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Using the Integrative Model to predict protective behaviors around air quality: An in-depth look at the influence of the information environment on behavior.

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Ramondt, Steven

Publication Date

2018

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UNIVERSITY OF CALIFORNIA, MERCED

Using the Integrative Model to predict protective behaviors around air quality: An in-depth look at the influence of the information environment on behavior.

A dissertation submitted in partial satisfaction of the requirements
for the degree of Doctor of Philosophy

in

Psychological Sciences

by

Steven Ramondt

Committee in charge:
    Professor A. Susana Ramirez, Chair
    Professor Anna V. Song
    Professor Jan Wallander

2018

The Dissertation of Steven Ramondt is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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Co-Chair (*if applicable*)

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Chair

University of California, Merced
2018

Dedicated to my son, Boris Hugo Ramondt

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Education

2012 – present	*University of California, Merced*
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- Completed coursework: Advanced Psychological Statistics I and II, Structural Equation Modeling, Research Design and Methodology, Methods for Public Health Analysis, Measurement Theory and Psychometrics, Health Psychology, Issues in Health Psychology, Foundations of Public Health, Current topics in Health Psychology, Relationships and Health, Professional Seminar I and II

2005 - 2011	*University of Amsterdam*

- Bachelor of Science: Communication Science
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2007 - 2008	*Leiden University*

- Public Administration

Statistical software

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2017	Psychological Sciences Graduate Student Research Award, UC Merced ($5012)
2017	Health Psychology Research Dissemination Award, UC Merced ($285)
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2016	American Public Health Association Student Achievement Award finalist: Environment, Occupational Safety and Health track, for: "Public Awareness of Air Pollution and Health Threats in the San Joaquin Valley: Community Perspectives of Air Quality Communication"
2016	Psychological Sciences Graduate Student Research Award, UC Merced ($4,454)
2016	First Place, UC Merced School of Social Sciences, Humanities, and Arts Research Week Poster Competition, for: "Stakeholder perspectives on air quality communication in the San Joaquin Valley: Opportunities for communication strategies to improve health" ($100)
2016	Health Psychology Research Dissemination Award, UC Merced ($250)
2015	Psychological Sciences Graduate Student Research Award, UC Merced ($4,470)
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2012	Research Fellowship, San Joaquin Valley Air Pollution Control District, "Reducing Health Impacts of Air Pollution through the development of a Personalized RAAN for Asthma sufferers in the San Joaquin Valley" ($25,000)

Research experience prior to graduate school

2011 - 2012   Research assistant
Leiden University Medical Center, department of Medical Psychology
Supervisor: Dr. A.A. Kaptein, Professor of Medical Psychology
Responsibilities: Conduct statistical analyses, interpret the results, and writing of the manuscript.

2010 - 2012   Research assistant
Leiden University Medical Center, department of Endocrinology and Metabolism
Supervisors: Dr. A.M. Pereira A.M. & Dr. J. Tiemensma
Responsibilities: Confederate for the Trier Social Stress Test, statistical analyses, interpreting the results, and writing of the manuscript.

Teaching experience

2017   TA for the graduate class Methods for Public Health Analysis: Cleaning and analyzing data from national datasets with STATA, SPSS & R

2012 - 2017   TA for various undergrad classes in Psychology and Public Health
              Classes included: Analysis of Psychological Data, Health
              Communication, Environmental Health, Health Promotion,
              Introduction to Psychology, and Psychology of Stereotype and Prejudice

Guest Lectures

Fall 2017   Graduate level course: Methods for Public Health Analysis
              Tutorial lecture: Introduction to SPSS and R
Fall 2016   Undergraduate level course: Health Promotion
              Lecture topic: Survey Design
Fall 2016   Undergraduate level course: Health Promotion
              Lecture topic: Statistical Inference
Fall 2014   Undergraduate level course: Analysis of Psychological Data
              Lecture topic: Frequency and Graphing Distributions
Spring 2014   Undergraduate level course: Analysis of Psychological Data
              Lecture topic: Descriptive Statistics
Fall 2013   Undergraduate level course: Analysis of Psychological Data
              Lecture topic: Descriptive Statistics
Spring 2013   Undergraduate level course: Health Psychology
              Lecture topic: Research Methods
Fall 2012   Undergraduate level course: Health Psychology
              Lecture topic: Research Methods

Workshops & Certificates

2016   Undergraduate Learning Outcomes Assessment: Pedagogy and
              Program Planning (Semester long program, competitively selected)
2016   Student Engagement in Large-Enrollment Courses

Academic service

2013 – present Ad hoc reviewer *Psychology, Health & Medicine*
2015   Member, Search Committee (Public Health, junior faculty)
2015   Member, Search Committee (Public Health, open rank faculty)

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2014 - 2015 International Society of Behavioral Medicine
2013 - 2015 Society of Behavioral Medicine
2013 - 2014 European Health Psychology Society
2013 - 2014 Endocrine Society
2013 - 2014 Association for Psychological Science

Peer-reviewed publications (reverse chronological order)

1. **Ramondt, S**. & Ramirez, A.S. (2017). Fatalism and Exposure to Health Information from the Media: Examining the Evidence for Causal Influence. *Annals of the International Communication Association*, 41(3-4), 298-320. https://doi.org/10.1080/23808985.2017.1387502

2. Brown, P.M., Cameron, L.D., Cisneros, R., Cox, R., Gaab, E., Gonzalez. M., **Ramondt, S**., & Song, A. (2016). Latino and non-Latino perceptions of the air quality in California's San Joaquin Valley. *International Journal of Environmental Research and Public Health*, 13(12), 1242. https://doi.org/10.3390/ijerph13121242

3. **Ramondt, S**., Tiemensma, J., Cameron, L.D., Broadbent, E., & Kaptein, A. A. (2016). Drawings of Blood Cells Reveal People's Perception of Their Blood Disorder: A Pilot Study. *PLOS ONE*, 11(4), e0154348. http://doi.org/10.1371/journal.pone.0154348

4. Andela, C. D., Scharloo, M., **Ramondt, S.,** Tiemensma, J., Husson, O., Llahana, S., Pereira, A.M., Kaptein, A.A., Kamminga, N.G.A. & Biermasz, N. R. (2016). The development and validation of the Leiden Bother and Needs Questionnaire for patients with pituitary disease: the LBNQ. *Pituitary*, 19(3), 293–302. http://doi.org/10.1007/s11102-016-0707-4

5. Brown, P.M., Cameron, L.D., & **Ramondt, S.** (2015). Sustainability of Behavioral Interventions: Beyond Cost-Effectiveness Analysis. *International Journal of Behavioral Medicine*, 22(3), 425–433. http://doi.org/10.1007/s12529-014-9437-z

6. Tiemensma, J., Daskalakis, N.P., van der Veen, E., **Ramondt, S.**, Richardson, S.R., Broadbent, E., Romijn, J.A., Pereira, A.M., Biermasz, N.R. & Kaptein, A.A. (2012). Drawings Reflect a New Dimension of the Psychological Impact of Long-Term Remission of Cushing's Syndrome. *Journal of Clinical Endocrinology & Metabolism*, 97(9): 3123-3131.

Manuscripts under review

1. **Ramondt, S**. & Ramirez, A.S. (*revise and resubmit decision at Patient Education and Counseling, rebuttal in progress*). Assessing the Impact of Exposure to the Public Nutrition Information Environment: Adapting the Cancer Information Overload Scale to Measure Diet Information Overload.

2. Ramirez, A.S., **Ramondt, S**., Van Bogart, K. & Perez Zuniga, R. (*under review Journal of Health Communication*) Public Awareness of Air Pollution and Health Threats in the Central Valley: Challenges and Opportunities for Communication Strategies to Improve Health.

Manuscripts in preparation

1. **Ramondt, S**. & Ramirez, A.S. Using the Integrative Model to predict protective behaviors around air quality: The role of the information environment as a distal variable. *Manuscr Prep*.

2. **Ramondt, S**. & Ramirez, A.S. Constructing Air Pollution in the Media: Examining threat and efficacy information in local and national newspapers. *Manuscr Prep*.

Published abstracts

1. Andela C.D., Scharloo M., **Ramondt S**., Tiemensma J., Kaptein A.A., Pereira A.M., Kamminga N. & Biermasz N.R. (2015). The development and validation of a new burden and needs assessment questionnaire for patients with pituitary diseases: the BNQ-pituitary. *Endocrine Reviews,* 37 (2), SAT-541.

2. Andela C.D., Scharloo M., **Ramondt S**., Tiemensma J., Kaptein A.A., Pereira A.M., Kamminga N. & Biermasz N.R. (2015). The development and validation of a new burden and needs assessment questionnaire for patients with pituitary diseases: the BNQ-pituitary. *Endocrine Abstracts*, 37, EP749.

3. **Ramondt S**. & Tiemensma J. (2014). Evaluation of the IPQ-R's core seven factor structure in pituitary adenomas. *Endocrine Reviews*, 35, SAT-0628.

4. **Ramondt S**., Tiemensma J., Cameron L., Broadbent E. & Kaptein A.A. (2014). Patients' drawings of blood cells reveal patients' perception of sickle cell disease. *Annals of Behavioral Medicine*, 47 (Suppl 1): S124.

5. **Ramondt S**., Cameron L.D., Milhoff S. & Brown P. (2014). Moving beyond effectiveness: extent to which behavioral interventions report other types of evidence of sustainability. *International Journal of Behavioral Medicine*, 21 (Suppl 1): S96

6. **Ramondt S.**, Tiemensma J., Cameron L., Broadbent E. & Kaptein A.A. (2014). Patients' drawings of blood cells reveal patients' perception of sickle cell disease. *International Journal of Behavioral Medicine*, 21 (Suppl 1): S213.

7. **Ramondt S.**, Tiemensma J., Cameron L., Broadbent E. & Kaptein A.A. (2013). Patients' drawings of blood cells reveal patients' perception of sickle cell disease. *Psychology & Health*, 28, (Suppl 1):139-140.

8. Tiemensma J., Daskalakis N.P., van der Veen E., **Ramondt S.**, Richardson S.R., Broadbent E., Romijn J.A., Pereira A.M., Biermasz N.R. & Kaptein A.A. (2012). Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome, *Endocrine Reviews*, 33: MON-479.

9. Tiemensma J., Daskalakis N.P., van der Veen E., **Ramondt S.**, Richardson S.R., Broadbent E., Romijn J.A., Pereira A.M., Biermasz N.R. & Kaptein A.A. (2012). Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome, *International Journal of Behavioral Medicine*, 19 (Suppl 1): S181.

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Peer-Reviewed Conference Presentations (reverse chronological order)
1. **Ramondt, S**. (presenter & author) & Ramirez, A.S. CDC National Cancer Conference. "Using the Integrative Model to predict protective behaviors around air quality: The role of information exposure on health behavior", Atlanta, GA, Oral presentation (August 2017)

2. **Ramondt, S**. (presenter & author), Alazzeh, N., Diaz, J., Huynh, K., Pena Marquez, N., Villa, Y. & Ramirez, A.S. National Conference on Health Communication, Marketing and Media. "Constructing air pollution in the media: A content analysis of two national newspapers", Atlanta, GA, Oral presentation (August 2017)

3. **Ramondt, S**. (presenter & author) & Ramirez, A.S. American Society of Preventive Oncology, "Beyond Fatalism: Adapting the Cancer Information Overload Scale to Assess Exposure to Contradictory Nutrition Information", Seattle, WA, Poster Presentation (March, 2017)

4. **Ramondt, S.** (presenter & author), Ramirez, A.S. & Perez Zuniga, R. American Public Health Association, "Public Awareness of Air Pollution and Health Threats in the San Joaquin Valley: Community Perspectives of Air Quality Communication" Denver, CO, USA, Poster Presentation (October, 2016)
   ➔ Top Abstract Award finalist, Environmental Health Division

5. Ramirez, A.S., **Ramondt, S.** (presenter & author), Van Bogart, K. & Perez Zuniga, R. Annual Meeting of the Society of Behavioral Medicine, "Stakeholder perspectives on air quality communication in the San Joaquin Valley: Opportunities for communication strategies to improve health" Washington, DC, USA, Poster Presentation (April, 2016).

6. Ramirez, A.S., **Ramondt, S.** (presenter & author), Van Bogart, K. & Perez Zuniga, R. UC Merced research week, "Stakeholder perspectives on air quality communication in the San Joaquin Valley: Opportunities for communication strategies to improve health" Merced, CA, USA, Poster Presentation (March, 2016)
   ➔ Graduate Social Science, Humanities and Arts. Poster Award, First place.

7. Ramirez, A.S., **Ramondt, S.** (author) & Perez Zuniga, R. UC Merced research week, "Public Awareness of Air Pollution and Health Threats in the San Joaquin Valley: Community Perspectives of Air Quality Communication" Merced, CA, USA, Poster Presentation (March, 2016)

8. Andela, C. D., Scharloo, M. , **Ramondt, S.** (author) , Tiemensma, J. , Husson, O. , Llahana, S. , Pereira, A. M. , Kaptein, A. A. , Kamminga, N. G. & Biermasz, N. R. Annual Meeting of the Endocrine Society, "The development and validation of the Leiden Burdens and Needs Questionnaire for patients with Pituitary diseases: the LBNQ-Pituitary," Washington, DC, USA, Poster Presentation. (April 2016).

9. Andela, C. D., Scharloo, M., **Ramondt, S.** (author), Tiemensma, J., Husson, O., Llahana, S., Pereira, A. M., Kaptein, A. A., Kamminga, N. G. & Biermasz, N. R. European Congress of Endocrinology, "The development and validation of the Leiden Burdens and Needs Questionnaire for patients with Pituitary diseases: the LBNQ-Pituitary," Dublin, Ireland. Poster Presentation. (May 2015).

10. **Ramondt, S**. (presenter & author) & Tiemensma, J. International Convention of Psychological Science, "Evaluation of the IPQ-R's core seven factor structure in pituitary adenomas", Amsterdam, The Netherlands. Poster Presentation. (March 2015).

11. **Ramondt, S.** (presenter & author), Tiemensma, J., Cameron, L. D., Broadbent, E., & Kaptein, A. A. International congress of Behavioural Medicine. Patients' drawings of blood cells reveal patients' perception of sickle cell disease. Groningen, Netherlands. Oral presentation. (August 2014)

12. **Ramondt, S**. (presenter & author), Brown, P., Millhoff S., Cameron, L.D. International congress of Behavioural Medicine, "Moving beyond effectiveness: Extent to which behavioral interventions report other types of

evidence of sustainability", Groningen, Netherlands. Poster presentation. (August 2014)

13. **Ramondt, S**. (presenter & author), Tiemensma, J. Annual Meeting of the Endocrine Society, "Evaluation of the IPQ-R's core seven factor structure in pituitary adenomas," Chicago, IL, USA. Poster Presentation. (June 2014).

14. **Ramondt, S**. (presenter & author), Tiemensma, J., Cameron, L., Broadbent, E., Kaptein, A. A. Annual Convention of Association for Psychological Science, "Patients' drawings of blood cells reveal patients' perception of sickle cell disease," San Francisco, CA, USA. Poster Presentation. (May 2014).

15. **Ramondt, S.** (presenter & author) & Tiemensma, J. Annual Convention of Association for Psychological Science, "Evaluation of the IPQ-R's core seven factor structure in pituitary adenomas," San Francisco, CA, USA. Poster Presentation. (May 2014).

16. **Ramondt, S**. (presenter & author), Tiemensma, J., Cameron, L., Broadbent, E. & Kaptein, A. A. Annual Conference of the European Health Psychology Society, "Patients' drawings of blood cells reveal patients' perception of sickle cell disease," Bordeaux, France. Oral Presentation. (July 2013).

17. Tiemensma, J., Daskalakis, N. P., van der Veen, E. M., **Ramondt, S**. (author), Richardson, S. K., Broadbent, E., Romijn, J. A., Pereira, A. M., Biermasz, N. R. &Kaptein, A. A. The European NeuroEndocrine Association, "Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome," Vienna, Austria. Oral presentation. (September 2012).

18. Tiemensma, J., Daskalakis, N. P., van der Veen, E. M., **Ramondt, S.** (author), Richardson, S. K., Broadbent, E., Romijn, J. A., Pereira, A. M., Biermasz, N. R. & Kaptein, A. A. International Congress of Behavioral Medicine, "Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome," Budapest, Hungary. Poster Presentation. (August 2012).

19. Tiemensma, J., Daskalakis, N. P., van der Veen, E. M., **Ramondt, S**. (author), Richardson, S. K., Broadbent, E., Romijn, J. A., Pereira, A. M., Biermasz, N. R. & Kaptein, A. A. Annual Meeting of the Endocrine Society, "Drawings reflect a new dimension of the psychological impact of long-term remission of Cushing's syndrome," Houston, TX, USA. Poster Presentation. (June 2012).

GENERAL ABSTRACT

Using the Integrative Model to predict protective behaviors around air quality: An in-depth look at the influence of the information environment on behavior.
Steven Ramondt
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University of California, Merced, 2018
Committee Chair: A. Susana Ramirez

Air pollution is the single largest environmental risk and one of the largest global risk factors. The adverse effects of air pollution on health call for efforts to reduce the pollution in the air. However, since that is a long-term goal that requires the successful engagement of multiple stakeholders, efforts are also necessary to reduce the adverse health effects of air pollution on an individual level. Even though risk reducing behavior is possible (and recommended), the majority of people don't take such action. Through a series of studies, factors related to risk reducing behavioral intention and the relation with the information environment were explored. Study I examined how air pollution is covered in the media, utilizing a content analysis of two national (the *New York Times* and the *Washington Post)* and two local newspapers (the *Fresno Bee* and the *Bakersfield Californian*). Newspapers report on the potential health impacts of air pollution, but lack efficacy information, suggesting that the reporting is not conducive to risk reducing behavior. Study II modelled the integrative model of behavior prediction (IM) using data from an online survey of emerging adults (n = 938) living in the SJV. Attitude, social norms, and self-efficacy consistently predicted behavioral intentions in the three primary risk reducing behaviors: staying indoors, limiting physical activity, and using air filters. The information environment was found to be an inconsistent predictor of components in the IM. Exposure to the air quality index – the primary air quality communication tool – was low and was found to have limited effect on determinants of risk reducing behavioral intentions. Attention to media was related with attitude and social norms, but not with self-efficacy. The emphasis of health communication efforts focused on increasing behavioral intention should be on increasing awareness and self-efficacy of the primary risk reducing behaviors.

CHAPTER ONE

General Introduction

Air pollution is the single largest environmental risk and one of the largest global risk factors (Forouzanfar et al., 2015; Landrigan et al., 2017). Studies have consistently shown associations between air pollution and exacerbations of illness and increases in mortality rates (Brunekreef & Holgate, 2002; Kampa & Castanas, 2008; Pope et al., 2002; Seaton, Godden, MacNee, & Donaldson, 1995). Numerous studies have linked air pollution with increases in hospital admissions (Capitman & Tyner, 2011; Iskandar et al., 2012; Meng et al., 2010; Schwartz, 1995; Zanobetti, Schwartz, & Dockery, 2000). In addition to having carcinogenic properties (Loomis et al., 2013), adverse health effects of pollution include: asthma attacks, acute and chronic bronchitis, myocardial infarction, and pneumonia (Capitman & Tyner, 2011; J. V. Hall, Brajer, & Lurmann, 2008b).

California's San Joaquin Valley (SJV), which is a rural and economically disadvantaged region that lacks resources and access to address environmental and public health threats (Abood, 2014; Taylor & Martin, 2000), contains some of the most polluted air in the country. According to an American Lung Association report (State of the air, 2015), this economically disadvantaged region includes four of the five most polluted cities in the United States in terms of year-round particle pollution and short term particle pollution. Exceeding the federal ozone standards have been estimated to cause 460 premature deaths each year, and the cost of unhealthy levels of ozone and particulate matter has been appraised above 3 billion (J. V. Hall et al., 2008b).

The adverse effects of air pollution on health call for efforts to reduce the pollution in the air. However, since that is a long-term goal that requires the successful engagement of multiple stakeholders, efforts are also necessary to reduce the adverse health effects of air pollution. Effective precautionary measures individuals can take include: staying indoors, limiting physical activity, and using air filters to clean indoor air during severe air pollution days (Laumbach, Meng, & Kipen, 2015). However, even though risk reducing behavior is possible (and recommended), the majority of people don't take such action (McDermott, Srivastava, & Croskell, 2006; Semenza et al., 2008; Wen, Balluz, & Mokdad, 2008).

In this dissertation, I examined factors related to risk reducing behavioral intention utilizing a theoretical model. In case of environmental risk such as air quality, we often rely on external sources of information to increase awareness of risk of air quality and the actions we can take to reduce risk, helping us formulate risk perceptions and guide individual risk reducing behavior (Mello, 2015; Slovic, 1987). I therefore also examined the role of the public information environment about air quality. In particular, I performed an in-depth investigation of the media, as people primarily report using the mass media (in addition to sensory and health cues) as air quality information sources (Brown et al., 2016a; Johnson, 2012a).

In a series of studies, factors related to risk reducing behavioral intention and the relation with the information environment were explored. Study I (Chapter 2) examined how air pollution is covered in the media, utilizing a content analysis of two national and two local newspapers. The center point in this study is the prevalence of threat and efficacy information; two key components of the extended parallel process model (Witte, 1992). Study II (chapter 3) modeled the Integrated Model of Behavioral Prediction ((IM), Fishbein & Ajzen, 2010; Fishbein & Cappella, 2006) using data from an online survey of emerging adults living in the SJV. In accordance with the IM, information environment variables were included as distal variables to predict the key determinants of behavioral intention (Fishbein & Yzer, 2003).

CHAPTER TWO

Constructing air pollution in the media:
A content analysis comparison of national and local rural newspapers

Air pollution is the single largest environmental risk and one of the largest global risk factors (Forouzanfar et al., 2015; Landrigan et al., 2017). Air quality advisories are the primary official forms of communication about air pollution; however, the information environment is much broader than targeted campaigns (Moldovan-Johnson, Tan, & Hornik, 2014a). The broad public information environment is an important determinant of knowledge, attitudes, and other cognitive and emotional determinants of behavior (Niederdeppe, Froch, & Hornik, 2008; Viswanath, 2005) and should be investigated beyond air quality advisories. Previous research has shown that the mass media are reported as a cue to recognize poor air quality episodes, together with sensory cues (Brown et al., 2016a; Johnson, 2012a). Furthermore, media have significant influence on perceptions about air quality that can lead to behavior change. Media have the ability to affect change at the population level, both through changes in knowledge and attitudes on an individual level (Brodie, Hamel, Altman, Blendon, & Benson, 2003a; Stryker, 2008) as well as on a policy level (Yanovitzky & Bennett, 1999). Additionally, media is often the primary source of health news (Clarke & Everest, 2006a; Pew Research Center, 2009), and has the potential to distort perceptions (Jensen, Moriarty, Hurley, & Stryker, 2010). It is therefore important to extend our understanding of the air pollution information environment beyond the primary official forms of communication about air pollution such as air quality advisories. Examining what information individuals encounter about air pollution in the news media can shape health promotion efforts. By informing which essential risk reducing information is missing and which adverse messages individuals are exposed to, health promotion efforts can be tailored to take the revealed information into account, creating more effective campaigns.

Context
California's San Joaquin Valley (SJV) is a rural and economically disadvantaged region that lacks resources and access to address environmental and public health threats (Abood, 2014; Taylor & Martin, 2000). The SJV is also one of the worst air polluted areas in the US (Billings et al., 2017; Place Matters, 2012; Taylor & Martin, 2000). Air pollution in the SJV contributes to increased rates of emergency room visits and hospitalizations (Capitman & Tyner, 2011; Meng et al., 2010b). The related costs of unhealthy levels of the criteria pollutants (i.e., ozone and particulate matter) afflicting the SJV has been estimated in excess of 3 billion dollars (J. V. Hall, Brajer, & Lurmann, 2008a).

Not surprisingly, air pollution is perceived as a primary health concern among SJV residents (Brown et al., 2016b; Cisneros et al., 2017a), and there is a need to reduce the adverse effects of air pollution in the region. Current regulation in the SJV fail to keep air pollution levels from exceeding the federal standard for

air pollution (Billings et al., 2017) and as such, residents of the SJV cannot rely on policy to protect themselves. This increases the saliency of individual risk reducing behavior in the form of exposure reduction. However, to manage their exposure to air pollution, individuals need to be aware of when the air quality is poor (Cairncross, John, & Zunckel, 2007a; Laumbach, Meng, & Kipen, 2015a). A challenge to this process is that environmental risks, including air pollution, cannot easily be accurately detected with sensory cues such as smell, taste, and vision (Beck, 1992).

The role of media as an air pollution information source

Since we cannot rely on our innate senses to detect poor air quality, the mass media play an important part in negating adverse effects of environmental health threats. The information found in the media can increase awareness of air pollution levels and risk, and help individuals with processes that lead to risk reducing behavior (Mello, 2015; Slovic, 1987). The influence of the mass media on risk reducing behavior can work through direct and indirect pathways (Wakefield, Loken, & Hornik, 2010). The media can modify or amplify risk (Renn, Burns, Kasperson, Kasperson, & Slovic, 1992; Wachinger, Renn, Begg, & Kuhlicke, 2013), remind people of normative behavior, moderate barriers, and improve skills, thereby influencing intentions and likelihood of risk reducing behavior (M. Fishbein & Ajzen, 2010; Wakefield et al., 2010). Mass media messages can also indirectly influence health behavior. Through agenda setting processes, media can increase the frequency and depth of interpersonal discussions about a health issue (Jones, Denham, & Springston, 2006; Rogers, 1996). In addition, the large reach of mass media messages can change norms within networks, and therefore influence a person without them being directly exposed to the message (Wakefield et al., 2010). Lastly, media messages can spark public discussions that can result in change on a policy level, thereby indirectly influencing (health) behavior (Wakefield et al., 2010; Yanovitzky & Bennett, 1999).

Recent research has found that media, together with sensory and health cues, are the primary sources of air pollution information for residents of polluted regions (Brown et al., 2016a; Johnson, 2012a). News media are used by the general public and medical personel as a primary source of information about health (Niederdeppe et al., 2007; Phillips, Kanter, Bednarczyk, & Tastad, 1991). News media may be a particularly important source of information for residents of the SJV, since the lack of resources in the area and the geographically-dispersed nature of rural areas such as the SJV make it hard to reach the population through other channels (Abood, 2014). In addition, Latino, low-income, and less-educated populations —which are overrepresented in the SJV— have less access to health information (Ramírez, Estrada, & Ruiz, 2017; Kasisomayajula Viswanath & Ackerson, 2011). For ethnic minorities that suffer from this lack of access, news media are the primary and trusted sources of health information (Livingston, Minushkin, & Cohn, 2008; Mollyann Brodie, 1999). Given the crucial role of the news media as an information

source that can shape risk perceptions and guide protective behavior, I explored the following research questions:

RQ1: How is air pollution covered in the news media?
RQ2: How does news coverage of air pollution differ in national news compared to local news in highly polluted areas?

I aimed to answer these questions by performing a content analysis of newspapers, as they are considered to be a reasonable proxy of the overall news media (Niederdeppe et al., 2008).

Local vs national news

Local news is important to people, especially in areas with high concentrations of low-SES residents (Bentley, 2001; Pew Research Center, 2015). Agenda-setting research has shown that news coverage plays a role in shaping public opinion and the local policy agenda, and that this role is more prominent for local level news (Nagler, Bigman, Ramanadhan, Ramamurthi, & Viswanath, 2016). For example, local media use has been associated with knowledge of public affairs (Kasisomayajula Viswanath, Kosicki, Fredin, & Park, 2000), higher political interest, knowledge and participation (Mcleod et al., 1996), and community integration and participation (Mcleod et al., 1996; Paek, Yoon, & Shah, 2005). Although health and environmental health stories have been shown to be lacking in local news media (Caburnay et al., 2003; Ramírez et al., 2017), local print news covers news that is locally or graphically situated. Since air pollution levels in the SJV are higher compared to many other places in the US (Billings et al., 2016), local news media content about air pollution could play a central role in providing information to the residents in the SJV .

Theoretical model

The extended parallel process model ((EPPM), Witte, 1992) is an integrative model originally developed to explain the persuasiveness of fear appeals, and is now commonly used to explain how individuals process health messages. While developed to explain individual behavior, it has also been applied to explain collective behavior (Smith, Ferrara, & Witte, 2007). The EPPM has been extensively used in communication campaigns, both to guide message design (Cho & Witte, 2005), as well as to evaluate effectiveness (Cohen, Shumate, & Gold, 2007). However, it has also been applied to content not designed to be persuasive, including the analysis of news coverage of the H1N1 virus (Goodall, Sabo, Cline, & Egbert, 2012) and cancer (Shim, Kim, Kye, & Park, 2016). The EPPM proposes two internal mechanisms of health message processing: danger control and fear control. Danger control processes lead to an adaptive change in which the message is accepted, and induce self-protective actions such as attitude, intention, and behavior changes (Witte & Allen, 2000). However, fear control processes lead to maladaptive responses (e.g. message rejection) as a result of individuals trying to control their fear. The onset of these processes depends on two steps of appraisals (Witte, 1992).

The first appraisal judges the severity and susceptibility of the threat. If the perceived severity ("an individual's belief about the seriousness of the threat" (Witte, 1992; p.332) and susceptibility (" an individual's belief about his or her chances of experiencing the threat" (Witte, 1992; p.332) of the threat are both high, then fear is evoked and action is deemed to be necessary. The second appraisal determines whether the initial appraisal is adaptive or maladaptive – that is, whether the behavioral recommendation in the message is accepted or rejected. During this second appraisal, judgments about self-efficacy ("belief of being able to perform the recommended behavior" (Basil & Witte, 2012; p.43) and response efficacy ("a feeling that the behavior will actually be effective in avoiding the risk" (Basil & Witte, 2012; p.43) are made. When the perceived threat is judged to warrant action and the efficacy judgment suggests that the response can avert the threat, then people are motivated to engage in danger control processes. In contrast, if there is a threat that warrants action, but perceived efficacy is low, then people will engage in fear control processes (Witte, 1992).

The current research aimed to analyze how much threat and efficacy air pollution coverage contains. Prior research has shown fear control responses such as denial and avoidance of information is greater when threat is high and efficacy information is low in messages (Witte & Allen, 2000). It is important to analyze threat and efficacy in air pollution coverage as these are factors that can affect self-protective actions. The threat of air pollution to an individual's health is well documented (Forouzanfar et al., 2015; Landrigan et al., 2017). Despite the health risks of exposure to air pollution, individuals can engage in behaviors that reduce the risk of adverse effects of air pollution exposure. Effective precautionary measures individuals can take include: staying indoors, limiting physical activity, and using air filters to clean indoor air during severe air pollution days (Laumbach, Meng, & Kipen, 2015).

Content analyses of news coverage of health risks such as smoking (He, Shen, Yin, Xu, & Lan, 2014), influenza (Dudo, Dahlstrom, & Brossard, 2007; Goodall et al., 2012) and cancer (Jensen et al., 2010; Shim et al., 2016) and other environmental risks such as climate change (Feldman, Hart, & Milosevic, 2015; Hart & Feldman, 2014) have shown that information about threat is more prevalent compared to efficacy information. Consistent with prior content analyses of environmental risks (Feldman, Hart, & Milosevic, 2015; Hart & Feldman, 2014), I hypothesized that:

> H1 Newspapers are more likely to report information about threat to health compared to efficacy information to reduce individual health risk.

Due to the impact air pollution has on the SJV and the concerns it raises with its residents (Cisneros et al., 2017a; Hall et al., 2008a), I expected local newspapers to focus more on reporting about air pollution and reducing the adverse effects of air pollution. Therefore, I proposed the following hypotheses:

> H2 Local newspapers are more likely compared to national newspapers to report on the threat of air pollution on health.

H3a Local newspapers are more likely compared to national newspapers to provide efficacy information about precautionary measures individuals can take to reduce risk from air pollution.

H3a Local newspapers are more likely compared to national newspapers to report on the three primary precautionary measures: staying indoors, limiting physical activity, and using air filters.

In addition to providing individuals with information to guide risk reducing behavior, news coverage influences the salience of health issues by drawing attention to them (Nagler et al., 2016). In addition, the framing of these health issues can shape public perceptions and support for public policies (Chong & Druckman, 2007; Entman, 1993; Nagler et al., 2016). Media coverage of environmental issues has been critiqued for lacking substance, adequate coverage, and lack of potential solutions (Boykoff & Boykoff, 2007; Nissani, 1999; Zamith, Pinto, & Villar, 2013). For example, the way news media focus on oppositional viewpoints on climate change has contributed to the heavy debate around global warming despite scientific consensus (Boykoff & Boykoff, 2007; Brossard, Shanahan, & McComas, 2004; Zamith et al., 2013). The predisposition of journalist towards certain sources may have played an important role in this (Zamith et al., 2013), as the choice of sources for a story influence how the story is framed (Liebler & Bendix, 1996). The coverage of environmental issues in the media are more likely to include official and environmental sources (Reis, 1999). Furthermore, the media coverage of environmental issues are more likely to include business and industry groups (Brossard et al., 2004), and have a pro-corporate bias (Nissani, 1999). To understand the potential influence of journalists' information sources on the framing of air pollution, I sought to explore a third research question:

RQ3: Which information sources are cited in the news coverage of air pollution.

RQ4: Do national news stories rely on different types of sources than local news stories from highly polluted areas?

METHODS
Data
Two national newspapers, the *New York Times* and the *Washington Post,* were selected to represent the national-level discourse of air pollution in the media. Two newspapers from the SJV, the *Fresno Bee* and the *Bakersfield Californian*, represented local news about air pollution. The *New York Times* and the *Washington Post* have high circulation and influential status and are considered to be agenda setters for other media in the US (McCombs, 2004). Both the *Fresno Bee* and the *Bakersfield Californian* are among the highest circulating papers in the SJV and are the hometown papers of the two most polluted cities in the US[1] (Billings et al., 2016).

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[1] Short term particle pollution (24-hour $PM_{2.5}$). Both Fresno and Bakersfield are in the top 4 of all most at risk pollution rankings in the US in the American Lung Association report: State of the Air 2016

The data for this study were news stories about air pollution published in the four newspapers during the five-year period 2011-2015. The sampling unit and unit of analysis was the news story (Neuendorf, 2002). News stories were obtained from the Lexis-Nexis database for the two national newspapers and the Newsbank World News database for the two local newspapers. Following procedures described by Stryker, Wray, Hornik, and Yanovitzky (2006), a search term was constructed using coverage of air pollution outside of the news collection period, specifically newspaper articles from 2010. Multiple words related to air pollution (e.g. "smoke", "respiratory", "bad air", "dirty air") were tested to improve the recall of articles. Since claims made at the top of an article are more likely to be read and remembered (Trumbo, 1996), Brossard and colleagues' (2004) frame importance scale was used to improve precision of the articles selected (i.e. to make sure that the focus of the articles was on air pollution). News stories about air pollution were operationalized as needing to include air pollution content in the title and/or first three paragraphs[2]. The following search term was used to collect the sample: ATLEAST1(air quality or air pollution) AND HLEAD(air pollution or air quality or clean air or dirty air or polluted air or smok! or fume! or cloud or gas! or exhaust! or vapor or inhale! or breathe! or respir! or emission! or smog or ozone).

To keep our sample size manageable while obtaining an accurate estimate of the population, a constructed week sampling approach was used. Constructed week sampling is a stratified random sampling technique that is preferred to simple random sampling as it accounts for variation of news content over a seven-day news week (Luke, Caburnay, & Cohen, 2011). For example, constructing one week of a population (in our case, a year), involves randomly selecting a Monday for each Monday of that year, and continuing this process for each day of the week. This approach has been shown to be an unbiased and cost-efficient approach to sample news stories from newspapers (Lacy, Riffe, Stoddard, Martin, & Chang, 2001). A simulation study has found little benefit of sampling beyond six constructed weeks for one year population values (Luke et al., 2011). The current study sampled 6 constructed weeks for each of the five years in which news stories (both national as well as local) were collected for a total of 30 constructed weeks, yielding a total of 276 articles[3].

Coding Instrument
The codebook can be found in Appendix I (national newspapers) and II (local newspapers).

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[2] The process of needing air pollution in the title or first three paragraphs was automated in the Lexis-Nexis database search with the following command: "HLEAD(air pollution or air quality or clean air or dirty air or polluted air or smok! or fume! or cloud or gas! or exhaust! or vapor or inhale! or breathe! or respir! or emission! or smog or ozone". For the local newspapers articles this operationalization was performed manually.

[3] This was the sample that was coded completely and consisted of the articles after manual selecting only articles that were about air pollution in the title or first three paragraphs. 351 articles were sampled before the manual operationalization.

EPPM

To examine how individuals might process media messages I used the two central aspects of the EPPM: threat and efficacy (Witte, 1992). To indicate the inclusion of threat (0 = no; 1 = yes) in the news articles, stories were coded 1 if an article included any information about air pollution being a threat to health. Self-efficacy (0 = no; 1 = yes) was coded to be 1 if the article included *any* information about the protective measures an individual can take to reduce risk from air pollution.

The coding of efficacy information included an additional stage. If an article was coded 1 (i.e. included efficacy information), the nature of the efficacy information was investigated to see if the efficacy information included any of the effective precautionary measures individuals can take: staying indoors, limiting physical activity, or using air filters to clean indoor air during severe air pollution days (Laumbach, Meng, & Kipen, 2015). Codes indicated if an article suggested staying indoors (0 = no; 1 = yes), limiting physical activity (0 = no; 1 = yes), and using air filters (0 = no; 1 = yes).

Source typology

To examine which sources were utilized in the articles about air pollution, 5 types of sources were coded. The source typology was based on work by Brossard et al. (2004) and included: academics and scientists (0 = absent; 1 = present), non-expert/citizen (0 = absent; 1 = present), business/industry groups (0 = absent; 1 = present), governmental sources (0 = absent; 1 = present), and health and environmental advocacy groups (0 = absent; 1 = present). All articles were analyzed to see if any of these sources were utilized. It was possible to select multiple sources per article.

Content Coding Procedures

Two coders were utilized to analyze the content of the air pollution news stories that were identified. Training of the coders was conducted over a period of 4 months in which a weekly series of training articles outside of the study period of 2011-2015 were coded and iterative modifications to the codebook were performed. Codebook development included clarifying concepts, providing examples, and developing decision rules that ultimately led to the instrument used for the content analysis. Once the codebook was developed the coders were randomly assigned three sections[4] (N = 109, 39.5% of total sample) to code. There were 8 codes of interest, see Table 1. Cohen's kappa showed substantial agreement (mean k = .68) (Neuendorf, 2002). The remaining years of air pollution news articles were randomly distributed and coded independently by the two coders. Initial interrater reliability was below the threshold set a priori (k <.7) for three codes classifying cited sources: "non-expert/citizen sources", "business/industry groups", and "health and advocacy groups." To achieve a higher level of reliability, the two coders double coded all articles for these codes and conducted consensus meetings afterwards. During consensus meetings both coders revisited all the newspaper article where there was disagreement. One by one articles were recoded to see if a source was

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[4] National newspaper years 2012 and 2015, local newspaper year 2011.

present, after discussing the results consensus was reached. As a result, the average Cohen's kappa increased to high agreement (mean k = .85) (Neuendorf, 2002).

Table 1. Interrater reliability

	Kappa pre-consensus	Kappa post-consensus
What is the central focus of the article relative to the newspaper being analyzed?	.823	-
Did the article mention health?	.768	-
Did the article include information about the protective measures an individual can take to reduce risk from air pollution?	.760	-
Sources present in the article		
Academics and scientist	.713	-
Non-expert/citizen sources	.502	1.0
Business/industry groups	.660	1.0
Governmental sources	.722	-
Health and advocacy groups	.475	1.0

Analytic Procedure
To compare differences between local and national newspapers, chi-square independence tests were conducted. Fisher's exact test was used in case the expected cell count was less than 5. All descriptive statistics, reliability, and chi-square tests and were performed with IBM SPSS Statistics 24.0.

RESULTS
A total of 276 articles met our selection criteria and were read and analyzed: 162 national newspaper articles and 114 local newspaper articles. The *New York Times* (n=98) accounted for the majority of the coverage, followed by the *Washington Post* (n=64), the *Bakersfield Californian* (n=61), and the *Fresno Bee* (n=53).

Threat and efficacy
When examining the threat and efficacy information in newspapers I found support for H1. Specifically, threat information (39.9%) was reported more than efficacy

information (7.6%) in the combined sample (X^2= 34.626, P=.001). Threat was reported more frequently compared to efficacy in both local newspapers (X^2= 15.039, P<.001) and national newspapers (X^2= 18.935, P<.001).

Table 2 compares threat and efficacy information for local and national newspapers. When comparing local newspapers with national newspapers, local newspapers reported more threat information (44.7%) compared to national newspapers (36.4%). However, this difference was not statistically significant (X^2= 1.931, P=.165), thus not supporting H2. Similarly, no significant difference (X^2= 1.118, P=.209) was found for the reporting of efficacy information in local newspapers (13.0%) compared to national newspapers (6.9%). Hence H3a was not supported. When reporting recommended efficacy information, no significant differences were found for the individual risk reducing behavior "stay indoors" (X^2= .885, P=.347), and "use of air filters" (X^2= .953, P=.652). However, local newspapers did report more on "limiting physical activity" compared to national newspapers (X^2= 5.105, P=.036), demonstrating partial support for H3b.

Table 2. Threat and efficacy information.

	Total (N=276)	Local (N=114)	National (N=162)
Threat	110 (39.9%)	51 (44.7%)	59 (36.4%)
Efficacy	21 (7.6%)	11 (8.8%)	10 (6.2%)
Stay indoors	13 (4.7%)	7 (6.1%)	6 (3.7%)
Limit physical activity*	9 (3.3%)	7 (6.1%)	2 (1.2%)
Use air filter	5 (1.8%)	1 (0.9%)	4 (2.5%)

* Significant difference of threat and efficacy information between local and national newspaper, P<.05

Information sources
As shown in Table 3, aggregate numbers show that reporters primarily used governmental sources, followed by business/industry groups, a tie between academics and scientist, and health and environmental advocacy groups, and non-expert/citizen sources. A similar order was found for national newspapers. Local newspapers also used governmental sources primarily, followed by business/industry sources, and health and environmental advocacy groups. Although they used more non-expert citizen sources compared to academic sources.

Table 3. Information sources

Sources	Total (N=276)	Local (N=114)	National (N=162)
Academics and scientist sources*	60	9	51
Non-expert/citizen sources	27	11	16
Business/industry groups*	79	13	66
Governmental sources*	168	49	119
Health and environmental advocacy groups	63	12	51

* Significant difference of sources utilized between local and national newspaper, P<.05

National newspapers used disproportionally more information sources in their articles compared to local newspapers. National newspapers utilized significantly more academic and scientist sources (X^2=21.881, P<.001), business/industry groups (X^2=28.189, P<.001), governmental sources (X^2=26.089, P<.001), and health and environmental advocacy groups (X^2=16.680, P<.001). No significant differences were found in the use of non-expert/citizen as information sources for reporters (X^2= .004, P=.950).

DISCUSSION

Although exposure to air pollution is one of the largest global risk factors (Forouzanfar et al., 2015), it is often overlooked in health promotion research (Howze, Baldwin, & Kegler, 2004) and practice. Opportunities for air pollution health promotion campaigns to enlist the media more strategically exists as media has been shown to be a primary source of air pollution information (Brown et al., 2016a; Johnson, 2012b). By examining the reporting of air pollution in the media, we can examine how air pollution is covered, and tailor health promotion efforts to the information found about air pollution in the news media. The present study is the first to look at the nature of air pollution reporting in the media, exploring factors in news reporting about air pollution that might affect individual risk reducing behavior. Similarly to other content analyses analyzing newspaper reporting of other health issues (e.g. Hart & Feldman, 2014; He et al., 2014; Jensen et al., 2010; Shim et al., 2016), I found that air pollution stories contained more threat information than efficacy information. It is important that newspapers report about the threat of air pollution on health, as this informs the public on the need for action. However, by not providing any information on what to do to reduce the introduced threat, undesirable side effects can happen. The EPPM posits that when threat information is high and efficacy information is low, individuals will manifest a maladaptive coping response (Witte, 1992). While results can differ for individuals, as individual differences including prior experiences, culture, and personality influence appraisal of threat and efficacy (Witte, 1992), our results

suggest that current reporting about air pollution in newspapers is not conducive to promotion of risk reducing behavior.

This study found that news reporting about air pollution lacked information about effective precautionary measures that individuals can take. Moreover, local newspapers in the San Joaquin Valley reported less about air pollution compared to national newspapers, despite being located in one of the worst air polluted areas in the US, and despite the fact that air pollution is a major concern for residents of the valley (Cisneros et al., 2017a; Meng et al., 2010b). These results are not entirely surprising, as there is research suggesting that news stories about health are scarce (Caburnay et al., 2003). In addition, this relative absence of news stories about air pollution is in line with a recent study analyzing local news reporting about health in the SJV, which also found limited coverage of air pollution (Ramírez et al., 2017). Similar to other content analyses (e.g Brossard et al., 2004; Zamith et al., 2013), both local and national newspapers over-relied on governmental sources. The high reliance on governmental sources is concerning as they are likely to present established views (Zamith et al., 2013). Then high reliance on governmental sources is particularly concerning in the current political climate as governmental agencies are acting in conflict with their goals. For example, the agency in charge of mitigating air pollution, is advocating for relaxation of the Clean Air Act legislation (Tabuchi, 2018). The relative lack of sources that might present unconventional views limits the range of concerns and solutions presented in the news. In addition, academics and scientist sources were present in less than a quarter of the articles. The primary reliance of air pollution reporting on sources that might not be impartial and lack expertise, might not be conductive to the understanding of air pollution by the general audience. Including more academic and scientist sources would be a good first step to contest these potentially detrimental sources.

Limitations

Despite the strengths, this study suffers from some limitations. To begin, only a select number of newspapers were included in the current study. It is possible that a selection of different newspapers would reveal different patterns. Similarly, a selection of different news sources (e.g., online news or broadcast) could show different results. However, I am reasonably confident that this is unlikely because newspapers -and in particular widespread national newspapers such as the national newspapers (i.e. *New York Times* and *Washington Post*) utilized in this content analysis- are agenda setters for other media sources (Niederdeppe et al., 2008). Additionally, our coding for threat and efficacy information were simple binary codes. Coding therefore ignores any nuanced tones and implications that potentially exist in the news story. Lastly, coverage patterns could have changed since the time of the study (2011-2015), as new developments such as the WHO campaign ("BreatheLife," 2018) to mobilize people to bring air pollution to safe levels or the 2016 presidential election and resulting changes at the EPA could have influenced the coverage. The salient new efforts made by the WHO to convince the public and policy makers of the disastrous effects of air pollution by branding it "the silent

killer" might increase the amount of threat reporting in newspapers, potentially mobilizing people into action. To neutralize potential undesirable effects, the campaign would do well to provide efficacy information on how to reduce individual risk from air pollution. Changes at the EPA might result in a short-term increase of reporting about air pollution as certain environmental policy aimed at reducing air pollution is being reconsidered. However, long-term I might expect a reduction in the use of governmental sources and an unwelcome reduction in both threat as well as efficacy information provided in newspapers as protective environmental policy is no longer a priority.

Conclusion

The findings of this study suggest that reporting about air pollution in newspapers is not conducive to risk reducing behavior. Newspapers report on the health impacts air pollution can have. However, there needs to be a better balance between threat and efficacy information -especially effective precautionary measures that individuals can take- in the reporting about air pollution. Given the large impact air pollution has on the SJV and the importance of local news on public opinion and the local policy agenda, more health promoting news stories about air pollution would be beneficial. The current reliance on conventional sources of information by journalists might forestall the understanding of complex issues such as air pollution. Air pollution reporting would benefit from more diverse, expert, and impartial sources. In addition, air pollution reporting would benefit from more efficacy information, informing individuals of actions they can take to reduce risk from air pollution.

CHAPTER THREE

**Using the Integrative Model to predict protective behaviors around air quality:
Including the information environment as a distal variable.**

Air pollution is the single largest environmental health risk, estimated to be responsible for one in eight of total global deaths (WHO, 2014). In addition, this risk impacts nearly everybody, as 92% of the world's population lives in cities where air quality levels exceed WHO limits, and air pollution levels continues to rise at alarming rates (Landrigan et al., 2017). California's San Joaquin Valley (SJV), which is home to about 4 million people (Abood, 2014), contains some of the most polluted air in the country. According to an American Lung Association report (Billings et al., 2017), this economically disadvantaged region includes four of the five most polluted cities in the United States in terms of year-round particle pollution and short term particle pollution. Exceeding the federal ozone standards have been estimated to cause 460 premature deaths each year, and the cost of unhealthy levels of ozone and particulate matter has been appraised above 3 billion (Hall et al., 2008b).

Air pollution has been formally declared a carcinogen (Loomis et al., 2013), and studies have consistently shown associations between air pollution and exacerbations of illness and increases in mortality rates (Brunekreef & Holgate, 2002; Kampa & Castanas, 2008; Pope et al., 2002; Seaton et al., 1995). Numerous studies have linked air pollution with increased hospital admissions (Capitman & Tyner, 2011; Iskandar et al., 2012; Meng et al., 2010; Schwartz, 1995; Zanobetti, Schwartz, & Dockery, 2000). In addition to having carcinogenic properties, adverse health effects of pollution include: asthma attacks, acute and chronic bronchitis, myocardial infarction, and pneumonia (Capitman & Tyner, 2011; J. V. Hall et al., 2008b). These negative health outcomes, which are linked to poor air quality, add to the complexity of the existing poor overall health in the SJV. Asthma and other related respiratory problems are highly prevalent in the SJV (Meng et al., 2010) – one in six children is diagnosed with asthma before the age of 18 (*Place Matters for Health in the San Joaquin Valley: Ensuring Opportunities for Good Health for All*, 2012). Regions in the SJV with the highest respiratory risk are comprised disproportionately of low-income and Hispanic neighborhoods (Morelli, Rieux, Cyrys, Forsberg, & Slama, 2016; *Place Matters for Health in the San Joaquin Valley: Ensuring Opportunities for Good Health for All*, 2012; Schwartz & Pepper, 2009). The SJV is not only one of the poorest communities in the United States, but it also lacks a sufficient number of physicians and other health resources (Schwartz & Pepper, 2009). The SJV has the highest percentage of Hispanic/Latino residents in California (Place Matters, 2012; Schwartz & Pepper, 2009). Over 60% of the SJV population lives in rural and isolated regions lacking resources and access to address environmental and public health threats (Abood, 2014; Taylor & Martin, 2000). Nearly 30% of the SJV population is without a high school diploma – double

the national average (14.7%) (*Place Matters for Health in the San Joaquin Valley: Ensuring Opportunities for Good Health for All*, 2012).

The adverse effects of air pollution on health call for efforts to reduce the pollution in the air. However, since that is a long-term goal that requires the successful engagement of multiple stakeholders, efforts are also necessary to reduce the adverse health effects of air pollution. There are some actions that individuals can take to mitigate the negative health effects of pollution. Effective precautionary measures individuals can take include: staying indoors, limiting physical activity, and using air filters to clean indoor air during severe air pollution days (Laumbach, Meng, & Kipen, 2015). However, even though risk reducing behavior is possible (and recommended), the majority of people don't take such action (McDermott, Srivastava, & Croskell, 2006; Semenza et al., 2008; Wen, Balluz, & Mokdad, 2008). Given the health impact of air pollution, I aimed to investigate why individuals do not participate in risk reducing behavior. This study utilizes the Integrated Model of Behavioral Prediction (Fishbein, 2000; Fishbein & Cappella, 2006) to examine perceptions and behavioral intention related to three specific risk reducing air quality behaviors: staying indoors, limiting physical activity, and using air filters. In case of environmental risk such as air quality, we often rely on external sources of information to increase awareness of risk of air quality and the actions we can take to reduce risk, helping us formulate risk perceptions and guide individual risk reducing behavior (Mello, 2015; Slovic, 1987). I therefore also examined the role of the public information environment about air quality utilizing the Integrated Model of Behavioral Prediction.

Integrated model of behavioral prediction

The Integrated Model of Behavioral Prediction integrated key determinants as suggested by behavioral theories, including: Health Belief Model, Social Cognitive Theory, and the Theory of Reasoned Action (Fishbein & Yzer, 2003). The integrated model uses a reasoned action approach: when behavior is considered to be good, people are more likely to act on it compared to behavior that is considered bad. Therefore, beliefs about behavior influence behavior reasonably, although not necessarily rationally (Yzer, 2012). According to the integrative model, one of the leading predictors of behavior is behavioral intention, and people are likely to act on their intentions if not hindered by barriers. However, if a person does not have the skills to perform behavior and/or if there are environmental restraints (such as lack of resources), a strong intention to perform the behavior will not necessarily result in the behavior. The integrative model assumes three primary determinants of intention and behavior: *attitude* (attitude towards behavior based on costs and benefits), *perceived norms* (perception about the expectation and the performance of the behavior in one's social network), and *self-efficacy* (the extent that a person perceives his or her ability to perform the behavior) (Fishbein & Yzer, 2003; Yzer, 2012). Other salient behavioral predictors are not ignored in the model. The integrative model considers other variables that are associated with behavior to be background variables that influence behavior indirectly, through their influence on

attitudes, norms, or self-efficacy (Fishbein & Yzer, 2003; Yzer, 2012). See figure 1 for model depiction.

Figure 1. Integrative model of Behavioral Prediction
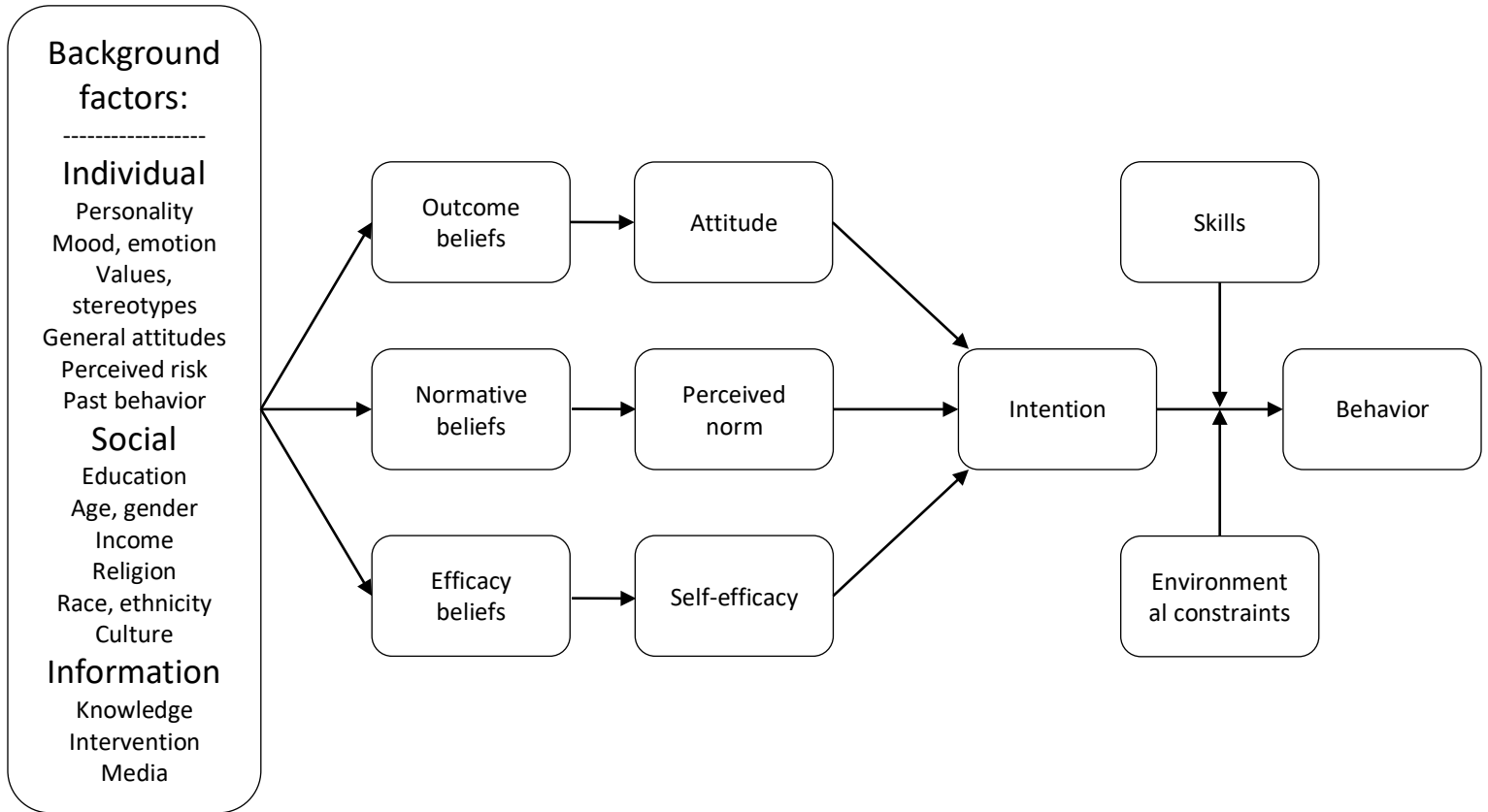
The integrative model has been shown to consistently predict behavioral intent in many contexts (Fishbein & Ajzen, 2010). We therefore posit the following:

H1: Attitude is positively associated with risk reducing air quality behavioral intention.

H2: Perceived norms are positively associated with risk reducing air quality behavioral intention.

H3: Self-efficacy is positively associated with risk reducing air quality behavioral intention.

Communication and Health

Public communication about environmental risks is important in indirectly guiding protective behavior (Mello, 2015; Slovic, 1987). The information stemming from public communication is an important determinant of knowledge, attitudes, and other cognitive and emotional determinants of behavior (Niederdeppe, Froch, & Hornik, 2008; Viswanath, 2005). To investigate the role of public communication about air quality, I examined the role of three public communication background

factors on behavior through determinants as proposed by the integrative model. Specifically, I examined 1) the primary official forms of communication about air quality: Air quality advisories, 2) information seeking in the broader air quality information environment, and 3) the role of media attention to air quality messages.

Air Quality Advisories

One of the primary objectives of air pollution risk communication is for the public to take precautionary measures (i.e. reduce exposure) to protect themselves from the adverse health effects of air pollution (Cairncross, John, & Zunckel, 2007; Laumbach, Meng, & Kipen, 2015; Stieb, Doiron, Blagden, & Burnett, 2005). Currently, the communication of the health risk of air pollution is accomplished by using an air quality index (AQI) (*Air Quality Index (AQI)*, 2014; Cairncross et al., 2007). The AQI is an index created by the US Environmental Protection Agency (EPA) for reporting air quality. It rates pollutants from 0-500, with higher levels indicating more pollution. Levels above 100 exceed the national air quality standard set for air pollutants, and are therefore considered unhealthy. The AQI has 6 categories, ranging from good (0-50) to hazardous (301-500) (*Air Quality Index (AQI)*, 2014; Johnson, 2003). Air quality data collected by monitoring stations is recalculated to fit the AQI and the resulting air quality advisories or air quality forecasts, can then be accessed through a variety of sources (e.g. television, radio, newspapers and the Internet) of different origins (*Air Quality Index (AQI)*, 2014; Kelly, Fuller, Walton, & Fussell, 2012). In accordance with the Integrated Model of Behavioral Prediction, exposure to this background factor indirectly predicts behavior through the three key determinants of the model (Yzer, 2012). I therefore propose the following hypothesis:

H4: Exposure to air quality forecasts is positively associated with attitudes, perceived norm, and self-efficacy.

Information Seeking

Air quality advisories are the primary official forms of communication about air pollution; however, the information environment is much broader than targeted campaigns (Moldovan-Johnson, Tan, & Hornik, 2014b). The broad information environment is an important determinant of knowledge, attitudes, and other cognitive and emotional determinants of behavior (Niederdeppe, Froch, & Hornik, 2008; Viswanath, 2005) and should be investigated beyond air quality advisories. It is therefore important to extend our understanding of the air pollution information environment beyond air quality advisories and other deliberate communications. Air pollution has a serious impact in the SJV (J. V. Hall et al., 2008b), and residents in the SJV living in areas with high exposure levels rate air pollution as their most serious problem above other community problems such as unemployment, crime and obesity (Cisneros et al., 2017b). I therefore expect people living in the SJV to be motivated to pursue air quality information. Information seeking has been found to be positively related to components of the IM in other environmental contexts (Mello & Hovick, 2016). As proposed in the Integrated Model of Behavioral

Prediction, this background factor indirectly predicts behavior through the key behavioral determinants of the model. I therefore expect that:

H5: Information seeking is positively associated with attitudes, perceived norm, and self-efficacy.

Media attention

Media is the primary source of health news for most people (Clarke & Everest, 2006; *Local TV A Top Source For Swine Flu News*, 2009). Furthermore, the media have the ability to affect change at the population level, both through changes in knowledge and attitudes on an individual level (Brodie, Hamel, Altman, Blendon, & Benson, 2003b; Stryker, 2008) as well as on a policy level (Yanovitzky & Bennett, 1999). Consideration of the role of the media is of particular interest for understanding environmental risks. Environmental risk are often not easy to detect with our innate senses (Beck, 1992), so we need to rely on external sources for information. Even in the case where acute risks are physically detected (e.g., extremely poor air quality associated with a wildfire), long-term risks may not be known or understood. Additionally, individuals cannot rely on regulation to protect themselves, as current regulation in the SJV fails to prevent air quality levels from exceeding the federal standard for air pollution (Billings et al., 2017). Since we can't rely on our innate senses, and regulation in some instances fails, individuals must rely on the on the public information environment, in particular the mass media, to provide information in order to guide protective behavior (Mello, 2015; Slovic, 1987). Research has shown this to be the case in air pollution as well. People primarily report using the mass media (in addition to sensory and health cues) as information sources to needed to increase awareness and guide individual risk reducing behavior (Brown et al., 2016b; Johnson, 2012a). In accordance with the Integrated Model of Behavioral Prediction exposure to this background factor indirectly predicts behavior through attitudes, perceived norm, and self-efficacy. However, studies analyzing news media reporting about health issues, including a recent study about air pollution newspapers, have found news media content to lack efficacy information (e.g. Hart & Feldman, 2014; He et al., 2014; Jensen et al., 2010; Ramondt, dissertation chapter 2; Shim et al., 2016). Thus, I hypothesize that:

H6: Media attention to news about air quality is positively associated with attitudes and perceived norm, but not self-efficacy.

METHOD

Data Collection and Respondent Profile

I conducted an online survey of emerging adults living in one of the most air polluted regions in the US (Meng et al., 2010; State of the air, 2015). Participants (n=1013) were recruited at a university in rural California through a research participation system. A total of 38 participants did not complete the survey. In addition, 37 participants were excluded because they finished the survey in under 6 minutes, resulting in a total sample of 938 participants. The majority of the sample was Hispanic/Latino (59.5%), reflecting the ethnically diverse university from which

the sample was recruited, and exemplifying the diversity of the broader state of California ("Fast Facts," 2015; "Quick Facts California," 2016). Full demographics can be found in Table 1.

Table 1. Sociodemographic characteristics (N =938)

	N	%
Demographics		
Ethnicity		
Hispanic/Latino	540	59.5%
Asian	177	19.5%
White (non-Hispanic)	100	11.0%
African American	52	5.7%
Other	38	4.2%
Smoke		
Every day	5	.5%
Some days	45	4.8%
Not at all	888	94.7%
Self-identified sensitive*[1]	176	25.6%
Health problems exacerbated*[2]	93	9.9%
Asthma or COPD*	131	19.0%
Family member asthma or COPD*		
Yes	264	38.4%
No	309	44.9%
I don't know	115	16.7%

*Total sample N=688, [1] Answered yes on the question: "Do you feel that you are more affected by a given amount of air pollution than other people", [2]Answered yes on the question: "In the past month, did you have any health problems that were made worse by the air quality?

Measures

All IM variables were developed using guidelines outlined by (Azjen, 2006), and were distinct for each risk reducing behavior (staying indoors, limiting physical activity, and using air filters). All variables used in analyses were recoded for interpretation purposes to range from poor/low to good/high.

Integrative model of behavioral prediction (IM)
The three determinants of behavioral intention – attitude, social norms and self-efficacy – were adapted from de Leeuw, Valois, Ajzen, and Schmidt (2015).

Intent was measured with a single question using the following base "During the next year, I intend to [do risk reducing behavior] when the air quality is poor". For example, "During the next year, I intend to stay indoors with windows and doors closed when the air quality is poor.". Response categories were measured on a 5-point scale and ranged from Strongly agree (1) to Strongly disagree (5).

Attitude was measured by combining responses to the following item: "For me, [doing risk reducing behavior] when the air quality is poor in the next 12 months, would be…" Response categories were measured using two semantic

differential pair on a 5-point scale: Not important at all (1) to very important (5), and useless (1) to very useful (5). For example: "For me, staying indoors with windows and doors closed when the air quality is poor in the next 12 months, would be…"

Social norms were measured with the combination of two items. One question assessed descriptive norms: "People who are important to me [risk reducing behavior] when the air quality is poor." The other question assessed injunctive norms: "People who are important to me think I should [risk reducing behavior] when the air quality is poor.". For example: "People who are important to me think I should stay indoors with windows and doors closed when the air quality is poor." Response categories were measured on a 5-point scale and ranged from Strongly agree (1) to Strongly disagree (5).

Self-efficacy was measured with the combination of two items on a 5-point scale. Participants were asked, "I feel that I'm able to [risk reducing behavior] when the air quality is poor in the next 12 months.", with response options ranging from Strongly agree (1) to Strongly disagree (5). In addition, participants were asked, "For me, [risk reducing behavior] when the air quality is poor in the next 12 months, would be…", with response options ranging from Very easy (1) to Very difficult (5).

Distal variables

Exposure to air quality forecast was measured using a single item, "How often do you encounter an air quality forecast?". Response options ranged from Never (1) to Daily (5).

Information seeking was assessed using a single item adapted from (Mello & Hovick, 2016): "Thinking about the past six (6) months, did you actively look for information about the relationship between health and air quality? For instance, from the mass media, doctors or other people?". Response options were Yes (1) or No (0).

Media attention to air quality news was adapted from (Ho, Liao, & Rosenthal, 2015) and assessed by asking: "How much attention do you pay to [medium] coverage about air quality", separately for four media channels: television news, newspaper, online news and radio news. Response categories were measured on a 5-point scale and ranged from Very little attention (1) to Very close attention (5).

Data Analysis

All descriptive statistics were performed with IBM SPSS Statistics 24.0. Assessment of the IM was implemented through three separate path analyses. These data were analyzed using Mplus version 7.31 (Muthén & Muthén, 1998). The amount of missing data was low (<.0001%),presumed missing at random, and Mplus defaults were used for missing data imputation (Muthén & Muthén, 1998). To assess the fit of the models, I computed and compared the comparative fit index

(CFI), the root mean square error of approximation (RMSEA), the standardized root mean squared residual (SRMR), and the chi-square (X^2). The CFI is a measure of model fit ranging from 0-1 where larger values (closer to 1) indicate better fit (Hu & Bentler, 1999). The RMSEA is a measure of model misfit where values of .05 or lower indicate excellent fit, values <.8 indicate fair fit and values >.1 indicate unacceptable fit (Hu & Bentler, 1999; MacCallum, Widaman, Preacher, & Hong, 2001). SRMR indicates good fit at .08 or lower (Hu & Bentler, 1999). A significant X^2 test indicates a poorly fitting model (Bentler & Bonett, 1980; Hu & Bentler, 1999). In addition, the Akaike information criterion (AIC), and the Bayesian information criterion (BIC) were used to directly compare models; lower scores indicate better fit (Akaike, 1987). Attitude, social norms and self-efficacy were allowed to correlate as is customary with in IM and theory of reasoned action research (Mello & Hornik, 2015).

RESULTS

Descriptive statistics of the distal variables and IM variables by risk reducing behavior are reported in Table 2.

Table 2. Descriptive statistics

	Mean (SD)	Air filter Mean (SD)	Physical activity Mean (SD)	Stay inside Mean (SD)
Integrative Model				
Intention		3.36 (1.02)	3.40 (.94)	3.36 (.98)
Attitude		3.40 (.93)	2.99 (.97)	3.14 (.97)
Subjective norm		3.02 (1.01)	3.00 (1.01)	3.06 (1.02)
Self-efficacy		3.29 (.94)	3.24 (1.02)	3.18 (1.08)
Distal variables				
Information seeking[a]	25.5%			
Attention media	2.11 (.81)			
AQI exposure	2.14 (1.08)			

Note. For variables measured with multi-item scales, the mean of the item was used.
Except where indicated, all items were measured on a 5-point scale. [a]Yes/no question, percentage of participants answering yes

Path analyses demonstrate support for Hypotheses H1-H3 and H6 in all three risk reducing behaviors, but no support for Hypotheses H5. Hypothesis H4 was only supported for using air filters (Table 3). Details for each model are described below.

Table 3. Fit indices of the path models for the three risk reducing behavioral intentions.

Fit indices.	Air filter	Physical activity	Stay inside
Absolute fit			
CFI	.998	.987	.998
RMSEA	.025 (.000-.065)	.058 (.027-.093)	.023 (.000-.064)
SRMR	.008	.014	0.009
X^2	4.797	12.482*	4.541
Comparative fit			
AIC	9465.470	9630.767	9589.508
BIC	9576.803	9742.099	9700.840

CFI = Comparative Fit Index, RMSEA = Root Mean Error of Approximation, SRMR = Standardized Root Mean Square Residual, AIC = Akaike Information Criterion and BIC = Bayesian Information Criterion, *p<0.05

Intention to stay inside to protect against poor air quality
Figure 2 shows the significant paths of the path analysis for intention to stay inside. The model results suggest excellent fit (see Table 3), X^2 = 4.541, p = .209, CFI = .998, RMSEA = .023 (CI = .000-.064), SMSR = .009 (See Table 3). Attitude (ß =.223, p<.001), social norms (ß = .237, p<.001), and self-efficacy (ß = .420 , p<.001) were each related with intention to stay inside when the air quality is poor, indicating that H1, H2, and H3 were supported. However, H4 and H5 were not supported, as neither air quality index exposure nor information seeking were related with any of the intention determinants in the IM. Attention to air quality in the media was related with attitude (ß =.194, p<.001), and social norms (ß = .144, p<.001), thus supporting H6. The model variables explained 48.8% of the variance in intention to stay inside, but the distal variables explained only 4.6% of the variance in attitude and 2.5% of the variance in social norms.

Figure 2. Standardized path coefficients for intention to stay inside to protect against poor air quality.
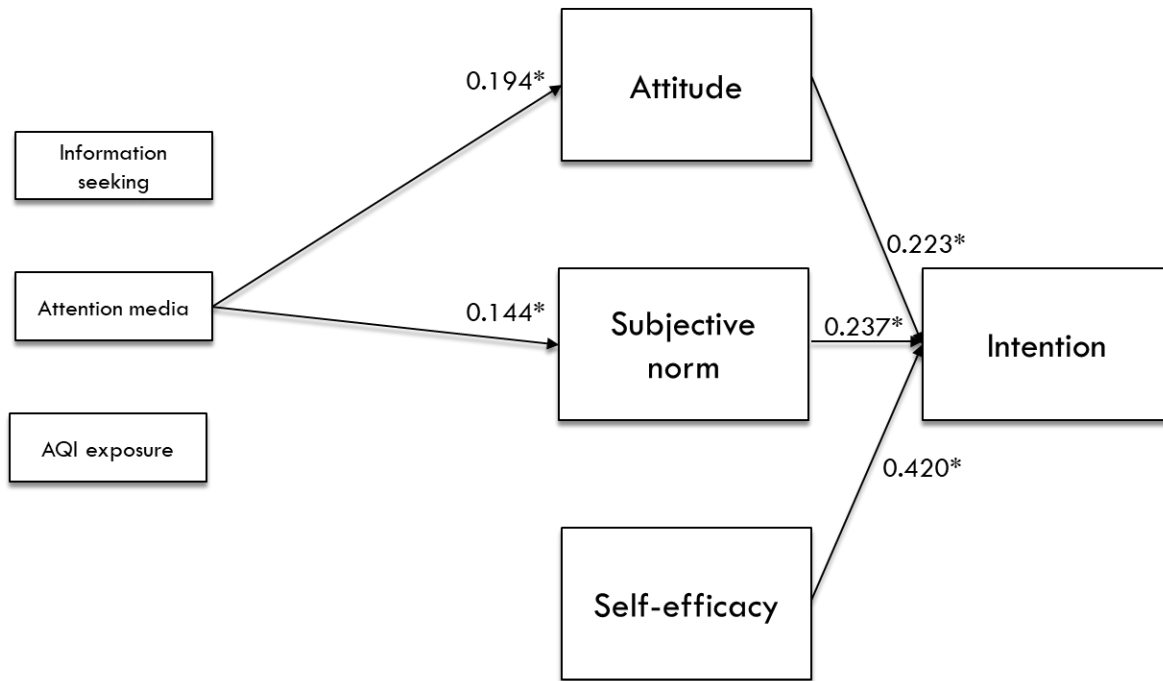
*p<0.05

Reducing physical activity to protect against poor air quality

Figure 3 shows the significant paths of the path analysis. The model predicting intention to reduce physical activity during times of poor air quality showed satisfactory fit, X^2 = 12.482, p < .05, CFI = .987, RMSEA = .058 (CI = .027-.093), SMSR = .014. Similar to the risk reducing behavior "staying inside", attitude (ß =.256, p<.001), social norms (ß =.151, p<.001), and self-efficacy (ß = .417, p<.001) were all related with the behavioral intention, thus supporting H1, H2, and H3. Only attention to air quality in the media was related with any of the intention determinants in the IM, specifically attitude (ß = .149, p<.001), and social norms (ß =.101, p<.007). As such, H4 and H5 were not supported, but the results supported H6. Forty-two point two percent of the variance in behavioral intention was explained by the model. The distal variables explaining attitude and social norms explained 2.6% and 1.6% of the variance respectively.

Figure 3. Standardized path coefficients for intention reduce physical activity to protect against poor air quality.
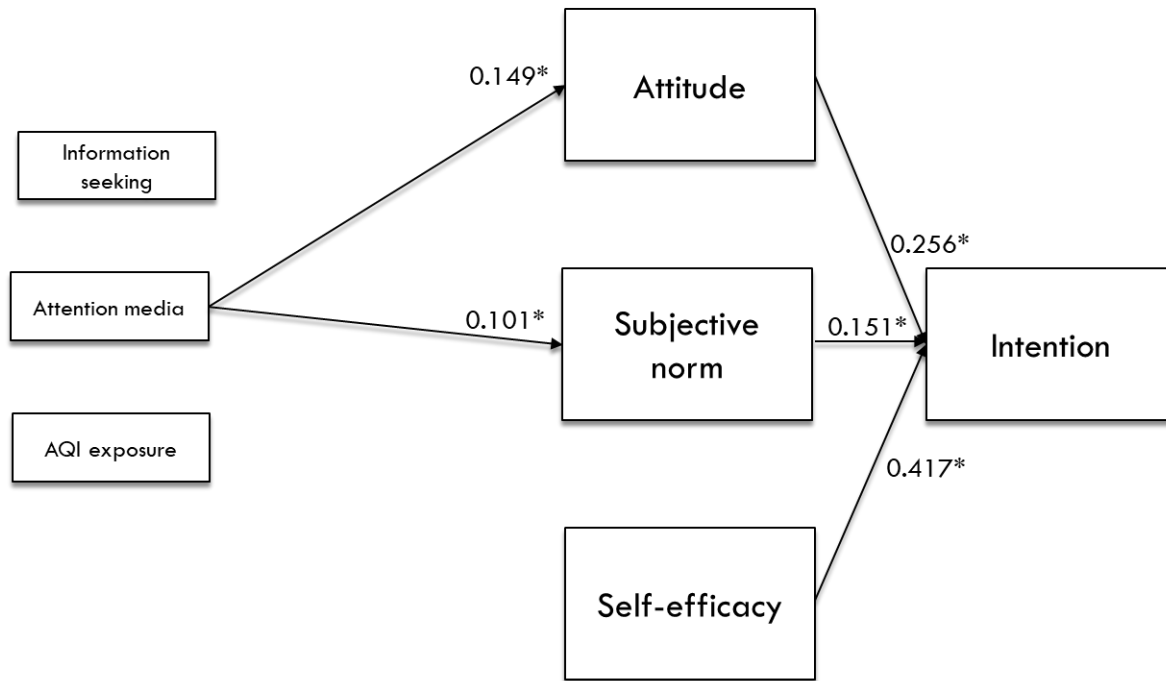
*p<0.05

Using air filters to protect against poor air quality

Figure 4 shows the significant paths of the path analysis. The model predicting intention to use air filters showed excellent fit, $X^2 = 4.797$, $p < .187$, CFI = .998, RMSEA = .025 (CI = .000-.065), SMSR = .008. Comparable to the other risk reducing behaviors, attitude (ß =.187, p<.001), social norms (ß =.239, p<.001), and self-efficacy (ß = .407, p<.001) were all related with the behavioral intention. Hence, H1, H2, and H3 were supported. In contrast with both other risk reducing behaviors, air quality index exposure was related with social norms (ß =.082, p<.029), thus supporting H4. However, H5 was not supported as information seeking was not related with any of the intention determinants in the IM. Attention to air quality in the media was related with attitude (ß = .153, p<.001), and social norms (ß =.090, p<.014). As such, the results supported H6. The variables explained 43.7% of the variance in behavioral intention. However, the distal variables explained only 3.5 % of the variance in attitude and 2.2 % in social norms.

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**Figure 4.** Standardized path coefficients for intention to use air filters to protect against poor air quality.
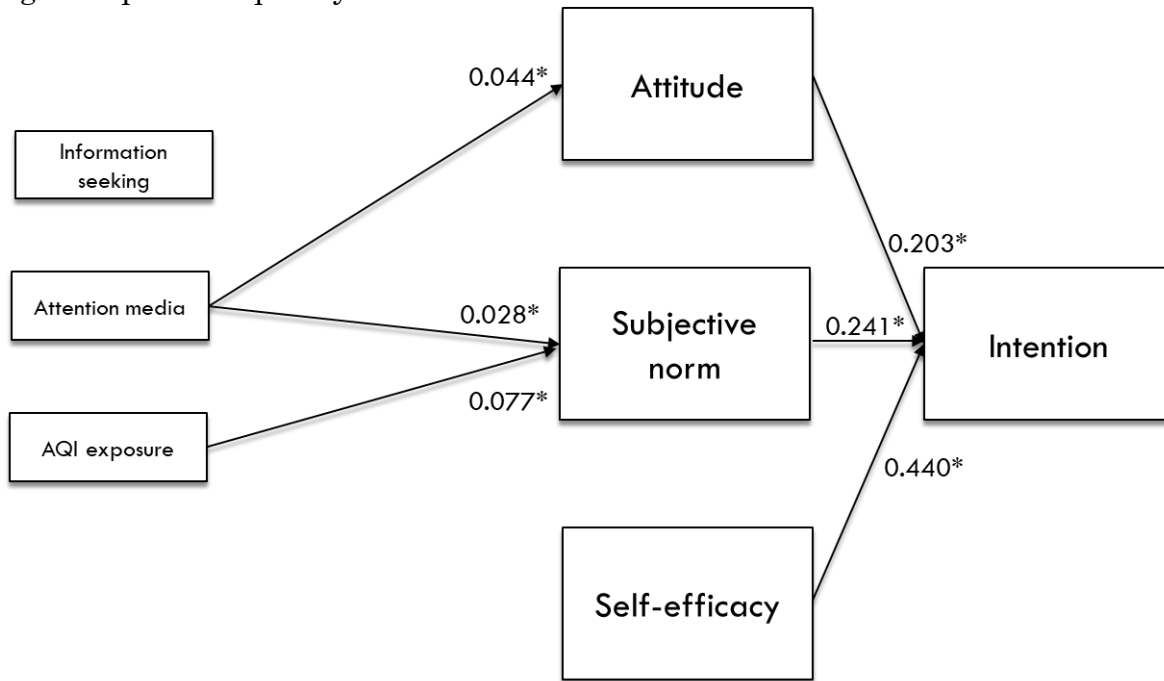
*p<0.05

DISCUSSION

This study was the first to test the IM within the context of individual air quality risk reducing behavior. I compared behavioral determinants across the three primary individual air quality risk reducing behaviors: staying indoors, limiting physical activity, and using air filters. Our findings support the IM in predicting risk reducing behavioral intentions in the context of air pollution. All three determinants of behavioral intention -attitude, social norms, and self-efficacy- consistently predicted risk-reducing intention, and explained a large part of the variance in behavioral intention.

For all three behaviors, self-efficacy was the biggest predictor of behavioral intention, suggesting that participants are more likely to engage in individual risk reducing behaviors when they feel themselves able to perform the behavior that reduces the risks of adverse air quality. Recent research on residents living in the SJV has showed that while many people are aware of the poor air quality in the region (Brown et al., 2016b), people do not know what to do to prevent themselves from the adverse effects of air pollution and even feel fatalistic about reducing risk from air pollution (Ramirez, Ramondt, Van Bogart, & Perez Zuniga, 2018). Air quality related communication should therefore focus on augmenting awareness of the primary risk reducing behaviors and should attempt to increase self-efficacy.

After self-efficacy, social norms were the biggest predictor of behavioral intentions with the exception of reducing physical activity. These results suggest that

perceptions regarding descriptive norms (i.e., people important to the target audience perform risk reducing behavior) and injunctive norms (i.e., people important to the target audience think risk reducing behavior is important) should be reinforced. I did not identify normative beliefs about who matters when deciding on risk reducing behavior around air quality. Future research should capture important referents in vulnerable populations to help develop messages capable of increasing individual risk reducing behavior. For reducing physical activity when the air quality is poor, the association between social norms and intention was smaller compared to the other behaviors. Attitudes about reducing physical activity were the second largest predictor of intention, and this should be taken into consideration when promoting the reduction of physical activity when the air quality is poor.

Contrary to hypotheses, the information environment was found to be an inconsistent predictor of components in the IM. AQI exposure was limited and not found to be predicting components of the IM, except for social norms in air filter use. These results are consistent with other research on AQI. AQI exposure utilization that shows that awareness of the AQI is low (Johnson, 2012; Semenza et al., 2008; Wen et al., 2008), and official data is little known or sought in recognizing air pollution (Johnson, 2012a). Furthermore, research shows that awareness of the AQI makes no significant difference in changing behavior during poor air quality episodes and control days (Semenza et al., 2008). Additionally, the majority of behavior change was reported to be due to personal perception of poor air quality, not air quality advisories. Similarly, Johnson (2012) found that protective behavior was predicted by perceived air quality. Showing that the influence on protective behavior is not limited to the AQI and other factors that influence perception should also be taken into consideration. Individuals living in the SJV in areas with high exposure levels perceive air pollution as their most serious problem above other community problems such as unemployment, crime, and obesity (Cisneros et al., 2017b). Hence, more efforts should be made to increase the effectiveness of the AQI - the primary health communication effort related to air quality in the region.

Despite having participants living in one of the worst polluted areas of the nation (Meng et al., 2010a), only a small percentage of the participants actively searched for information about air quality, and information seeking was not found to be related to any of the intention determinants. A potential explanation for these results is that the current media environment and even the AQI consist primarily of information on the threat of air pollution (Ramondt, *dissertation in preparation*), something residents of the SJV are already aware of (Brown et al., 2016b). The current information environment lacks efficacy information that has been shown to be critical for effecting behavior change in the face of threat (Witte & Allen, 2000). The lack of new and relevant information in the current information environment might explain the missing relationship between searching for information and IM components, and the lack of searching for information about air quality an sich.

Consistent with the IM, attention to media was associated with attitude for all three risk reducing behaviors. The IM posits that the beliefs that are responsible for the attitudes about the behavior can be primed and even changed by information

exposure (Fishbein & Cappella, 2006). Attention to media was also related with social norms, but not with self-efficacy. This is consistent with our recent research that shows that media content lacks efficacy information (Ramondt, *dissertation in preparation*). Nonetheless, the present study's findings provide further evidence of the impact of mass media in influencing behavioral determinants with regards to environmental health (Hansen, 2011).

One limitation of the study is that our sample of emerging adults in one region is not representative of the national population. However, the strategic sample provides some advantages given the purpose of this study. Specifically, sample consisted of individuals living in one of the areas with the worst air pollution in the US (Meng et al., 2010a). This allowed us to investigate the influence of communication efforts that are meant to reach this population. Our sample is also large (>900) and ethnically diverse, which is important for effective studies of health behavior models (Noar & Zimmerman, 2005). However, conclusions about causal direction are limited by the cross-sectional nature of our study.

Conclusion

Air pollution is an increasingly impactful health risk and our findings explain the psychological mechanisms driving risk reducing behavior. This study added to the validation of the use of the IM in an environmental health setting. Results demonstrate that the integrative model of behavior change can be used to predict behavioral intentions in the context of air pollution: attitude, social norms, and self-efficacy, consistently predicted risk reducing intentions. Exposure to the AQI – the primary air quality communication tool – is low and was found to have limited effect on determinants of risk reducing behavioral intentions. Future air quality risk communication efforts might take into consideration media, as attention to media messages about air quality has the potential to influence behavior. However, future campaigns should first and foremost increase awareness and self-efficacy of the primary risk reducing behaviors as this may likely increase the chances of people engaging in risk reducing behavior.

CHAPTER FOUR

General discussion

Through a series of studies, factors related to risk reducing behavioral intention and the relation with the information environment were explored. Study I (Chapter 2) examined how air pollution is covered in the media, utilizing a content analysis of two national (the *New York Times* and the *Washington Post)* and two local newspapers (the *Fresno Bee* and the *Bakersfield Californian*). Focusing on two key components of the extended parallel process model (Witte, 1992): threat and efficacy information. In addition, the utilization of sources in newspaper articles about air pollution was examined. Results of Study I suggest that reporting about air pollution in newspapers is not conducive to risk reducing behavior. Newspapers report on the potential health impacts of air pollution. However, the reporting about efficacy information is insufficient. In addition, the current reliance on conventional sources of information by journalists might forestall the understanding of complex issues such as air pollution. The results of Study I might explain some of the information environment as a predictor results in Study II.

Study II (chapter 3) modelled the IM (Fishbein & Ajzen, 2010; Fishbein & Cappella, 2006) using data from an online survey of emerging adults living in the SJV. In accordance with the IM, information environment variables were included as distal variables to predict the key determinants of behavioral intention for three effective precautionary measures individuals can take (Fishbein & Yzer, 2003). Results of Study II showed that the three key determinants of the IM (Fishbein & Ajzen, 2010; Fishbein & Cappella, 2006) -attitude, social norms, and self-efficacy- consistently predicted behavioral intentions in the three primary risk reducing behaviors: staying indoors, limiting physical activity, and using air filters (Laumbach, Meng, & Kipen, 2015). However, the information environment was found to be an inconsistent predictor of components in the IM. Exposure to the air quality index – the primary air quality communication tool – was low and was found to have limited effect on determinants of risk reducing behavioral intentions. Attention to media was related with attitude and social norms, but not with self-efficacy. Future air quality risk communication efforts might take into consideration media, as attention to media messages about air quality has the potential to influence behavior. Despite having participants living in one of the worst polluted areas of the nation (Meng et al., 2010a), only a small percentage of the participants actively searched for information about air quality, and information seeking was not found to be related with any of the intention determinants.

Moving forward, research aimed at investigating the promotion of individual risk reducing behavior should focus on the many barriers surrounding air pollution that prevent individuals from taking action, and tailor their efforts to their target audience in an effort to reduce these barriers. Individual risk reducing efforts are necessary to reduce the risk of air pollution. Especially as current air pollution levels are high and air pollution levels continue to rise at alarming rates (Landrigan

et al., 2017). However, the salient threat of air pollution requires a more integrative approach to maximize a reduction of risk. The high cost and large barriers of behavioral change to individuals -especially for the low income and Hispanic individuals most impacted by air pollution (Morelli, Rieux, Cyrys, Forsberg, & Slama, 2016; Schwartz & Pepper, 2009)- require more policies focused on air pollution reduction. In addition, more research and health promotion efforts are necessary that focus on both individual risk reduction as well as pollution reduction efforts. Utilizing the awareness and concern about health risk from air pollution to create a sense of urgency in pollution reduction efforts and advocacy could be a promising route.

Health promotion efforts should consider enlisting the media more strategically, as media has been shown to be a primary source of air pollution information. These efforts should take into consideration the current information environment about air pollution. Study I, investigating news reporting about air pollution, and a recent study investigating air pollution communication efforts in the SJV (Ramirez et al., 2018), show that the current air pollution information environment lacks efficacy information on individual risk reducing behavior. This could explain some of the underwhelming results of the information environment as a predictor as efficacy information, which has been shown to be critical for affecting behavior change in the face of threat (Witte & Allen, 2000). In the SJV, where awareness of the threat of air pollution is high (Brown et al., 2016a), and the information environment is lacking efficacy information, the emphasis of health communication efforts focused on increasing behavioral intention should be on increasing awareness and self-efficacy of the primary risk reducing behaviors.

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Codebook content analysis: National Newspapers

To reduce errors, and to speed up the coding process, Qualtrics is used to code the newspaper articles.

Articles are found using Lexis-Nexis (Academic), and are provided to coders using word files.

C.0 – Identifier: article being analyzed.

Each article will have a number attributed to itself. E.g. 1 of 296 DOCUMENTS. This means that this is article 1.

Identifier: number of the article.

Page: The page number the article was found on. Given in the line above the article title. No letters, just the number.

Year: the year this article was published.

Week: the constructed week that was coded.

Code 0: week 1	Code 2: week 3	Code 4: week 5
Code 1: week 2	Code 3: week 4	Code 5: week 6

Newspaper: The newspaper the article appeared in.

Code 0: The New York Times   Code 1: The Washington Post

C.1 – Relevant: should this article be coded.

While our search is designed to be very precise (i.e. include only relevant articles), there might be articles that are not relevant to our coding. This section will be updated during our testing to include guidelines on which articles should not be coded.

All articles (also indoor air pollution) except articles falling in the categories below should be coded. If not clear, code the article and make a note in the comment section.

Articles that must not be coded are:
- Articles that have the following "document type" at the bottom of the article: summary
- Articles that have the following "document type" at the bottom of the article: digest
- Articles that have the following "document type" at the bottom of the article: correction
- "WEEK IN REVIEW" articles.
- Washington post "NATION IN BRIEF" topics that do not discuss air quality (town/state indicates new topic starting). note that Washington post "NATION IN BRIEF" has multiple articles in one. Start counting from relevant section (i.e. from town/state).

Read the full article and decide if the article is relevant.
Relevant:
Code 0: No   Code 1: Yes
 If code is 0 (no), stop here. No additional coding for this article is necessary.

C.2 – Determine type of article

Scope of the article: Central focus of the article relative to the newspaper being
analyzed: individual, local, regional, national, international, unclear. E.g. New
York Times reporting on LA air quality: this is local for LA Times, but national for
New York Times.

Local: City or county in which the paper is located (e.g. Story about Merced or
Merced County for a paper located in Merced)
Regional: State in which the paper is located (e.g. Story about California for a paper
located in Merced)
National: Anywhere in the country that the paper is located (e.g. anywhere in the
U.S. for a paper located in Merced)
International: Anywhere outside of the U.S. (e.g. article in a paper located in
Merced that talks about air pollution in Europe)

Code 0: local or   Code 2: international
regional Code 1:   Code 888: unclear.
national

C.3 – Information source

Source typology: Sources used in the article:
0: Academics and scientist   3: Governmental sources
1: Non-expert/citizen sources   4: Health and environmental advocacy
2: Business/industry groups   groups

Academics and scientist: Dr., Medical doctors, Universities, information from
scholarly articles. Pew Research Center
Non-expert/citizen sources: Locals, affected individuals.
Business/industry groups: Companies, factories.
Governmental sources: Department of State/Energy/Commerce etc., Environmental
Protection Agency (EPA), this includes local government such as city council, a
city's major and people working for the county
Health and environmental groups: Non-governmental environmental organizations
such as Greenpeace, National Wildfire Federation, or the Citizens Climate Lobby.

Also groups that advocate health such as American Lung Association (ALA) and Asthma and Allergy Foundation of America (AAFA).

A source is a person or thing from which something comes into being or is derived or obtained.
Example of Business/industry groups:
No source: "The problem with the Northport's plant.."
Source: "Recently, St. Lawrence Cement announced some changes to its plan, …"

Note that affiliation is coded above personal titles (with the exception of doctors who will be always coded as "academics and scientists"). Example:
"Mr Whitman lawyer at the EPA" will be coded as "government sources" because of his affiliation with the EPA.

Note that a letter writer is not a source. We consider only sources that are found in the article itself.

For each potential source, code:
Code 0: Absent   Code 1: Present

C.4 –Health/threat

Health: Did the article mention health at all?
Any mention health. E.g. the article containing the word unhealthy would receive code 1. Similarly if the article mentions a disease (e.g. asthma).
        Code 0: No   Code 1: Yes

C.5 – Information efficacy

Efficacy information: Provides information that can be used to make health decisions. Efficacy includes actionable information that is specific, credible, and substantial enough to facilitate the reader to take action upon having read the article. Credible information is that which is substantiated by an expert source (e.g., clinicians, public health officials, researchers, industry workers/experts, people who have experienced the problem/solution the article is reporting). Specific information should mention information about the protective measures an individual can take to reduce risk from air pollution.

An article coded 1 for efficacy should provide facts to the reader that would help them reduce risk from air pollution. It should provide them with protective measure that would aid them in reducing individual risk to them or their family.

Example: The *specific mention* that stopping smoking will reduce risk to health or the mention that people should stay inside during this poor air quality moment would both result in a code of 1. Avoiding g street because of a gas cloud would also result in a 1.

Code 0: No information about risk reducing behavior included.
Code 1: Information about risk reducing behavior included.

- Protective measures stay indoors: *Only if "Efficacy information" is coded 1*
  Article includes information about protective measure staying indoors
  Code 0: No   Code 1: Yes

- Protective measures limit physical activity: *Only if "efficacy information" is coded 1*
  Article includes information about protective measure limiting outdoor physical activity
  Code 0: No   Code 1: Yes

- Protective measures use air filters: *Only if "efficacy information" is coded 1*
  Article includes information about protective measure using air filters to clean indoor air
  Code 0: No   Code 1: Yes

Comments/notes: Space to leave any comments or notes relevant to the article. E.g. unclear if needed to be coded. Or any errors that could not be corrected afterwards.

Leave empty if nothing to comment/note.

APPENDIX II

Codebook content analysis: Local Newspapers

To reduce errors, and to speed up the coding process, Qualtrics is used to code the newspaper articles.
Articles are found using Newsbank, and are provided to coders using pdf files.

C.0 – Identifier: article being analyzed.

<u>Identifier:</u> Record the last two numbers of the "Record" under the article . E.g. Record: 422676625 that this is you would score 25.
<u>Page:</u> The page number the article was found on. Given in the line above the article title. No letters, just the number.
<u>Year:</u> the year this article was published.
<u>Week:</u> the constructed week that was coded.

Code 0: week 1	Code 2: week 3	Code 4: week 5
Code 1: week 2	Code 3: week 4	Code 5: week 6

<u>Newspaper:</u> The newspaper the article appeared in.
Code 0: Bakersfield Californian   Code 1: The Fresno Bee
<u>Letter to the editor:</u> Code 0: No, Code 1: Yes

C.1 – Relevant: should this article be coded.

While our search is designed to be very precise (i.e. include only relevant articles), there might be articles that are not relevant to our coding.

All articles (also indoor air pollution) except articles falling in the categories below should be coded. If not clear, code the article and make a note so it can be discussed during weekly meetings. If the article contains a keyword in the title and first three paragraphs, but you believe it is not about air pollution, code it and make note in the notes section.
Articles that must not be coded are:
-   Articles that not discuss anything about air quality/pollution in the first three paragraphs and title. Do note that some articles have multiple articles in one (e.g. Around the valley). Start counting from relevant section.
-   Articles only discussing pollution. E.g. do not code toxic pollution, but do code toxic fumes.
-   Event articles

Words that indicate air pollution/quality:

Air	Fume(s)	Cloud (of)	Gas(es)	Exhaust(s)
Smoke	Vapor	Inhale(s)	Breathe(s)	Respire
Respiratory	Emission(s)	Smog	(Ground-level)ozone	

Read the full article and decide if the article is relevant. *Error on the side of coding the article!*
Relevant:
Code 0: No   Code 1: Yes
 If code is 0 (no), stop here. No additional coding for this article is necessary.

C.3 – Determine type of article
Scope of the article: Central focus of the article relative to the newspaper being analyzed: individual, local, regional, national, international, unclear. E.g. New York Times reporting on LA air quality: this is local for LA Times, but national for New York Times.

Local: City or county in which the paper is located (e.g. Story about Merced or Merced County for a paper located in Merced)
Regional: State in which the paper is located (e.g. Story about California for a paper located in Merced)
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Code 0: local or   Code 2: international
regional Code 1:   Code 888: unclear.
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C.5 – Information source

Source typology: Sources used in the article:
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2: Business/industry groups   groups

Academics and scientist: Dr., Medical doctors, Universities, information from scholarly articles. Pew Research Center
Non-expert/citizen sources: Locals, affected individuals.
Business/industry groups: Companies, factories.
Governmental sources: Department of State/Energy/Commerce etc., Environmental Protection Agency (EPA), this includes local government such as city council, a city's major and people working for the county
Health and environmental groups: Non-governmental environmental organizations such as Greenpeace, National Wildfire Federation, or the Citizens Climate Lobby. Also groups that advocate health such as American Lung Association (ALA) and Asthma and Allergy Foundation of America (AAFA).

A source is a person or thing from which something comes into being or is derived or obtained.
Example of Business/industry groups:
No source: "The problem with the Northport's plant.."
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"Mr Whitman lawyer at the EPA" will be coded as "government sources" because of his affiliation with the EPA.

Note that a letter writer is not a source. We consider only sources that are found in the article itself.

For each potential source, code:
Code 0: Absent   Code 1: Present

C.6 –Health/threat

Health: Did the article mention health at all?
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        Code 0: No   Code 1: Yes

C.7 – Information efficacy

Efficacy information: Provides information that can be used to make health decisions. Efficacy includes actionable information that is specific, credible, and substantial enough to facilitate the reader to take action upon having read the article. Credible information is that which is substantiated by an expert source (e.g., clinicians, public health officials, researchers, industry workers/experts, people who have experienced the problem/solution the article is reporting). Specific information should mention information about the protective measures an individual can take to reduce risk from air pollution.

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  Article includes information about protective measure limiting outdoor physical activity
  Code 0: No   Code 1: Yes

- <u>Protective measures use air filters:</u> *Only if "efficacy information" is coded 1*
  Article includes information about protective measure using air filters to clean indoor air
  Code 0: No   Code 1: Yes

<u>Comments/notes:</u> Space to leave any comments or notes relevant to the article. E.g. unclear if needed to be coded. Or any errors that could not be corrected afterwards.

Leave empty if nothing to comment/note.