*Article*

# Avoiding Trouble: Exploring Environmental Risk Information Avoidance Intentions.

**Lee Ann Kahlor[1] ⓘD, Hilary Clement Olson[1], Arthur B. Markman[1], and Wan Wang[1]**

## Abstract

This study explores predictors of risk information avoidance intentions in the context of a novel environmental threat—induced earthquakes in Texas. Given the paucity of research on risk information avoidance, this work was guided by a cognitive information behavior model. Survey data ($N = 541$) from a random sample of Texas adults allowed us to explore these variables. While previous research has shown risk information seeking intentions to be robustly guided by a number of constructs, our current data suggest that risk information avoidance intentions may be more narrowly predicated on risk information avoidance-related subjective norms, attitudes, and perceived knowledge insufficiency. We discuss these findings and suggest avenues for future environmental risk research.

## Keywords

communications, risk perception, attitudes, norms, energy, person–environment

[1]The University of Texas at Austin, USA

**Corresponding Author:**
Lee Ann Kahlor, Stan Richards School of Advertising and Public Relations, The University of Texas at Austin, 300 W. Dean Keeton (A1200), Austin, 78712-1076, USA.
Email: Kahlor@austin.utexas.edu.

When faced with uncertain, urgent, and potentially severe risks, such as hurricanes or risks to one's livelihood, we often choose to seek more information about the risk (Dalrymple, Young, & Tully, 2016; Liao, Yuan, & McComas, 2018; Rickard et al., 2017). This response to risk has been extensively studied, with researchers examining what types of risks are most likely to instigate information seeking, who seeks information, and why (Griffin, Dunwoody, & Neuwirth, 1999; Ho, Detenber, Rosenthal, & Lee, 2014; Kahlor, 2010). But risk also involves another (albeit less studied) information behavior: risk information avoidance (RIA; Barbour, Rintamaki, Ramsey, & Brashers, 2012; Case, Andrews, Johnson, & Allard, 2005; Narayan, Case, & Edwards, 2011; Sweeny, Melnyk, Malone, & Shepperd, 2010). The lack of research on RIA is notable because avoidance is not simply the opposite of seeking; it is a discrete and distinct information behavior (Barbour et al., 2012; Case et al., 2005; Garrett, 2009; Narayan et al., 2011). This distinction mirrors that of the psychological concepts of approach motivation and avoidance motivation (Higgins, 1997; Miller, 1959).

The limited work on information avoidance is splintered across communication, psychology, organizational behavior, and information sciences, which means research is progressing slowly and without interdisciplinary collaboration (Sweeny et al., 2010). This is unfortunate, as information avoidance behaviors have wide-ranging applications for a number of fields, including environmental psychology, communication, and policy. For instance, a better understanding of RIA could help explore such applied questions as "Why do people avoid environmental risk information that could help them stay healthy and safe?"

This study takes an incremental, empirical step toward a better understanding of RIA in the context of a specific environmental threat, earthquakes associated with oil and gas extraction (hereafter called induced earthquakes). Within the central and eastern United States, including portions of Texas, earthquakes have dramatically increased since 2009, and the increase has been linked to wastewater disposal wells used in oil and gas extraction practices (U.S. Geological Survey, 2017). To explore RIA within this context, we adapted variables from a cognitive model of risk information seeking and investigated the corresponding variables with survey data collected in Texas on the topic of induced earthquakes.

## Literature Review

RIA refers to the active avoidance of risk information and is a common behavior that includes shutting off a radio or television to avoid hearing about a risk-related topic or changing the topic in conversation to avoid being

exposed to risk information (Barbour et al., 2012; Narayan et al., 2011). RIA is distinct from inertia, which refers to a lack of action to support the status quo (Polites & Karahanna, 2012). Consistent with other researchers, we conceptualize RIA as occurring with both known and unknown risk information (Case et al., 2005; Sweeny & Miller, 2012). To date, information avoidance research has produced mixed results, suggesting that RIA occurs in response to negative and positive information and can be self- or other-focused (Sweeny et al., 2010; Yang & Kahlor, 2013). Thus, we do not have a clear understanding of who is most likely to undertake RIA, when, or why, especially in risky contexts.

Risk information seeking research has benefited from a variety of behavioral models, including cognitive-behavioral models (the risk information seeking and processing model [RISP]; Griffin et al., 1999, and the planned risk information seeking model [PRISM]; Kahlor, 2010), uncertainty management (Afifi, 2015), and coping response models (the extended parallel process model [EPPM]; Witte, 1992). Yet no such model has emerged for RIA; indeed, the research appears to be proceeding piecemeal with some research focused on traits such as the need for psychological closure (Kruglanski & Webster, 1996; Sweeny et al., 2010), motives such as the desire to maintain a consistent self-concept (Narayan et al., 2011), or uncertainty management such as how uncertainty is conceived and addressed (Barbour et al., 2012).

To address RIA, we use the concept of "methodological fit"—the notion that research methods should fit the developmental stage of a research field. Work in nascent fields should be exploratory, work in intermediate fields should test and propose relationships between established and new constructs, and work in mature fields should rely on existing constructs to test a priori theories (Edmondson & McManus, 2007). The RIA field appears to be in the intermediate stages of development, and therefore, it is appropriate to establish relationships between "new" (RIA intentions) and "old" constructs (factors that have been conceptualized as contributing to information behaviors, such as norms, attitudes, and emotions). As such, a theoretical framework for risk information seeking (PRISM, detailed in the following; Kahlor, 2010) guides our selection of variables likely to contribute to RIA in this environmental context.

## The Environmental Risk Context: Induced Earthquakes in Texas

Since 2008, the rate of felt earthquakes in Texas has increased. The U.S. Geological Survey (USGS) released its first induced earthquake hazard model in 2016, which indicates that portions of Texas (e.g., Dallas) now

experience earthquake hazard levels similar to cities such as Los Angeles (Petersen et al., 2017; U.S. Geological Survey, 2017). Evidence suggests that wastewater fluid injection (a process in energy production) is primarily responsible for the increase of earthquakes experienced in Texas (Frohlich et al., 2016). Despite the increase in earthquakes, it is unclear whether risk perceptions have increased apace. There has been little research on how the public perceives risks from induced earthquakes (Drummond & Grubert, 2017; McComas, Lu, Keranen, & Furtney, 2016; Trutnevyte & Ejderyan, 2017). However, research suggests that overall awareness is low (Boudet et al., 2014; Israel, Wong-Parodi, Webler, & Stern, 2015).

Research shows that human-caused risks tend to elicit more negative affect than do natural risks (Siegrist & Sutterlin, 2014, 2016) and this is the case with induced earthquakes (McComas et al., 2016). Furthermore, risk perceptions differ according to earthquake exposure based on where one lives (Perlaviciute, Steg, Hoekstra, & Vrieling, 2017). There is also evidence that some induced earthquake risks are seen as likelier than others, including house damage and decreased house values (Perlaviciute et al., 2017). However there is little research on perceptions among Texans related to this newly emergent risk. Texas is likely in the early stage of a risk controversy, which is marked by what Leiss (2001) calls "incomplete hazard characterization" where the science is unsettled, and it is unclear who is at risk (see also, Lofstedt, 2008).

## PRISM

The PRISM (Kahlor, 2010; see Figure 1) addresses the psychosocial determinants of risk information seeking intentions and merges variables from the theory of planned behavior (Ajzen, 1991; Ajzen & Fishbein, 2011) and the RISP (Griffin et al., 1999). Variables borrowed from the theory of planned behavior are attitudes toward the behavior, subjective norms, perceived behavioral control, and behavioral intentions. Variables borrowed from the RISP are perceived insufficiency, risk perceptions, and affective risk responses (Kahlor, 2010). Like the models that informed it, PRISM assumes behavior is cognitively determined (Hornik, 1990) and treats behavior as a reasoned, but not necessarily rational, process (Yzer, 2013).

We selected the PRISM framework to begin exploring RIA because it is theoretically sound and has consistently explained variance in risk seeking intentions across environmental contexts, which suggests its empirical robustness. The range of variance accounted for by the model is .34 to .64, and it has been applied to such environmental contexts as climate change (Ho et al., 2014) and energy extraction practices (Eastin, Kahlor, Liang, & Abi
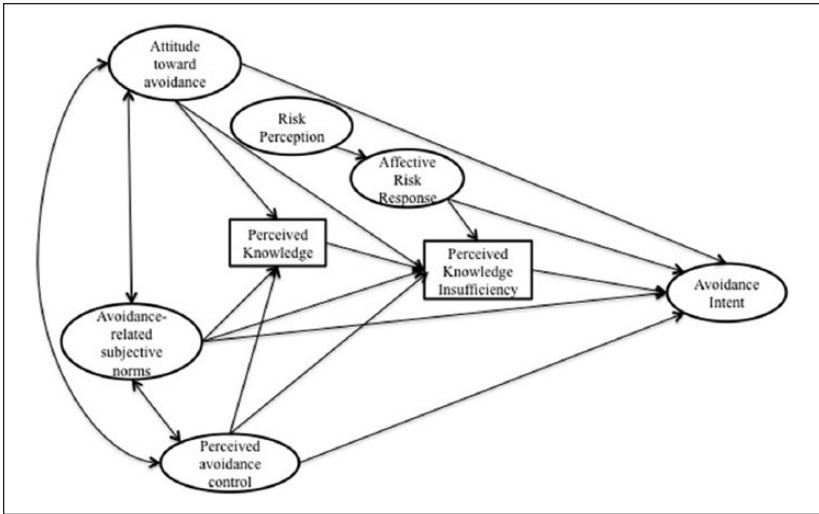
**Figure 1.** The planned risk information seeking model (Kahlor, 2010) adapted for risk information avoidance.

Ghannam, 2015). Our adaptation of the PRISM to RIA is consistent with other work in the theory of planned behavior tradition (Yzer, 2013) as we conceive of RIA as a behavior that is cognitively determined, similar to risk information seeking (Kahlor, 2010). Using the methodological fit approach, we seek to examine the relationship between "old" factors identified in PRISM as contributing to one information behavior, risk information seeking, with the "new" behavior of RIA intentions (Edmondson & McManus, 2007). In the following, we detail each of the PRISM variables under investigation in this study, along with relevant RIA research results.

## Attitudes

In PRISM, attitudes are conceptually consistent with the theory of planned behavior and refer to how the performance of a given behavior is positively or negatively valued (Fishbein & Ajzen, 2011; Hovick, Kahlor, & Liang, 2014; Kahlor, 2010). A recent meta-analysis of the theory of planned behavior showed that intentions to perform health-related behaviors were most influenced by such attitudes (McEachan, Conner, Taylor, & Lawton, 2011). Similarly, in PRISM studies, attitudes toward risk information seeking are consistently predictive of risk information seeking intentions in both health and environmental contexts (Ho et al., 2014; Hovick et al., 2014; Kahlor,

2010; Willoughby & Myrick, 2016). RIA research results suggest that self-reported risk information seeking attitudes are negatively related to RIA (Yang & Kahlor, 2013). That is, when individuals have more positive attitudes toward seeking risk information, they are less likely to avoid it. Other research has shown that implicit attitudes about learning health information predicted RIA (Howell, Ratliff, & Shepperd, 2016). This suggests that both explicit and implicit attitudes might guide RIA intentions and behaviors.

## Subjective (Social) Norms

Response to risk is often mediated by social contacts such as friends, family, and coworkers (Liao et al., 2018; Short, 1984). Indeed, Douglas and Wildavsky (1982) argue that social groups can influence whether we emphasize or de-emphasize some risks, as we attempt to stay consistent with the groups that are important to our identity. This ultimately affects how we behave in response to perceived risk, including whether we seek or avoid information about the risk. In the context of information seeking, these group-oriented beliefs are often studied via the theory of planned behavior concept of subjective norms, which is the perceived social pressure to undertake (or not) a specific behavior (Ajzen, 1991). These perceived norms represent individual assessments of collective norms, which are socially signaled consensus judgments about appropriate behavior (Paluck & Shepherd, 2012; Real & Rimal, 2007; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). In the aforementioned meta-analysis, social norms also had strong relations to behavioral intentions (McEachan et al., 2011). In risk information seeking and avoidance studies, perceived norms related to information seeking appear to have the strongest relationship with seeking intentions (Griffin, Dunwoody, & Yang, 2012).

## Perceived Behavioral Control

Perceived behavioral control refers to perceptions that one has the ability to act (Ajzen, 1991). It has been found to have a strong relationship (second only to attitudes) with health-related behavioral intentions (McEachan et al., 2011). A handful of researchers have investigated perceived behavioral control in relation to information avoidance. In the health field, researchers have examined it as an attribute of the information. For example, information can signal whether an illness is controllable or noncontrollable (e.g., "I can manage this illness if I learn I have it," or "I cannot manage this illness if I learn I have it"). The lower the perceived behavioral control, the higher the RIA (Sweeny et al., 2010). Yang and Kahlor (2013) looked at perceived

behavioral control as it relates to information outcomes regarding RIA and found that perceived seeking control was negatively related to RIA (Yang & Kahlor, 2013).

## Perceived Knowledge Insufficiency

Perceived knowledge insufficiency is based on the sufficiency principle (Eagly & Chaiken, 1993) of the heuristic-systematic model (HSM) of information processing. According to Chaiken and colleagues, one of the key motivators of effortful processing is the perceived need for additional information (Chaiken, Liberman, & Eagly, 1989; Maheswaran & Chaiken, 1991). Perceived need is based on one's desire to have confidence in subsequent judgments about the content of the message being processed. This need is balanced against processing effort such that the individual will exert the least amount of effort required to reach his or her desired level of judgmental confidence (Chaiken et al., 1989). That desired level ranges from very low to very high, contingent on other motivational factors. That is, individuals will continue to actively engage in processing until they have reached the depth or breadth of understanding that they perceive to be sufficient (Eagly & Chaiken, 1993). According to Eagly and Chaiken (1993), the perception of a large gap between one's current level of understanding and the perceived level of desired understanding should be associated with more effortful seeking of information to fulfill processing goals. The RISP concept of information insufficiency is based on this assumption, and suggests that information seeking is motivated by the gap between what one currently knows and the knowledge needed to have a personally sufficient understanding of a given topic (Griffin et al., 1999; Griffin et al., 2012; Kahlor, 2010). In PRISM (see Figure 1), perceived knowledge insufficiency is motivated by perceived (existing) knowledge, affective risk response (detailed in the following) and the norms, attitudes, and perceived behavioral control concepts detailed earlier. The limited research on perceived knowledge insufficiency and RIA has produced mixed results, one study indicating no relationship (Yang & Kahlor, 2013) and another indicating that information insufficiency is negatively related to RIA (Kahlor, Dunwoody, Griffin, & Neuwirth, 2006).

## Affective Risk Response

Perceptions of risk are often linked to how we feel about a threat. When addressing emotion, the risk literature has often focused on valence (or affect; Slovic, Peters, Finucane, & Macgregor, 2005). Affective reactions are best understood as reflecting our motivational orientation to the threat—which may

not be a direct result of our fact-based understanding of the threat (Higgins, 1997). One specific negative affect, dread, often determines how people respond to potential threats (Slovic & Peters, 2006). Heightened risk appraisals (including higher levels of affect such as worry) also have a strong impact on risk-related intentions and behaviors (Västfjäll, Peters, & Slovic, 2014). Within information seeking models such as the RISP and PRISM, affect has been shown to have relationships with insufficiency perceptions and subsequent seeking intentions and behaviors (Griffin et al., 2012; Kahlor, 2010).

In the small amount of work on RIA and affect that we could find, researchers generally posit RIA as an emotion management strategy (Narayan et al., 2011; Sweeny et al., 2010) rather than examining how emotion affects cognitions like intentions. For example, Barbour and colleagues (2012) found that one of the major self-reported motives for RIA was to maintain hope in the face of potential disease. Researchers have examined this relationship empirically and have shown that positive affect is associated with avoidance, whereas negative affect is negatively related to avoidance (Yang & Kahlor, 2013). That is, the more one felt positive affect like happiness about a risk, the more one undertook RIA, whereas the more one felt negative affect like concern about a risk, the less one undertook RIA. This suggests that RIA might be used for mood management, in an effort to maintain positive affect. Other work has examined how affect directly contributes to RIA (Witte, 1992). The EPPM research theorizes that if people experience a high level of threat without a high level of perceived behavioral control, they feel fear and undertake potentially maladaptive coping strategies like RIA (Witte, 1992). A recent meta-analysis shows that fear appeals appear to have a ". . . maximum effective value, beyond which there is no additional impact of depicting fear" (Tannenbaum et al., 2015, p. 1193). This suggests that RIA will not increase if fear increases beyond its maximum effective value.

## Risk Perception

Risk perceptions result from both interpersonal and mediated communication, and often focus on the perceived likelihood and severity of an event (Kasperson et al., 1988). These judgments are often studied alongside other factors such as the perceived risk/benefit balance, perceived risk familiarity, and who or what is at risk (such as the self vs. the environment; Kahlor et al., 2006; Schultz, 2001; Slovic, 2016). Risk judgments and affective components of risk perception often emerge as strongly correlated (see Griffin, Neuwirth, Dunwoody, & Giese, 2004). The most common relationship to emerge is that between risk perception and negative affect (Yang, Aloe, &

Feeley, 2014). The little research on RIA in this area suggests that risk perceptions are also related to affect in the context of RIA (Griffin et al., 2008) and have an indirect effect on RIA through positive and negative affect (Yang & Kahlor, 2013).

## Research Questions

Although the directional relationships mapped in PRISM can be seen in Figure 1, the aforementioned literature review suggests that more empirical research into RIA is needed before we can pose expectations about directional relationships in the avoidance context. Thus, we developed the following research questions in hopes that future work can pose and test specific avoidance-focused hypotheses:

> **Research Question 1:** What variables are associated with RIA intentions?
> **Research Question 2:** If variables are associated with RIA intentions, do some show a stronger relationship than others?

## Method

A multimode survey was run in five Texas communities (Dallas, Houston, Monahans, Uvalde, and Scurry County) by a survey center at a small Texas university in the last six months of 2016. The random sampling process saw a little over 11,000 Texans contacted via phone and U.S. mail, with a response rate of 11%. Although this limits the generalizability of the sample, it does allow for tests of theoretical relationships, which is the thrust of this research effort.

This study focuses on the subsample of the survey that completed the questions specifically focused on RIA ($N = 541$). Despite recruitment difficulties, the final sample was similar on several demographics to the state of Texas. Our sample was 54% female, compared with 50.4% in Texas (U.S. Census Bureau, 2017). The sample had a slightly higher median income, US$60 to US$69,000 compared with US$53,000 for the state, and fewer respondents (5%) had less than a high school education than the state as a whole (18%; U.S. Census Bureau, 2017). Seventy-six percent of the sample were White, which is comparable with 79% of Texans (U.S. Census Bureau, 2017). Finally, the sample had more seniors than in the state of Texas. The sample ranged in age from 21 to 95 ($M = 60$), while statistics from the Census Bureau indicate that only 12% of the population in Texas is over age 65.

## Measures

Our measures are detailed in the following, along with original sources for item wording and reliability statistics for multi-item indices. Item wording can also be found in Online Appendix A. The measures from PRISM that are originally theory of planned behavior measures are attitudes, subjective norms, perceived behavioral control, and RIA intentions. Consistent with other studies that have adapted theory of planned behavior measures for a variety of behaviors (Dixon, Deline, McComas, Chambliss, & Hoffmann, 2014; McEachan et al., 2011), these measures were adapted for the specific behavior of RIA. The measures from PRISM that are originally from the RISP model (risk perceptions, affective risk response, and perceived knowledge insufficiency) have been adapted over the years for a number of different risk contexts (Ho et al., 2014; Hovick et al., 2014; Kahlor, 2010; Willoughby & Myrick, 2016), and we followed this tradition by adapting these measures for earthquake risks. The order that these measures were presented to participants was the following: perceived knowledge, perceived knowledge insufficiency, risk perception, attitudes, subjective (social) norms along with RIA intentions and perceived behavioral control (these items were mixed together in one block), and finally, affective risk response.

*Attitudes, subjective (social) norms, and perceived avoidance control.* Attitudes toward RIA were adapted from past research (Yang & Kahlor, 2013) and consisted of five 5-point semantic differential items measuring whether avoiding information about the potential risks posed by earthquakes is worthless–valuable, bad–good, harmful–beneficial, unhelpful–helpful, unproductive–productive (Cronbach's α = .91). Consistent with the theory of planned behavior (Ajzen & Fishbein, 2011), we operationalized subjective norms through the inclusion of both descriptive and injunctive norms. Descriptive norms are perceptions of popular behaviors; injunctive norms are perceptions of social approval or disapproval (Rimal & Lapinski, 2015). Eight items (six injunctive, two descriptive) on a 5-point Likert scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). The items were used to construct an avoidance norm index variable (Cronbach's α = .92). The items were initially based on items reported in Kahlor (2010) that reference family and friends, but we also included references to "people in my community." A sample injunctive norm item was, "Most people in my community (excluding my family members and close friends) expect me to avoid information about potential risks posed by earthquakes," while a sample descriptive norm item was "Most of my family whose opinions I value avoid information about potential risks posed by earthquakes." Perceived RIA control was based on

efficacy perceptions of one's ability to avoid information about earthquakes (Yang & Kahlor, 2013). There were four 5-point Likert items that ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). A sample item read, "When it comes to avoiding information about the potential risks posed by earthquakes, I know what to do" (Cronbach's $\alpha$ = .88).

*Perceived knowledge insufficiency.* Consistent with past research (Griffin et al., 1999; Griffin et al., 2012; Kahlor, 2010; Kahlor et al., 2006), this concept was measured in two steps to capture the gap between current knowledge and knowledge needed. First, respondents were instructed, "Please rate your knowledge of the potential risks posed by earthquakes, where zero means knowing nothing about the potential risks posed by earthquakes and 100 means knowing everything you could possibly know about the potential risks posed by earthquakes." Then they were prompted, "Think of that same 0-100 scale again. This time estimate how much knowledge you *need* to deal adequately with the potential risks posed by earthquakes." This second item was intended to capture the need to reach a personally sufficient understanding of the topic, in this case the risks associated with earthquakes.

*Affective risk response.* Participants indicated their affective risk response on a 5-point semantic differential scale for concern, worry, and anxiety about earthquake risks; items were similar to previous work (Yang & Kahlor, 2013) and demonstrated good reliability (Cronbach's $\alpha$ = .88). The measure specifically asked, "Using the scale below of 1-5, please indicate how you feel about the potential risks posed by earthquakes." Choices were *not concerned* (1) to *very concerned* (5), *not worried* (1) to *very worried* (5), and *not anxious* (1) to *very anxious* (5).

*Risk perception.* Participants rated perceived risk using a 0-to-10 scale for the following: overall risk (please rate the overall level of risk posed to you by earthquakes), risk seriousness (how serious are the current risks posed to you personally by earthquakes), risk likelihood (how likely is it that you will be affected by the risks associated with earthquakes in the next year), and risk severity (if you were to be affected by the risks associated with earthquakes in the next year, how severe do you think it would be). The resulting index of items were based on Kahlor (2010) and demonstrated good reliability (Cronbach's $\alpha$ = .86).

*RIA intentions.* Consistent with past work on information seeking intentions (Yang & Kahlor, 2013), we measured the intention to avoid risk information about earthquakes in the future. This was based on five items on a 5-point

Likert scale that ranged from 1 (*strongly disagree*) to 5 (*strongly agree*; Cronbach's α = .94). A sample item was, "I will avoid information related to potential risks posed by earthquakes in the near future."

## Results

Structural equation modeling was conducted in Mplus7 to examine paths and model fit of the PRISM-based RIA model in the earthquake context. A maximum likelihood robust estimator was used to account for issues with multivariate normality. We used listwise deletion for missing data as we assessed the data as missing at random. Latent variables were constructed for attitude toward avoidance, avoidance-related subjective norms, perceived avoidance control, risk perception, affective risk response, and avoidance intent. Two-step modeling verified the measurement model before adding the paths to test the structural model. All standardized factor loadings were greater than or equal to .66 (see Table 1). Indicators of model fit included chi-square, comparative fit index (CFI; values close to or greater than .95), root mean square error approximation (RMSEA; values lower than .08), and standardized root mean residual (SRMR; values lower than .08; Brown & Cudeck, 1993; Hu & Bentler, 1999). The fit of the measurement model was good: $\chi^2(362)$ = 763.40 ($p < .001$), RMSEA = .045 (90% confidence interval [CI] [.041, .050]), CFI = .94. SRMR = .040. The model accounted for 70% of the variance in RIA intention.

Next, proposed structural paths were added to explore the PRISM-recommended relationships. Results show the PRISM-informed RIA model fits the data adequately: $\chi^2(564)$ = 1085.12 ($p < .001$), RMSEA = .047 (90% CI [.043, .051]), CFI = .92, SRMR = .063. We then tested the model using bootstrapping with 1,000 resamples (Hayes, 2015). Bootstrapped model fit results were $\chi^2(564)$ = 1352.86 ($p < .001$), RMSEA = .058 (90% CI [.054, .061]), CFI = .92, SRMR = .063. Relationship results (direct and indirect) from bootstrapping analysis are depicted in Table 2. The following variables had significant direct relationships with avoidance intention (see Figure 2): Attitude toward avoidance (β = .09, $p < .01$), avoidance-related subjective norms (β = .79, $p < .001$), affective risk response (β = −.11, $p < .01$), perceived knowledge insufficiency (β = −.07, $p < .05$). Also significant were the relationships between risk perception and affective risk response (β = .63, $p < .001$), affective risk response and perceived knowledge insufficiency (β = .25, $p < .001$), perceived knowledge and perceived knowledge insufficiency (β = .34, $p < .001$), and perceived avoidance control and perceived knowledge (β = .26, $p < .001$). Two relationships were at first significant, but then surfaced as not significant in bootstrapped analysis: avoidance-related subjective norms and perceived

**Table 1.** Items Means, Standard Deviations, Factor Loadings, and Factor Loading Confidence Intervals for All Variables in the Measurement Model.

| Variable | Item | M | SD | Factor loading | Factor loading CI Lower 2.5% | Upper 2.5% |
|---|---|---|---|---|---|---|
| Attitude | Attitude_1 | 2.17 | 1.33 | 0.75 | 1.00 | 1.00 |
| | Attitude_2 | 1.99 | 1.27 | 0.79 | 0.86 | 1.14 |
| | Attitude_3 | 2.17 | 1.39 | 0.88 | 1.07 | 1.36 |
| | Attitude_4 | 2.13 | 1.37 | 0.88 | 1.05 | 1.34 |
| | Attitude_5 | 2.13 | 1.35 | 0.82 | 0.95 | 1.18 |
| Norm | Norm_1 | 2.15 | 0.97 | 0.67 | 1.00 | 1.00 |
| | Norm_2 | 2.04 | 0.94 | 0.77 | 0.99 | 1.36 |
| | Norm_3 | 2.16 | 0.93 | 0.79 | 1.00 | 1.37 |
| | Norm_4 | 2.26 | 0.95 | 0.78 | 0.98 | 1.37 |
| | Norm_5 | 2.13 | 0.90 | 0.86 | 1.08 | 1.42 |
| | Norm_6 | 2.14 | 0.91 | 0.89 | 1.10 | 1.48 |
| | Norm_7 | 2.17 | 0.92 | 0.85 | 1.08 | 1.45 |
| | Norm_8 | 2.42 | 0.95 | 0.66 | 0.87 | 1.26 |
| Perceived avoidance control | Contro_1 | 3.15 | 1.18 | 0.81 | 1.00 | 1.00 |
| | Contro_2 | 3.13 | 1.18 | 0.86 | 1.02 | 1.25 |
| | Contro_3 | 3.03 | 1.21 | 0.79 | 0.91 | 1.13 |
| | Contro_4 | 3.26 | 1.12 | 0.74 | 0.77 | 1.03 |
| Risk perception | Risk_1 | 2.62 | 1.40 | 0.77 | 1.00 | 1.00 |
| | Risk_2 | 2.39 | 1.32 | 0.87 | 0.96 | 1.33 |
| | Risk_3 | 2.14 | 1.23 | 0.83 | 0.87 | 1.21 |
| | Risk_4 | 3.09 | 2.77 | 0.66 | 0.74 | 1.09 |
| Affective risk response | Affect_1 | 2.45 | 2.65 | 0.90 | 1.00 | 1.00 |
| | Affect_2 | 2.14 | 2.51 | 0.95 | 0.93 | 1.10 |
| | Affect_3 | 2.74 | 2.63 | 0.71 | 0.60 | 0.80 |
| Intent | Intent_1 | 2.00 | 0.94 | 0.80 | 1.00 | 1.00 |
| | Intent_2 | 2.01 | 0.94 | 0.87 | 1.01 | 1.23 |
| | Intent_3 | 2.00 | 0.90 | 0.91 | 1.01 | 1.29 |
| | Intent_4 | 1.96 | 0.89 | 0.87 | 0.98 | 1.24 |
| | Intent_5 | 2.02 | 0.93 | 0.85 | 0.96 | 1.22 |
| Knowledge | | 41.43 | 29.76 | | | |
| Sufficiency | | 60.00 | 30.76 | | | |

*Note.* CI = confidence interval.

knowledge, and avoidance-related subjective norms and perceived knowledge insufficiency. Overall the results from the bootstrapped analysis supported two mediated relationships: risk perception and avoidance intent mediated by

**Table 2.** Mediation Analysis Bootstrap Results.

| Direct effects (standardized) | Coefficient | 95% CI | |
| --- | --- | --- | --- |
| | | Lower 2.5% | Upper 2.5% |
| Intent on | | | |
|   Attitude | 0.09** | 0.01 | 0.12 |
|   Norm | 0.79*** | 0.75 | 1.12 |
|   Control | −0.01 | −0.08 | 0.05 |
|   Affect | −0.11** | −0.11 | −0.02 |
|   Insufficiency | −0.07* | −0.01 | 0.00 |
| Affect on | | | |
|   Risk | 0.64*** | 0.34 | 0.47 |
|   Knowledge on | | | |
|   Attitude | −0.02 | −3.72 | 2.95 |
|   Norm | −0.11 | −10.67 | −0.30 |
|   Control | 0.26*** | 4.56 | 12.30 |
| Insufficiency on | | | |
|   Attitude | 0.03 | −1.82 | 3.73 |
|   Norm | −0.12* | −11.66 | −1.05 |
|   Control | −0.03 | −4.71 | 2.38 |
|   Affect | 0.24*** | 3.45 | 7.99 |
|   Knowledge | 0.34*** | 0.24 | 0.44 |
| Attitude with | | | |
|   Control | −0.14** | −0.24 | −0.03 |
|   Norm | 0.18*** | 0.06 | 0.19 |
| Control with | | | |
|   Norm | 0.27*** | 0.09 | 0.24 |
| Indirect relations (unstandardized) | | | |
|   Intent–insufficiency–knowledge | 0.001* | 0.00 | 0.00 |
|   Intent–insufficiency–control | 0.01 | 0.00 | 0.01 |
|   Intent–insufficiency–norm | 0.01 | 0.00 | 0.03 |
|   Intent–insufficiency–attitude | 0.00 | −0.01 | 0.00 |
|   Intent–affect–risk | −0.03** | −0.05 | −0.01 |
| Indirect relations (standardized) | | | |
|   Intent–insufficiency–knowledge | −0.03* | −0.06 | 0.00 |
|   Intent–insufficiency–control | 0.002 | −0.01 | 0.01 |
|   Intent–insufficiency–norm | 0.01 | 0.00 | 0.02 |
|   Intent–insufficiency–attitude | −0.002 | −0.01 | 0.01 |
|   Intent–affect–risk | −0.07** | −0.12 | −0.02 |

*Note.* CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.
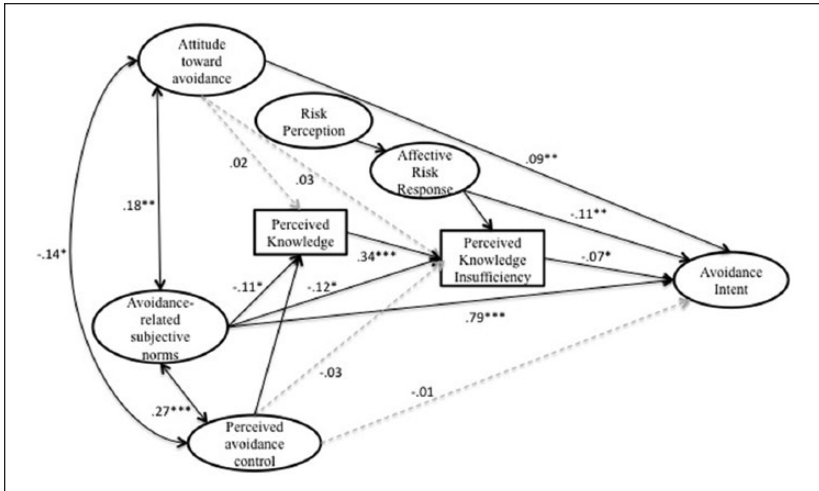
**Figure 2.** SEM results for the PRISM-informed risk information avoidance model.
*Note.* Standardized betas reported; significant relationships appear with solid lines; bootstrapping results suggest that the relationships between avoidance-related subjective norms and perceived knowledge insufficiency and between norms and perceived knowledge are not significant. SEM = Structural Equation Modeling; PRISM = planned risk information seeking model.

affective risk response, and perceived knowledge and RIA intent mediated by perceived knowledge insufficiency. The analysis did not show mediation by perceived knowledge insufficiency in the relationships between RIA intent and attitude toward avoidance, avoidance-related subjective norms, and perceived avoidance control.

## Discussion

Our results suggest that the variables found in PRISM offered a good starting point for exploring RIA in the context of induced earthquake risk. Below, we examine the results more closely and offer relevant risk communication strategies.

### Direct Relationships With RIA Intentions

*RIA intentions and subjective norms.* The relationship between RIA-related subjective norms and RIA intentions was the strongest to emerge in this context. To better understand this relationship, it may be useful to consider RIA intentions in relation to norm influence. Norm influence is the propensity for

people to be more likely to look to social referents about how to appropriately behave in situations of uncertainty such as the case with induced earthquakes (Barbour et al., 2012; Deutsch & Gerard, 1955; Latane & Darley, 1968; Sweeny et al., 2010). Researchers have shown that norm influence occurs through attention to the frequency of descriptive norms and attachments to communities and groups (Liao et al., 2018; Paluck & Shepherd, 2012). Two types of norm influence are normative and informational. In the former, individuals attend to social norms because of a need for social acceptance (impression motive), which drives their attention to social expectations (Chaiken, Giner-Sorolla, & Chen, 1996; Deutsch & Gerard, 1955; Griffin et al., 2012). Informational influence is when individuals attend to social norms to obtain information about social reality, and is driven by a motive to have accurate information (Chen, Shechter, & Chaiken, 1996; Deutsch & Gerard, 1955). Early work on the HSM examined this notion of normative or informational influence with impression or accuracy motivations (Chen et al., 1996). In that work, those with impression goals paid close attention to others to judge the social consensus, while those with accuracy goals largely relied on their own initial attitudes to judge the social consensus (Chen et al., 1996). This appears to show that impression goals are associated with normative influence, and accuracy goals with informative influence (Chen et al., 1996).

This strong association between perceived social norms and RIA intentions might have occurred because of the risk context—induced earthquakes, which appears to be in its early stages (Leiss, 2001). Slovic (2016) notes that more familiar risks are often accepted, whereas novel risks are often considered to be more serious and raise alarm. Emergent environmental risks are often perceived as novel (Feygina, Jost, & Goldsmith, 2010). Situational novelty can prompt information processing and the abandonment of habits (Gersick & Hackman, 1990; Weiss & Ilgen, 1985). Thus, a risk that is situationally novel might disrupt informational influence, because informational influence is predicated on habitual reliance on individual and previously held attitudes to process social consensus information (Chen et al., 1996; Verplanken, 2006). If the risk situation is highly novel, normative influence might prevail, prompting more attention to others' attitudes to make judgments about the social consensus. For example, Midden and Huijts (2009) studied public attitudes toward carbon capture and storage, which was a novel technology to most survey respondents. Their results suggested that in the context of a novel environmental risk, trust in actors was more predictive of attitudes toward the novel technology than other factors including perceived risks. To explore these propositions, future RIA research in environmental contexts should include measures assessing accuracy and impression motives.

To further investigate this strong social norm and RIA intention relationship in the context of earthquakes, cultural theory (Douglas & Wildavsky, 1982) might also prove useful. This theory explains why people pay attention to information and perceive risks differently (Price, Walker, & Boschetti, 2014). It states that four socially constructed patterns of values and beliefs guide information attention and risk perception, resulting in different policy preferences (Price et al., 2014; Xue, Hine, Loi, Thorsteinsson, & Phillips, 2014). These four types of patterns are based on high or low differences in group attachments and social stratification values and beliefs (Xue et al., 2014). These differing types selectively process information to reinforce their existing cultural perspectives (Price et al., 2014). This means that these groups perceive risks when these risks threaten their preferred way of life (Xue et al., 2014). For example, hierarchists, who are theorized to have high social stratification values, dismiss risks if acknowledging such risks threatens social hierarchies. Alternatively, egalitarians, who are theorized to have high low social stratification values, focus on risks that are associated with social inequality (Xue et al., 2014). Given the profile of oil and gas in Texas, such social cues are worthy of additional study.

Social norms are key ways to identify and maintain groups (Hogg & Reid, 2006; Tankard & Paluck, 2016). Perhaps the cultural types with a strong focus on high group attachments (hierarchists and egalitarians) are more likely to be sensitive to norm influence. And if, as suggested earlier, early risk controversies are subject to increased normative influence, then possibly hierarchists and egalitarians are more likely to experience normative influence than individualists or fatalists. This might result in stronger affirmation or dismissal of risks for these two types. For instance, a meta-analysis found that hierarchists are more likely to dismiss hazards caused by human activity, while egalitarians are more likely to perceive risks caused by human activity (Xue et al., 2014). Perhaps in an early stage risk, normative influence is more pronounced for egalitarians and hierarchists. This attenuation might lead to more extreme affirmation or dismissal of natural or human hazards by these types. More research on early stage environmental risks, normative and informational influence, and cultural theory could begin to investigate these intersections.

*RIA intentions and attitudes.* In line with prior research, the attitudes that we investigated in this study referred to whether RIA regarding induced earthquakes was positively or negatively valued. This is the first study that we know of that examined avoidance attitudes in relation to RIA intentions. The results suggest that people who have a more favorable attitude toward RIA are more likely to intend to undertake RIA, at least in the context of induced

earthquakes. Recent research on avoidance attitudes has also examined how implicit attitudes influence RIA, and suggest that the avoidance behavior—what is done as a consequence of the attitude—is deliberate (Howell et al., 2016). This body of work indicates that efforts to shift avoidance attitudes may need to target both implicit and explicit avoidance attitudes to explore how they impact RIA.

*RIA intentions and perceived knowledge insufficiency.* The finding that as perceived knowledge insufficiency increases, RIA intentions decrease has not, to our knowledge, been empirically documented until now. Work that focuses on RIA behavior (different from intentions) is inconsistent, with two studies showing significant negative relationships between perceived knowledge insufficiency and RIA (Dunwoody & Griffin, 2015; Kahlor et al., 2006). However the relationship is not surprising as it suggests that as information need decreases, information avoidance increases—this is reminiscent of the concept of cognitive misers. According to Kool, McGuire, Rosen and Botvinick (2010, p. 665), "anticipated cognitive demand plays a significant role in behavioral decision-making" such that if one perceives no need for additional cognitive processing, processing will be avoided if avoidance is the least demanding option. This finding suggests that more research into the relationship between RIA intentions and perceived information insufficiency will be productive for researchers, particularly in the context of emerging risks such as induced earthquakes.

*RIA Intentions with affective risk response.* Affective risk response was significantly associated with RIA intentions in the context of induced earthquakes, which is consistent with risk information seeking models and the nascent work on RIA. The work on RIA and affect posits RIA as an emotion management strategy (Narayan et al., 2011; Sweeny et al., 2010) and suggests that negative affect reduces the likelihood of RIA (Yang & Kahlor, 2013). This suggests that future environmental risk research should continue to explore affect as a predictor of RIA.

## Indirect Relationships With RIA Intentions

One significant mediated relationship to surface in our analysis was between risk perception and RIA intention, mediated by affective risk response. This finding is consistent with other work in the information seeking tradition (Griffin et al., 2012; Kahlor, 2010) and confirms that in risk-relevant contexts, it is important to account for perceptions of risk and related affect when seeking to understand information avoidance behaviors. In other words, this

supports the need for an RIA model, rather than a generic information avoidance model.

Also consistent with other work in the PRISM tradition, our results show that perceived current knowledge was positively related to perceived knowledge insufficiency, and that the relationship between perceived knowledge and RIA intent was mediated by perceived knowledge insufficiency (Ho et al., 2014; Willoughby & Myrick, 2016; Yang & Kahlor, 2013). However, no other relationships with RIA intent were mediated by perceived knowledge insufficiency.

Although perceived knowledge insufficiency (or knowledge need) is a key mediator in several information-seeking models (Afifi, 2015; Griffin et al., 1999; Kahlor, 2010), it did not surface as integral to our RIA model in the context of earthquake risk. Given past research, this might not be all that surprising. The findings related to risk information seeking suggest mixed results regarding the mediating role of information insufficiency within information seeking models (Eastin et al., 2015; Ho et al., 2014; Hovick et al., 2014; Kahlor, 2010; Yang et al., 2014). However, in the case of avoidance, the lack of a relationship may be consistent with social expectation behavior models, where strong social norms negate the influence of individual knowledge on a topic (Hornik, 1990). More research into the normative context of information insufficiency would be productive for researchers. It is clear that avoidance-related norms are an important factor in RIA avoidance (just as they are in risk information seeking) and more needs to be learned about potential mediators of that relationship. The lack of a mediated relationship between perceived avoidance control and RIA intent is not surprising given that there also was not a significant direct relationship between control and intent. However, the link between perceived behavioral control and information behaviors is often tenuous; some risk information seeking studies have also failed to find such a relationship (Hovick et al., 2014; Willoughby & Myrick, 2016). This may have to do with the risk context. For example, Grasso and Bell (2015) found that when perceived risk is relatively low, as observed in this study (see Table 1), perceived behavioral control does not motivate information seeking. The relationship may hold with RIA.

The lack of a mediated relationship between attitude toward avoidance and RIA intent is also not surprising, given the nonsignificant direct relationship between attitude toward avoidance and perceived knowledge insufficiency and the weak relationship between attitude toward avoidance and RIA intent. However, theoretically speaking, the lack of a relationship is unexpected, given the role that attitudes often play in risk information seeking (Kahlor, 2010). Our operationalization of attitudes, although consistent with the theory of planned behavior, touches on the perceived efficacy of the

information to help an individual meet a goal (i.e., the information is useful, helpful, etc.). Another way to explore this potential relationship with information need is to conceive of these attitudes as something more akin to expected outcomes. Afifi and Weiner (2004) conceptualize expected outcomes as individuals' assessments of the benefits and costs of a particular information behavior. The researchers talk about result-based expectancies, which are predictions related to the content of the information they are likely to receive, and suggest that these expectations can impact seeking and avoidance. This is an approach worth investigating further in the context of RIA intentions.

## Risk Communication Strategies

Our results have implications for risk communication strategies in several ways. A risk communication strategy is a plan about how to best communicate about risk and reduce risk to target audiences (Smillie & Blissett, 2010; Veil, Reynolds, Sellnow, & Seeger, 2008). Such planning often includes consideration of key factors, such as audience segmentation, the effects of communication channels, and stages of risk exposure (Daellenbach, Parkinson, & Krisjanous, 2018; Okazaki, Benavent-Climent, Navarro, & Henseler, 2015; Veil et al., 2008). Here, we focus on two of these factors, communication channels and stages of risk. Turning first to communication channels, a key consideration in such strategies is the channels that publics use to obtain their information about risks and protective action guidance regarding induced earthquakes, which channels they should be directed to in order to obtain such risk information and guidance, and the beliefs that they hold about these channels (Griffin et al., 2012; Lindell & Perry, 2012; Wood et al., 2018). If, as we discussed, early stage risk contexts disrupt informational influence, and strengthens normative influence in risk subjects, then social norms, particularly descriptive norms, might be a key channel for risk information in the early stages of an environmental risk. Descriptive norms refer to perceptions of the frequency of others' behavior in a particular context (Rimal & Lapinski, 2015).

Unfortunately, there is a lack of research into social norms in environmental hazards and earthquake preparedness writ large (Vinnell, Milfont, & McClure, 2018). However, some research indicates that social norms are used in hazard situations to make sense of mitigation and response activities. For example, researchers studying hurricanes found that the social cues of peers evacuating and businesses closing (what could reasonably be called descriptive risk response norms) were positively and significantly associated with evacuations (Huang, Lindell, & Prater, 2016). Similarly, other research has found that taking

action to mitigate risk related to earthquakes is directly related to observing social cues (read: descriptive norms; Mileti & Fitzpatrick, 1992). This suggests that descriptive norms might be a key communication channel to suggest potential mitigation behaviors in reaction to earthquake risk.

A second implication of this research concerns the stages of a risk communication strategy in line with stages of the risk context (Leiss, 2001). Such strategies often seek to change behaviors in relation to the risk (Veil et al., 2008). Behavior change or adoption can be considered a process across stages of time (Bartholemew et al., 2011; Cho & Salmon, 2007; Eastin et al., 2015; Weinstein, Lyon, Sandman, & Cuite, 1998), consistent with conceiving of different stages of risk domains (Leiss, 2001). Behavioral stage models include the precaution adoption process model (PAPM; Weinstein et al., 1998; Weinstein, Sandman, & Blalock, 2008), the protective action decision model (PADM; Lindell & Perry, 2012), and the trans-theoretical model of behavior change (TTM; Prochaska & DiClemente, 1984). Using a stage approach to communication strategies suggests that people in different stages require different processes to help them progress through change (Bartholomew et al., 2011). Eastin et al. (2015) tested PRISM in the context of hydraulic fracturing, taking into account individuals' stages from the PAPM (as a moderator); the results showed overall model differences among people who have not decided to take action on hydraulic fracturing, people who have decided to take action, and people who have decided not to take action. This work has implications for other environmental risks as well.

One way that communication practitioners segment the key audiences for these strategies is by focusing on early adopters (French, 2016; Veil et al., 2008). Early adopters are those who are likely to adopt the change or behavior early on in the stages of change, and are most likely to be opinion leaders (Rogers, 2010). If, as we suggest, early stage risk contexts amplify normative influence, this might strengthen risk perceptions among those cultural types who are more likely to be attuned to norms, due to their emphasis on strong group attachments: the hierarchists and the egalitarians. These stronger risk perceptions might encourage affirmation or dismissal of natural or human hazards by these types. In this way, hierarchists and egalitarians might function as early adopters of affirmation or dismissal of risk perceptions pertaining to human caused risks, and act as possible opinion leaders on the issue.

Opinion leaders exert opinion leadership within social networks, including risk perceptions that are socially amplified (Boster, Kotowski, Andrews, & Serota, 2011; Mileti & Fitzpatrick, 1992; Paluck & Shepherd, 2012). The amplification of certain beliefs, especially beliefs about hazards, preparedness, and personal beliefs, in turn, influences risk management choices (Becker, Paton, Johnston, & Ronan, 2013). Hierarchists are more likely to

dismiss hazards caused by human activity, while egalitarians are more likely to consider risk caused by human activity, such as induced earthquakes (Xue et al., 2014). For example, hierarchists could promote a disaster culture of information avoidance of hazards caused by human activity. Disaster culture pertains to adjustments performed in response to disaster and associated cultural defenses to cope with danger, such as norms, values, and beliefs (Mileti & Darlington, 1997). Environmental communication risk strategies might, therefore, consider which cultural types might be most likely to become attenuated to human caused environmental risks, how these cultural types might influence the information landscape for early stage risks, and how to enhance or counter opinion leadership among social networks affected by the risk.

## *Limitations*

There are several limitations of the present study that deserve discussion. First, this study was exploratory, which means that additional research is needed to ensure that the relationships observed in this data set hold across other samples and environmental risk contexts. Second, the data used in this study came from a random sample of Texans, but with an 11% response rate, which limits its generalizability and suggests the potential for nonresponse bias (Panel on a Research Agenda for the Future of Social Science Data Collection, 2013). However, the bias does not appear to be related to survey questions but the topic itself, as our survey contractor had an 88% refusal rate from people that he called to gauge interest before the initial mailing of the actual survey. Thus, our survey sample may over-represent Texans who are more interested in the topic of induced earthquakes than Texans who are not interested in the topic.

A further limitation of this study is that it focused on RIA intentions rather than behaviors. Researchers have criticized the theory of planned behavior, and similar cognitive-behavioral models, for assuming that intentions are strongly related to behaviors (Dixon et al., 2014; Webb & Sheeran, 2006). These critiques suggest that the study of RIA behaviors in addition to RIA intentions would be fruitful, especially considering the paucity of research on RIA behaviors (see Barbour et al., 2012 and Narayan et al., 2011).

Another limitation may be our reliance on self-report items, particularly when it comes to direct self-reported perceptions of one's own knowledge. Self-report measurements tend to suffer from a number of biases. This includes social desirability bias, that is, respondents might be sensitive to portraying themselves as being naïve or uninformed (Cook & Selltiz, 1964; Greenwald et al., 2002). There are also limits to how well individuals can consciously know or access their preferences or attitudes (Howell et al.,

2016; Smith & Tetlock, 2015; Wilson & Dunn, 2004; Yang, Aloe, & Feeley, 2014); thus, attitudes or estimates of ones' own knowledge may be inaccessible or skewed. However, before studies can be done that put people in a situation like the one in which they would actually be seeking information, it is important to know their general orientation toward information related to a novel topic, such as is the case with earthquakes. To deal with this limitation, future research can rely on additional methods of measurement to triangulate with direct self-report data such as implicit attitudinal measures (Krosnick, Judd, & Wittenbrink, 2005; Smith & Tetlock, 2015).

Also, risk perception exhibited lack of variance in the data, as observations were clustered at the low end of the scale: the mean was 2.7 on a 10-point scale. Thus, most participants considered there to be low risk from earthquakes in Texas. This finding is consistent with other research on induced earthquake risk perceptions in the United States (McComas et al., 2016) and suggests that the population we sampled in Texas might be in the early stage of a risk domain (Leiss, 2001). To further study the variables presented in this article, contexts that provide more risk perception variance should be investigated. Finally, the overall lack of response might also be a kind of RIA phenomenon itself. As Grasso and Bell (2015) note about information seeking behavior, even when perceived efficacy to seek information is strong, individuals may prefer to avoid information that changes their perception that they are safe. Perhaps the survey was viewed as having the potential to shift existing risk perceptions related to earthquakes. Regardless, the results allow us to expand our exploration from risk information seeking to RIA, which is theoretically meaningful, and suggests that further research is needed.

## Conclusion

The purpose of this study was to explore potential predictors of RIA intentions in the context of a specific environmental threat—induced earthquakes in Texas. This threat is suggestive of an early stage environmental risk domain (Leiss, 2001). This work was guided by adapted variables from the PRISM, a socio-cognitive model for an information behavior, risk information seeking. Several direct and indirect relationships from PRISM surfaced as significant in the context of RIA; the strongest of these relationships is between avoidance-related subjective norms and RIA intent regarding induced earthquakes. The strongest indirect relationship was between risk perception and RIA intent, moderated by affective risk response. If future research continues to find that these relationships hold, then this provides guidance on how to theoretically consider the RIA phenomenon. For example, it may be that RIA

is more strongly driven by social expectations than by individual attitudes (Hornik, 1990) or that early stage environmental risks are more likely to be associated with normative influence. Continuing to explore RIA will help bring these mechanisms and relationships into relief. Beginning to develop our understanding of RIA as a discrete phenomenon in its own right will enrich the environmental information management field and will assist us in understanding how individuals deal with environmental information.

## ORCID iD

Lee Ann Kahlor [iD] https://orcid.org/0000-0003-3372-9589

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## Author Biographies

**Lee Ann Kahlor**, Ph.D., is an associate professor in the Stan Richards School of Advertising & Public Relations, University of Texas at Austin. Dr. Kahlor's research is focused on risk information behaviors related to environmental topics including climate change, induced seismicity, hydraulic fracturing and indoor environments.

**Hilary Clement Olson**, Ph.D., is the Director of Education, Training and Outreach at the Center for Petroleum and Geosystems Engineering in the Hildebrand Department of Petroleum and Geosystems Engineering, University of Texas at Austin. Her research examines the Earth's stratigraphic record.

**Arthur B. Markman**, Ph.D., Director of UT's Human Dimensions of Organizations program, Professor of psychology, University of Texas at Austin. Dr. Markman is an international expert in decision making, consumer behavior, and knowledge representation.

**Wan Wang** is a doctoral student in the Stan Richards School of Advertising & Public Relations at University of Texas at Austin. Her current research interests are risk communication, environmental communication, and emotion effects in strategic communication.