Neuroticism and Information Seeking Surrounding the 2014 U.S. Ebola Outbreak: Evidence from Internet Panel Study and Internet Search Trend Data

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In the context of 2014 U.S. Ebola virus outbreak, this paper conducted two studies to investigate whether neuroticism, one dimension of the Big Five personality traits, is associated with health information seeking behavior. Study 1 examined the relationship between neuroticism and use of diverse mediated channels to seek information on the Ebola virus. Study 2 used Google Trends Service to show that the strength of the association between neuroticism and Internet search activity was dependent upon levels of media attention to the Ebola virus. These findings contribute to a better understanding of personality-based predictors of health information seeking behavior in the face of a global public health crisis.

Keywords: The Big Five, Neuroticism, Information Seeking Behavior, Google Trends, Ebola

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Introduction

Information seeking behavior is an integral part of health message processing as it bridges exposure to health information and adoption of recommended behavioral measures (So, Kuang, & Cho, in press). However, not every individual seeks out information as a result of exposure to health-related messages (So, 2013), making understanding of when and what health-related messages motivate people to seek out information an important task for health researchers (Kahlor, 2010; Zhao & Cai, 2009).

Previous studies have shown that an anxious emotional state may guide individual attention to the source of threat, motivating people to seek out more information through mediated channels (So, 2013; Turner, Rimal, Morrison, & Kim, 2006). While the motivating role of anxiety in information seeking behavior has been extensively documented (e.g. Lowrey, 2004; So et al., in press), relatively little attention has been paid to the psychological basis that gives rise to anxiety. Specifically, the current study argues that neuroticism—one dimension of the Big Five personality traits that is characterized as sensitivity towards negative and distressful events (Costa & McCrae, 1980)—may be closely related to the extent to which people feel anxiety, an emotion that likely motivates people to seek out information to reduce emotional discomfort.

This study tests whether—and if so under what conditions—neuroticism motivates information seeking behavior in the context of 2014 U.S. Ebola outbreak. Study 1 used data from an Internet panel survey to examine the relationship between neuroticism and use of diverse mediated channels. Study 2 examined Internet search trend data to investigate how aggregate-level neuroticism in concert with changes in volume of news media coverage of the Ebola virus predict change in Internet search activity. The findings of the current study unveil the psychological basis that motivates information seeking behavior when a mass health threat takes place.
Neuroticism, Anxiety, and Individual Responses to a Health Crisis

Neuroticism and Anxiety

Psychologists have argued that human personalities can be mapped onto five dimensions, each of which characterizes an enduring and consistent behavioral tendency towards external stimuli (McAdams & Pals, 2006; McCrae & Costa, 2003). Specifically, neuroticism captures the individual propensity to experience anxiety and negative emotions when facing external threats (Costa & McCrae, 1992).

While people naturally become anxious when anticipating dreadful events that are potentially harmful to their psychological and physical well-being (Öhman, 2008), individual differences in “propensity” to experience stress may influence intensity of emotional experience in response towards threatening situations (Bolger & Schilling, 1991; Zelenski & Larsen, 2002). Indeed, people with high neuroticism have strong psychological and psychophysiological responses to threatening mood-induction instructions (Rusting & Larsen, 1997; Zelenski & Larsen, 2002), fear-inducing films (Reynaud, Khoury-Malhame, Rossier, Blin, & Khalifa, 2012), and negative emotion-provoking images (Norris, Larsen, & Cacioppo, 2007). People with high neuroticism likely have greater reactivity to threatening stimuli in local brain regions that govern negative emotional responses (Canli, Zhao, Desmond, Kang, Gross, & Gabrieli, 2001).

Taken together, neuroticism is a psychological marker of individual propensity to have stronger negative emotional responses to external threats. For this reason, we expect that neuroticism is positively associated with feelings of anxiety as a response towards the 2014 U.S. Ebola outbreak. Therefore, this study hypothesizes that people with high neuroticism would be more likely to feel anxiety during the outbreak (H1).

Anxiety and Information Seeking Behavior

Anxiety directs individuals’ attention to the source of threats and facilitate acquisition of information related to threatening events (Mathews, 1990; Turner et
al., 2006; Zhao & Cai, 2009). As anxiousness makes people perceive that they have insufficient amount of information (Griffin, Neuwirth, Dunwoody, & Giese, 2004; Kahlor, 2010; So et al., in press), the emotion may motivate people to seek out information (Lowrey, 2004; So, 2013, So et al., in press). Indeed, public perception of threats from a disruptive event such as a terrorist attack leads people to depend on diverse media channels to satisfy their informational needs (Ball-Rokeach & DeFleur, 1976; Dutta-Bergman, 2004; Lowery, 2004). These observations suggest that anxiety may motivate people to use diverse news channels to obtain information about the source of threats in order to reduce emotional discomfort. Therefore, this study expects that people who feel anxiety engage in more sources to gain information during the outbreak (H2).

Considering the expected relationship between neuroticism and anxiety, and that between anxiety and information seeking behavior, anxiety is likely to mediate the relationship between neuroticism and the consumption of diverse information sources. Specifically, people with high neuroticism are more likely to feel anxiety when a public health crisis takes place due to their propensity to feel anxiety. Because anxiety is a positive predictor of willingness to engage in diverse media channels, anxiety may mediate the relationship between neuroticism and use of diverse information sources. Taken together, people with high neuroticism are more likely to engage with diverse mediated channels in an attempt to alleviate anxiety when a stress invoking public health crisis takes place. Therefore, we hypothesize that anxiety would mediate the relationship between neuroticism and engagement with information sources (H3).

**Study 1**

**Participants**

Study 1 combined two surveys from the Understanding America Study (UAS), a panel study (https://uasdata.usc.edu/) maintained by the Center for Economic and Social Research at University of Southern California. The panel consists of more than 6,000 individual members and is designed to be representative of the U.S.
population. To test the proposed hypotheses, individual responses for one of the modules (UAS 12) that captured the awareness of the Ebola virus within the U.S. public was matched with another module (UAS 1) that measured personality traits. UAS 12 was fielded from October, 2014 to January, 2015. A total of 1,367 panel members completed the online questionnaire in return for $5 (response rate 67.3%). All participants completed the personality questionnaire (UAS 1) prior to the UAS 12 module. Participants who have missing values on any of the measures used in the study were excluded from the analyses, leaving a total of 1,298 participants.

Measures

Information source diversity. Participants were asked to identify their sources of information about the Ebola virus. The question wording was “What are your sources of information about the Ebola virus?” The ten mediated information sources available to choose were “Local newspaper (N = 555, 42.8%),” “Other newspaper (N = 197, 15.2%),” “Local television (N = 989, 76.2%),” “Other television (N = 540, 41.6%),” “Local radio (N = 491, 37.8%),” “Other radio (N = 168, 12.9%),” “Twitter (N = 73, 5.6%),” “Other social media (N = 404, 31.1%),” “Internet search engine (N = 433, 33.4%),” and “Other internet (N = 274, 21.1%).” On average participants used about three mediated channels to acquire information about the Ebola virus (M = 3.18, SD = 1.69).

Anxiety. Anxiety was measured by a single binary question that asked participants whether the recent cases of Ebola in the U.S. made them experience anxiety or stress. A total of 121 participants (9.3%) indicated that they felt anxiety or stress due to the Ebola outbreak.

Personality traits. A total of 44 questions were used to capture participants’ personality traits on the Big Five framework (John & Srivastava, 1999). Participants were asked to indicate their agreement on each of these questions on a 5-point scale (1 = “Disagree strongly” ~ 5 = “Agree strongly”). To capture neuroticism, participants were asked to indicate whether they are someone who (a) “is depressed,
blue,” (b) “is relaxed, handles stress well (recorded),” (c) “can be tensed,” (d) “worries a lot,” (e) “is emotionally stable, not easily upset (recoded),” (f) “can be moody,” (g) “remains calm in tense situations (recoded),” and (h) “gets nervous easily.” Individual answers to these eight questions were averaged to construct the neuroticism scale ($M = 2.64, SD = .82, \alpha = .83$).

**Control variables.** A set of variables including sex (Female = 1, $n = 671, 51.7\%$), age ($M = 48.21$ years, $SD = 2.32$), education ($M = 11.39, SD = 2.33, 1 = “Less than 1st grade” ~ 16 = “Doctorate degree”), race (White = 1, $n = 1,076, 82.9\%$), household income ($M = 10.92, SD = 4.18, 1 = “Less than $5,000” ~ 16 = “$150,000 or more”), and a dummy variable that indicates residency in the three states with confirmed Ebola cases (NY, OH, and TX = 1; $N = 188, 14.5\%$) were used as controls. Although the effects of other dimensions of the Big Five personality traits (i.e. openness to experience, conscientiousness, and extraversion, agreeableness) on the use of various Internet sources was not hypothesized, the remaining dimensions were included in the models to control for unobserved variance due to personality traits (Cheng, Zamarro, & Orriens, in press; Openness to experience: $M = 3.64, SD = .51, \alpha = .77$; Conscientiousness: $M = 4.07, SD = .60, \alpha = .76$; Extraversion: $M = 3.35, SD = .79, \alpha = .82$; Agreeableness: $M = 4.02, SD = .58, \alpha = .73$).

**Data Analysis**

A logistic regression model was specified to test H1, as anxiety was a binary dependent variable. An OLS regression model was specified to test H2, as information source diversity was a continuous variable. H3 was tested by conducting a mediation analysis using a Stata program called “binary_mediation (UCLA: Statistical Consulting Group, n.d.).” The program estimates the indirect effect of a predictor if either or both the mediator and/or a dependent variable is a binary variable.

**Result**

H1 predicted a positive association between neuroticism and anxiety.
Neuroticism was a positive predictor of anxiety due to the outbreak \((b = .45, SE = .14, p < .01)\). Other personality traits failed to reach the conventional significance level (see column 2 of Table 1). H2 predicted a positive association between anxiety and information source diversity. As shown in column 3 of Table 1, anxiety had a positive association with information source diversity \((b = .32, SE = .16, p < .05)\), supporting H2.

H3 predicted that anxiety would mediate the influence of neuroticism on information source diversity. A mediation analysis revealed that anxiety mediated the influence of neuroticism on information source diversity \((b = .01, SE = .01, 95\% CI [.001, .03])\). People with high neuroticism were more prone to feel anxiety during the outbreak, and anxiety, in turn, made them more likely to use diverse mediated channels, supporting H3.

<table>
<thead>
<tr>
<th>Table 1. Individual Reaction to U.S. Ebola Outbreak</th>
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<tbody>
<tr>
<td><strong>Anxiety</strong> (^{a)})</td>
</tr>
<tr>
<td>(b) ((SE))</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Female (=1, Yes)</td>
</tr>
<tr>
<td>Education</td>
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<tr>
<td>White (=1, Yes)</td>
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<td>Affected States (=1, Yes)</td>
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<td>Openness to Experience (O)</td>
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<td>Conscientiousness (C)</td>
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<tr>
<td>Extraversion (E)</td>
</tr>
<tr>
<td>Agreeableness (A)</td>
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<tr>
<td>Neuroticism (N)</td>
</tr>
<tr>
<td>Anxiety</td>
</tr>
<tr>
<td>Constant</td>
</tr>
</tbody>
</table>

**Adj. R\(^2\) 4.8% \(^{b)} 2.2%**

\(^{a)}\) Logistic Regression Model, \(^{b)}\) Pseudo R\(^2\). Affected States = Texas, Ohio, and New York.

**Discussion**

Our findings showed that a public health crisis such as the Ebola outbreak would be more likely to provoke individuals with the propensity to feel anxiety (i.e. 
high in neuroticism) to engage with diverse mediated channels for information about the crisis. Of note, it is not surprising to see a positive relationship between extraversion and information source diversity, as people with high extraversion more frequently use news media (e.g. Mondak, 2010).

Although helpful in establishing a relationship between neuroticism, anxiety, and information source diversity (which implies information seeking behavior), this study comes with certain limitations. The binary nature of the questions used to construct the anxiety and information source diversity might be too insensitive to capture the variances in respondents’ reactions to the Ebola outbreak and their subsequent engagement with media. Also, information source diversity is an indirect measure of information seeking behavior at best and thus the findings of Study 1 should be read with caution. The issue regarding the internal validity is one common limitation that follows from using a secondary data set (Holbert & Hmielowski, 2011) and may explain why the model accounted for only a small amount of the variance in information source diversity. Additionally, the data only captured retrospective responses to the outbreak, as the survey was fielded during late October of 2014 when the U.S. media attention to the Ebola virus had already declined. Moreover, the cross-sectional nature of the Study 1 prevents this study from establishing a causal relationship. Therefore, additional research is necessary to confirm the relationship between neuroticism and health information seeking.

**Aggregate-level Neuroticism, News Coverage and Public Responses to a Health Crisis**

Study 2 examined Internet search activity about the virus across U.S. states collected from Google Trends Service (hereafter GTS) to understand conditions in which neuroticism motivates people to seek out information about the virus. Admittedly, the measure of Study 2 differs from that of Study 1, as the former captured the volume of Internet search activity while the latter measured the diversity of communication channels that individuals used for information seeking (Study 1). However, we believe that GTS can serve as a cost-effective alternative that captures *immediate* public responses to the Ebola outbreak that may address some methodological limitations associated with Study 1.
First, GTS measures levels of individual interests in certain issues within specified regions (Lee, Kim, & Scheufele, 2016; Mellon, 2014; Whyte, 2016). Moreover, as an increasing number of people rely on the Internet to obtain health-related information (Tausczik, Faasse, Pennebaker, & Petrie, 2012), GTS can be used as a valid indicator of aggregate-level change in public interests in specific issues (Ripberger, 2011; Watson, 2017). Second, GTS addresses limitations associated with self-report measures (e.g. Prior, 2013; Fowler, 2014) as it unobtrusively captures actual online information seeking behavior instead of measuring to what extent respondents think that they engaged in information seeking behavior (Mellon, 2014). Therefore, GTS allows for tracking information seeking behavior as a health crisis unfolds. For these reasons, GTS could be a readily available research tool that examines conditions in which neuroticism motivates information seeking behavior.

**News Coverage and Internet Search Activity**

Previous studies have shown that media attention to a certain issue would likely translate into public information seeking behavior (Lee et al., 2016; Watson, 2017), especially when news media focus on controversial issues (Alicino et al., 2015; Weeks, Friedenberg, Southwell, & Slater, 2011). Indeed, the volume of news coverage about the president (Ragas & Tran, 2013) and crimes (Watson, 2017) respectively predict the online search volume of related terms. This is perhaps because the volume of news coverage is an indicator of issue significance and saliency that motivates the public to engage in information seeking behavior (Mellon, 2014; Ripberger, 2011). Indeed, previous studies have shown that changes in the volume of news coverage of the Ebola virus had a positive association with internet search activity regarding the virus (Alicino et al., 2015; Towers et al., 2016). These observations lead to the expectation that a positive association between the volume of news coverage about the Ebola virus and aggregate-level Internet search activity (H4).
Aggregate-level Neuroticism and Public Responses to a Mass Threat

Previous studies have shown that there exists geographical variation in Internet search activity across states (Kalichman & Kegler, 2015; Watson, 2017; Whyte, 2016). This study expects that geographical variation in personality traits across U.S. states, among others, could account for the geographical differences in Internet search activity during the 2014 U.S. Ebola outbreak. However, the pressing question becomes whether aggregate-level personality traits would be associated with similar behavioral consequences, because the findings from individual-level studies do not automatically translate into behavior of the mass public (i.e. compositional fallacy) or vice versa (i.e. ecological fallacy; Pettigrew, 1997).

Nevertheless, evidence from previous studies provides strong reasons to expect that individual-level and aggregate-level personality traits would bring about similar behavioral consequences. Indeed, geographical differences in personality traits account for meaningful differences in aggregate-level characteristics (Rentfrow, Gosling, Jokela, Stillwell, Kosinski, & Potter, 2013; see Rentfrow, Gosling, & Potter, 2008 for three hypotheses about the causes of geographical variations in personality traits in the United States). For a geographical region that scored high in one dimension out of the Big Five traits than other regions, a larger proportion of individuals living in the region would be expected to exhibit psychological and behavioral tendencies associated with the particular dimension of the personality trait in question (Rentfrow et al., 2008, 2013). Indeed, behavioral tendencies found in individual-level studies are also found in aggregate-level behavioral indices. For examples, states with high openness to experiences tend to have higher proportion of liberals and voting share for Democratic candidates (Avery, Lester, & Yang, 2015), as individuals with high openness to experience tend to identify themselves as liberals and vote for Democratic candidates (Mondak, 2010). Residents who live in states with high neuroticism tend to have poor health conditions as measured by aggregate-level indices (James & McCann, 2011; Pesta, Bertsch, McDaniel, Mahoney, & Poznanski, 2012), as individuals with high neuroticism tend to have poorer health conditions (Lahey, 2009; Sutin, Ferrucci, Zonderman, & Terracciano, 2011).

These observations suggest that individual and aggregate-level personality traits
would bring about similar behavioral consequences when a mass threat takes place. For this reason, this study expects that states with high neuroticism were more likely to engage in aggregate-level information seeking behavior and thus produced a larger volume of Internet search activity regarding the Ebola virus during the outbreak (H5).

While aggregate-level neuroticism could be associated with how residents in each state as a whole would respond to a health crisis, the strength of such responses may be affected by the severity of the crisis. Specifically, media coverage of the 2014 U.S. Ebola virus outbreak was found to be highly sensational and fear-provoking, thus potentially elevating the perception of risk (Ihekweazu, 2017; Sell et al., 2017).

This suggests that states with high neuroticism and thus with a high proportion of residents with high neuroticism would have become more anxious from the same volume of news coverage about the Ebola virus than states with low neuroticism. As shown in Study 1, such tendency to feel anxiety would have manifested in increased information seeking behavior. Therefore, this study expects that states with high neuroticism would have strongly responded towards media attention to the Ebola virus and were more likely to search the information on the disease. Hence, this study hypothesizes that a positive association between aggregate-level neuroticism and aggregate-level Internet search activity would be stronger as the volume of news coverage about the Ebola virus increases (H6).

Study 2

Data

Internet search activity. GTS was used to capture Internet search activity originating from different states, an indicator of public information seeking behavior on the Ebola Virus. GTS normalizes the index of internet search volume in such a way that individual observations represent the volume of internet search at a given time unit (i.e. day or week) relative to the highest search volume during the pre-specified time period within specified regions (Rogers, 2016).
Two search criteria—the time frame and the search term—were used. First, the time frame of the study was from September 30, 2014 to October 31, 2014, about a month from the day when the Center for Disease Control (CDC) confirmed the first Ebola case in the United States. Of note, extending the time period beyond these two time points did not fundamentally change the findings reported here. Second, the term “Ebola” was used, as previous studies have demonstrated that search term “Ebola” was a good indicator of the degree of public attention to the Ebola issue (e.g. Alicino et al., 2015; Tower et al., 2015).

The first step of the data collection procedure involved identifying the state with the largest search volume to make Internet search activity across states comparable. This is because each and every data entry for an individual state is rescaled relative to the highest data point of the state. Identifying a state with the highest search volume addresses this incompatibility issue as the state with the highest search volume served as an anchor point to which each observation of individual states is referenced. The internet search volume using the term “Ebola” reached its pinnacle on October 16, 2014 in Connecticut when President Obama issued an executive order to authorize use of the National Guard to help contain the Ebola virus.

Once the state with highest search volume was identified (i.e. Connecticut), each of the remaining states were paired with the reference state to query the volume of Internet search activity, creating a total of 51 time series (50 states in the U.S. as well as Washington D.C.) with a total of 1,632 observations. Each data point in these fifty-one time series is the normalized volume of Internet search activity on a given day relative to the highest point. Therefore, differences in aggregate-level Internet search activity at a given day can be treated as differences in the proportion of the public who sought out information using the term “Ebola.” For example, a search volume of 27 means that the volume of Internet search activity using “Ebola” took place in State A on a specific date was about 27% of the day that marked the highest Internet search activity during the time frame (i.e. October 16, 2014 in Connecticut). The average internet search volume in this period was 17.57 ($SD = 10.65$).
**Volume of news coverage.** The volume of media coverage for the same period was used as an approximate measure of media attention to the issue. Using the LexisNexis database, any newspaper article and television news script that included the term “Ebola” in their headlines and were published in U.S. based newspapers (e.g. The New York Times, The USA Today, and The Washington Post) and television stations (e.g. CBS, CNN, MSNBC, and Fox News Channel) were collected (N = 3,016). The sum total of news coverage published on the same day was operationalized as the daily volume of news coverage. The volume was normalized to make it consistent with the measure of Internet search activity, making each data point the relative volume of news coverage to the highest volume (October 17th, 2014). The average volume of news coverage was about 48.34 (SD = 18.91).

**Aggregate-level personality traits.** Following previous studies (e.g. James & McCann, 2011; Pesta et al, 2012), this study adopted the aggregate-level personality traits index constructed by Rentfrow et al. (2013). This aggregate-level personality trait index was constructed by combining five independent surveys conducted in the United States (Aggregated N = 1.6 million) and exhibited strong inter-study consistency (Rentfrow et al., 2013). The personality scores for Alaska and Hawaii were replaced by aggregate-level personalities scores provided in Rentfrow et al. (2008). The aggregate-level personality trait scores for each state were converted to a T-score with a mean of 50 and a standard deviation of 10 (see Rentfrow et al., 2008, 2013 for more details about the measurement construction procedure).

**Controls.** A set of aggregate-level indices from the U.S. Census Bureau estimations of 2014, which were based on the result of the 2010 U.S. census, were included to control for impacts of state-specific characteristics. These are logged state population (M = 15.20, SD = 1.02), female population (M = 50.7%, SD = .6), white population (M = 77.8%, SD = 11.6), median age (M = 38.06, SD = 2.04), proportion of college education (M = 29.8%, SD = 6.20), median income (M = $53,79K, SD = 8.80), and Internet penetration rate (M = 96.1%, SD = .7). A dummy variable that indicates three states (i.e. New York, Ohio, and Texas) that had confirmed Ebola cases and were under CDC watch during this time period was also
included in the models. The number of days from the first confirmed case (September 30\textsuperscript{th}, 2014) and its quadratic term were included to control for the linear and non-linear trend of Internet search activity during the time frame. Finally, as in Study 1, the other dimensions of the Big Five personality traits and their interaction terms with the volume of news coverage were included in the models to control for unobserved variance due to personality traits.

**Data Analysis**

Two Ordinary Least Square models with robust standard errors were specified to adjust within-state autocorrelation (Rabe-Hesketh & Skrondal, 2012). Model 1 tested whether aggregate-level neuroticism predicts aggregate-level Internet search activity. Model 2 tested whether the strength association between aggregate-level neuroticism and aggregate-level Internet search activity is a function of the volume of news coverage about the Ebola virus. Of note, the analyses using the multilevel modeling approach that allows each state to have a different intercept and the fixed-effect modeling approach that removes the differences across states and time did not fundamentally change the findings reported in the study.

**Results**

Two H4 and H5 respectively predicted that the volume of media coverage of Ebola virus and aggregate-level neuroticism would have a positive association with aggregate-level information seeking behavior. As expected, the volume of news coverage ($b = .38, SE = .02, p < .01$) and aggregate-level neuroticism ($b = .22, SE = .07, p < .01$) were statistically significant predictors of aggregate-level Internet search activity. This supports both H4 and H5.

H6 predicted that the association between neuroticism and Internet search activity at the aggregate-level will be stronger when the media pay greater attention to the virus. As expected, there was a significant interaction between the volume of news coverage and aggregate-level neuroticism ($b = .003, SE = .001, p < .01$; see
Column 3 of Table 2). This indicates states with high neuroticism tend to exhibit more Internet search activity when news media pay greater attention to the Ebola virus, supporting H6.

Figure 1 presents the marginal effects of aggregate-level neuroticism on aggregate-level Internet search activity over the volume of news coverage. The association between aggregate-level neuroticism Internet search activity became stronger as the volume of news coverage increased. To put this effect in perspective, two standard deviations difference in neuroticism between two states (= 20) is associated with about a 2% difference in aggregate-level Internet search activity when the volume of news coverage of the virus was relatively low (19%). The same difference in aggregate-level neuroticism is associated with about an 8% difference in aggregate-level Internet search activity when the volume of news coverage of the virus reached the highest point.
Table 2. Predicting Internet Search Activity

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>$b$ (SE)</td>
<td>$b$ (SE)</td>
</tr>
<tr>
<td>Time</td>
<td>-.47 (.08)**</td>
<td>-.47 (.08)**</td>
</tr>
<tr>
<td>Time$^2$</td>
<td>-.003 (.001)</td>
<td>-.003 (.002)</td>
</tr>
<tr>
<td>Volume of News Coverage</td>
<td>.38 (.02)**</td>
<td>.25 (.10)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Aggregate-level Characteristics</strong></td>
<td></td>
<td></td>
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<tr>
<td>Affected States (=1, Yes)</td>
<td>3.24 (1.58)*</td>
<td>3.24 (1.59)**</td>
</tr>
<tr>
<td>Population (logged)</td>
<td>-.03 (.48)</td>
<td>-.03 (.49)</td>
</tr>
<tr>
<td>Female Population (%)</td>
<td>-25.12 (77.96)</td>
<td>-25.13 (79.09)</td>
</tr>
<tr>
<td>Median Age</td>
<td>-.21 (.14)</td>
<td>-.21 (.15)</td>
</tr>
<tr>
<td>White Population (%)</td>
<td>-9.17 (2.43)**</td>
<td>-9.17 (2.43)**</td>
</tr>
<tr>
<td>College Educated (%)</td>
<td>.31 (.13)*</td>
<td>.31 (.13)*</td>
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<tr>
<td>Median Income (K)</td>
<td>-.05 (.10)</td>
<td>-.05 (.10)</td>
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<tr>
<td>Uninsured Population (%)</td>
<td>.41 (.16)**</td>
<td>.41 (.16)**</td>
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<tr>
<td>Internet Penetration (%)</td>
<td>-52.58 (62.94)</td>
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<td>Openness to Experience (O)</td>
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<td>Conscientiousness (C)</td>
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<td>Neuroticism (N)</td>
<td>.22 (.07)**</td>
<td>.20 (.07)**</td>
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<td>News Coverage $\times$ O</td>
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<td>News Coverage $\times$ C</td>
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<td>News Coverage $\times$ N</td>
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<td>Constant</td>
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<tr>
<td>$R^2$</td>
<td>63.2%</td>
<td>63.7%</td>
</tr>
</tbody>
</table>

Note. $N = 1,632$. **, * $p < .01$, * $p < .05$.

Numbers in the parentheses are robust standard errors to adjust for within-states correlations (see Rabe-Hesketh & Skrondal, 2012). Time = “The Number of days from the first U.S. case confirmed by CDC on Sep, 30th 2014.” Affected States = Texas, Ohio, and New York.
Figure 1. Marginal Effects of Neuroticism on the Internet Search Activity over the Volume of News Coverage

Note. The marginal effect plot illustrates the change in the impact of a unit change in variable X (Neuroticism) on variable Y (Internet search activity) as the function of moderating variable M (Volume of news coverage; see Brambor, Clark, & Golder, 2006).

Discussion

Study 2 revealed that differences in the individual psychological propensity to feel anxiety exert a notable influence on how people engage in Internet search activity when a public health crisis takes place. In other words, it is possible that neuroticism is closely related to an appraisal of a public health crisis (through news coverage of the crisis) that gives rise to emotional responses towards the crisis.

Some limitations, however, should be noted. First, the findings of the study is circumstantial evidence at best, as the proposed relationship among neuroticism, anxiety, and Internet search activity at the aggregate-level was not tested. A future
study could benefit from taking into account aggregate-level anxiety when testing the relationship between aggregate-level neuroticism and Internet search activity. Second, it is possible that the moderating effects of news coverage at a given day may have been dependent upon the actual severity of the news coverage of that day. That is, more sensationalized news stories could be more likely to motivate people with high neuroticism to engage in Internet search activity by provoking stronger emotional reactions. An additional analysis was conducted to test this possibility. Using a computer-assisted text analysis program (i.e. LIWC), the number of “negative” words that appeared in each article used to construct the volume of news coverage measure was counted to create an index of negative news coverage, an approximate measure of negativity. The results showed that using the index of negative news coverage instead of the volume of news coverage about the Ebola virus did not change the findings reported in the current study.

**General Discussion**

The findings of this study shed new light on the psychological basis of health information seeking behavior during a public health crisis. The findings of Study 1 established how psychological basis (i.e. neuroticism) motivates people to engage in diverse mediated channel. Study 2 revealed that states with high neuroticism is associated with high volume of Internet search activity especially when the media pay greater attention to the virus.

The significance of these studies is twofold. First, the findings of the current study add to health communication literature by revealing how neuroticism could explain why people respond differently to similarly threatening situations. In other words, individual differences in neuroticism may influence the effectiveness of media messages designed to produce actual information seeking behavior. Thus, it is advised to consider the potential impact of neuroticism when designing health communication messages since people with different levels of neuroticism could react differently to the same message and therefore bring about different behavioral consequences. Moreover, the findings of this study also suggest the importance of message coordination in disseminating a consistent message across diverse mediate
channels. People with high neuroticism may engage with diverse mediated channels in a public health crisis context. Thus, the existence of inconsistency across different channels may cause unnecessary fear in such individuals. Second, Study 2 used an innovative method to examine differences in aggregate-level information seeking behavior. This method allows researchers to address the budgetary and practical constraints of conventional survey research which prevent the tracking of public interests over time across states and/or countries. For this reason, researchers and government officials could take advantage of aggregate-level personality traits and change in volume of Internet search activity to predict and prioritize regions that require immediate intervention when a public health crisis takes place.

As neuroticism is closely related to how people respond to stress inducing situations, it is also possible that neuroticism may influence behavioral consequences beyond information seeking behavior. For example, given that how people feel about risk is closely related to risk perception (Slovic & Peters, 2006), neuroticism may set in motion of a spiral of fear—overestimating the risks associated with a health crisis. The overestimation of the risks may potentially lead to the adoption of unnecessary behavioral measures that may increase social costs (e.g. Friedman, Veazie, Chapman, Manning, & Duberstein, 2013). A future study would benefit from taking into account the impact of neuroticism on health message reception.

In conclusion, taking neuroticism into account could reveal the nuanced differences in individual and public behavioral responses towards a public health crisis. Examining neuroticism and other personality traits may provide a new way to understand why and how health messages do or do not achieve their objectives.

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