses to some items were missing not at random but due to systematic attitudes or experiences that we were unable to measure. Under these circumstances multiple imputation can perpetuate or even exaggerate the bias created by missing responses (White and Carlin, 2010). Complete-case results are therefore presented as an honest presentation of the participants' responses.

Covariate selection was performed using measures of information (e.g., Akaike Information Criterion) to assess the effect of deleting predictors. Outliers were investigated using Pearson and deviance residuals and estimates of the change in each of those following deletions of individual observations. Overly influential observations were identified using leverages and estimates of the effect of case deletion on parameter estimates. Overdispersion was assessed using the size of Pearson and deviance statistics relative to degrees of freedom. Due to collinearity among certain predictor variables (e.g., insurance status, employment, income, and self-reported health status), all of the ordinary logistic regression models were restricted to sets of three or four predictor variables that demonstrated no appreciable collinearity: threat sensitivity, insurance status, age, and comorbidity.

3. Results

A total of 483 men participated in this study, with 249 (51%) recruited from the HealthStreet database, 177 (37%) from walk-ins to the HealthStreet facility, and 57 (12%) from community outreach activities. Demographic characteristics are shown in Table 1.

Table 1
Characteristics of Study Participants (n = 483).

Age, mean years ± S.D. (range)	49.0 ± 10.9 (21–78)
Education, n (%)	
Less than high school	113 (23.4)
GED	58 (12.0)
High school graduate	136 (28.2)
Some college, no degree	102 (21.1)
Associate's degree	35 (7.2)
Vocational/Technical School	10 (2.1)
Bachelor's degree	24 (5.0)
Postgraduate degree	4 (0.8)
Missing	1 (0.2)
Employment, n (%)	
Full time	50 (10.4)
Part time	66 (13.7)
Unemployed	155 (32.1)
Retired	28 (5.8)
On disability or unable to work	138 (28.6)
Student	21 (4.3)
Other (self-employed, temporary)	15 (3.1)
Missing	10 (2.1)
Marital Status, n (%)	
Never married	232 (48.0)
Living as a couple	17 (3.5)
Married	58 (12.0)
Separated	47 (9.7)
Divorced	113 (23.4)
Widowed	16 (3.3)
Total household income, n (%)	
< $20,000	368 (76.2)
$20,000 to $34,999	57 (11.8)
$35,000 to $49,999	19 (3.9)
$50,000 to $74,999	9 (1.9)
≥ $75,000	4 (0.8)
Don't know	16 (3.3)
Missing	10 (2.1)
Covered by health insurance or other health care plan?, n (%)	
Yes	309 (64.0)
No	172 (35.6)
Don't know	2 (0.4)
(If yes) What kind of health insurance or health care coverage?, n (%)	
Medicaid	119 (38.5)
Medicare	81 (26.2)
Military health care plan	67 (21.7)
State-sponsored health plan	53 (17.2)
Private health insurance	38 (12.3)
Other government program	19 (6.1)
Single service plan (dental, vision, rx)	7 (2.3)
Medi-Gap	1 (0.3)
Don't know	3 (1.0)
(If yes to any of the above) Any time in the past 12 months without coverage?, n (%)	
Yes	82 (26.7)
No	225 (73.3)
BIS Total Score, mean ± S.D.	13.81 ± 3.47
Comorbidity Score, mean ± S.D.	1.05 ± 1.7
[a]Self-Assessed Health, mean ± S.D.	3.00 ± 1.06
Any Perceived Discrimination, n (%)	
Yes	252 (52.2)
No	231 (47.8)
[a]CMNI Self-Reliance, mean ± S.D.	2.37 ± 1.18
[a]MMI Total Score, mean ± S.D.	11.04 ± 4.02

[a] Not all participants completed all of the psychometric measures: Self-Assessed Health, n = 482; CMNI Self-Reliance, n = 482; MMI total score, n = 477.

3.1. Predictors of HCU source

Participants were divided into three groups according to their most common HCU source, including 64 (14.1%) who cited "No place," 85 (18.8%) who cited the emergency room, and 304 (67.1%) who cited a doctor's office or clinic. Thirty cases were not included in these analyses, including 13 men who reported that their most frequent healthcare source was "Some other place," five who did not answer that question,

Table 2
Predictors of Primary Source of Healthcare Utilization.

	Office or Clinic vs. No Place		
	Odds Ratio	95% C.I.	p
Threat sensitivity (BIS score)	1.13	1.02–1.24	0.019
Insured vs. none	43.31	12.76–146.99	<0.0001
Lapsed insurance vs. none	6.77	2.82–16.30	<0.0001
Age (per 1 year increase)	1.05	1.02–1.09	0.001
	Office or Clinic vs. Emergency Room		
	Odds Ratio	95% C.I.	p
Threat sensitivity (BIS score)	0.91	0.84–0.99	0.023
Insured vs. none	5.70	3.08–10.54	<0.0001
Lapsed insurance vs. none	2.66	1.33–5.33	0.006
Age (per 1 year increase)	1.04	1.02–1.07	0.002

and 12 who had missing values on one or more of the predictor variables.

3.1.1. Doctor's office or medical clinic vs. no usual source

Insurance status and older age were both associated with higher odds of citing a doctor's office or medical clinic as the most frequent HCU source as compared to having no usual place for healthcare. Higher levels of threat sensitivity were also associated with greater utilization of a doctor's office or medical clinic when compared to citing no usual healthcare source (Table 2). Taking into account the effect of threat sensitivity, insurance status, and age, no other covariates were associated with differential utilization of a doctor's office or medical clinic compared to no usual source.

3.1.2. Doctor's office or medical clinic vs. emergency room

Insurance status and older age were again associated with utilizing a doctor's office or medical clinic for healthcare, this time as compared to utilization of an emergency room. In this analysis, lower levels of threat sensitivity were associated with more utilization of a doctor's office or medical clinic as compared to an emergency room (Table 2). Taking into account the effect of insurance status and age, no other covariates were associated with differential utilization of a doctor's office or medical clinic compared to emergency room.

3.2. Predictors of HCU frequency in the past year

A total of 352 (74.7%) men reported that they had made at least one medical visit in the previous year and 119 (25.3%) men reported that they had made no visits. Twelve cases were not included in these complete case analyses because they had missing values on one or more of the predictor variables. Compared to men who had made no healthcare visits in the previous 12 months, those who had made one or more healthcare visits were more likely to be insured, to have a greater number of medical comorbidities, and to be older (Table 3). Taking into account the effect of insurance status, age, and medical comorbidities, no other covariates were associated with HCU frequency.

4. Discussion

Threat sensitivity was significantly associated with two of three measures of HCU, even after controlling for key predictors of HCU. Specifically, we found that men who were more likely to cite a physician's office or medical clinic as their most common source of healthcare were higher in threat sensitivity than men who had no usual place for healthcare and lower in threat sensitivity than men who cited the emergency room as their most common healthcare source. These findings are consistent with the hypothesis that there is an optimal level of threat sensitivity that would manifest in the most adaptive behaviors in the face of threat (Corr, 2008). Too little threat sensitivity could lead to neglect of plausible risks (e.g., not having established a regular healthcare source) while too much could lead to heightened sensitivity to risks (e.g., going most often to an emergency room for healthcare).

Table 3
Predictors of Frequency of Healthcare Utilization (Any Medical Visits in Past Year).

	Odds Ratio	95% C.I.	p
Insured vs. none	6.04	3.38–10.80	<0.0001
Lapsed insurance vs. none	2.78	1.48–5.24	0.002
Comorbidity	1.43	1.10–1.87	0.008
Age	1.02	1.001–1.05	0.041

Our findings are also congruent with other studies of threat sensitivity and health-related behaviors. For example, individuals who scored in the lowest tertile on the Harm Avoidance scale of the Temperament and Character Inventory (Cloninger et al., 1994) took longer to recognize the seriousness of emerging symptoms of rectal cancer compared to those who scored in the middle and highest tertiles. In addition, lower levels of threat sensitivity among these subjects were associated with a lower likelihood of having had any form of cancer screening prior to their cancer diagnosis and with better personal judgments of overall health (Ristvedt et al., 2005). Interestingly, the relationship between low threat sensitivity and longer times to recognizing the seriousness of cancer symptoms was later found to be true for men but not women (Ristvedt and Trinkaus, 2008), and that relationship was later replicated using the BIS measure of threat sensitivity (Carver and White, 1994) in a larger sample of rectal cancer patients (Ristvedt et al., 2014). Taken together with the present study, these findings suggest that people – particularly men – who are low in threat sensitivity tend to be less worried and thus more complacent about health matters in general.

Conversely, individuals with high levels of threat sensitivity are particularly prone to experience anxiety when confronted with potentially aversive situations (Gable et al., 2000; Gray, 1982; Jorm et al., 1998). For example, in a study of 220 women with early stage breast cancer, women with higher scores on the BIS (Carver and White, 1994) along with greater expectancy of recurrence reported the highest levels of emotional distress (Carver et al., 2000). The link between the motivational construct of threat sensitivity and the emotional experience of anxiety may help to explain the present findings, particularly in light of the fact that anxiety is associated with a heightened perception of physical symptoms (Howren and Suls, 2011). That is, the combination of high threat sensitivity and the emergence or worsening of symptoms could conceivably prompt a more urgent pursuit of medical attention and trips to the emergency room.

Unsurprisingly, we found that having insurance, being older, and having comorbidities were significantly associated with utilizing a doctor's office or clinic rather than an emergency room or having no usual healthcare source. Contrary to expectation, we found that psychosocial constructs that had been important for HCU in other studies – perceived discrimination and medical mistrust – were not associated with HCU in this study where we controlled for threat sensitivity, insurance status, and other factors.

The findings presented here suggest that innate motivational factors, specifically threat sensitivity, may have an influence on basic patterns of health behavior. From a theoretical perspective, these findings fit within the literature showing associations between threat sensitivity and other domains of human behavior. From a practical perspective, these findings could inform the design of public health initiatives aimed at optimizing HCU as well as other preventive behaviors. For example, various social marketing campaigns take into account characteristics of the target audience that would guide the development of messages to capture their attention and motivate them to engage in some healthy behavior (Grier and Bryant, 2005). In this approach, the larger audience is typically segmented into subgroups that differ in terms of demographics (e.g., age, ethnicity, income), current behavior (e.g., diet, physical activity), or other domains.

Pertinent to the present findings, audience segmentation is also done on the basis of "psychographics," such as personality traits or

motivational tendencies (Schmid et al., 2008). Such a strategy has been used to motivate screening mammography by tailoring messages according to women's "need for cognition" information-processing styles (Williams-Piehota et al., 2003) as well as their monitor-blunter coping styles (Williams-Piehota et al., 2005). A similar strategy has been used to optimize anti-drug campaigns by matching message design (i.e., sensation value) with target audience personality traits (i.e., sensation seeking) (Harrington et al., 2014). In a series of studies, the practice of dental flossing increased after subjects were exposed to messages that were framed to be congruent with their motivational orientation. Specifically, subjects with higher BIS (relative to BAS) scores (Carver and White, 1994) were more likely to increase flossing in response to loss-framed messages (not flossing "causes bad breath") while subjects with lower BIS (relative to BAS) scores were more likely to increase flossing in response to gain-framed messages (regular flossing "promotes great breath") (Sherman et al., 2008). It is thus conceivable that, in a similar way, public health initiatives could be designed to optimize HCU by tailoring messages according to individual differences in threat sensitivity. People with no usual source of healthcare may be more responsive to messages tailored to appeal to those low in threat sensitivity while people who tend to seek care at an emergency room rather than at a doctor's office or clinic may be more responsive to messages tailored to appeal to those high in threat sensitivity. Such hypotheses could be further developed and tested in future work.

4.1. Strengths and limitations

This study had two primary strengths. First, we combined both system variables (i.e., insurance status) and individual variables in our analyses, which allowed us to investigate the role of motivational characteristics within the context of socioeconomic forces. Second, we recruited a large sample of low-income African American men over a broad age range, which allowed us to assess the roles of insurance status, age, and medical comorbidity in HCU. There is no reason to believe that the association between threat sensitivity and HCU is specific to African American men, however (c.f., Causadias et al., 2018). Future studies could investigate whether this association generalizes beyond our sample as well as beyond this particular demographic group.

There are four notable limitations to the current study. The first was the geographic focus of our recruitment strategy. Most participants were recruited at the HealthStreet facility, so results may have been biased because of similarities in access to medical facilities (i.e., close proximity to a Federally Qualified Health Center as well as two major university health centers and their respective emergency departments).

The second limitation concerns the overall design of the study. A cross-sectional study, such as this one, does not in itself offer the opportunity to infer causal direction between correlated variables. In this case, it may not be clear whether the characteristics assessed by the BIS influenced our participants' healthcare seeking behaviors or vice versa. However, when research design does not allow statements to be made regarding causality, it is still possible to call upon rational argument. In his book, "The Logic of Causal Order," Davis (1985) has convincingly argued that, when two variables demonstrate significant correlation, the causal arrow typically points from the one that is relatively stable and difficult to change (e.g., individual differences in threat sensitivity) to the one that is less stable and more subject to change (e.g., patterns of healthcare utilization). The contention that the BIS scale taps relatively stable individual differences is supported by studies in behavioral genetics. In one of those studies, genetic factors accounted for around one-third of the variance in BIS scores, suggesting that the trait being measured by the BIS was a genetically stable individual characteristic. In support of that interpretation, additional analyses revealed that the BIS demonstrated a high degree of temporal stability ($r = .63$) over a period of two to three years (Takahashi et al., 2007). In another study, participants who carried the BDNF met allele had significantly higher BIS scores than participants without that allele (Johnson et al., 2016). The wording of the BIS items (e.g., *"I worry about making mistakes"*) – would also suggest that we were assessing individual differences in an emotional and motivational predisposition that existed well before and during the time that healthcare decisions were being made. We would thus argue that threat sensitivity likely had some causal influence on whether the men in our study cited an emergency room, a doctor's office or medical clinic, or no place at all as their most common source of healthcare. However, it is important to add that future research may employ study designs that could test this relationship while providing greater confidence in the results.

Third, we did not assess participants' reasons for seeking medical help as they did. For example, the association between higher threat sensitivity and greater reliance on the emergency department may be explained by some unmeasured mediating variable, such as a greater proneness to injury-causing accidents.

Lastly, two of the measures used in this study had rather low levels of reliability: the BIS measure (Cronbach's alpha = .62) and the measure of self-reliance (Cronbach's alpha = .50). Other studies that have included the BIS have reported reliability estimates ranging from .72 to .80 (Carver and White, 1994; Corr and Cooper, 2016; Hall et al., 2008; Johnson et al., 2016; Jorm et al., 1998; Sherman et al., 2006). The reasons for the lower reliability in our sample is unclear, although concerns have been raised about the reliability of measures validated on college students when they are administered to diverse community samples (Shepperd et al., 2016). The low reliability that we observed for the self-reliance measure, on the other hand, may have to do with the fact that it consisted of just two items.

We are unaware of any other research that has attempted to link individual differences in threat sensitivity to the utilization of healthcare resources; thus, efforts to replicate our findings are warranted. Also, future studies may improve on this one in a few different ways. First, a broader recruitment strategy could be employed to include people from diverse communities, racial/ethnic backgrounds, and both sexes. Differences across these variables could then be tested. Second, to address the issue of causality, a longitudinal design might be considered, given sufficient time and resources. Third, more detailed information regarding the attitudes and events leading up to various instances of healthcare utilization could be enlightening. Lastly, alternative or additional measures of the constructs investigated here – most importantly threat sensitivity and self-reliance – should be considered.

Declarations

Author contribution statement

Stephen Ristvedt, Kathryn Trinkaus, Erika Waters, Aimee James: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This work was supported by Grant 1 R21 HL113751 from the National Heart, Lung, and Blood Institute (NHLBI) and by the Washington University Institute of Clinical and Translational Sciences grant UL1TR000448 from the National Center for Advancing Translational Sciences (NCATS) of the National Institutes of Health (NIH). The content is solely the responsibility of the authors and does not necessarily represent the official view of the NIH.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

Agency for Healthcare Research and Quality, 2017. *2016 National Healthcare Quality and Disparities Report* (17-0001). Retrieved from Rockville, MD. www.ahrq.gov/qual/qrdr10.htm.

Amodio, D.M., Master, S.L., Yee, C.M., Taylor, S.E., 2008. Neurocognitive components of the behavioral inhibition and activation systems: implications for theories of self-regulation. Psychophysiology 45 (1), 11–19.

Armstrong, K., Putt, M., Halbert, C.H., Grande, D., Schwartz, J.S., Liao, K., et al., 2013. Prior experiences of racial discrimination and racial differences in health care system distrust. Medical Care 51 (2), 144–150.

Artiga, S., Young, K., Garfield, R., Majerol, M., 2015. Racial and Ethnic Disparities in Access to and Utilization of Care Among Insured Adults. Kaiser Family Foundation, Washington, DC. Retrieved from. http://kff.org/disparities-policy/issue-brief/racial-and-ethnic-disparities-in-access-to-and-utilization-of-care-among-insured-adults/.

Becker, M.H., 1974. The Health Belief Model and Personal Health Behavior, vol. 2. Slack, Thorofare, N.J.

Blackwell, D.L., Villarroel, M.A., 2016. Tables of Summary Health Statistics for U.S. Adults: 2015 National Health Interview Survey. Retrieved from. http://www.cdc.gov/nchs/SHS/tables.htm.

Boulware, L.E., Cooper, L.A., Ratner, L.E., LaVeist, T.A., Powe, N.R., 2003. Race and trust in the health care system. Publ. Health Rep. 118 (4), 358–365.

Braddock, K.H., Dillard, J.P., Voigt, D.C., Stephenson, M.T., Sopory, P., Anderson, J.W., 2010. Impulsivity partially mediates the relationship between BIS/BAS and risky health behaviors. J. Personal. 79 (4), 793–810.

Carver, C.S., Meyer, B., Antoni, M.H., 2000. Responsiveness to threats and incentives, expectancy of recurrence, and distress and disengagement: moderator effects in women with early stage breast cancer. J. Consult. Clin. Psychol. 68 (6), 965–975.

Carver, C.S., White, T.L., 1994. Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS BAS Scales. J. Personal. Soc. Psychol. 67 (2), 319–333.

Causadias, J.M., Vitriol, J.A., Atkin, A.L., 2018. Do we overemphasize the role of culture in the behavior of racial/ethnic minorities? Evidence of a cultural (mis)attribution bias in American psychology. Am. Psychol. 73 (3), 243–255.

Centers for Disease Control and Prevention (CDC), 2004. Behavioral Risk Factor Surveillance System Survey Questionnaire. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, Georgia.

Charlson, M.E., Pompei, P., Ales, K.L., MacKenzie, C.R., 1987. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J. Chronic Dis. 40 (5), 373–383.

Cloninger, C.R., 1987. A systematic method for clinical description and classification of personality variants. A proposal. Arch. Gen. Psychiatr. 44 (6), 573–588.

Cloninger, C.R., Przybeck, T.R., Svrakic, D.M., Wetzel, R.D., 1994. The Temperament and Character Inventory (TCI). Center for Psychobiology of Personality, St. Louis, MO.

Cools, R., Calder, A.J., Lawrence, A.D., Clark, L., Bullmore, E., Robbins, T.W., 2005. Individual differences in threat sensitivity predict serotonergic modulation of amygdala response to fearful faces. Psychopharmacology (Berl) 180 (4), 670–679.

Corr, P.J., 2008. Reinforcement sensitivity theory (RST): introduction. In: Corr, P.J. (Ed.), The Reinforcement Sensitivity Theory of Personality. Cambridge University Press, Cambridge, pp. 1–43.

Corr, P.J., 2016. Reinforcement sensitivity theory of personality questionnaires: structural survey with recommendations. Pers. Indiv. Differ. 89, 60–64.

Corr, P.J., Cooper, A.J., 2016. The reinforcement sensitivity theory of personality questionnaire (RST-PQ): development and validation. Psychol. Assess. 28 (11), 1427–1440.

Corr, P.J., McNaughton, N., 2008. Reinforcement sensitivity theory and personality. In: Corr, P.J. (Ed.), The Reinforcement Sensitivity Theory of Personality. Cambridge University Press, Cambridge, pp. 155–187.

Courtenay, W.H., 2000. Constructions of masculinity and their influence on men's well-being: a theory of gender and health. Soc. Sci. Med. 50 (10), 1385–1401.

Davis, J.A., 1985. The Logic of Causal Order. Sage Publications, Beverly Hills, Calif.

Dumitrescu, A.L., Toma, C., Lascu, V., 2010. Evaluation of inter-relationship between behavioral inhibition, behavioral activation, avoidance, daily stressors and oral health. Rom. J. Intern. Med. 48 (3), 281–290.

Friedberg, M.W., Hussey, P.S., Schneider, E.C., 2010. Primary care: a critical review of the evidence on quality and costs of health care. Health Aff. 29 (5), 766–772.

Gable, S.L., Reis, H.T., Elliot, A.J., 2000. Behavioral activation and inhibition in everyday life. J. Personal. Soc. Psychol. 78 (6), 1135–1149.

Gray, J.A., 1982. The Neuropsychology of Anxiety : an Enquiry into the Functions of the Septo-Hippocampal System. Oxford University Press, Oxford.

Gray, J.A., McNaughton, N., 2000. The Neuropsychology of Anxiety : an Enquiry into the Functions of the Septo-Hippocampal System, second ed. Oxford University Press, Oxford.

Grier, S., Bryant, C.A., 2005. Social marketing in public health. Annu. Rev. Public Health 26 (1), 319–339.

Hall, P.A., Coons, M.J., Vallis, T.M., 2008. Anxious temperament and disease progression at diagnosis: the case of type 2 diabetes. Psychosom. Med. 70 (7), 837–843.

Hamilton, C.J., Mahalik, J.R., 2009. Minority stress, masculinity, and social norms predicting gay men's health risk behaviors. J. Couns. Psychol. 56 (1), 132–141.

Harrington, N.G., Palmgreen, P.C., Donohew, L., 2014. Programmatic research to increase the effectiveness of health communication campaigns. J. Health Commun. 19 (12), 1472–1480.

Hathaway, S.R., McKinley, J.C., 1943. The Minnesota Multiphasic Personality Inventory, Rev. ed. The University of Minnesota press, Minneapolis.

Howren, M.B., Suls, J., 2011. The symptom perception hypothesis revised: depression and anxiety play different roles in concurrent and retrospective physical symptom reporting. J. Personal. Soc. Psychol. 100 (1), 182–195.

Johnson, S.L., Carver, C.S., Joormann, J., Cuccaro, M.L., 2016. Genetic polymorphisms related to behavioral approach and behavioral inhibition scales. Pers. Indiv. Differ. 88, 251–255.

Jorm, A.F., Christensen, H., Henderson, A.S., Jacomb, P.A., Korten, A.E., Rodgers, B., 1998. Using the BIS/BAS scales to measure behavioural inhibition and behavioural activation: Factor structure, validity and norms in a large community sample. Pers. Indiv. Differ. 26 (1), 49–58.

Katz, J.N., Chang, L.C., Sangha, O., Fossel, A.H., Bates, D.W., 1996. Can comorbidity be measured by questionnaire rather than medical record review? Medical Care 34 (1), 73–84.

LaVeist, T.A., Isaac, L.A., Williams, K.P., 2009. Mistrust of health care organizations is associated with underutilization of health services. Health Serv. Res. 44 (6), 2093–2105.

Lazarus, R.S., Folkman, S., 1984. Stress, Appraisal, and Coping. Springer Pub. Co, New York.

Leventhal, H., Nerenz, D.R., Steele, D.J., 1984. Illness representation and coping with health threats. In: Baum, A., Taylor, S.E., Singer, J.E. (Eds.), Handbook of Psychology and Health (Vol. IV: Social Psychological Aspects of Health. Erlbaum, Hillsdale, NJ, pp. 219–252.

MacAndrew, C., Steele, T., 1991. Gray behavioral inhibition system: a psychometric examination. Pers. Indiv. Differ. 12 (2), 157–171.

McWilliams, A., Tapp, H., Barker, J., Dulin, M., 2011. Cost analysis of the use of emergency departments for primary care services in Charlotte, North Carolina. N. C. Med. J. 72 (4), 265–271.

Musa, D., Schulz, R., Harris, R., Silverman, M., Thomas, S.B., 2009. Trust in the health care system and the use of preventive health services by older Black and White adults. Am. J. Public Health 99 (7), 1293–1299.

National Center for Health Statistics, 2010. National Health Interview Survey. Centers for Disease Control and Prevention, Hyattsville, MD.

Nelson, D.E., Kreps, G.L., Hesse, B.W., Croyle, R.T., Willis, G., Arora, N.K., et al., 2004. The health information national Trends survey (HINTS): development, design, and dissemination. J. Health Commun. 9 (5), 443–460.

Ristvedt, S.L., Birnbaum, E.H., Dietz, D.W., Fleshman, J.W., Kodner, I.J., Read, T.E., 2005. Delayed treatment for rectal cancer. Dis. Colon Rectum 48 (9), 1736–1741.

Ristvedt, S.L., Pruitt, S.L., Trinkaus, K.M., 2014. Appraisal of emerging symptoms of colorectal cancer: associations with dispositional, demographic, and tumor characteristics. J. Behav. Med. 37 (4), 698–708.

Ristvedt, S.L., Trinkaus, K.M., 2008. Sex differences in responding to rectal cancer symptoms. Psychol. Health 23 (8), 935–944.

Rogers, R.W., 1975. A Protection Motivation Theory of fear appeals and attitude change. J. Psychol. 91 (1), 93–114.

Schmid, K.L., Rivers, S.E., Latimer, A.E., Salovey, P., 2008. Targeting or tailoring? Mark. Health Serv. 28 (1), 32–37.

Shackman, A.J., McMenamin, B.W., Maxwell, J.S., Greischar, L.L., Davidson, R.J., 2009. Right dorsolateral prefrontal cortical activity and behavioral inhibition. Psychol. Sci. 20 (12), 1500–1506.

Shepperd, J.A., Emanuel, A.S., Dodd, V.J., Logan, H.L., 2016. The reliability of psychological instruments in community samples: a cautionary note. J. Health Psychol. 21 (9), 2033–2041.

Sherman, D.K., Mann, T., Updegraff, J.A., 2006. Approach/avoidance motivation, message framing, and health behavior: understanding the congruency effect. Motiv. Emot. 30 (2), 165–169.

Sherman, D.K., Updegraff, J.A., Mann, T., 2008. Improving oral health behavior: a social psychological approach. JADA (J. Am. Dent. Assoc.) 139 (10), 1382–1387.

Starfield, B., Shi, L., 2004. The medical home, access to care, and insurance: a review of evidence. Pediatrics 113 (5 Suppl), 1493–1498.

Stepanikova, I., Oates, G.R., 2017. Perceived discrimination and privilege in health care: the role of socioeconomic status and race. Am. J. Prev. Med. 52 (1S1), S86–S94.

Takahashi, Y., Yamagata, S., Kijima, N., Shigemasu, K., Ono, Y., Ando, J., 2007. Continuity and change in behavioral inhibition and activation systems: a longitudinal behavioral genetic study. Pers. Indiv. Differ. 43 (6), 1616–1625.

Weinstein, N.D., 1988. The precaution adoption process. Health Psychol. 7 (4), 355–386.

Whisman, M.A., Richardson, E.D., Smolen, A., 2011. Behavioral inhibition and triallelic genotyping of the serotonin transporter promoter (5-HTTLPR) polymorphism. J. Res. Personal. 45 (6), 706–709.

White, I.R., Carlin, J.B., 2010. Bias and efficiency of multiple imputation compared with complete-case analysis for missing covariate values. Stat. Med. 29 (28), 2920–2931.

Williams-Piehota, P., Pizarro, J., Schneider, T.R., Mowad, L., Salovey, P., 2005. Matching health messages to monitor-blunter coping styles to motivate screening mammography. Health Psychol. 24 (1), 58–67.

Williams-Piehota, P., Schneider, T.R., Pizarro, J., Mowad, L., Salovey, P., 2003. Matching health messages to information-processing styles: need for cognition and mammography utilization. Health Commun. 15 (4), 375–392.