

**AMBIGUITY AND ANXIETY IN THE PROCESSING OF
HEALTH RISK MESSAGES**

A Thesis

**Presented to the Faculty of the Graduate School
of Cornell University**

**in Partial Fulfillment of the Requirements for the Degree of
Master of Science**

by

Sukriti Issar

January 2006

© 2006 Sukriti Issar

ABSTRACT

This study looks at the effects of manipulating the ambiguity of health risk messages on worry and perceived susceptibility. In view of literature that indicates robust emotion-congruent effects of anxiety on the interpretation of ambiguous information, a procedure was used to manipulate levels of state-anxiety for a treatment group.

Fifty-two participants completed an experimental task involving the reading of six health risk messages on different topics. Each message was followed by a short questionnaire to assess levels of worry, risk perception and attributional confidence. In addition, the participant's familiarity with the message as well as his/her risk profile for the particular health risk in the message was assessed to provide context for their response to the messages. The experiment followed a 2 (within-group variables, ambiguous vs. unambiguous) x 2 design (between-group variables, state-anxiety induction vs. control group).

It was hypothesized that anxious readers would report higher worry than non-anxious readers, and that worry would be higher for disambiguated messages. Results indicated partial support. A significant interaction effect was found between state-anxiety induction and ambiguity, such that high state-anxious readers reported higher worry than non-anxious readers, for unambiguous messages only.

It was also hypothesized that risk profile information would predict worry. This hypothesis was supported.

BIOGRAPHICAL SKETCH

Sukriti Issar was born in India, in 1978. After receiving a Bachelor of Arts in Psychology in 1998, she completed a two-year diploma in marketing communication and research methodology. This was followed by three years of corporate work experience in consumer behavior research. In addition, Sukriti taught Communication Theory and Research Methods at an undergraduate college in Mumbai, India.

During her MS at Cornell, Sukriti focused on public health and risk communication issues, both at the individual and community level. The impetus for this thesis also stemmed from an interest in bridging theoretical orientations toward uncertainty/ambiguity in communication and psychological research.

ACKNOWLEDGEMENTS

I would like to thank my thesis committee – my advisor, Jim Shanahan and committee members, Jeff Hancock and Cliff Scherer, for their support and encouragement. Due to medical reasons, Jim Shanahan, was unable to attend the defense. I would like to thank Professor Scherer for stepping in as advisor during the defense.

I would also like to thank my fellow graduate students for their troubleshooting help on statistical techniques and software.

TABLE OF CONTENTS

BIOGRAPHICAL SKETCH	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vi
LIST OF FIGURES	vii
CHAPTER ONE Theoretical Background	1
Introduction	1
Uncertainty as lexical device	3
Uncertainty as a construct in communication theory	6
Ambiguity as a construct in psychological theory	13
The special case of risk communication	18
Research question and hypotheses	23
CHAPTER TWO Research Design	24
Manipulation of between-subjects variable	24
Manipulation of within-subjects variable	25
Self-report scales	26
Dependent measures and covariates	27
Procedure	30
Research Design	32
CHAPTER THREE Results	33
Anxiety Induction	33
Ambiguity Scale	35
Predicting worry	37
Predicting perceived susceptibility	42
Attributional confidence and ambiguity manipulation	43
CHAPTER FOUR Discussion	46
Worry and the interaction effect	46
Worry and perceived susceptibility	50
Attributional confidence and ambiguity	51
Limitations	52
Conclusions and recommendations	53
APPENDIX A	55
APPENDIX B	61
APPENDIX C	63
APPENDIX D	65
REFERENCES	68

LIST OF TABLES

Table 1. Worry and susceptibility for by type of message and treatment	43
--	----

LIST OF FIGURES

Figure 1. Worry ratings for ambiguous and un-ambiguous messages	39
---	----

CHAPTER ONE: THEORETICAL BACKGROUND

Introduction

The process of resolving ambiguity is both pervasive and central for everyday cognition.

-Blanchette and Richards, 2003

Uncertainty is theorized to be a pervasive experience in modern life. The interpretation and negotiation of uncertainty emerges then as a critical affective and cognitive task for individuals and groups. Uncertainty, as implying unpredictability of outcomes or the existence of multiple outcomes, is not only a ubiquitous phenomenological experience; it is also a central and pervasive concept in a range of disciplines. In physics, Heisenberg's Uncertainty principle lays down important measurement constraints; in psychology, Tolerance of Ambiguity is an important trait variable used to predict the response of individuals to situations/stimuli that are unstructured or ambiguous; communication has often been defined as uncertainty reducing giving uncertainty an important place in communication theory; in organizational behavior research, the study of decision making under conditions of uncertainty investigates how groups and individuals make decisions with access only to incomplete information. However, in none of these disciplines does uncertainty occupy as central a place as in the area of risk (particularly, risk perception and risk communication theory), since by its very definition, risk refers to probabilities, conditions, uncertainties and

ambiguities (Gorke and Ruhrmann, 2003; Kahlor, Dunwoody and Griffin, 2002). Various theoretical conceptions of uncertainty are thus highly relevant to the understanding of risk.

Any message about risk to a lay audience can embody (un)certainty at various levels. At the stimulus level, uncertainty could be manifest in qualifiers (words such as *may*, *perhaps*, *possibly*) or in active disclaimers (which explicitly question the validity of a claim) (Stocking, 1999), in addition to direct probabilities or percentages of occurrence (for example, *a 1 in 100 chance*). Such a message could then evoke uncertainty (and other related phenomena of interest, such as perceived susceptibility, worry, intention to search for more information) to varying degrees depending on how an individual evaluates the message and how they relate it to their personal lives.

This research investigates the effect on lay readers of risk messages that relate specifically to scientific causation claims about health risks and have been *made ambiguous* through the use of qualifiers. The literature review begins with a discussion of how uncertainty is textually encoded in scientific journals and the popular media, establishing the relevance of the substantive domain under study. This is followed by a discussion of the evolution of the concept of uncertainty in communication theory. This section of the literature review is of interest from the point of view of the evolution of the concept of uncertainty in communication theory than from a methodological point of view. The third part of the literature review outlines conceptions of uncertainty from psychological theory with a particular emphasis on a cognitive psychological paradigm that has heavily influenced this research. Finally, the literature

review ends with an application of these theoretical strands to the special case of risk communication.

'Uncertainty' as lexical device in scientific journals and popular media

Risk communication, about health or environmental risks, is unique within communication domains in that it requires a translation of scientific and technical research into a 'manageable' format for lay publics. This process of translation can result in information being modified in many ways as it moves from the scientific realm to the mass and popular media. One of the crucial rhetorical changes that may occur in this transition relates to changes in the level of uncertainty that are embodied in the risk message.

Scientists tend to use qualifiers, hedges, caveats and other lexical/discursive strategies that stress the tentativeness of their conclusions and invite dialogue with their readers (in this case, other scientists) (Hyland, 1996, Rier, 1999). Hyland (1996) defines hedging as any linguistic means that '*indicate either (a) a lack of complete commitment to the truth of a proposition, or (b) a desire not to express that commitment categorically*'.

While it is fairly well documented and agreed upon that scientific articles employ a range of rhetorical strategies to hedge and qualify (one in every 50 words in Hyland's 1996 study; extremely common as caveats in Results and Discussions sections of epidemiological articles in Rier's 1999 study), the question of how the mass / popular media treats such hedges and qualifying

statements is less well established. On one hand there are theorists such as Fahnestock (1998) and Rier (1999) who take the position that the media tends to translate the tentativeness of scientific reports into 'definitive fact' (Cole, 1988). Similarly, Singer (1990) found that journalists tended to omit qualifying statements when translating scientific reports into popular media. On the other hand, theorists Stocking (1999) argue that more recent studies question these earlier insights into the media's treatment of uncertain science. They suggest that with the increasing complexity of scientific problems, scientific uncertainty is increasing and that scientists and the media often strategically employ this uncertainty. In a similar vein, Stocking (1998) also argues that '*journalists do not always reduce ignorance claims*'. There is thus not enough consensus on this issue though the question of the effects that qualified risk messages would have on lay readers increases in significance if such messages are indeed widespread in popular media, as more recent scholarship seems to suggest.

The issue of such effects is not well researched, even though risk messages form the basis for the risk perceptions and engagement in preventive behaviors of lay publics. There is a wide range of literature, in various disciplines, on uncertainty and ambiguity (hedges, qualifiers and caveats seem to be useful ways to operationalize the theoretical concepts of ambiguity and uncertainty, Stocking, 1999) – however, none of these literatures answers quite this question. Thus, while communication theory (such as Problematic Integration and Uncertainty Management) study uncertain situations (such as initial interpersonal encounters and health situations), there is limited experimental work on how readers would respond to uncertain information from risk messages. The psychological paradigm proves much more

informative for setting up experimental protocols, with a wide range of empirical work and a fairly cumulative theory development path, but tends to deal with lexical tasks involving words or sentences and rarely uses texts with high ecological validity (such as health messages) that are likely to be encountered in naturalistic settings.

Although inadequately researched, the question of effects is an important one – in at least some cases, a stance of scientific certainty (which often can not be sustained over time as differing findings emerged from different studies) has resulted in reduced trust amongst the lay public for scientific institutions (Wynne, 1996). In a similar vein, though arguing from the opposite direction, Rier (1999) claims that in some cases caveats can serve to strengthen claims of credibility and inspire confidence.

In order to clarify the primary purpose of this study the difference between caveats and qualifiers needs to be outlined – a caveat is more a discursive strategy than a qualifier which is lexical. In other words, a caveat could be a single paragraph or sentence describing how the results of a scientific study are tentative and giving a particular reason for that (such as, small sample size, atypical sample, etc.). On the other hand, qualifiers are more like rhetorical/lexical strategies that can be used throughout a text and enhance the tentativeness of claims without necessarily any specific reason being given for this tentativeness. This research focuses on qualifiers since qualifiers are more a part of the text than caveats are – caveats tend to be inserted into text (and are thus harder to miss being specifically flagged as limitations on the validity of scientific claims) while qualifiers can inform the message as a

whole. As a result, qualifiers are more likely to be processed differently from caveats – for instance, more likely to be processed outside of awareness.

Uncertainty as a construct in communication theory

Within communication theory, the concept of uncertainty has played a pivotal role. For instance, Dance (1970) listed uncertainty reduction as one of the key definitions of communication. There has been an evolution of the concept of uncertainty from a stimulus-response view as embodied in Uncertainty Reduction Theory to a more nuanced view that stresses the varied ways in which individuals interact with uncertainty as embodied in Uncertainty Management Theory. This section elaborates on this evolution, beginning with Berger and Calabrese's (1975) classic formulation of Uncertainty Reduction Theory.

The paradigmatic research design for the study of uncertainty in communication theory seems to be the initial interaction situation between strangers as outlined by Berger and Calabrese (1975). It was assumed that the initial interaction universally involved high levels of felt uncertainty and that interactional behaviors (such as amounts of verbal interaction and information seeking) resulted in uncertainty reduction in an almost law-like fashion – the theory was therefore called **Uncertainty Reduction Theory** (or URT). Uncertainty was theorized as being involved in both proactively predicting as well as retroactively explaining another's (and one's own) behavior. In this way uncertainty was critically related to the making of attributions and efforts to increase predictability.

Berger and Calabrese's listed a range of axioms and theorems in an attempt to relate crucial communicative behaviors (such as verbal communication, information seeking) and interpersonal constructs (such as liking) to uncertainty. These axioms reflect the manner in which uncertainty was construed in this seminal paper; uncertainty was conceived somewhat as a 'given' in the initial interaction situation – that is, uncertainty was postulated to exist as an intrinsic part of the relational environment, similarly perceived by all individuals. Uncertainty was also conceived as a state that individuals strive to reduce or ameliorate.

Berger and Calabrese's (1975) theory is considered to be a *rational choice theory* (Bowers, Metts, Duncanson, 1987), because of its focus on information seeking and its conception of uncertainty as a cognitive state. Berger (1979) himself emphasizes the cognitive nature of uncertainty.

The law-like suppositions of Uncertainty Reduction Theory were modified in Berger (1979), which outlined three factors that enhance monitoring of the interpersonal situation and to that degree differentially motivate efforts to reduce uncertainty – these factors are *perceived value*, *deviance* and *anticipated future interaction*. Thus, by his 1979 paper, Berger was qualifying his earlier axiomatic claims of uncertainty reduction – uncertainty reduction remained a key motive for the individual except that its activation had become somewhat contingent on characteristics of the interaction situation which functioned as mediating forces. The strict stimulus-response view was reformulated toward a more situational theory.

Sunnafrank (1986) elaborated on one of these mediating factors (*perceived value/utility*) as a critical variable in his 'reformulation of uncertainty reduction theory'. His reformulation is prompted at least in part by inconsistent and weak empirical support for Berger and Calabrese's (1975) hypotheses in the case of both initial interaction and established relationship situations. Sunnafrank argues that most past research has not adequately operationalized uncertainty and for example used the same measures (such as filled pause ratio or the degree of *ahs* and *ums*, Lalljee and Cook, 1973) to assess both the level of uncertainty inherent in the situation as well as critical dependent variables such as the amount of verbal communicative behavior. In other words, the operationalizations have been tautological.

Attempts have been made to use more direct, self-report measures of uncertainty, such as attributional confidence (Kellermann and Reynolds, 1990; Cioffi, 1991). Kellermann and Reynolds (1990) use a set of scaled items for attributional confidence (including statements about confidence, accuracy, certainty, empathy) – which they assert is a commonly used 'inverted measure' of uncertainty. Overall, there does not seem to be enough formal research into establishing construct validity for measurements of uncertainty and there is pressing need for such research. In addition, there needs to be an agreed upon measure for the state of uncertainty that includes both affective and cognitive elements. The lack of agreed-upon and widely used operationalizations is a serious impediment to theory development in this area. Even in the psychological paradigm, as will be seen in the next section, there

is no agreed upon operationalization for ambiguity – instead, the stimulus situation encodes ambiguity.

Berger's (1979) inclusion of mediating factors and Sunnafrank's reformulation (1986) helped move the conception of uncertainty away from a stimulus-response (environmentally induced) model toward a more stimulus-organism-response view where the environment interacts with individual characteristics. This shift can be termed a shift in theorizing about the *locus* of uncertainty – that is, about the site of at which uncertainty is created or experienced.

A more sophisticated account of the locus of uncertainty emerges in the work of Eisenberg (1984). Eisenberg talks of ambiguity rather than uncertainty (as does much of psychological theory). His construal of ambiguity includes connotations of indirectness, lack of clarity, vagueness and disqualification. He posits an *interactional view* of ambiguity which stresses that the interaction between environment and the individual's interpretations is the locus of ambiguity. Eisenberg has a number of points of divergence with URT (Berger and Calabrese, 1975; Berger, 1979) formulations; to begin with, Eisenberg works within the paradigm of organizational communication which is different from the paradigm in which URT was formulated (namely, dyadic interpersonal communication). He stresses message production and interpretation rather than a stimulus-response relationship.

Another important difference is that of their underlying (different) conceptions of communication – Eisenberg stresses that communication is not an 'epiphenomenon' and that language and knowledge are interdependent; this

contrasts with Berger's slightly 'realist' perspective where individuals directly and unproblematically perceive the uncertainty that exists 'out there' without the mediation of language or interpretation. Most importantly, Eisenberg (1984) stresses a strategic use of ambiguity to achieve multiple goals – that is, communicators have multiple goals and ambiguity does not imply ineffective communication. From a view of man as 'inquirer' (Berger, 1979), Eisenberg posits a 'more rhetorical view of communicator as strategist' (Eisenberg, 1984). This is the conception adopted by this study – the focus is thus not on whether or not there is a master motive to reduce uncertainty but rather on how individuals cognitively and affectively interact with situations of uncertainty and what resources they bring to bear on the task.

In keeping with a 'social meaning' perspective (Shapiro, 2002), Eisenberg (1984) criticizes theorists who situate the locus of ambiguity in the message itself; Eisenberg differentiates between *ambiguity* and *perceived ambiguity*. Thus, ambiguity is not a 'given' but must be perceived and ambiguity is not necessarily something that individuals strive to reduce, but rather a discursive, rhetorical strategy that can be purposefully used to navigate important social goals. Eisenberg's (1984) work thus rules out a uni-dimensional response to the experience of uncertainty. This notion of multiple, and often conflicting, goals was elaborated in the Problematic Integration theory (Babrow, 1992).

Babrow (1992) put forth **Problematic Integration Theory** (henceforth PI) on the basis of 2 paradigmatic propositions: that individuals 'need' probabilistic *and* evaluative understandings of the world. Babrow (1992) added to this his third proposition – namely, that probabilistic and evaluative understandings are

integrated, not just in terms of synchronous co-occurrence, but in terms of reciprocal effect and integration with larger networks of beliefs, values, and attitudes. Unlike Berger and Calabrese's (1975) work, Babrow's theory is not embedded in any particular substantive phenomena, such as initial relational interactions. Instead, the substantive phenomena that PI deals with (or purports to apply to) are broad – health and illness are particularly well represented. In addition, a notion of uncertainty as pervasive (a state that an individual is constantly navigating and negotiating) is put forth which distinguishes between the URT perspective of uncertainty as a recurring disequilibrating psychological state.

A major contribution of Babrow's PI theory is the focus on both cognitive and affective elements and the stress on the linking of problematic integrations to wider networks of knowledge and attitudes. However, this perspective also does not adequately address the question of the experience of uncertainty or an operationalization of uncertainty. In fact to some degree, this initial paper does not address the notion of the experience / phenomenology of uncertainty to any extent. Instead, uncertainty seems to be associated with the probabilistic orientation (as opposed to the evaluative orientation).

The substantive phenomenon of chronic illness has been a key site for the formulation of **Uncertainty Management Theory**. Brashers et al (2000) studied the experience of AIDS sufferers through qualitative research. Uncertainty Management Theory has been found to be more relevant to the chronic illness experience than URT. Given that uncertainty is multi-layered, the focus of the individual is posited to be not so much a reduction in

uncertainty as a management of a multiplicity of goals. The choice of health risk messages as stimuli in the current study stems from this focus of recent uncertainty theory on the health and illness domain.

Uncertainty Management Theory is a wider conception than the original uncertainty reduction theory (Berger and Calabrese, 1975) and includes conceptions of strategic use of information to manage (increase, decrease, transform, maintain) uncertainty. While the inclination to increase uncertainty might seem counterintuitive, it might be especially relevant for the risk perception arena – for example, individuals might strive to increase uncertainty, as a way to cope with stress, when presented with an uncertain, threatening risk messages. This contrasts with Uncertainty Reduction Theory where uncertain messages are considered somewhat incomplete – they are theorized as messages that individuals will strive to clarify. In the case of risk perception however, readers might accept qualifiers and hedges as valid information about the scientific process or about the state of knowledge – thus, instead of trying to increase or decrease uncertainty they might accept it as it is.

Uncertainty Management theory can at times seem to be inefficient in the formulation of hypotheses since it stresses a constructivist and strategic perspective to uncertainty which might be taken as relativistic to the point where general principles are difficult to formulate. While the current research ascribes to a constructivist view – that individual readers bring different knowledge and dispositions to a risk message, an attempt is made to understand the mechanisms / processes by which uncertainty is negotiated.

Ambiguity as a construct in psychological theory

Ambiguity/uncertainty has been a widely researched area in both communication theory and psychology*. The focus of research and the larger paradigmatic view of uncertainty is however different in the two disciplines. In psychology, main areas of research have included trait conceptions (tolerance of ambiguity scale as a trait), lexical ambiguity resolution (e.g. Gaskell and Marslen-Wilson, 2001) and the interaction of ambiguity and anxiety (e.g. Blanchette and Richards, 2003; MacLeod and Cohen, 1993). Each of these main strands of research is dealt with in turn in this section.

The trait variable, tolerance of ambiguity (also, referred to as tolerance for ambiguity, intolerance of ambiguity) was well established by the 1950s. In psychology then, ambiguity was theorized as the stimulus feature that produces the state of uncertainty and is responded to in different ways by different people – it was thus a more complex construct than the stimulus-response view set forth by Berger and Calabrese (1975) since the trait variable is an affective-cognitive structure (Izard, reported in Bowers, Mets and Duncanson, 1987) and the focus is on variable responses to ambiguous stimuli, mediated by the trait variable. A trait notion implies that stable predispositions mediate the perceptual and behavioral response to ambiguity – individuals low in tolerance for ambiguity tend to perceive ambiguous

* The term ambiguity is favored in psychology (hence, Tolerance of Ambiguity scale), while the term uncertainty is favored in communication research (hence, Uncertainty Reduction Theory, Uncertainty Management Theory). The term ambiguity is somewhat more favored in this study as it is more influenced by the psychological paradigm.

situations as threatening (Norton, 1975) and to strive toward clear-cut or unambiguous solutions of problems (Frenkel-Brunswick, 1949).

While the trait approach continues to be a focus, particularly in applied research (such as management theory, e.g. Hai and See, 1997), more recent research focuses on how ambiguity is interpreted. One aspect of this research focuses on lexical ambiguity. The main research question here is how individuals resolve lexical ambiguity – that is, how does the listener resolve the ambiguity of, for example, homophones (words that sound the same but have different meanings). The question put forth by various models concerns exactly how important *context* is in influencing this resolution. Gaskell and Marslen-Wilson (2001) point out that *modular accounts* of ambiguity resolution assume that all meanings of ambiguous words are activated regardless of context, and then in the next stage, context constrains the selection of the most appropriate option. In contrast, *interactive accounts* posit that context guides the activation of alternative meanings to begin with. While there is still some contestation between these two types of models, and variations that fall between these two, Lucas (1999) in a meta-analysis, concluded that contextually-appropriate meanings of ambiguous words are more significantly activated than the contextually-inappropriate meanings; that is, the context of the word (or, the sentence and larger conversational/textual frame within which it was encountered) serves to guide the interpretation.

Research on lexical ambiguity resolution provides an investigation into basic cognitive processes of language and the cognitive activation that occurs in response to ambiguous words, both acoustically and semantically. A third

major strand of research that can be identified in research into ambiguity, and which is of central importance to the current research, is a cognitive based experimental paradigm that focuses on anxiety and ambiguity, and the effects of mood states on cognitive processes – thus, when this paradigm investigates words, it extends the lexical ambiguity resolution paradigm by investigating how mood states influence lexical resolution and other cognitive processes.

Within this cognitive based experimental paradigm, robust effects for the emotion-congruent interpretation of ambiguous stimuli have been found (Blanchette and Richards, 2003). The emotion-congruent view implies that individuals tend to interpret ambiguous stimuli in line with the emotional state that they're in. The feeling state of anxiety is particularly well represented in this research (Calvo et al, 2003). The research into the effects of anxiety on the processing of ambiguous stimuli focuses on both state and trait anxiety (for instance, MacLeod and Cohen (1993) focus on trait-anxiety while Blanchette and Richards (2003) focus on state-anxiety) – findings on interpretive biases of anxiety tend to be similar for both trait- and state-anxiety. The present research focuses on state-anxiety. State anxiety can be defined as a feeling state that varies over time in its intensity and is contrasted with trait anxiety which is a relatively stable predisposition to 'perceive a wide range of stimulus situations as threatening' (Schmukle and Egloff, 2004).

The effects of anxiety are classified as three anxiety-relevant cognitive biases (MacLeod and Cohen, 1993) – *attentional*, *memory related*, and *interpretive*. The *attentional bias* refers to the finding that anxious individuals show selective attention for threat-related information – that is, a higher encoding of

threat related over neutral stimuli; also, as Calvo et al (2003) note, threat related information already encoded should be 'especially retrievable'. The *memory-related bias* implies a higher recall for threat-related information (there is inconsistent support for this bias, Calvo et al, 2003). Finally, the *interpretive bias* refers to the tendency of anxious individuals to draw more threatening interpretations from ambiguous information. Interpretive biases have been found for both trait and state-anxiety (Blanchette and Richards, 2003) and are the most pertinent for this study as they refer specifically to ambiguous stimuli.

The basic experimental paradigm in the study of ambiguity and anxiety involves presenting an ambiguous word (generally one that could be interpreted in either a threatening or non-threatening manner). If the word is a homograph (e.g. a word such as *stroke*, which has the same spelling as another word but a different meaning), it might be followed by a word that implies a more or less threatening interpretation (e.g. *heart* or *cat*) in a lexical decision task. Reaction times to these lexical decision tasks are then used to ascertain attentional and interpretive biases. For instance, the degree to which more threatening interpretations (such as *heart* in response to *stroke*) are responded to, is taken as evidence of an interpretive bias. Recall tests are used to ascertain memory-related biases. The stimuli most often used include single words (homographs and homophones are often used, e.g. Blanchette and Richards, 2003) or short sentences (e.g. MacLeod and Cohen, 1993, Hock et al, 1996) and occasionally short paragraphs, for instance describing social situations (e.g. Mathews and Mackintosh, 2000). The most commonly used paradigm, then, does not include texts such as health messages or other

naturalistic texts that must be evaluated in terms of relevance for the self and then used for decision making. This paradigm also does not include any operationalization for ambiguity – instead, ambiguity is operationalized at the level of the stimulus and threatening interpretations are operationalized as both the level of ratings and reaction times to threatening vs. non-threatening interpretations.

Blanchette and Richards (2003) argue that while emotion-congruent effects related to anxiety (such as the attentional and interpretive biases) exist in some situations they might be overridden by contextual information in more complex / naturalistic settings. They stress the importance of context in resolving and interpreting ambiguity. They argue that given additional information, an anxious individual might not make a threatening interpretation of ambiguous information if contextual information helps resolve the ambiguity.

While Blanchette and Richards (2003) raise the issue of interpretation of ambiguity in more naturalistic settings, they continue to use the traditional paradigm of a homophone (*die/dye*) spelling task to investigate the interaction of anxiety and contextual information in the interpretation of ambiguous stimuli. Participants heard the homophone (*die/dye*) and simultaneously saw the contextual cue (*death* or *hair* depending on whether the emotional or neutral context was being used in that trial). They then wrote down the target word they had heard (the spelling task). Blanchette and Richards (2003) found that contextual information constrained interpretation (that is, there was a main effect for context on interpretation). They also found an interaction effect for anxiety and context – in that, anxious participants were more sensitive to

contextual information than low anxious participants (although there was no main effect for mood). Thus, the effect of anxiety was mediated by the presentation of contextual information leading to mood-incongruent effects. They also consider whether the *emotionality hypothesis* is more relevant in this case – the emotionality hypothesis predicts that anxiety is related to increased attention to emotional stimuli in general (and not just threatening or negative information). They find that this is in fact the case – anxiety increases sensitivity to contextual information regardless of the emotional content of the ambiguous material.

The special case of risk communication

Threat vs. non-threat

The positive findings in the psychological paradigm are based on a stimulus model where ambiguous stimuli are constructed so as to have either a threatening or a non-threatening interpretation. Risk communication, however, can be considered a special case of ambiguity in that it always deals with potentially threatening information that is associated with a probability of occurrence (Gorke and Ruhrmann, 2003; Kahlor, Dunwoody and Griffin, 2002). The question of interpretation then is not about whether a threatening or non-threatening interpretation was made, but rather about *degree of threat* ascribed to the stimulus. Thus, while the psychological paradigm uses reaction times for threatening vs. non-threatening sentence continuations as the standard response protocol, the current research uses a scaled variable that measures worry as a means to assess the *degree* of threat evoked by a message.

In addition, risk messages are already ambiguous (even when they do not contain any ambiguating words) since it is understood that they deal not with absolutes but with relatives, and probabilities. This study then is not about the effects of ambiguity, since all risk messages are ambiguous at some level – rather, it is about the effect of ambiguating words or qualifiers over and above the ambiguity that any risk message implies. Thus, even when the messages used in this study are referred to as ambiguous and un-ambiguous messages, it is understood that both imply a certain base level of ambiguity which is inherent in any risk message.

This ambiguity can further refer not only to the strength of the causal claim (*X leads to Y* as opposed to *X might lead to Y*) – which as indicated above is compounded by the inherent ambiguity of risk information – but also to the degree to which a particular message is perceived as applicable to oneself. In other words, an ambiguous stimulus can create ambiguity as a felt experience in two ways – either one is uncertain about the strength of the causal claim being made and/or one is uncertain about the degree to which this causal claim applies to oneself. The latter (applicability to oneself, which can also be cast as perceived susceptibility and risk profile/context, as explicated below) can also explain why contextually appropriate interpretations are made – context serves to constrain meaning about at least one facet of ambiguity, that relating to applicability to oneself. In other words, ambiguity (over and above that inherent in any risk message) can be conceptualized as stemming from both the qualifiers in the stimulus and from the interpretations that personal context or risk profile brings to bear.

Since a risk message implies a threat, an ambiguous risk message is likely to imply a lesser threat since the very knowledge claim on which the threat is based is cast as uncertain. This paper therefore advances the hypothesis that ambiguous risk messages will result in lower interpretations of threat than un-ambiguous messages. Anxiety will likely result in higher interpretations of threat for un-ambiguous messages due to the activation of threat related information, which in interaction with the higher threat implied by the certainty of claims, creates a reinforcing effect.

As regards un-ambiguous risk messages, it is difficult to make predictions based on the psychological paradigm as this paradigm does not directly use un-ambiguous messages. This is a limitation of the psychological paradigm's use of individual words (and sometimes even sentences) as the experimental task – it is not always possible to have un-ambiguous controls (that is, un-ambiguous versions of the ambiguous stimuli). In the case of an ambiguous sentence, while presenting un-ambiguous control messages to another experimental group is possible, it is not generally done (although un-ambiguous messages are often used in the recognition task, these are not strictly controls). The current research uses texts that have two versions: an ambiguous version and an un-ambiguous version, thus providing a more efficient control.

The role of context

Studies within the psychological paradigm tend to use single words or sentences in isolation. In real life discourse, such words are likely to be encountered in sentences/paragraphs which provide context for their interpretation. Even more important for this study, ambiguous words are likely to make ambiguous entire messages and in the case of health risk messages, the reader's own risk profile (risk factors, knowledge about their own behavior that helps interpret claims about the severity and susceptibility of risks) is likely to serve as such a context.

As Blanchette and Richards (2003) indicate, anxious individuals make *more* contextually appropriate interpretations; however, in the case of health messages *contextually appropriate* could imply a range of hypotheses including a closer relationship between context/risk profile and worry for anxious individuals or a higher discrimination between ambiguous and unambiguous messages or even a faster/deeper activation of context related information.

Further, for the current research, context means something somewhat different from what it meant for Blanchette and Richards (2003) or for lexical ambiguity theory. For Blanchette and Richards (2003), context was a within subjects factor that they manipulated at the level of context cues presented before the stimuli material. They were attempting to extend earlier work on the emotion-congruent effects of anxiety by considering a situation where context could constrain the interpretation of ambiguity. The context, was thus something that could be provided or withheld by the researchers in an

experimental design. On the other hand, for the purposes of this study, context also refers to the risk profile of each reader for a particular message. It thus includes not only the context provided by message structure and continuation sentences but also that provided by each reader's personal frame for interpreting that specific message – it is the past experiences, meanings and self-specific knowledge of behavior that can be assumed to be activated when a reader encounters a risk message and then subsequently guides their interpretation of the message. It is not only supplied by the experimental context, but also functions as a covariate.

Although Blanchette and Richards (2003) use contextual probes, these probes apply to the semantic meaning of the words alone. The context they provide is not in the realm of the kind of personal knowledge about oneself and one's own behavior that would make one or the other interpretation more relevant. This study uses a conception of context that more strongly evokes personal meanings and situates relevance.

The design of the current research utilizes naturalistic texts that have a higher affinity with real-world decisions involving ambiguity. The ambiguous texts used in this research are more akin to knowledge claims that are in dispute. Homophone and homograph tasks are not coherent arguments, nor do they claim for themselves any application to the reader's life.

As mentioned in the previous section, ambiguous messages not only imply an ambiguity about the strength of causal claims, but can also create ambiguity about the degree to which these claims are perceived as applying to oneself.

This source of ambiguity can be conceived as existing in any risk message (regardless of whether or not it has been ambiguated through qualifiers).

Research question

How is worry and susceptibility for health risks affected by ambiguity, anxiety and risk profile?

Hypotheses

H1 In keeping with the emotion-congruent effect, that state-anxiety induction will result in higher levels of worry and susceptibility ratings for both ambiguous and un-ambiguous messages.

H2 Ambiguous messages will result in lower levels of worry and susceptibility than un-ambiguous messages

H3 Contextually appropriate interpretations will be made in that a higher risk profile will result in higher worry and susceptibility

CHAPTER TWO

This chapter elaborates on the research procedure followed in this study. It begins with details on the manipulation of between- and within-subjects independent variables, followed by a discussion of the main dependent variables, a note on procedure and a final sum up on research design.

Manipulation of between-subjects variable: State-anxiety Induction

State-anxiety is a mood state that ‘varies in intensity and fluctuates over time’ (Schmukle and Egloff, 2004). Blanchette and Richards (2003) used a state-anxiety manipulation where participants were told that they were being filmed while they completed the experimental task, and that their facial expressions would be analyzed. This particular induction procedure did not prove to be successful in a pilot test – that is, it did not seem to induce state-anxiety as evidenced by the difference between pre- and post-task measures. In addition, the drawbacks of this manipulation are that there is a possibility that having a video camera on during the entire reading task could detract cognitive resources, thus introducing a potential confound. A slightly more rigorous induction procedure was employed that involved a video camera and a public speaking task. Schmukle and Egloff (2004) use the public speaking task as a means to induce state-anxiety and report it to be an effective manipulation in inducing state-anxiety.

Manipulation of within-subjects variables: Stimuli Materials

The key stimuli used in this study were 6 messages about a range of health risks – Lyme disease, acrylamides in fried foods, a link between coffee and osteoporosis, a link between cell phone usage and brain tumors, high cholesterol in young people, and a link between jogging and knee arthritis.

Attempts were made to select message topics that are not as commonly targeted to youth populations as are messages about, for example, alcohol and STDs. An attempt was also made to include health risks that do not have a widely known scientific consensus (by this count a topic like AIDS would not qualify as its etiology is well known). This was done to limit the role of prior knowledge and also to limit the possibility that ambiguation would be considered implausible (for instance, ambiguation of a message about AIDS etiology is likely to be considered implausible).

Messages were created by searching health websites on the Internet and synthesizing multiple sources to create a short message; two versions were then formulated for each message – an ambiguous version and an un-ambiguous version (average message length was 80 words for the ambiguous messages and 64 words for the un-ambiguous messages). The ambiguous version was formulated by adding a range of qualifying or hedging words (such as *might*, *seem*, *perhaps*, *possibly*, *probably*, *sort of*, *suggested*) to the message. Guidelines for ambiguation of messages were taken from Hyland (1996). Un-ambiguous versions were created by removing any such qualifiers.

Each message was preceded by an introduction that mentioned the topic of the message and served to draw the attention of the participant to the fact that a new message was going to appear on their screen. Each message was then followed by a set of questions that appeared in the same order after each message. These questions are the dependent measures for this study. (The two versions of the six messages, together with introductions, are included in the Appendix A).

In sum, message type (6 different topics) and message versions (ambiguous and un-ambiguous) were the within-subject factors in this experiment.

Self-report scales

An ambiguity scale was used to assess tolerance of ambiguity, an important trait variable in the psychological paradigm. The ambiguity scale was taken from a website about online surveys, accessed at http://www.prenhall.com/whetten_dms/chap1_4.html. A sample of this scale can be seen in the Appendix B. The scale consists of 16 statements, on a 7 point agree-disagree scale. The ambiguity scale was the first task that respondents completed on entering the experimental room.

A multi-item anxiety scale was prepared that included items referring to feelings of anxiety, tenseness, excitement and nervousness. Items were taken from Spielberger's 20 item State Anxiety Inventory (1983, accessed at <http://www.psych.uncc.edu/pagoolka/StateAnxiety-intro.html>) and then

converted into an 8 item (6 anxiety related items from the State Anxiety Inventory and 2 distractors related to *hunger* and *fatigue*), 10 point bipolar scale in an attempt to improve discrimination. A sample of this scale can be seen in the Appendix C. The same set of items was used to assess anxiety before and after the experimental task, resulting in pre- and post-task state-anxiety measures. Blanchette and Richards (2003) use a single-item state-anxiety measure – this provided some precedent and rationale for using an ad-hoc multi-item scale, instead of a proprietary validated scale such as the State Anxiety Inventory.

Dependent measures and covariates

A range of dependent variables were measured for each message, including attributional confidence, relevance, perceived susceptibility, and worry; the variables covered both affective and cognitive measures (the exact wording of questions can be found in the Appendix D). Of particular relevance to this study are:

- Attributional confidence – this variable serves as an inverted measure of perceived ambiguity or uncertainty of a message (Kellermann and Reynolds, 1990). While the original conceptualization of this message was formulated for interpersonal interaction situations, the variable is being used for message effects in this case. The wording of this measure refers to the confidence that a reader feels in using that particular message to guide decision making about health. Similar to Kellermann and Reynolds (1990) conception, this is an inverted

measure, in that lower attributional confidence implies a higher level of perceived uncertainty.

- Perceived Susceptibility – The particular question employed to assess this variable in this research refers specifically to the perceived likelihood or susceptibility to a particular health risk. The wording of this question is fairly standard in the risk perception domain (for instance, Windschitl and Wells, 1996) and this is an important variable in risk communication research.
- Worry – This variable is an affective variable that reflects concern evoked by a message. It is being employed as an operationalization of the degree to which threatening interpretations are made of a risk message.

While these measures reflect dependent variables, two other variables, risk profile information, as a measure of context, and familiarity, as a binary measure of prior knowledge, reflect covariates or, more precisely, contextual variables. They are being termed as such since these are likely to be message-independent measures – in other words, they are independent of the particular version of the message, but are linked to the basic topic of the message instead. They refer to the context within which the messages are likely to have been read and interpreted by the participant in the experimental task; these two variables represent then the particular pattern of prior knowledge that would have guided reading and interpretation.

- Risk profile information – This measure assessed personal risk profile information in a unique way for each message – thus, the message about coffee drinking and its link to osteoporosis assessed risk profile

by asking how many cups of coffee the participant drank while the message about jogging and its link to knee arthritis assessed risk profile by asking whether or not the participant tends to jog on a hard surface.

- Familiarity – This measure was a binary (yes/no) measure of whether or not the reader had heard about the particular message topic before.

These questions were asked in an invariant order after each of the six messages that participants were exposed to. The order of questioning was as follows: worry, perceived susceptibility, risk profile information, attributional confidence, motivation to seek more information, relevance, familiarity. The rationale behind this order was to ask affective questions related to worry as soon as the message was read; to ask perceived susceptibility questions before risk profile information was explicitly activated; to ask the questions which seemed to be not as dependent on recency, such as familiarity and relevance of the topic, at the end.

Theorists, such as MacLeod and Cohen (1993) and Hock et al (1996), stress the importance of unobtrusive measurements, such as reaction time, as being critical in avoiding response bias effects. The experimental software recorded the reading latencies and response latencies for all messages and dependent variables. The reading latencies were operationalized as the time elapsing between the participant clicking NEXT on the introduction to the message and then clicking NEXT on having read the message. Response latencies were operationalized as the time it took participants to read the each question (representing dependent variables and covariates) as it appeared after the message, and clicking/writing their response.

Procedure

The sample for this study consisted of 52 undergraduate students drawn from Communication classes (though not from either Risk Communication or Science Communication). Participants received extra credit for their participation in the study. There were 26 participants each in the treatment (anxiety-induction) and control group.

Participants were assigned randomly to the treatment (state-anxiety induction) or control condition. Within each condition, participants were randomly assigned to one of six message orders, created so as to control for order effects. Each participant read 3 ambiguous and 3 un-ambiguous messages in random order. Participants were told that the study was about how students read and respond to health messages prepared for a student population. This instruction was an attempt to increase involvement with the messages. Participants completed the experiment individually. The testing room, laptop, and other settings (such as orientation of furniture in the room), were the same for all participants. In addition, the researcher was the experimenter for the entire study.

In the anxiety induction group, participants filled out the ambiguity scale, followed by the pre-task state-anxiety scale. They were then informed that a separate part of the study involved them making a speech about a health topic and that they would be videotaped while doing so – it was at this point that the consent form was introduced (state-anxiety was measured prior to participants being informed of the speech task – this was done to create an equal

condition for the pre-task state-anxiety measure with the control group). They were told that the speeches would then be rated for the logic of their arguments and also to understand how people think about health topics. They were then given a couple of minutes to 'prepare' their speech while the researcher set up a video camera on a tripod right in front of the table where the participant was preparing their speech. Participants made a speech lasting a couple of minutes. They were allowed to stop whenever they felt they had said what they wanted to.

After making the speech, participants were told to move on to the 'message part' of the study and they completed the experimental task of message reading. The anxiety induction manipulation was thus set up to seem a different part of the study – this was done so that it created more of a priming situation and so as to not detract from the cognitive resources being allocated to the experimental reading task (which might have occurred if, for instance, participants were told that the speech would be made *after* the reading task). Further, none of the messages used in the study related to the topic of the speech in the anxiety induction phase - 'whether smoking should be allowed in public places'. After reading the messages, participants completed the post-anxiety scale.

In the control group, participants completed the ambiguity and anxiety scales and went straight to the reading task. The reading task was the main experimental task and required participants to read six health messages in a self-paced manner; in other words, participants could control the speed with which they read each message.

At the completion of the experiment, participants were debriefed. Participants in the state-anxiety induction condition were informed that the aim of the public speaking task was to enhance their concern levels and that their speeches would not be analyzed in any way. The process by which messages were made ambiguous was explained to all participants. In addition, participants were reminded that if they were really concerned about any of these health risks, they should either search for information about it themselves or ask a health care provider.

Research design

The study used a mixed experimental design – *state-anxiety-induction* served as the between-subjects factor while *ambiguation of messages* served as the within-subjects factor. Further, the design was partially nested – it was *nested* in the sense that repeated measurements were nested within individuals who were then nested within the treatment vs. control group (Bordens and Abbott, 2002); it was *partially* nested in that participants received either the ambiguous or un-ambiguous version of each of 6 messages – that is, participants were not exposed to all versions of all messages and if they received the ambiguous version of message 1, they would not receive the un-ambiguous version of that same message.

CHAPTER THREE - RESULTS

This section focuses first on sample characteristics, followed by assessments of the efficacy of the experimental manipulations. Multi-level models with worry as the dependent variable are presented next, followed by a short discussion of susceptibility.

Sample profile

There were 26 participants each in the treatment (anxiety-induction) and control group, with an overall mean age of 20.4 years (there was no significant age difference between the treatment and control group) and of which 65% were women (there was no significant difference in the gender make-up of the two groups).

Anxiety induction

Items 1, 3, 7 and 8 were reverse coded so that higher scores on the state-anxiety scale implied higher levels of state anxiety. A composite pre- and post-task anxiety score was created by summing all items other than item 1 and 4 (which were distractor items about fatigue and hunger respectively) and item 3 (which was an item about excitement and was found to compromise the internal consistency of the scale as measured by Cronbach's alpha). The resulting scale had a Cronbach's alpha of .643 for the pre-task measure and .689 for the post-task measure. The pre- and post-task measures were then used to create a pre- and post-index.

This section of the results focuses on whether the anxiety-induction method (or the manipulation of the between subjects variable) was effective. Two-tailed independent samples t-tests were conducted to ascertain whether the state-anxiety group and the control group differed in their state-anxiety levels prior to the manipulation of state-anxiety, i.e. on the pre-task state-anxiety measure. None of the state-anxiety items showed any significant differences between the two groups – in other words, there were no pre-existing differences in state-anxiety between the two groups.

In order to assess whether there was a significant difference between pre- and post-task measures of any of the state-anxiety items, an overall *anxiety differential* was calculated for the scale, by subtracting the pre-task index from the post-task index. Positive anxiety differentials, then, indicate an increase in anxiety over the course of the experiment. At the overall level, independent sample two-tailed t-tests were insignificant in establishing an anxiety differential between the treatment and control groups ($t(49) = -1.1420, p = .162$).

Anxiety differentials were then calculated for each item on the scale.

For the control group, one anxiety differential was significant, according to a two-tailed one sample t-test, against the criterion zero (that is, the null hypothesis stated that the anxiety differential was equal to zero). This item was Item 2, and referred to the degree to which the participant felt tense, $t(25) = -3.333, p = .003$. However, the mean difference (from zero) in this case

was $-.9231$, indicating that anxiety as measured by this item, actually fell over the course of the experimental task for the control group.

For the state-anxiety induction group (or the treatment group), one anxiety differential was significant, item 6, referring to the degree to which the participant felt unpleasant, $t(25) = 4.028$, $p = .000$, with a mean difference (from 0) of 0.880 . Further, this anxiety differential was also significantly different between the two groups (that is, the treatment group showed a greater increase in unpleasantness over the course of the experimental task, than the control group, $t(49) = -2.524$, $p = .015$).

In sum, there was only one anxiety item that showed a significant increase between pre- and post-measurement for the treatment group (and this item did not show a difference in the control group). This piece of evidence is not enough to conclude that state-anxiety was in fact induced – although this is a tested induction procedure for state-anxiety, it is possible that it did not function effectively in this study.

Ambiguity scale

The ambiguity scale was found to be multi-dimensional with a Cronbach's alpha of 0.492 . Due to its low reliability, it was excluded from further analysis.

Multi-level modeling

The primary statistical technique used for assessing the effects of the experimental manipulation and covariates was multi-level modeling. This technique is especially appropriate for situations where data is hierarchically structured (Kreft and De Leeuw, 2002) or nested. It is also suitable for repeated measures (which is a special case of nesting, as observations are nested within individuals) where not every participant receives every treatment (in this research, not every subject received all versions of the six messages – i.e. they either received the ambiguous or the un-ambiguous version for each message). Finally, multi-level modeling is useful to control for intra-group correlations (in this case, correlations within the same treatment / control group or correlation of observations within the same participant) – in other words, it controls for the similarity that comes from membership within a group (whether that ‘group’ is a treatment group or a group of measurements within the same person).

The main analysis for this study is the effects of Treatment, Message, Ambiguity and Context on worry. The multi-level models were run step-by-step, starting with the between-group variable (control group vs. state-anxiety induction / treatment group) and moving onto the within-group variables of message and ambiguity. These were the three variables that were experimentally manipulated in this study. Context was then entered into the equation as the covariate/non-manipulated independent variable.

Predicting Worry

Effects of State-Anxiety

A repeated effects model was run with Treatment (state-anxiety induction vs. control group) as the only fixed effect specified for the dependent variable of worry. There was a significant main effect of Treatment in the hypothesized direction ($F(df:49.765) = 2.771, p = .102$; since this is a directional hypothesis we can consider $p/2 = .051$ and conclude that there is a significant effect of treatment). That is, participants in the state-anxiety induction treatment group interpreted the health risk messages as more threatening, i.e. worrisome ($M = 2.676, SE = .117$) than participants in the control group for whom state-anxiety levels were not manipulated ($M = 2.401, SE = .117$).

The next model was run with Treatment and an additional variable, Message (the six different messages used) as main effects; an interaction term between the two was also specified. The Message variable had a significant main effect ($F(df:84.671) = 3.605, p = .005$) indicating that the topic of the message itself resulted in significantly different levels of worry. Pair-wise comparisons for the six messages indicate that Message 2, the message about Lyme disease, resulted in significantly lower worry ($M = 2.077, SE = .159$) than most other messages (for example, Message 3 about knee arthritis had the highest worry ratings, with $M = 2.885, SE = .175$).

There was no significant interaction of Treatment and Message ($F(df:84.671) = 1.054, p = .392$) indicating that state-anxiety resulted in higher interpretations of threat as manifested in ratings of worry, regardless of the

type of message that the reader was exposed to. This result then indicates the generalizability or robustness of Treatment effects.

Effects of Ambiguation

The next multi-level model was run by adding Ambiguity (each respondent received three ambiguous and three un-ambiguous messages) as a variable in the above model and specifying all possible interaction terms for the three main effects of Treatment, Message and Ambiguity. A significant main effect for ambiguity was found ($F(df:236.584) = 5.485, p = .020$) in the expected direction – ambiguous messages resulted in lower worry ($M = 2.407, SE = .104$) than un-ambiguous messages ($M = 2.703, SE = .104$). There was no significant interaction between Ambiguity and Message ($F(df:85.476) = 1.129, p = .351$) indicating that the effects of ambiguity on worry were independent of the type of message that the reader was exposed to. There was also no significant three-way interaction between Treatment, Message and Ambiguity ($F(df:85.476) = .552, p = .737$).

Further, there was a significant interaction between Treatment and Ambiguity ($F(df:236.584) = 3.875, p = .050$), implying that the effects of Treatment and Ambiguity differ at different levels of these variables. In order to further specify the interaction between Treatment and Ambiguity, the model was re-run retaining the significant terms, Treatment, Message, Ambiguity and the interaction term for Treatment and Ambiguity.

The graph in Figure 1, illustrates the interaction between Treatment and Ambiguity and its effect on the dependent variable of worry.

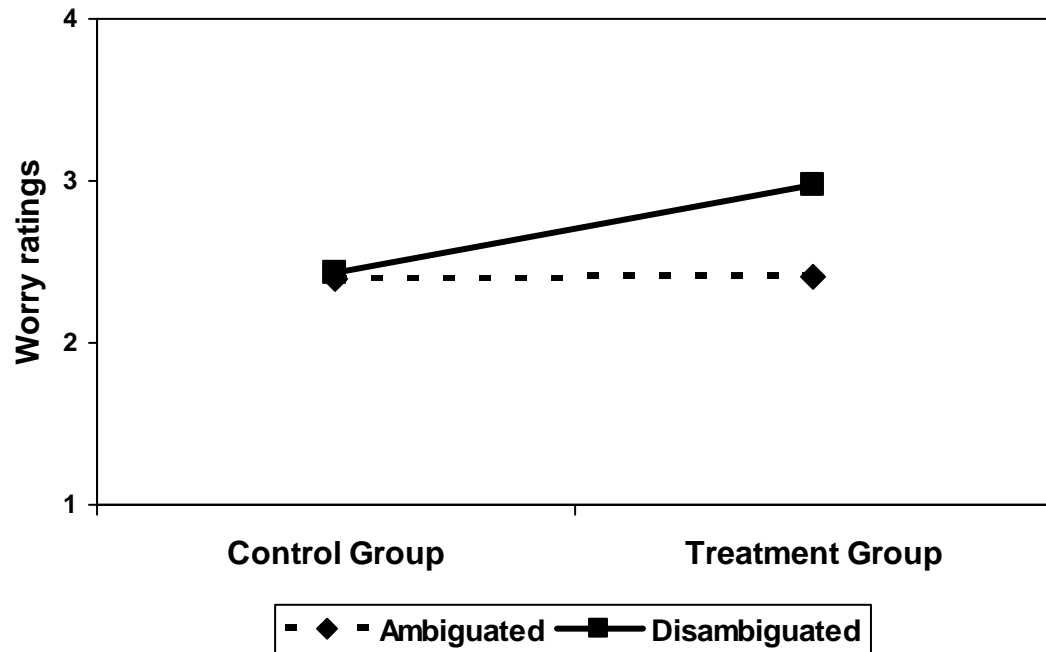


Figure 1. Worry ratings for ambiguous and un-ambiguous messages

Figure 1 indicates that participants in the state-anxiety group showed a higher degree of worry for un-ambiguous messages than for ambiguous messages. On the other hand, participants in the control group did not show significant differences in worry for the two different types of messages. This indicates that Treatment and Ambiguity main effects are largely (if not entirely) a result of differences in the way in which participants in the state-anxiety group interpreted the un-ambiguous messages.

This finding partially supports Hypothesis 1 and 2. Hypothesis 1 stated that state-anxiety induction will result in higher levels of worry for both ambiguous and un-ambiguous messages, while Hypothesis 2 postulated that ambiguous messages will result in lower levels of worry than un-ambiguous messages. Due to the interaction effect, Hypothesis 1 and 2 hold only for anxious participants and un-ambiguous messages.

*Effect of Context**

The above analysis reflects the impacts of experimentally manipulated variables on worry. This section analyzes the effects of context, which can be considered a covariate, on worry. As argued earlier, personal context or risk profile can rightfully be considered a covariate or akin to an independent variable. Statistical analyses further support this in that there is no significant effect of Treatment or Ambiguity on risk profile information (or context) – that is, different experimental manipulations did not affect the risk profile information evoked (in other words, state-anxiety induction or ambiguation of messages did not result in participants reporting a higher or lower risk profile). Message has a significant main effect on risk profile but this is likely to be because the population being studied has higher risk profiles for certain of the health risks being studied than others.

A standardized risk profile or context variable was then added to the multi-level model of worry. The risk profile variable was standardized in order to account for the disparity in units. The disparity arose since risk profile was

* Context here refers to the risk profile information that was gathered for each participant for each message that they read. That is, context is the message-specific risk profile reported by the participant.

measured with a different message-specific question for each message (for instance, one risk profile question focused on number of cups of coffee drunk per day while another was a nominal question asking the participant if they had ever done any of the following). (See Appendix D for more details on the questions asked to ascertain risk profile for each message).

On adding this standardized context variable to the above multi-level model of worry, a significant main effect was found ($F = 48.290$, $p = .000$), indicating a robust effect of risk profile on worry in the expected direction (a positive influence of risk profile on worry, such that a higher risk profile results in more worry; in other words, contextually appropriate interpretations are made. There were no significant interactions of context with Treatment, Message or Ambiguity. The model was run again without these insignificant interactions (the interaction of Treatment and Ambiguity had reduced in significance; $F = 3.587$, $p = .059$)

Since the addition of context does not impact main effects of Treatment, Message or Ambiguity we can conclude that its effect is orthogonal to these effects. In other words, the effects of risk profile information on worry are not affected by either the treatment condition or message ambiguity.

This also implies that the effect of ambiguity, as a message variable, on worry is independent of the effect of risk profile, an individual variable constraining the interpretation of personal applicability.

These findings offer strong support for Hypothesis 3 which predicted that contextually appropriate interpretations of threat would be made.

Predicting Perceived Susceptibility

The same step-by-step model as above was run for perceived susceptibility. In the final model, the only two variables that attain significance in predicting perceived susceptibility are risk profile ($F(df:277.516) = 100.761, p = .000$) and message ($F(df:74.013) = 6.394, p = .000$). Thus, neither Treatment nor Ambiguity have a predictive significance for perceived susceptibility – anxious readers are not more likely to perceive themselves as more susceptible, nor did ambiguous messages evoke lower susceptibility than un-ambiguous messages. For the case of susceptibility then, neither Hypothesis 1 nor 2 were supported. However, Hypothesis 3 was supported in that personal context or risk profile was a strong predictor of susceptibility.

Table 1 below summarizes the worry and perceived susceptibility ratings for the two independent variables that were manipulated in this study. The interaction effect between Treatment and Ambiguity can be clearly seen for the dependent variable of worry. No such pattern exists for perceived susceptibility.

Table 1. Worry and susceptibility for by type of message and treatment*

WORRY	Control Group	Treatment Group
Ambiguous	2.389	2.408
Un-ambiguous	2.438	2.97
SUSCEPTIBILITY	Control Group	Treatment Group
Ambiguous	42.022	40.412
Un-ambiguous	40.916	44.342

Attributional confidence and the Ambiguity manipulation

Was ambiguity perceived – that is, did the ambiguous messages result in lower attributional confidence as was expected of this dependent measure? This question is not being asked as a manipulation check. Building on O’Keefe’s (2003) argument about manipulation checks, the messages *were* different, and therefore the question is then one of whether they were perceived as such. Participants were asked to report their level of confidence in each message as an inverted measure of ambiguity; with the assumption that lower levels of attributional confidence imply higher levels of perceived ambiguity*. The mean attributional confidence scores indicate no significant main effect for Ambiguity ($F(df:233.727) = .022, p = .883$). As mentioned (pg.19), ambiguity (over and above that inherent in any risk message) can be conceptualized as stemming from both the qualifiers in the stimulus and from the interpretations that personal context or risk profile brings to bear. It would

* Worry is measured on a five point scale, while susceptibility is measured on a 0 to 100 scale.

* The exact question asked of participants was: *How CONFIDENT are you in using the information presented in this message to guide your health decisions? Please enter a number from 1 to 5, where 1 means not at all confident and 5 means very confident.*

appear that attributional confidence as a ratings measure does not tap into ambiguity at the level of the qualifiers in the message.

While there was a significant main effect for Message and a significant interaction between Message and Ambiguity, there was no pattern to this interaction (that is, ambiguous messages did not consistently receive lower attributional confidence scores). Thus, ambiguity did not predict attributional confidence in any systematic way.

However, risk profile information did predict attributional confidence (F (df:224.969) = 6.943, $p = .009$). In other words, the higher a participant's reported message-specific risk profile, the higher their reported confidence in a message. That is, the ambiguity that stems from uncertainty about whether or not a message applies to one is captured in attributional confidence. This might be a result of the personalizing tone of the question '*how confident are YOU*' which might be activating risk profile information or contextual information in its interpretation.

Further, Ambiguity did significantly predict the *time taken* to make decisions about attributional confidence (F (df:227.590) = 5.757, $p = .017$), with ambiguous messages resulting in a higher response latency ($M = 8054.2$, $SE = 372.4$) than un-ambiguous messages ($M = 7113.1$, $SE = 372.4$). This might be evidence of an effective measure of ambiguity. As Hock et al (1996) point out, the time taken to make self-report ratings is as important as the ratings themselves. A higher response latency implies more time taken to reach conclusions and hence a possibility that the respondent was considering more

than one response. Finally, risk profile information also significantly predicted time taken to make conclusions about attributional confidence ($F (df:256.626) = 4.658, p = .032$). Thus, those with a higher risk profile thought longer about their degree of confidence in the health risk message.

CHAPTER FOUR - DISCUSSION

This study built on the cognitive experimental paradigm to study the effects of anxiety on the interpretation of ambiguous stimuli. Risk messages were conceptualized as being different from the types of ambiguous stimuli used in the traditional psychological paradigm. It seemed likely that ambiguous health messages would result in lower levels of threatening interpretations since there would be more leeway for interpretation, a range of possible degrees of threat and hence lower concern. This was in fact found to be partially the case. Ambiguous messages served somewhat as a baseline; in the case of non-anxious participants, ambiguous and un-ambiguous risk messages evoked similar degrees of worry. In the case of high anxious participants, ambiguous messages evoked the same degree of worry as was evoked in the control group. However, higher worry was evoked in the state-anxiety induction group for the un-ambiguous messages. In other words, participants in the state-anxiety induction group discriminated between the ambiguous and un-ambiguous messages, while control group participants did not.

Worry and the Interaction Effect

In the traditional paradigm, ambiguity is interpreted in a more threatening manner under conditions of anxiety than under control conditions. In my study, ambiguous information was interpreted in largely the same way by treatment and control participants. It was the un-ambiguous messages that were interpreted as more worrisome by anxious participants.

What could have resulted in this discrimination?

Before answers to this question are considered, the issue of induction and measurement of state-anxiety must be raised. The possibility cannot be ruled out that the treatment and control group did not differ in state-anxiety but differed in some other variable that remained unmeasured (for instance, cognitive arousal, self-presentation concerns raised by the public speaking task leading to greater environmental monitoring and so on). Only one state-anxiety item showed evidence of a significant increase in state-anxiety over the course of the experimental task for the treatment group vs. the control group.

At the same time it can be argued that state-anxiety measurements, like other self-report measurements that attempt to tap into current mood state, are subject to validity limitations (Schmukle and Egloff, 2004), including demand characteristics and a lack of awareness – this would make it unsurprising that a state-anxiety induction procedure that has been tested in past research and found to be effective (e.g. Schmukle and Egloff, 2004) did not show pre-post induction differences. In addition, the timing of the post-task state-anxiety evaluation might have been too delayed to capture inductions of state-anxiety done before the task.

In another vein, Castro et al (1998) argue that the effects of mood state depend not on intensity of mood, but rather on the '*cognitive context activation*'. In other words, a weak mood induction could still result in treatment effects such as those seen in this study. This again leaves open the idea of just what this *cognitive context activation* would be given a public speaking

task and the particular topic on which it focused (*smoking in public places*). Participants did not focus only on health issues during their extempore public speaking task – they also focused on issues of civil freedoms, hygiene and personal stories. It cannot therefore be concluded that some health related cognitive network was activated and served as a framework for the experimental reading task. It is likely that the public speaking task increased overall levels of alertness (although as discussed below, reading times do not differ by treatment). In counterargument, it can be said that the treatment resulted in some affective rather than cognitive change since the effects of the treatment were on an affective variable (worry) rather than on a cognitive variable (susceptibility).

Since its difficult to conclude about what differed between the treatment and control groups that created the interaction effect in predicting worry, explanations for the interaction effect are not straightforward. A few alternative hypotheses are considered below.

One possibility for the interaction effect is that the state-anxiety induction resulted in either higher arousal (which is a conjecture and cannot be ascertained at this time) or in more strategic processing of messages. The time taken to read each message could be taken as a crude measure of strategic processing in that longer reading times could indicate more attention was paid. However, time to read messages (adjusted for length of message) does not vary by Treatment ($F = 1.011, p = .320$). In other words, time taken to read the message cannot be used to explain the discrimination between ambiguous vs. un-ambiguous messages made by anxious readers.

A more likely reason for higher concern levels for un-ambiguous messages in the Treatment group could be a higher discrimination for threat levels. Since the un-ambiguous messages are more unequivocal as to their threat levels, anxious readers likely interpret it as such. Blanchette and Richards (2003) found that anxious participants were more sensitive to the emotional context of stimuli, in that they made more contextually appropriate interpretations than did non-anxious participants. As mentioned earlier, context can be conceptualized both as a stimulus characteristic and as personal context/covariate. Which of these two meanings of context can best explain the difference found between ambiguous and un-ambiguous messages for anxious participants?

An explanation based on context as personal covariate can be argued on two grounds, both of which seem unlikely. Firstly, it can be argued that if risk profile information interacts with either Treatment or Ambiguity it could potentially explain the interaction of Treatment and Ambiguity. However, personal context or risk profile information did not interact with either Treatment or Ambiguity (nor was there a three way interaction of Treatment/Ambiguity/Context) and it therefore seems unlikely that personal context had anything more than a main effect. The second argument could be that the Treatment or state-anxiety induction condition resulted in a greater retrievability of threat related information from memory (in this case, threat related information can be taken to mean risk profile information). However, the time taken to respond to the question on risk profile (which could serve as a crude measure of the retrievability of threat related information) did not vary

by Treatment – in other words, state-anxiety induction did not result in a faster reaction time to questions about risk profile ($F = .474, p = .495$).

Therefore, it seems more likely that this interaction effect is a result of the context of the stimulus itself. That is, anxious participants were more sensitive in discriminating between disambiguation and ambiguity.

In sum, contrary to the predominant paradigm, mood-congruent effects were only found for un-ambiguous messages.

Worry and Perceived susceptibility

While it might be tempting to conclude that the measures of worry and perceived susceptibility adequately capture severity and susceptibility (the two components of risk perception, Rimal, 2001) respectively, it is more likely that both capture susceptibility in some sense; this is because both measures are personalized and do not ask about the severity of the claim *except* in connection with the self. The worry measure is however probably tapping more into affective elements of susceptibility than is the perceived susceptibility measure. It can also be said that the two measures reflect a numerical vs. verbal approach to measuring uncertainty.

Research into numerical and verbal measures indicates that verbal measures are more closely linked to behavioral intentions than are numerical measures of uncertainty (Windschitl and Wells, 1996). This finding can be mapped onto this study even though worry and perceived susceptibility are not exactly

measuring uncertainty. However, the numerical measure used in the Windschitl and Wells (1996) study are akin to those used in this study (using a similar 0 to 100% scale). The present research extends this finding somewhat in that worry is more predictive of motivation to seek more information ($F(df:277.736) = 64.623, p = .000$) than is perceived susceptibility ($F(df:275.712) = 0.970, p = .326$).

Information seeking is often cast as a behavioral outcome (Rimal, 2001) and the present research indicates that the affective measure of worry is a better predictor of behavior than is the perceived susceptibility measure. This gives credence to the recommendation that affective measures such as worry should be more widely employed in risk research.

Attributional confidence and ambiguity

While Ambiguity had a main effect on worry, attributional confidence did not significantly discriminate between ambiguous and un-ambiguous messages, implying that this was not a valid measure for ascertaining felt ambiguity. On the other hand, as was true of worry and perceived susceptibility, risk profile information significantly predicted attributional confidence. In other words, the higher a reader perceived their own risk profile to be, the more confidence they had in using the message to guide decision making. Attributional confidence was not related to any inherent characteristics of the message, but rather to the relevance of the message to the individual. However, the response latency for attributional confidence did vary by Ambiguity implying

that more time was required to make judgments about the self-reported confidence in ambiguous messages.

Limitations

There are some possible limits to the generalizability of these results. To begin with, it is not clear what cognitive / affective changes were actually brought about in the treatment condition. This makes it harder to generalize the effects of the treatment condition to real-world situations relevant to the health risk substantive domain. For instance, it can be assumed that a common situation of state-anxiety with respect to health risks might be an individual doing a strategic, intentional search for information on a particular health topic about which they are already concerned.

The ambiguation of messages focused on causation claims and not on, for instance, response efficacy claims (that is, claims about the efficacy of behavioral recommendations for alleviating risk; Rimal, 2001). Ambiguation might therefore have different effects when different aspects of health risk messages are made ambiguous.

The sample was small and homogeneous. While the sample at the level of messages was large (each of the 52 participants read 6 messages; hence 52 x 6), the sample size at the between-factor level was small (26 participants in

each group). Further, all participants were young students and results might be limited to this population.

Conclusion and Recommendations

This study attempted to address some of the limitations of the experimental psychological paradigm on the interpretation of ambiguity. Firstly, the current research uses naturalistic texts, rather than single words or sentences or hypothetical situations. Secondly, a measure of ambiguity is used to assess perceived ambiguity for health risk messages – neither the psychological paradigm nor the communication research paradigm tend to use perceived ambiguity measures such as attributional confidence. Finally, the notion of context was expanded to refer not only to sentential frames, but also personal knowledge structures that are likely to be activated while reading.

This study also has some interesting implications for the formulation of health risk messages. It appears that under normal, i.e. control, conditions, there was no difference found between ambiguous and un-ambiguous messages – readers were not able to differentiate between the messages, perhaps because the manipulation was subtle and they were not reading with any strategic comprehension tasks in mind (that is, they were reading under normal conditions, and not in a situation where they would be likely to pay explicit attention to nuances).

An important finding for this study was the critical role of personal context or risk profile information in the interpretation of health risk messages. The measurement of this variable is straightforward and behaviorally oriented; it is not an attitudinal or perceptual measure. Given its predictive power with respect to a range of dependent variables (worry, perceived susceptibility, attributional confidence), and its almost 'objective' behavioral nature, it seems to be a very useful variable that should be more used in risk research.

In addition, worry emerged as a useful variable for risk research since it had higher predictive power for information seeking than did susceptibility as commonly measured (using 100 point scales).

Future research could focus on better understanding the precise mechanisms by which the Treatment and Ambiguity interaction effect arises. Studies could also investigate the effects of varying degrees or manifestations of uncertainty. Future research could also attempt a more complete understanding of exactly how popular texts of various kinds (pharmaceutical prescription advices, articles) on various topics (the controversial and un-controversial) encode ambiguity. A detailed content analysis into this question does not seem to exist in the literature at present.

APPENDIX A – STIMULUS MESSAGES

MESSAGE 1

Introduction

Message 1 is about health risks associated with caffeine intake. Press CONTINUE...

Ambiguous Version

Excessive caffeine intake might increase the possible risk of osteoporosis later in life. It is suggested that caffeine might be a diuretic, and therefore might increase calcium loss in the urine.

For every 150 milligrams of caffeine (found in approximately an 8-ounce cup of coffee or 2 ½ cans of caffeinated soda), approximately five milligrams of calcium can be excreted out in the urine. This loss can add up and could be detrimental for your bones.

Un-ambiguous Version

Excessive caffeine intake increases the risk of osteoporosis later in life.

Caffeine is a diuretic and increases calcium loss in the urine.

For every 150 milligrams of caffeine (an 8-ounce cup of coffee or 2 ½ cans of caffeinated soda), five milligrams of calcium is excreted out in the urine. This loss adds up and is detrimental for your bones.

MESSAGE 2**Introduction**

Message 2 is about health risks associated with Lyme disease, common in North Eastern USA. Press CONTINUE...

Ambiguous Version

Some studies indicate that people who spend time outdoors in areas with high vegetation may be at risk for Lyme disease. Lyme disease is likely caused by deer ticks, and the symptoms are most often a characteristic "bull's-eye" rash, probably accompanied by fever, fatigue, headaches, muscle aches (myalgia), and joint aches (arthralgia).

Un-ambiguous Version

People who spend time in areas with high vegetation are at risk for Lyme disease. Lyme disease is caused by deer ticks, and the symptoms are a characteristic "bull's-eye" rash, accompanied by such as fever, fatigue, headaches, muscle aches (myalgia), and joint aches (arthralgia).

MESSAGE 3**Introduction**

Message 3 is about health risks associated with wear and tear of knee joints. Press CONTINUE...

Ambiguous Version

Knee Arthritis is said to be a sort of excessive and premature wear-and-tear of the cartilage that “cushions” the bone surfaces in a joint. A possible cause for knee arthritis could be putting excessive strain on the joint (e.g. such as happens to a certain extent from jogging).

The symptoms of arthritis possibly include: the joint might not handle as high a load as before, there may be difficulty in flexing or straightening the joint fully, some irritation/pain and "heating up".

Un-ambiguous Version

Knee arthritis is excessive and premature wear-and-tear of the cartilage that cushions the bone surfaces in a joint. The causes for knee arthritis include putting excessive strain on the joint (e.g. from jogging).

The characteristic symptoms of arthritis are: the joint does not handle as high a load as before, difficulty in flexing or straightening the joint fully, irritation/pain and "heating up".

MESSAGE 4**Introduction**

Message 4 is about health risks associated with eating fried potato foods.

Press CONTINUE...

Ambiguous Version

The Food and Drug Administration (FDA) released some new data on acrylamide levels in about 750 new food samples. Some scientists contend

that acrylamide is probably a natural byproduct, most likely of frying, baking or roasting in certain potato-based and carbohydrate-rich foods, such as potato chips, pretzels and popcorn.

Two years ago Swedish researchers made a possible connection between acrylamides and cancer. "So far, our data suggests that perhaps acrylamides cause cancer and reproductive problems in animals and could potentially be a neurotoxin in humans," the FDA said in a statement.

Un-ambiguous Version The Food and Drug Administration (FDA) released new data on acrylamide levels in 750 new food samples. Acrylamide is a natural byproduct of frying, baking or roasting potato-based and other carbohydrate-rich foods, such as potato chips, pretzels and popcorn.

Two years ago Swedish researchers made the connection between acrylamides and cancer. "To date, acrylamide is known to cause cancer and reproductive problems in animals at high doses and is a neurotoxin in humans at high doses," the FDA said in a statement.

MESSAGE 5

Introduction

Message 5 is about health risks associated with mobile phone usage. Press CONTINUE...

Ambiguous Version

Epidemiological research has found a possible link between mobile phone usage and cancer. Research found both biological indications of changes in

chromosomal structure of blood cells and a correlation between mobile phone usage and certain types of brain cancer.

Researchers say that radio-frequency (RF) “radiation” from cell phones can cause cancer probably by forcing the body to produce somewhat higher than usual levels of heat shock proteins. Studies have shown that cell phone use might increase a person’s risk of developing a fairly rare tumor on the side of the head where the phone is normally held.

Un-ambiguous Version

Epidemiological research has found a link between mobile phone usage and cancer. Research found both biological changes in chromosomal structure of blood cells and a correlation between mobile phone usage and brain cancer. Researchers say that radio-frequency (RF) radiation from cell phones causes cancer by forcing the body to produce high levels of heat shock proteins. Studies have shown that cell phone use increased a person’s risk of developing a rare tumor on the side of the head where the phone is held.

MESSAGE 6

Introduction

Message 6 is about health risks associated with eating foods high in cholesterol. Press CONTINUE...

Ambiguous Version

Cholesterol levels might be relevant in young adults since it has been shown that atherosclerosis probably begins during the teen years and early 20s. High

cholesterol levels in young adulthood are one of the possible factors that could significantly increase the risk for developing some type of CHD (coronary heart disease) later in life. The Framingham Heart Study suggested that in some young adults, higher cholesterol levels were related to lower longevity and to some extent, higher cardiovascular mortality.

Un-ambiguous Version

Cholesterol levels are important in young adults since atherosclerosis begins during the teen years and early 20s. High cholesterol levels in young adulthood significantly increases the risk for developing CHD (coronary heart disease) later in life. The Framingham Heart Study showed that young adults with higher cholesterol levels have lower longevity and higher cardiovascular mortality.

APPENDIX B – AMBIGUITY SCALE

Questionnaire 1: Instructions

Please respond to the following statements by indicating the extent to which you agree or disagree with them. Use the scale from 1 to 7, where 1 means strongly disagree and 7 means strongly agree.

1. Strongly disagree
2. Moderately disagree
3. Slightly disagree
4. Neither agree nor disagree
5. Slightly agree
6. Moderately agree
7. Strongly agree

	Write number here
An expert who doesn't come up with a definite answer probably doesn't know too much.	
I would like to live in a foreign country for a while.	
There is really no such thing as a problem that can't be solved.	
People who fit their lives to a schedule probably miss most of the joy of living.	
A good job is one where what is to be done and how it is to be done are always clear.	
It is more fun to tackle a complicated problem than to solve a simple one.	

Ambiguity Scale continued...

In the long run it is possible to get more done by tackling small, simple problems rather than large and complicated ones.	
Often the most interesting and stimulating people are those who don't mind being different and original.	
What we are used to is always preferable to what is unfamiliar.	
People who insist upon a yes or no answer just don't know how complicated things really are.	
A person who leads an even, regular life in which few surprises or unexpected happenings arise really has a lot to be grateful for.	
Many of our most important decisions are based upon insufficient information.	
I like parties where I know most of the people more than ones where all or most of the people are complete strangers.	
Teachers or supervisors who hand out vague assignments give one a chance to show initiative and originality.	
The sooner we all acquire similar values and ideals the better.	
A good teacher is one who makes you wonder about your way of looking at things.	

APPENDIX C – STATE-ANXIETY SCALE

Questionnaire 2: Instructions

There are a number of pairs of opposites listed below. These phrases are used by people to describe their current feeling state. For each pair of statements, please respond in terms of how you feel right now. There are no right or wrong answers. Do not spend too much time on any one pair but give the answer which seems to describe your present feelings best.

Extremely tired

1 2 3 4 5 6 7 8 9 10

Not at all tired

Very relaxed

1 2 3 4 5 6 7 8 9 10

Very tense

Very excited

1 2 3 4 5 6 7 8 9 10

Not at all excited

Very hungry

1 2 3 4 5 6 7 8 9 10

Not at all hungry

Feel at ease

1 2 3 4 5 6 7 8 9 10

Not at all at ease

Feel pleasant

Not at all

pleasant

1 2 3 4 5 6 7 8 9 10

Very jittery

Not at all jittery

1 2 3 4 5 6 7 8 9 10

Very worried

Not at all worried

1 2 3 4 5 6 7 8 9 10

APPENDIX D - DEPENDENT MEASURES

Worry

How WORRIED do you feel about this health risk? Please enter a number from 1 to 5, where 1 means not at all worried and 5 means very worried.

Perceived susceptibility

How would you rate your PERSONAL RISK for this health problem? Please enter a number from 0 to 100 scale, where 0 is certain not to be affected and 100 is certain to be affected.

Risk profile question for Message 1

On average, how many cups of coffee or cans of caffeinated soda do you drink in a day? Please enter a number in the space below.

Risk profile question for Message 2

Have you engaged in any of these outdoor activities in the last one year?
Check all that apply.

Hiking

Barbecuing outside

Sitting on grass

Swimming in a gorge

Risk profile question for Message 3

Do you jog on a hard surface, such as a road? (YES/NO)

Risk profile question for Message 4

How often do you eat potato chips or other fried potato products?

Rarely / never

1 - 2 times a month

3 - 4 times a month

2 - 3 times a week

4 - 5 times a week

Almost everyday

Risk profile question for Message 5

On average, how long each day do you use your mobile phone?

I do not have a mobile phone

Less than 10 minutes

Between 10 minutes to half an hour

Between half an hour to one hour

Between one to two hours

More than two hours

Risk profile question for Message 6

How often do you eat foods high in fat content, such as fries, hamburgers, pizza and chocolate?

Rarely / never

1 - 2 times a month

3 - 4 times a month

2 - 3 times a week

4 - 5 times a week

Almost everyday

Attributional confidence

How CONFIDENT are you in using the information presented in this message to guide your health decisions? Please enter a number from 1 to 5, where 1 means not at all confident and 5 means very confident.

Motivation to seek information

Are you likely to seek out more information on this health risk? Please enter a number from 1 to 5, where 1 means not at all likely to seek more information and 5 means very likely to seek more information.

Relevance

How RELEVANT do you think this information is for you? Please enter a number from 1 to 5, where 1 is not at all relevant and 5 is very relevant.

Familiarity

Had you heard about this health risk before? (YES / NO)

REFERENCES

- Babrow, A. S. & Kline, K. N. (2000). From “reducing” to “coping with” uncertainty: reconceptualizing the central challenge in breast self-exams. *Social Science and Medicine*, 51, 1805-1816.
- Babrow, A. S. (1992). Communication and Problematic Integration: Understanding Diverging Probability and Value, Ambiguity, Ambivalence, and Impossibility. *Communication Theory*, 2, 95-130.
- Berger, C. R., & Calabrese, R. J. (1975). Some explorations in initial interactions and beyond: Toward a developmental theory of interpersonal communication. *Human Communication Research*, 1, 99-112.
- Berger, C. R. (1979). Beyond Initial Interaction: Uncertainty, Understanding, and the Development of Interpersonal Relationships. In Giles, H., & St. Clair, R. N. (Eds.), *Language and Social Psychology*. University Park Press: Baltimore.
- Blanchette, I., & Richards, A. (2003). Anxiety and the Interpretation of Ambiguous Information: Beyond the Emotion-Congruent Effect. *Journal of Experimental Psychology: General*, 132 (2), 294-309.

Bordens, K. S., & Abbott, B. B. (2002). *Research Design and Methods: A Process Approach (Fifth Edition)*. San Francisco: McGraw Hill.

Bowers, J. W., Metts, S. M., & Duncanson, W. T. (1987). Emotion and Interpersonal Communication. In Knapp, M. & Miller, G. (Eds.), *Handbook of Interpersonal Communication*. Beverly Hills: Sage.

Brashers, D. E., Neidig, J. L., Hass, S. M., Dobbs, L. K., Cardillo, L. W., & Russell, J. A. (2000). Communication in the Management of Uncertainty: The Case of Persons Living with HIV or AIDS. *Communication Monographs*, 67 (1), 63-84.

Brashers, D. E. (2001). Communication and Uncertainty Management. *Journal of Communication*, 51 (3), 477-497

Calvo, M. G., Averó, P., Castillo, M. D., & Miguel-Tobal, J. J. (2003). Multidimensional Anxiety and Content-specificity Effects in Preferential Processing of Threat. *European Psychologist*, 8 (4), 252-265.

Castro, F. J., Perez, R. G., Barrantes, N., & Capdevila, A. (1998). Mood States and Recall Biases: The Role of Affect. *Psychology in Spain*, 2 (1), 92-99.

Cioffi, D. (1991). Asymmetry of Doubt in Medical Self-Diagnosis: The Ambiguity of 'Uncertain Wellness'. *Journal of Personality and Social Psychology*, 61 (6), 969-980.

Cole, J. R. (1988). Dietary Cholesterol and heart disease: The construction of a medical 'fact'. In H. J. O'Gorman (Ed.), *Surveying social life*, 437-466. Middletown, CT: Wesleyan.

Dance, R. E. X. (1970). The "Concept" of Communication. *Journal of Communication*, 20, 201-210.

Eisenberg, E. M. (1984). Ambiguity as Strategy in Organizational Communication. *Communication Monographs*, 51, 227-242.

Endler, N. S., Parker, J. D. A., Bagby, R. M., & Cox, B. J. (1991). Multidimensionality of State and Trait Anxiety: Factor Structure of the Endler Multidimensional Anxiety Scales. *Journal of Personality and Social Psychology*, 60 (6), 919-926.

Fahnestock, J. (1998). Accommodating Science: The Rhetorical Life of Scientific Facts. *Written Communication*, 15 (3), 330-350.

Frenkel-Brunswick, E. (1949). Intolerance of ambiguity as an emotional and perceptual personality variable. *Journal of Personality*, 18, 108-143.

Ford, L. A., Babrow, S. A., & Stohl, C. (1996). Social Support Messages and the Management of Uncertainty in the Experience of Breast Cancer: An Application of Problematic Integration Theory. *Communication Monographs*, 63, 189-207.

Gaskell, G. M., & Marslen-Wilson, W. D. (2001). Lexical Ambiguity Resolution and Spoken Word Recognition: Bridging the Gap. *Journal of Memory and Language*, 44, 325-349.

Gorke, A., & Ruhrmann, G. (2003). Public communication between facts and fictions: on the construction of genetic risk. *Public Understanding of Science*, 12, 229-241.

Hai, Y. T., & See, L. F. (1997). Moderating effects of tolerance for ambiguity and risk-taking propensity on the role conflict-perceived performance relationship: evidence from Singaporean entrepreneurs. *Journal of Business Venturing*, 12, 1, 67-81.

Hock, M., Krohne, H. W., & Kaiser, J. (1996). Coping Dispositions and the Processing of Ambiguous Stimuli. *Journal of Personality and Social Psychology*, 70 (5), 1052-1066.

Hyland, K. (1996). Talking to the Academy: Forms of Hedging in Science Research Articles. *Written Communication*, 13 (2), 251-281.

Kahlor, L., Dunwoody, S., & Griffin, R. J. (2002). Attributions in explanations of risk estimates. *Public Understanding of Science*, 11, 242-257.

Kellermann, K., & Reynolds, R. (1990). When Ignorance Is Bliss: The Role of Motivation to Reduce Uncertainty in Uncertainty Reduction Theory. *Human Communication Research*, 17 (1), 5-75.

- Kramer, M. W. (1999). Motivation to Reduce Uncertainty: A reconceptualization of Uncertainty Reduction Theory. *Management Communication Quarterly*, 13 (2), 305-316.
- Kreft, I., & De Leeuw, J. (2002). *Introducing Multilevel Modeling*. Sage Publications.
- Lalljee, M., & Cook, M. (1973). Uncertainty in First Encounters. *Journal of Personality and Social Psychology*, 26 (1), 137-141.
- Lucas, M. (1999). Context effects in lexical access: A meta-analysis. *Memory and Cognition*, 27, 385-398.
- MacLeod, C., & Cohen, I. L. (1993). Anxiety and the Interpretation of Ambiguity: A Text Comprehension Study. *Journal of Abnormal Psychology*, 102 (2), 238-247.
- Mathews, A., & Mackintosh, B. (2000). Induced Emotional Interpretation Bias and Anxiety. *Journal of Abnormal Psychology*, 109 (4), 602-615.
- Norton, R. W. (1975). Measurement of Ambiguity Tolerance. *Journal of Personality Assessment*, 39 (6), 607-619.
- O'Keefe, D. J. (2003). Message Properties, Mediating States, and Manipulation Checks: Claims, Evidence and Data Analysis in Experimental

Persuasive Message Effects Research. *Communication Theory*, 13 (3), 251-274.

Richards, G. (1996). *Putting Psychology in its Place: An introduction from a critical historical perspective*. Routledge: London and New York.

Rier, D. A. (1999). The Versatile "Caveat" Section of an Epidemiology Paper: Managing Public and Private Risk. *Science Communication*, 21 (1), 3-37.

Rimal, R. N. (2001). Perceived Risk and Self-Efficacy as Motivators: Understanding Individuals' Long-Term Use of Health Information. *Journal of Communication*, 51, 633-654

Schmukle, S. C., & Egloff, B. (2004). Does the Implicit Association Test for Assessing Anxiety Measure Trait and State Anxiety? *European Journal of Personality*, 18, 483-194.

Shannon, C.E., & Weaver, W. (1949). *The mathematical theory of communication*. Urbana: University of Illinois Press.

Singer, E. (1990). A question of accuracy: how journalists and scientists report research on hazards. *Journal of Communication*, 40, 102-116.

Shapiro, M. A. (2002). Generalizability in Communication Research. *Human Communication Research*, 28, 491-500.

Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory (STAI)*. Palo Alto, CA: Consulting Psychologists Press.

Stocking, S. H. (1998). On Drawing Attention to Ignorance. *Science Communication*, 20 (1), 165-178.

Stocking, S. H. (1999). How Journalists Deal with Scientific Uncertainty. In *Communicating Uncertainty: Media Coverage of New and Controversial Science*, Friedman, S.M, Dunwoody, S., & Rogers, C. L. (Eds.). Lawrence Erlbaum: New Jersey.

Sunnafrank, M. (1986). Predicted Outcome Value During Initial Interactions: A Reformulation of Uncertainty Reduction Theory. *Human Communication Research*, 13 (1), 3-33.

Windschitl, P. D., & Well, G. L. (1996). Measuring Psychological Uncertainty: Verbal versus Numeric Methods. *Journal of Experimental Psychology: Applied*, 2 (4), 343-364.

Wynne, B. (1996). Misunderstood Misunderstandings: Social Identities and Public Uptake of Science. In *Misunderstanding Science? The public reconstruction of science and technology*, Alan Irwin and Brian Wynne, (Eds.), Cambridge University Press, 19-46.