The Psychophysics of Estimated Risk

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Two studies examine how base rates of health risk are psychologically transformed into perceptions of risk for an average person and one’s self. Study 1 examines risk perceptions for 13 causes of death with objective base rates ranging from 1:5 (heart disease) to 1:340,733 (fireworks discharge). We model perceived risk as following a power law where the denominator (N) is raised to an exponent the size of which is contingent on the size of the denominator itself (i.e., endogenously determined). Study 2 examines the moderating effect of visual versus numeric presentation format on risk perceptions.

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**SESSION OVERVIEW**

The importance of improving the communication of health risks and prescriptive actions is clear, yet there are many stumbling blocks associated with translating health risk information into consumer action. Questions emerge regarding how accurately individuals may interpret risk information, how they may respond to this risk information (engagement vs. denial or avoidance) and how health risk communications designed in the lab can be effectively presented in the field and scaled up to produce broad impact. This session brings together papers across the spectrum, from micro (e.g., perceptual and emotional) to macro (societal) approaches to understanding consumer reactions to risk. By bringing together papers that take perceptual, emotional, behavioral and societal views of health risk communication, this session will help move consumer research towards integrative solutions for motivating beneficial action.

First, Raghubir models, and empirically documents, fundamental (hard-wired) perceptual bias in risk assessment. Next, Samper, Luce and Purohit suggest emotion-based communication interventions to circumvent consumer bias in risk estimation, revealing that these types of communications can help or hurt depending on the degree of threat present. Keller and Lehmann demonstrate how to integrate across perceptual, emotional, and other variables of these kinds to design effective interventions. Finally, Bloom, Block and Trabold address the need to integrate insights from individual studies and “scale up” to improve societal actions. This fourth paper facilitates discussion and integration of all of the papers in the session.

**EXTENDED ABSTRACTS**

**“The Psychophysics of Estimated Risk”**

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This paper proposes a psychophysical function that translates raw base-rate information about health risk into perceptions of risk for the average person and one’s self. Unlike the standard power functions, in our formulation the exponent of the power function is endogenously determined as a function of the size of the base rate denominator, and varies as a function of base-rates. The value of the exponent is also modeled to be the parameter used to adjust risk estimates for oneself from the starting anchor of estimates of an average person. The model is parsimonious, requires no exogenous assumptions, is based on the psychology of how people process denominator information and an anchor-adjust model of risk estimation, and fits the data from two studies across 13 different causes of death, well.

A base rate is the likelihood of occurrence of an event (n=1), in terms of the size of the population from which it is drawn (“N”):

\[ \text{Base Rate} = \frac{1}{N} \]

Psychophysical models of estimation have shown that people’s estimates may be biased and follow a power law with an exponent<1 (Chandon and Wansink, 2007; Krider et al., 2001; Krishna, 2007), leading to smaller numbers being overestimated relative to larger numbers. In a risk perception context, we propose that the denominator, N, is the focal property being estimated. Therefore, rather than the exponent, \( \alpha \), being applied to the numerator (as is common in other psychophysical representations), it is applied to the denominator, or:

\[ \text{Perceived Risk} = \frac{1}{N^\alpha}, \text{ where } 0 < \alpha < 1, \]

When \( \alpha \to 1 \), perceptions are more accurate, and as \( \alpha \to 0 \), base rates are overestimated. The size of \( \alpha \) has been typically modeled to be a constant, independent of the base estimate to which it is applied. We suggest that \( \alpha \) is endogenously determined with its size contingent on the estimation quantity (or base rate) itself, or:

\[ \alpha = f(N) \]

This is because the larger the population (denominator N), the more difficult it is to identify with (Raghubir, 2008), leading to a smaller exponent, \( \alpha \to 0 \). The larger the overall number of people who are at risk, or the incidence of an event (n \( \to N \)), the easier it is to imagine oneself being a part of this group, and the larger the exponent, \( \alpha \), or the closer it is to 1. One representation of this model that satisfies the above conditions is:

\[ \alpha = K \log N \chi, \]

where K is a scaling constant, and \( \chi \) is a fraction between 0 and -1. This representation allows the rescaling of large numbers through the use of \( \log (N) \) versus N (e.g., 5 and 340,733 are scaled down to 0.70 and 5.53). The fractional exponent, \( \chi \), further rescales large differences closer to 1 (e.g., \( \chi = 1/8 \), transforms \( \log (5) \) from .70 to .9562, and \( \log (340,733) \) from 5.53 to 1.2384). This representation implies the following psychophysical function:

\[ \text{Perceived Risk} = \frac{1}{N K \log (N) \exp(\chi)}. \]

The prevalent belief in health risk is that self-perceptions are related to the perception of risk of others with the latter used as a starting anchor (Lin et al. 2003, Raghubir and Menon, 1998). We model self-estimate of risk as a function of the actual estimated risk of the average person (AP):

\[ \text{Self Perception} = K \log N \chi \times AP [\text{AP/ Perceived Risk}] \]

This formulation recognizes that the AP in the numerator serves as a starting anchor against which self perceptions of risk are formulated. The AP/ Perceived Risk ratio captures differences in risk perception due to other causes such as the perceived controllability of a cause of death (Lin et al. 2003). The closer the ratio is to 1, the better the fit of the psychophysical function, and the lower the effect of causes external to the actual base-rate itself (e.g., controllability). The constant, \( \alpha \), is a scaling parameter that is itself contingent on the base-rate and is the level of adjustment that people make after they anchor on the risk of the average person. The closer \( \alpha \to 1 \), the lower self-other biases in risk estimates, and the closer both perceptions are to actual base-rates.

Two studies were designed to test these two representations. In Study 1, we examine risk perceptions for 13 different causes of death varying odds. Study participants (n=100) were asked to estimate how likely a cause of death was for both themselves and the average person. A 13 (causes of death) x 2 (targets) ANOVA on risk
estimates revealed that estimates of risk of the average person are higher than estimates of risk for one’s self: the self-positivity bias. There was also main effect of cause reflecting different perceptions of risk for the various causes of death. A significant interaction revealed that the self-positivity bias was absent for three of the causes of death: MVAs, pedestrian accidents, and earthquakes.

We then fitted the psychophysical function to the mean estimate of risk for the average person. The function is characterized by an exponent that ranges from .7843 (for cancer) to .6056 (for fireworks discharge). The scaling constant, k, is .75, and the exponent for log(N) is 1/8. The fit follows actual estimates well. Study 2 examines the moderating role of manner of presentation of risk estimates as numeric versus graphic on risk perceptions.

“Imagine Yourself in This Patient’s Shoes: The “Identifiable Patient” and Health Threat”
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Identifiability—the presentation or description of a single, often named, individual as the subject of a message—has been shown to be a powerful instigator of emotion and affective processing (e.g., Small, Loewenstein, and Slovic, 2007). Most of this work has focused on the domains of altruism and helping behaviors. Researchers have coined the “identifiable victim effect” (Small and Loewenstein, 2003), pointing out that “society is willing to spend far more money to save the lives of identifiable victims than to save statistical victims” (Jenni and Loewenstein, 1997, p. 236). Affective processing has been shown to underlie these differences in giving (Small et al., 2007).

The effect of identifiability on health risk perceptions and behaviors has yet to be addressed. This is a critical gap because health communications aim to motivate recipients to take actions to benefit themselves, whereas prior work on identifiable victims aims to motivate actions to benefit others. Moreover, effective health messages are increasingly “self-relevant,” targeting information toward specific demographic groups. To date, research has yet to examine how the self-relevance of a communication might moderate the benefits of specifying an affect-inducing identifiable individual to motivate action.

We address the important questions of whether and how the presentation of an identifiable patient can motivate desired behavior in a health communication context. This research examines the conditions under which identifiability does, and does not, have beneficial effects. In Study 1, college undergraduates were instructed to read a pamphlet about the threat of genital herpes among college students vs. middle-aged adults. This pamphlet was accompanied by a picture of an individual college student (middle-aged adult) said to have genital herpes or a picture of a group of college students (middle-aged adults) with a statistical risk for genital herpes. The identifiable pictures were matched on sex. Underneath all pictures was a caption describing the statistical risk of genital herpes. We find that identifiability increases perceived vulnerability to disease, but only for those individuals presented with the identifiable college student. Thus, self-relevance is necessary for identifiable presentation to increase perceived threat.

Given that a great deal of health information is presented in situations of higher stress (e.g., physician’s office, hospital or clinic), in Study 2 we examine the effect of ambient stress on identifiable patient presentations, examining perceived vulnerability to herpes, concern about contracting herpes and intent to be tested for the disease. Participants were presented with herpes information depicting only college students, either identifiable or in a group. Next, we manipulated stress levels by asking participants to complete an easy (difficult) timed anagram task. We find that following the easy task, at low stress levels, identifiable patient presentation increases perceived vulnerability to herpes. However, following the difficult (high stress) anagram task, participants reported significantly reduced perceived vulnerability, suggesting a denial of risk under high stress, identifiable conditions.

Study 2 also revealed that group presentation may be better for promoting concern and screening in high-stress conditions. An interaction of stress by group presentation on concern and intent to be tested indicated that high-stress group presentation leads to both increased concern about contracting herpes as well as increased intent to be tested for herpes relative to low-stress group conditions. Finally, a moderated mediation analysis examining the effect of stress at identifiable and group presentation levels revealed that whereas there are significant positive relationships between stress and concern and stress and intent to be tested (and indirectly, concern and intent to be tested) in the group conditions, in the identifiable conditions, the effect of stress is actually no longer significant and is in fact negative. This supports the notion of a denial response under identifiable patient presentation, whereby increased stress leads to reduced concern and intent to be tested.

This research has important implications for the communication of health messages. While we find that identifiability increases susceptibility under low stress conditions, this effect is no longer present under high stress conditions. In addition, we find that group (non-identifiable) presentation may be optimal for generating behavioral intentions and appraisals of concern under high stress conditions. These findings support the notion that both avoidant and action-oriented responses arise from high threat, and examines how identifiability may activate these mechanisms. Given that identifiable patient advertisements are ubiquitous in the public health space, it is important to understand the boundary conditions that moderate their intended response.

“Promoting Health-Related Consumer Research: ARC Model Application to CDC’s Health Campaign”
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The massive costs of health care ($1.7 trillion and counting) and the problems posed by various diseases (e.g., AIDS, obesity, diabetes, cancer, heart disease, mental illness) are well known and documented. People worry more about their personal health care costs than losing their jobs, being a victim of a violent crime, or terrorist attacks. As a consequence, massive efforts to improve knowledge about detection, prevention, and treatment have been undertaken. Despite growing realization that health communication strategies need to be improved possibly by tailoring them to audience segments, there is no model that guides the design of health communications. Currently, four barriers prevent the application of consumer research studies to improve the effectiveness of public service health campaigns. First, the focus on one or two message tactics makes it difficult to generalize the results to situations where the audience is faced with a wide variety of message tactics in the same or different health campaigns (cf. Raghubir and Menon, 1996). Second, most consumer research studies do not provide guidelines for tailoring since they do not examine how message formats interact with measurable individual differences such as demographics. Third, small cell sizes in most lab studies raise concerns about whether lab findings can be replicated in the field. Finally, there is no evidence that message formats determine health intentions when other factors such as peer influence are accounted for.

We developed a model, Advisor for Risk Communication (ARC) to overcome these barriers. ARC examines the effects of 22
message tactics and 6 individual differences on intentions to comply with health recommendations. ARC is based on a meta-analysis of 60 studies, 584 different experimental conditions and 22,000 participants.

Our results can be viewed as making two key contributions to consumer research: 1) our results indicate which of twenty-two message variables remain significant when the effect of other message variables have been accounted for, 2) our model can be used to predict the effectiveness of health messages for audiences that vary in age, race, gender, regulatory focus, and involvement.

We propose the following model application steps:

1) Code the health communication message to reflect the levels of multiple message formats. What is the social effect? Does it contain pictures? Does it tell a story? Are there a lot of dry numbers? Is the communicator male or female?

2) Use ARC to predict the effectiveness of the health message.

3) Improve the effectiveness of the health message by changing it according to the recommendations in ARC.

The ARC model supports the use of several message tactics: case information (e.g., a story about a real or hypothetical person rather than numbers or percentages), social consequences (e.g., embarrassment works better than physical pain), other-referencing (e.g., focus on people around you rather than yourself), female communicators (are better than male communicators), a message that arouses emotions other than fear, and messages on detection behaviors (rather than prevention or remedial behaviors) to enhance health intentions.

ARC also recommends focusing on discouraging unhealthful behavior rather than promoting healthful behaviors and de-emphasizing source credibility and vividness (e.g., pictures, cf. Keller and Block, 1997). The results of our meta-analysis also indicate that communication dollars may be saved by not spending money on message factors that don’t enhance intentions unless they are matched with audience characteristics. For example, contrary to popular use, framed health messages (loss or gain frames) are not advisable without knowledge of target audience goals (promotion vs. prevention, cf. Lee and Aaker, 2004).

The ARC model also identifies effective matches between message tactics and audience characteristics. For example, ARC indicates that low-involvement audiences are more persuaded by moderately fearful gain frames, other-referencing, vivid messages, and strong source credibility, whereas highly involved audiences prefer base information and strong messages that are also moderately fearful, but they do not distinguish between levels of vividness, source credibility, and referencing. Younger audiences prefer social consequences over multiple exposures, whereas older audiences are more influenced by physical consequences regardless of the number of message exposures.

We demonstrate how ARC may be used for improving the effectiveness of public service campaigns by testing its ability to predict health intentions for CDC’s VERB campaign to encourage youth to exercise more in their free time. We find the ARC predictions and stated intentions are in close correspondence to each other. ARC predictions are significant predictors for stated intentions and behavior when socio-economic, social influence, beliefs and attitudes, number of ads, and exposure frequency are accounted for. Intention and behavior predictions are approximately equally sensitive to family and social influence, parent education, and recall of message exposures, and in general have less impact than the child beliefs/self-view and ARC predictions. Finally, ARC health intention predictions are significant predictors of self-reported exercise behavior. Taken together, these findings offer many opportunities to use consumer research to tailor health communications for different target audiences.

“Communication Strategies for Scaling Health-Focused Social Entrepreneurial Organizations”
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The term “social entrepreneur” is typically used to describe individuals who start up and lead new organizations or programs that are dedicated to mitigating or eliminating a social problem, deploying change strategies that differ from those that have been used to address the problem in the past. Notable social entrepreneurs include (a) Wendy Kopp, founder of Teach for America, which places recent college graduates as teachers in inner-city schools for a two-year stint, and (b) Paul Farmer, founder of Partners In Health, which has provided low-cost treatment for AIDS, TB, and other diseases throughout the developing world. These innovators—and their social entrepreneurial organizations—pursue scaling because they want to have as big an impact as possible on social problems and because their donors and supporters are hungry to achieve high “social” returns on their investments.

The social entrepreneurial organizations that focus on health problems tend to emphasize Prevention, Treatment, or Advocacy, or some combination of the three. Figure 1 presents a way of categorizing these organizations, based primarily on their “change strategy,” or on what some would call their “Theories of Change.” They have a causal model in mind that links their programs or interventions to a series of outcomes that eventually will help resolve a social problem (Colby, Stone, and Carttar, 2004). We suggest that the “Theories of Change” of health-focused social entrepreneurial organizations tend to fall in one of seven different categories:

- “Promoting Healthier Lifestyles” (a purely prevention approach).
- “Developing/Distributing Medications/Equipment” (a purely treatment approach).
- “Creating Healthier Environments” (a combination prevention and treatment approach).
- “Providing Patient Care/Therapy” (a combination prevention and treatment approach).
- “Training Health Workers” (a combination prevention, treatment, and advocacy approach).
- “Supporting/Assisting Patients” (a combination prevention, treatment, and advocacy approach).
- “Advocating for Better Health Policies” (a purely advocacy approach).

Bloom and Chatterji (2009) propose that successful scaling of social impact by a social entrepreneurial organization will require the possession of some combination of seven organizational capabilities, identified using the acronym SCALERS. This stands for: Staffing, Communicating, Alliance-building, Lobbying, Earnings-
generation, Replicating, and Stimulating market forces. They also propose that the extent to which an individual SCALER (i.e., driver or capability) will influence scaling success will depend on certain situational contingencies. Each social entrepreneurial organization may find itself facing rather unique situational contingencies, indicating that the most important capabilities for effective scaling of better health outcomes will vary across organizations.

It is extremely common for health-focused social entrepreneurial organizations to face a situational contingency of having weak public acceptance or support for the behaviors they would like their beneficiaries to engage in. They often have had only limited success in persuading individuals to (a) take preventive actions like wearing sunscreens, using condoms, eating healthier or obtaining inoculations, (b) obtain screening tests for HIV/AIDS, cancer, or other diseases where early-detection can save lives, or (c) comply with therapy and drug regimens. Communicating persuasively about the value of engaging in healthier behaviors has become a critical scaling challenge for many organizations.

In this paper, we offer propositions about communications strategies that have a higher likelihood of changing the behavior of beneficiaries. Based on the literature in consumer behavior, social marketing, and health communications, we identify several communication strategies that can help guide a health-focused social entrepreneurship organization to scale its impact. We provide additional support to the propositions by analyzing several case studies of organizations that seem to have had scaling success, in part, by using some of the identified communications strategies.

As just one example, we illustrate our proposition “When targeting younger audiences, messages that emphasize physical consequences are more effective than those that emphasize physical consequences” with the communications experiences of the organization Girls on the Run (Bloom, 2007). This self-esteem enhancement program for pre-teen girls uses games involving running to teach lessons about topics like healthy eating, peer pressure, bullying, and community service, and has grown from serving 13 girls in 1996 to serving over 40,000 per year by 2008. One of the keys to their scaling success appears to be the emphasis they have in their communications and lessons about the value for girls to be themselves. By stressing the social benefits of “being yourself,” in part by providing social support for this from the coaches and other girls in the 12-student classes, the program has achieved more success in enhancing self-esteem—and also encouraging healthier eating and exercise behaviors—than if they had stressed the physical consequences associated with diet and exercise.

REFERENCES


