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The unintended effects of health information base rates on health risk estimates and behavioral intentions

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ABSTRACT
Social marketers and health advertisers often use statistical health information to craft customized messages for specific consumer segments. However, the composition of these segments can vary greatly, inherently resulting in different base rate percentages about the same health issue (e.g. '51.9% of all COVID 19-related deaths in the U.S. occurred among Caucasians' vs. '16.6% of all COVID 19-related deaths in the U.S. occurred among Hispanics') that can potentially lead to different responses from consumers. Therefore, this research examines how individuals process, and respond to, manipulated base rates. Study 1 demonstrates that higher (vs. lower) base rates increase individuals' healthy behavioural intentions by elevating their risk perceptions. Study 2 uncovers a more complex serial process underlying the impact of base rates on intentions to follow recommended behaviours in health messages. Importantly, we demonstrate a critical effect reversal such that higher base rates have an unintended *negative* impact on individuals' compliance intentions when involvement is *lower* (vs. higher). Overall, our findings show how the use of base rates in health messages can serve as a 'double-edged sword'.

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Consumer health; social marketing; health framing; health risk; compliance; self-positivity bias; information base rates; involvement; obesity; boomerang effect; vaccines; COVID-19

Introduction

It has been well documented that unhealthy behaviours and diseases have a tremendous negative impact on individuals, as well as on society as a whole. Therefore, public policy makers, health officials, and consumer welfare advocates, alike, have a direct interest in more effectively communicating health risk information to consumers (Burton et al. 2015; Kim 2019; Netemeyer et al. 2016; Yoon 2018). Social marketing and public service announcements are often used to make consumers aware of specific health problems, influence their associated health risk perceptions, and positively impact their behaviours (e.g. 'Over 150,000 people die from lung cancer each year in the U.S. Stop smoking today') (Kees, Burton, and Tangari 2010; Wang, Fu, and Wu 2020). Many commercial marketers and direct-to-consumer advertisers also refer to health risks in an attempt to influence consumers' purchase decisions (e.g. '40% of adults suffer from gingivitis. Using Listerine daily can help reduce your risk').

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In the present research, we explore a critical, yet under-researched, aspect of health communications that can greatly influence their overall effectiveness: the use of information base rates[1]. Additional insight into the strategic use of base rates may lead to policies that more closely align individual and collective consumer needs. However, there also may be situations in which individuals misinterpret health base rate information, resulting in a negative impact on consumer health and welfare, as we explore later. Accordingly, this topic is also of high interest to a number of governmental organizations such as the Centers for Disease Control (CDC), Food and Drug Administration (FDA), Federal Trade Commission (FTC), and Federal Communications Commission (FCC) (Hastak and Mazis 2011; Berry, Burton, and Howlett 2017; Newman, Howlett, and Burton 2014).

Perhaps the most current and representative illustration of the potentially volatile impact of health communications is reflected in the ongoing COVID-19 global pandemic. Despite the high number of cases and deaths, many young people around the globe have infamously minimized the seriousness of COVID-19, and are quick to point out that symptoms, hospitalizations, and deaths due to the virus disproportionately affect the elderly and those with pre-existing conditions. As a result, many young people have responded to worldwide health directives to self-isolate and practice social distancing with disproportionate resistance relative to other consumer segments (Asperin 2020; Wise et al 2020). Many individuals (regardless of age) have similarly showed high levels of resistance to taking a COVID-19 vaccine. In fact, COVID-19 communications have been so ineffective at encouraging preventive behaviours in some cases that the United Nations recently resorted to crowdsourcing messaging ideas from the general public (Jardine 2020). While COVID-19-related health communications have undoubtedly saved many lives, the inability to generally garner compliance among many youth (and other segments) marks a communication failure that will be studied by researchers, policy makers, and health officials for years to come.

Though the aim of this research is not to explore the variety of factors leading to socially undesirable responses to COVID-19 directives, it does provide a relevant and timely backdrop for discussing the overall premise of our studies. In short, we propose that higher health base rates generally lead to higher perceptions of personal risk, resulting in higher intentions to take preventive health actions (Study 1). However, consistent with our prior discussion, we further posit that the positive impact of higher base rates is contingent on one's involvement with a given health message. Specifically, we propose that higher base rates can have an overall *negative* impact by leading to *lower* intentions to comply with recommended health behaviours (e.g. practicing social distancing) when involvement is *lower* (i.e. when message recipients are *less* similar to the targeted segment described by the rate) (Study 2).

We offer a unified conceptual framework integrating health information base rates, health risk estimates, and healthy behavioural intentions to formally predict and explain these assertions (see Figure 1). We empirically test several versions of it across two different health issues (motor vehicle accidents and obesity) to enhance the overall generalizability of our findings. Our overarching goal is to provide actionable insight into whether, and why, the same base rate in a given health communication can lead to conflicting outcomes (positive or negative) for different consumer segments. Our formal hypotheses follow below.

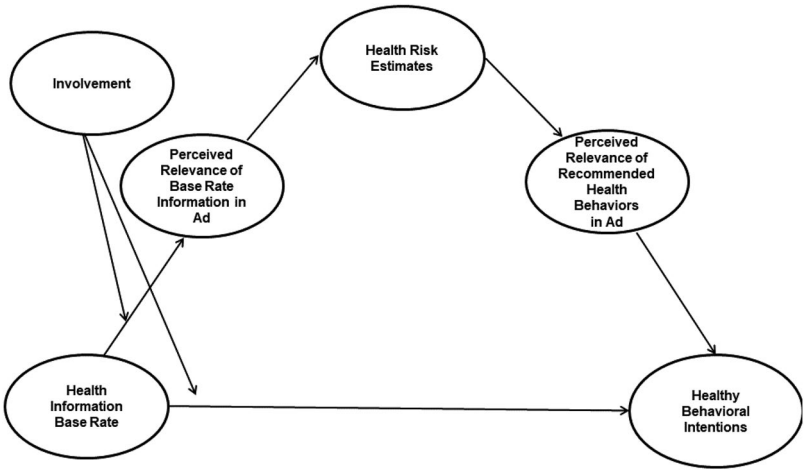


Figure 1. A conceptual framework integrating health information base rates, health risk estimates, and healthy behavioural intentions in a health communication context.

Theoretical framework and hypotheses

Common health framing techniques and the understudied use of information base rates

Past researchers have devoted considerable attention to the impact of different health framing techniques. However, the majority of this research has focused primarily on gain/loss framing (see Wansink and Pope 2015 for a review). Gain-framed health messages highlight the benefits of engaging in a particular behaviour, whereas loss-framed health messages describe the consequences of not engaging in a specific behaviour. Prior research generally suggests that loss-framed messages are more effective than gain-framed messages (e.g. Charry and Demoulin 2012), though the evidence remains inconsistent and contradictory (Wansink and Pope 2015).

Other widely studied health framing techniques include attribute framing and temporal framing. Attribute framing effects occur when evaluations of a message or object are more favourable when it is described by positive, rather negative, attributes (e.g. ground beef labelled as 80% lean vs. 20% fat) (Levin and Gaeth 1988). Temporal framing can also impact consumer responses to health messages by manipulating the perceived proximity of an event (Kim and Youn 2019). For example, self-risk perceptions are often higher when health risks are presented in more proximal, rather than distal, frames (e.g. smoking-related deaths per day vs. per year) (Chandran and Menon 2004; Raghubir and Menon 1998). Overall, health message framing has been shown to affect a variety of outcomes including message persuasion, risk perceptions, and behavioural intentions (e.g. Block and Keller 1995; Chandran and Menon 2004; Maheswaran and Meyers-Levy 1990; Menon, Block, and Ramanathan 2002; Selena and Bui 2015).

One widely-used health framing technique that has received relatively far less attention from researchers is the manipulation of information base rates. An

information base rate reflects the incidence of a certain event (e.g. number of people who have AIDS; number of people who have skin cancer) as a function of a particular referent group (e.g. all adults over 40; women aged 25 to 35; total people who die from obesity). The nature of referent groups can vary greatly, but their composition is explicitly defined by some shared characteristic(s) or feature(s). For example, people in a given referent group could share the same age, gender, or ethnicity as outlined above, or could have participated in the same shared life event (e.g. all people who contracted COVID-19; domestic abuse survivors; veterans) (or any combination thereof). In short, a referent group is a clearly defined population of interest that is used in the formulation of a specific base rate. A base rate is calculated by dividing an incident level by the size of the referent group, and is typically communicated as a percentage (e.g. '28% of Hispanic adults have high blood pressure'; '51.9% of all COVID 19-related deaths in the U.S. occurred among Caucasians') (see also Raghubir 2008; Yan and Sengupta 2013).

It is important to understand how the framing of information base rates impacts health communication effectiveness and consumer behaviour for several reasons. First, social marketers and health advertisers often use customized statistical health information about certain consumer segments (e.g. adults aged 18–44; African Americans; females) hoping that it will prompt greater responsiveness from the targeted consumer segments (Wansink and Pope 2015). However, the composition of the segments described in these messages can vary greatly, inherently resulting in the presentation of *different – but technically factual* - base rate percentages about the same health issue (e.g. 'Hypertension affects 8.3% of all adults aged 18–44'; 'Hypertension affects 32.9% of African Americans'; 'Hypertension affects 23.1% of females')[2] (Blackwell, Lucas, and Clarke 2014; Chang and Lee 2010).

This variance in base rates leaves several critical questions unanswered. First, do base rates affect only consumers' risk perceptions? Or can base rate manipulations be further used to ultimately affect their intentions to undertake certain health behaviours (i.e. can higher base rates increase consumers' health-risk perceptions, and thus, their intentions to engage in healthier behaviours)? The answer to this question is critical, as the ultimate objective of many health communications is to convince consumers to lead healthier, safer lives by better aligning their perceived risks with their actual risks (see Keller and Lehmann 2008).

Second, it is also important to determine if the provision of health base rates can *negatively* influence consumers' health risk perceptions and related health behaviours in some cases. Is it possible that health marketers are inadvertently *lowering* consumers' risk estimates and healthy behavioural intentions by communicating base rate information in certain ways? More specifically, are there instances when higher base rates can have the intended positive impact on a particular target audience from a health/safety standpoint, but simultaneously exert an unintentional *negative* influence on other (untargeted) consumers' risk perceptions and corresponding behavioural intentions? Considering these potentially divergent effects across different consumer segments is critical to better understanding the true, overall impact of base rates on public health (Burton and Kees 2012). We offer our hypotheses related to these inquiries below while focusing on the possible 'boomerang effect' of base rates, in particular.

Processing health base rate information and the role of health risk estimates

Prior research has long documented a robust 'self-positivity' bias that causes individuals to mistakenly believe they are less likely to experience negative events than others (Perloff and Fetzer 1986). This self-enhancing behaviour leads people to cling to an 'illusion of unique invulnerability' (Perloff 1983) and is frequently associated with the common belief that 'it won't happen to me' (Greening and Chandler 1997). Pertinent to the current research, this bias has also been aptly referred to as 'unrealistic optimism', which is defined as the favourable difference between the risk estimates individuals make for themselves and those suggested by an objective standard (such as health base rate information) (Shepperd et al. 2013; Weinstein 1980).

Existing work across numerous health domains has consistently shown that the self-positivity bias leads individuals to underestimate personal health risks and engage in suboptimal health behaviours. For example, individuals often view themselves as less likely than others to become ill (Perloff and Fetzer 1986), develop breast cancer (Skinner et al. 1998), have an accident (Robertson 1977), experience alcohol-related problems (Dillard, Midboe, and Klein 2009), or contract diseases such as hepatitis C (Menon, Block, and Ramanathan 2002) and AIDS (Raghubir and Menon 1998). Recent research on COVID-19 risk perceptions further supports these findings (Wise et al. 2020). This systematic bias is of great concern to social marketers and health officials, as it can lead individuals to believe they are 'special' and, thus, impervious to communicated health risks (Block and Williams 2002; Menon, Block, and Ramanathan 2002).

In general, processing objective base rate information should attenuate this self-positivity bias by helping individuals better align their perceived risk for a given health issue with their actual risk for it. Specifically, individuals should adjust their own (underestimated) risk perceptions upward in the presence of a higher base rate (i.e. higher actual risk) (Greening et al. 2005; Raghubir and Menon 1998). In support, prior research has shown that base rates with higher nominal values (e.g. 33%) lead to higher health risk estimates than base rates with lower nominal values (e.g. 24%) (Raghubir 2008). Greening and Chandler (1997) similarly showed that individuals reported higher perceived risk for a variety of events when presented with higher (vs. lower) base rates (e.g. motor vehicle accidents, burglary, parachute accidents).

Expanding upon this, we propose here that such heightened risk estimates will, in turn, increase intentions to engage in healthy behaviours aimed at reducing the risk (e.g. wearing seat belts; exercising each day). Prior research suggests that individuals' health risk perceptions are a key determinant of their subsequent associated health behaviours (Kemp, Williams, and Porter 2015; Wise et al. 2020). Indeed, according to the Health Belief Model (Janz and Becker 1984), individuals are influenced by their evaluations of the positive and negative consequences of behavioural alternatives: the more beneficial they perceive a health behaviour to be, the more likely they are to undertake it. The perceived benefit of a behaviour, though, is dependent on the perceived risk of the health issue and how likely the consequences are to occur (Janz and Becker 1984). We accordingly expect that higher base rates will increase individuals' perceived health risk, thereby increasing their intentions to engage in preventative action. This proposed mediation serves as the main focus of Study 1 and is formally hypothesized below:

H1. Health risk estimates will mediate the effect of base rates on healthy behavioural intentions.

Base rates in health communications and the role of message involvement

Whereas H1 predicts how individuals process, and respond to, base rate information *in general*, H2 (proposed later) focuses on how consumers process and respond to base rate information when it is strategically used in targeted health communications, specifically. Such communications offer additional aspects to consider when assessing the impact of base rates; for example, health marketers often use tailored base rate information that is most relevant to their intended target audience (i.e. their messages tend to feature base rates that explicitly refer to the target audience) (Wansink and Pope 2015). These messages also typically suggest specific behaviours for the target audience to undertake to reduce their personal risk of the communicated health issue (e.g. avoiding certain foods; wearing a condom) (Block and Williams 2002; Keller and Lehmann 2008). Thus, the overall impact of a (high or low) base rate on one's intentions to follow recommended behaviours in a health message likely depends on his/her involvement with the message (i.e. whether he/she is a member of the intended target audience). We focus in particular on the notion that the positive impact of higher base rates suggested generally in H1 (relative to lower rates) may be *reversed* in health communication settings when recipients' involvement is *lower* (i.e. when the message is *less* personally relevant).

Indeed, involvement has been widely recognized as an important determinant of how individuals process and respond to persuasive communications, though its conceptualization and measurement have long been debated in the marketing literature (see Andrews, Durvasula, and Akhter 1990). Prior conceptualizations include task involvement (Sherif and Hovland 1961), message involvement (Maheswaran and Meyers-Levy 1990), response involvement (Zimbardo 1960), issue involvement (Reinard 1988), and personal involvement (Petty, Cacioppo, and Goldman 1981), to name a few.

Regardless of terminology, a common key proposal of all these conceptualizations is that individuals are more involved with – and more likely to be persuaded by – communications that have higher personal relevance (Andrews, Durvasula, and Akhter 1990; Newman et al. 2012; Petty and Cacioppo 1981). This proposal aligns with the Relevance Accessibility Model (Baker and Lutz 1988) in the marketing literature, which posits that communicated information must be both accessible and *relevant* in order to be effective. Thus, consistent with prior research, we conceptualize involvement here as the extent to which a health message has 'personal meaning' to individuals (Sherif et al. 1973; p. 311) and 'consequences for their own lives' (Apsler and Sears 1968, p. 162) (Petty and Cacioppo 1979). Stated more simply, high (low) involvement manifests when a health message has a high (low) degree of personal relevance to a recipient (Petty and Cacioppo 1981). It is critical to note again here that health base rates inherently allude to specific referent groups whose composition can vary greatly (e.g. teen girls; all smokers; men over 65 with type 2 diabetes; veterans). Thus, the extent to which message recipients also possess the descriptive traits of those groups (e.g. age, gender) can also vary greatly. Involvement can therefore be considered here as a function of how (dis)similar the individual processing health base rate information is to the targeted group described by the base rate[3].

Perceived (dis)similarity to others who suffer from certain health issues has been identified as one of the most important antecedents of perceived risk (e.g. Gerend et al. 2004; Lek and Bishop 1995; Weinstein 1980). Thus, as suggested in Figure 1, varying levels of involvement should lead individuals to view the base rate information provided in a health message as more or less personally relevant and to adjust their risk perceptions accordingly (Block and Williams 2002; Petty and Cacioppo 1979, 1981). These risk estimates should, in turn, affect individuals' perceptions of how personally relevant the recommended behaviours aimed at reducing the risk are, ultimately influencing their intentions to undertake them (Greening et al. 2005; Keller 1999; Keller and Lehmann 2008).

This line of reasoning suggests that higher base rates (relative to lower rates) can potentially have a *negative* impact under conditions of *low* involvement. This notion is supported by prior research which highlights that health communications, especially those using quantitative information, can be ineffective, or more importantly, counterproductive (Biswas and Pechmann 2012; Puntoni, Sweldens, and Tavassoli 2011). Such 'backfire' or 'boomerang' effects have been documented across a variety of health contexts, such as healthy eating (Schwartz et al. 2007), self-administered breast exams (Kline and Mattson 2000) and practicing safe sex (Priester 2002).

We offer anchor and adjustment perspective here to more fully explain how higher base rates in health messages (as compared to lower rates) can result in a boomerang effect among low involvement individuals. Assimilation-contrast theory posits that individuals' own beliefs serve as internal reference points to which they compare subsequent external information (such as persuasion attempts) (Sherif and Hovland 1961). Thus, in the absence of external health information (e.g. base rates), individuals use their own internal health risk beliefs as an anchor, or reference point, for forming judgments and evaluations (Raghubir and Menon 1998). However, when a base rate is provided, it serves as an external anchor that individuals use to update their health risk estimates upon (and consequently their related health behaviours). They can adjust their risk perceptions upward toward higher base rates (an assimilation effect) or downward away from them (a contrast effect), resulting in a more positive or negative overall impact of higher rates, respectively.

Prior research indicates that self-evaluations are assimilated toward similar (in-group) targets, but contrasted away from dissimilar (out-group) targets (Bickart et al. 1994; Brewer and Weber 1994). This suggests that when the referent group in a health message is more similar to message recipients (i.e. when involvement is high), recipients should view higher base rate information as more personally relevant (relative to lower rates). This should lead them to adjust their own risk estimates upward toward to better align with the higher rate for the targeted group that they belong to. In turn, these heightened risk perceptions should increase the relevance they place on the recommended health behaviours, ultimately increasing their intentions to undertake them. Said differently, higher base rates (compared to lower rates) should have a *positive* indirect impact on intentions to comply with recommended health behaviours when involvement is *higher* (thus attenuating the self-positivity bias via an assimilation effect). This perspective aligns with, and builds upon, H1.

However, we expect the opposite to occur when the recipient is *less* similar to the targeted referent segment described by the base rate (i.e. when involvement is *low*). Individuals should view higher base rate information about a dissimilar referent group

as *less* personally relevant (relative to when a lower rate is presented), and should consequently adjust their own perceived risk *downward* away from that suggested by the rate for the dissimilar group. These reduced personal risk estimates should then *decrease* the relevance that recipients place on the health behaviours recommended in the message, ultimately *lowering* their intentions to comply with them. Said differently, higher base rates (relative to lower rates) should have a *negative* indirect impact on behavioural intentions when involvement is *lower* (thus enhancing the self-positivity bias via a contrast effect). These proposed convergent effects are further supported by prior research indicating that individuals consistently display a stronger self-positivity bias when they compare themselves to a less (vs. more) similar comparison target (e.g. a referent group in a health message) (Helweg-Larsen and Shepperd 2001). This proposed boomerang effect serves as the main focus of Study 2 and is formally hypothesized below:

> **H2.** When individuals are *less* involved with a health message, higher base rates (relative to lower rates) will have a *negative* indirect effect on their intentions to undertake recommended health behaviours via these sequential mediators: 1) perceived relevance of the base rate information, 2) perceived health risk, and 3) perceived relevance of the recommended health behaviours.

The current research

The present research tests the effects of base rate manipulations (higher vs. lower) across two main studies. In Study 1, we seek to gain initial insight on how individuals process and respond to health base rates, in general. There we assess how base rates affect health risk perceptions, and further, if such estimates underlie the effects of base rates on healthy behavioural intentions (see H1). We then assess the impact of base rates in a health communication context, specifically, in Study 2. There we test a more complex (serial) mediation chain to better understand the effects of base rates in targeted health messages, focusing primarily on the potential 'boomerang' effect under conditions of low involvement (see H2).

Study 1

Design and procedures

The purpose of Study 1 was to test H1. We incorporated procedures, stimuli, and measures consistent with prior marketing research on base rates (c.f., Raghubir 2008). A sample of 137 undergraduate students aged 18–24 completed an in-class survey for extra credit (mean age = 21.59). Approximately 51% (49%) of the sample was male (female). Each respondent was provided a table of annual statistics on the six leading causes of death in the U.S. for all age groups, and for 15–24 year olds specifically (see Figure 2). We manipulated the base rate in the text below the table by expressing a constant numerator (the total number of deaths among 15–24 year olds by motor vehicle accidents [MVAs]) as a function of either: 1) the total number of deaths among 15–24 year olds (i.e. a smaller referent group resulting in a higher base rate), or 2) the total number of deaths among all ages by MVAs (i.e. a larger referent group resulting in a lower base rate). Thus, Study 1 was a one-way between-subjects

Lower Base Rate Condition

Below, you are given the base rates for common causes of death among 15–24 year olds, as well as the total number of deaths by the same causes in the U.S. Motor Vehicle Accidents (MVAs) were a leading cause of death.

Cause of Death	All Ages		15-24 Year Olds
Total # of deaths	2,403,351	100%	31,307
Heart Disease	936,923	39.00%	1309
Cancer	553,091	23.00%	1713
Lung Disease	122,009	5.10%	190
Diabetes	69,301	2.90%	162
Influenza and Pneumonia	65,313	2.70%	189
Motor Vehicle Accident	43,354	1.80%	10,560

As many as 24.36% of the deaths of people due to motor vehicle accidents in the country happened to people in the 15–24 year old age range.

Higher Base Rate Condition

Below, you are given the base rates for common causes of death among 15–24 year olds, as well as the total number of deaths by the same causes in the U.S. Motor Vehicle Accidents (MVAs) were a leading cause of death.

Cause of Death	All Ages		15-24 Year Olds
Total # of deaths	2,403,351	100%	31,307
Heart Disease	936,923	39.00%	1309
Cancer	553,091	23.00%	1713
Lung Disease	122,009	5.10%	190
Diabetes	69,301	2.90%	162
Influenza and Pneumonia	65,313	2.70%	189
Motor Vehicle Accident	43,354	1.80%	10,560

As many as 33.73% of the total deaths of people in the 15–24 year old age range were due to motor vehicle accidents.

Figure 2. Study 1 experimental stimuli lower base rate condition higher base rate condition.

design in which respondents were presented with a higher or lower base rate about the same health issue (MVAs).

Dependent measures

We assessed risk estimates of each cause of death in the table through the statement: 'Given these rates of occurrence, please estimate how much at risk you are for the following:' with endpoints of 0 = not at all likely to happen to me/100 = definitely likely to happen to me. Respondents' MVA risk estimates served as a focal dependent measure, while the other five risk estimates were used as covariates to control for individual differences in risk propensity (Raghubir 2008). Respondents' behavioural intentions regarding 1) drinking and driving and 2) texting while driving were assessed by the statement: 'Given these rates of occurrence, please estimate how likely or unlikely you are to do each of the following:' with endpoints of 0 = not at all likely/100 = definitely likely. Consistent with prior research on consumer responses to health messages (Keller and Block 1999), these measures were averaged to form an overall behavioural intentions index. The index values were reverse coded so that higher values indicate healthier intentions related to the use of motor vehicles.

Following prior health advertising research (Block and Keller 1995), we also measured the perceived credibility and ease of comprehension of the information with the statement: 'The information presented was:' with endpoints of 1 = not believable/7 = believable and 1 = very hard to comprehend/7 = very easy to comprehend. These were used to rule out the possibility that the base rate manipulation affected the perceived comprehension and/or credibility of the information (which in turn could account for differences in responses across conditions). As a manipulation check, we also asked respondents, 'Which of the following best represents what you were told about 15–24 year olds' deaths?' The two options reflected the two base rates in the stimuli.

Study 1 results

Manipulation check

Chi-square test results suggested high levels of awareness of the base rate manipulation (χ^2 = 110.46, p < .001); approximately 94% (96%) of respondents in the higher

(lower) base rate condition accurately recalled the appropriate base rate provided, indicating a successful manipulation. One way ANCOVA results also revealed that the provided information was highly credible ($M = 5.94$ vs $M = 6.32$; $p > .06$) and well understood ($M = 5.39$ vs $M = 5.80$; $p > .12$). These perceptions importantly did not significantly differ across the two base rate conditions.

Tests of predictions

One-way ANCOVA results revealed a significant main effect of information base rates on risk estimates ($F(1,129) = 4.60$, $p < .04$). As expected, respondents presented with higher base rates reported higher MVA risk estimates (M = 58.04%) than those presented with lower base rates (M = 49.09%).

Expanding upon this, we next used Hayes' (2013) PROCESS Model 4 with 5,000 bootstrap samples and 95% bias-corrected confidence intervals (CI) to formally test the significance of the indirect effect (IE) of base rates on healthy behavioural intentions through MVA risk estimates. An overview of results is offered in Table 1. Analyses revealed that the CI surrounding the positive IE of the base rate did not contain zero (IE = 1.59; CI [.16, 4.26]). This suggests that risk estimates indeed served as a mediator (Hayes 2013). Thus, H1 is supported.

Study 1 discussion

We showed in Study 1 that higher (vs. lower) health base rates increase individuals' associated health risk estimates. We then built on this finding and extended prior research (Raghubir 2008) by further demonstrating that these heightened risk estimates, in turn, decrease individuals' intentions to engage in healthy behaviours aimed at reducing the risk. That is, we identified perceived risk as an important mechanism underlying the effect of health base rates on healthy behavioural intentions. From a health advertising and consumer welfare standpoint, these findings initially suggest that health communications which use higher (vs. lower) base rates may generally be more effective at reducing individuals' self-positivity biases. However, it is difficult to directly reach this conclusion based on our Study 1 findings, alone, since respondents did not process base rate information in an actual targeted communicated health message, per se.

Moreover, prior research indicates that perceived similarity to others who suffer from certain health issues is one of the most important antecedents of perceived risk (e.g. Gerend et al. 2004; Lek and Bishop 1995; Weinstein 1980). Since the ages of all Study 1 respondents fell within the stated age range of the referent group described by the base rate, it is possible that they viewed the referent group as highly similar to themselves, thus enhancing the positive effect of the higher rate on their risk perceptions and subsequent intentions (see also Maheswaran and Meyers-Levy 1990). In addition, health messages are typically tailored for specific consumer segments, making it likely that some individuals are exposed to health messages not specifically intended for them in 'real life' (especially in today's digital landscape). However, the impact of higher base rates in situations when individuals process base rate information about a *dissimilar* referent group in health messages remains unclear (i.e. when their involvement is *lower*).

Table 1. Study 1 test of the mediating role of perceived motor vehicle accident risk on healthy behavioural intentions.

	Model 1 Perceived motor vehicle Accident risk (Mediator)		Model 2 Healthy behavioural Intentions (Outcome)	
Independent variables	Coefficient	*T*-values	Coefficient	*T*-values
Base rate	8.95	2.14*	1.94	.57
Heart disease risk	.02	.13	.09	.85
Cancer risk	.55	4.36***	.12	1.18
Lung disease risk	−.20	−1.38	.05	.41
Diabetes risk	.16	1.12	−.26	−2.20*
Influenza and pneumonia risk	.32	2.35*	.05	.47

Note. All coefficients are unstandardized. Heart disease risk, cancer risk, lung disease risk, diabetes risk, and influenza and pneumonia risk were used as covariates (Raghubir 2008; Hayes 2015).
* $p <$. 05; ** $p < .01$, *** $p < .001$.

We therefore seek to clarify these unanswered questions in Study 2 by expanding our investigation into a social marketing context where we can examine the persuasiveness of base rate information in an actual targeted health message. Such messages typically recommend behaviours specifically designed to reduce the communicated health risk (Block and Williams 2002), allowing us to also ultimately assess the impact of base rates on message recipients' compliance intentions. This context also allows us to determine if several key aspects of health messages additionally underlie the effect of base rates on those compliance intentions (i.e. perceived relevance of the base rate information and perceived relevance of the recommended behaviours). Of primary importance in Study 2 is whether higher base rates have an unintended boomerang effect when message involvement is lower via the serial chain proposed in H2. We utilize a new health issue (obesity) to enhance the generalizability of our work.

Study 2

Design and procedures

The primary purpose of Study 2 was to test H2, so we utilized a 2 (Base Rate: Higher vs. Lower) × 2 (Involvement: Higher vs. Lower) between-subjects design. The 249 respondents in this online national study were recruited and paid on Amazon Turk (mTurk). Recent research has highlighted mTurk as a high quality data source for advertising researchers (Kees et al. 2017). Approximately 51% (49%) of this sample was male (female), and ages ranged from 18 to 70 (mean age = 37.24). 73% of respondents were white, 8% were African American, and the remaining were Hispanic, Asian, Native American, or Pacific Islander. We presented respondents with a social marketing advertisement that offered base rate information about obesity-related deaths in the U.S., as well as several recommended health behaviours designed to reduce obesity (see Figure 3). We calculated base rates from factual data from the American Heart Association (AHA 2012) and the CDC (Hoyert and Xu 2012). The health behaviours suggested in the ad were based on those provided by the CDC (CDC 2014).

Consistent with Study 1, we manipulated the base rate by expressing a constant numerator (the total number of deaths among white and black 40–85 year olds by obesity-related causes in the U.S.) as a function of either: 1) the total number of deaths

among white and black 40–85 year olds in the U.S. (the *lower* base rate), or 2) the total number of deaths among all ages by obesity-related causes in the U.S. (the *higher* base rate). We chose age and race as descriptors to mirror traditional segmentation approaches long used in health communications and social marketing campaigns (Albrecht and Bryant 1996; Maheswaran and Meyers-Levy 1990). We chose obesity as the health issue because of its importance to public policy and consumer health (e.g. Newman, Howlett, and Burton 2014). Respondents were randomly assigned to one of the base rate conditions and presented with the proper corresponding ad (see Figure 3).

Pretest of study 2 message involvement manipulation

We conducted an online pretest study with 64 adult respondents recruited from mTurk to ensure that the Study 2 involvement manipulation would work as intended. Prior health advertising researchers have manipulated involvement by varying the congruency between the age of the referent group described in an ad and the age of the message recipient (Maheswaran and Meyers-Levy 1990). Drawing from this, we manipulated involvement by strategically recruiting respondents such that one half of the sample consisted *only* of white and black U.S. respondents aged 40 to 85 (i.e. the higher involvement condition). That is, all respondents in the higher involvement condition were similar to the referent group on *both* descriptors (age and ethnicity). This was conceptually consistent with Study 1 where respondents' ages fell within the age range of the referent group. The other half of the sample, representing the lower involvement condition, consisted entirely of respondents whose age and ethnicity did not match *both* the age *and* ethnicity of the referent group (i.e. they could not be a 40–85 year old white or black adult living in the U.S.). Thus, respondents were assigned to the lower involvement group in both the pretest and in Study 2 even if they had one of the two traits in common with the referent group (either age or ethnicity). This assignment was done intentionally to ensure a more conservative manipulation and a more rigorous test of H2. From a practical standpoint, it also allowed us to assess the effects of base rates on: 1) individuals in the intended target audience (higher involvement group), and 2) those *not* specifically targeted by the ad (lower involvement group).

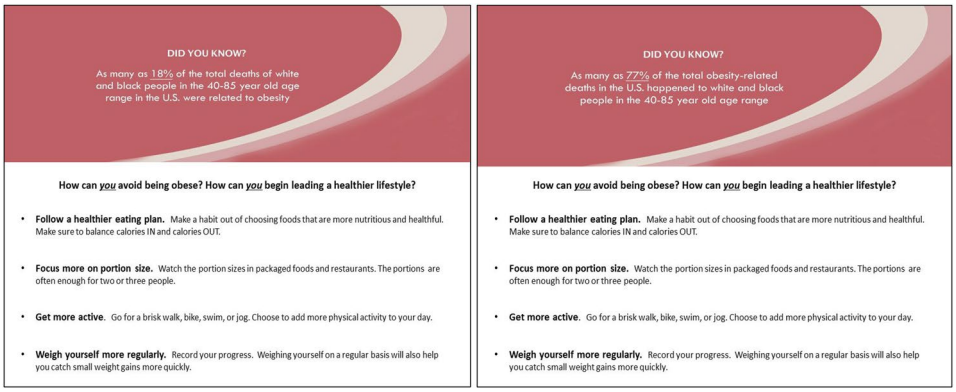


Figure 3. Study 2 experimental stimuli.

Involvement was measured by the statement, 'Overall the information shown in this advertisement is:' with endpoints of 1 = not at all involving/7 = very involving and 1 = not at all interesting/7 = very interesting (adapted from Maheswaran and Meyers-Levy 1990) (r = .70, p < .001). As expected, pretest results indicated that respondents in the higher involvement condition reported higher felt message involvement than those in the lower involvement condition (F(1,60)=6.79, p < .02; M = 5.28 vs M = 4.44). This indicates that the manipulation worked as intended, so we followed the same recruiting procedures again to create the higher and lower involvement groups in Study 2.

Study 2 dependent measures

We used the same health risk estimate measure from Study 1, slightly modifying it to reflect the new health context (obesity). We assessed the perceived relevance of the base rate information and the perceived relevance of the recommended health behaviours with the following statement: 'The obesity-related death statistics [suggested health behaviours] shown in the advertisement are' with endpoints of 1 = not very relevant/7 = very relevant, 1 = not at all important/7 = very important, and 1 = not very useful/7 = very useful (both α's >.85) (Miyazaki, Grewal, and Goodstein 2005). We assessed intentions to undertake each of the four recommended behaviours in the ad with the statement: 'Given the information shown in the ad, please estimate how likely or unlikely you are to do each of the following activities suggested in the ad' with endpoints of 0 = not at all likely/100 = definitely likely. Consistent with Study 1 and prior related research (Keller and Block 1999), we again averaged these measures to form an overall index of behavioural intentions. Also consistent with Study 1 and prior related research (Raghubir 2008), we again used risk propensity as a covariate and assessed it with the items: 'I prefer to avoid risks' and 'I do not take risks' with endpoints of 1 = totally disagree and 7 = totally agree, (r =.68, p <.001) (adapted from Meertens and Lion 2008). Lastly, we used the same Study 1 manipulation check again after modifying it to reflect the new base rates.

Study 2 results

Manipulation check

Chi square results again indicated a successful base rate manipulation (χ^2 =198.15, p< .001); approximately 95% (99%) of respondents in the higher (lower) base rate condition accurately recalled the appropriate base rate that was provided to them. The provided information was also again well understood (M = 6.62 vs. M = 6.64; p >.86) and highly credible (M = 6.25 vs. M = 6.30; p >.71). These perceptions did not significantly differ across base rate conditions, and involvement did not interact with base rates to influence information credibility or comprehension (both p's >.20).

Tests of predictions

MANCOVA results revealed significant base rate × involvement interactions for perceived relevance of the base rate information (F(1,244)=66.95, p < .001), health risk estimates (F(1,244)=112.52, p < .001), perceived relevance of the recommended health behaviours (F(1,244)=40.93, p < .001), and intentions to undertake the recommended health behaviours (F(1,244)=23.27, p < .001). As shown in Figure 4(a)–(d), the plots

of means were all highly similar such that higher base rates had a significant positive (negative) effect on each measure in the high (low) involvement group as compared to lower base rates. Thus, we discuss the plot for health risk estimates here as a representative example. As shown in Figure 4(b), highly involved respondents expressed higher health risk estimates when higher, rather than lower, base rates were provided (M = 70.43 vs. M = 41.29; $p < .001$). Conversely, those who were *less* involved expressed *lower* risk estimates when higher base rates were provided compared to when lower rates were provided (M = 33.38 vs. M = 17.42; $p < .001$). This highly consistent pattern of results across Figure 4(a)–(d) suggests that a significant negative indirect effect (i.e. boomerang effect) of higher base rates on behavioural intentions should emerge through the three sequential mediators for low involvement individuals (see H2). It also conversely suggests the emergence of a significant positive indirect effect through the same serial path when involvement is higher.

The primary purpose of Study 2 was to formally test the boomerang effect proposed in H2. In order to avoid the well-documented drawbacks of separate subgroup analyses (see Hayes 2013, p. 408), we directly followed the procedures outlined by Hayes (2015) to examine the IE's for both involvement groups simultaneously. We first used PROCESS Model 6 with 5,000 bootstrap samples and 95% bias-corrected CIs to assess the IE of base rates for the higher involvement group (Hayes 2013). We used the base rate as the independent variable (coded as 0 = lower, 1 = higher) and intentions to follow the recommended behaviours as the dependent measure. The 1) perceived relevance of the base rate information, 2) health risk estimates, and 3) perceived relevance of the recommended health behaviours were used as sequential mediators (in that order). We coded involvement as 0 = higher, 1 = lower, and used the base rate × involvement interaction and risk propensity as covariates (Hayes 2015). This allowed us to relatively assess the indirect effect of the base rate manipulation (higher vs. lower) on intentions to follow the recommended behaviours for each involvement group. The results are offered in Table 2.

Aligning with the Study 1 findings, results indicated a significant *positive* IE of higher base rates (relative to lower rates) through the three serial mediators on the *higher* involvement respondents' intentions to follow the recommended health behaviours, as expected (IE=.0191; CI [.0008, .1019]) (i.e. the 95% CI did not contain zero) (Hayes 2013). Continuing to follow Hayes' (2015) procedures, we then calculated the IE through the same mediation path for the *lower* involvement group using the unstandardized regression coefficients presented in Table 2. This resulted in an IE of −.1364. We then used the PROCESS code provided by Hayes (2013) to calculate the 95% bias-corrected CI for that IE, which was (-.5402, −.0092). This CI indicates that for lower involvement respondents, higher base rates (relative to lower rates) did indeed have the hypothesized significant *negative* indirect effect on intentions to comply with the recommended health behaviours. This unintended 'boomerang effect' fully supports H2.

General discussion

Marketers and public health officials frequently use statistical information to craft customized health messages for specific consumer segments (e.g. women over 60; African American teens) (Wansink and Pope 2015). However, the composition of the consumer groups described in such messages can vary greatly, inherently resulting

in the presentation of (sometimes very) different base rate percentages about the same health issue (e.g. 'Obesity affects 17% of children and adolescents aged 2–19'; 'Obesity affects 8.4% of children aged 2–5'; 'Obesity affects 22.4% of Hispanic children and adolescents') (CDC 2015).

To assess how individuals respond to varying base rates, we empirically tested a conceptual framework that integrates health information base rates, self-risk perceptions, and health-related behavioural intentions (see Figure 1). Findings from Study 1 demonstrated that higher (vs. lower) base rates lead to higher associated health

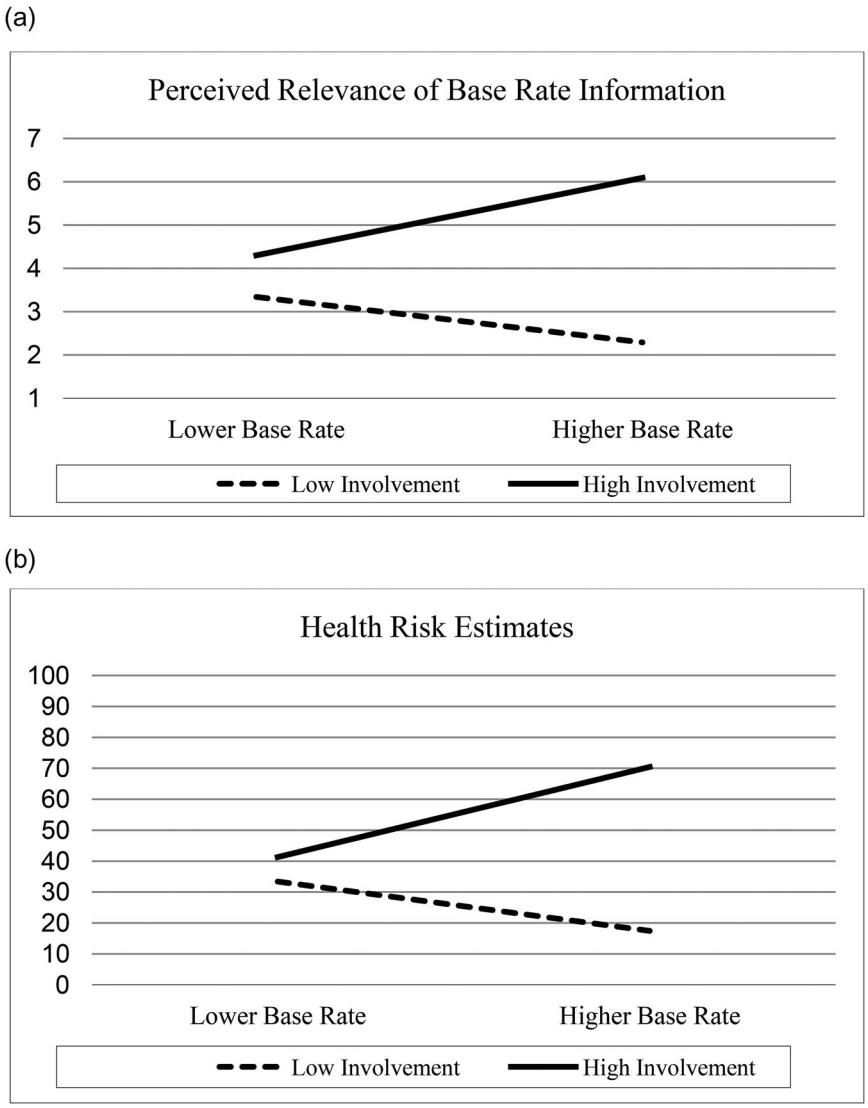
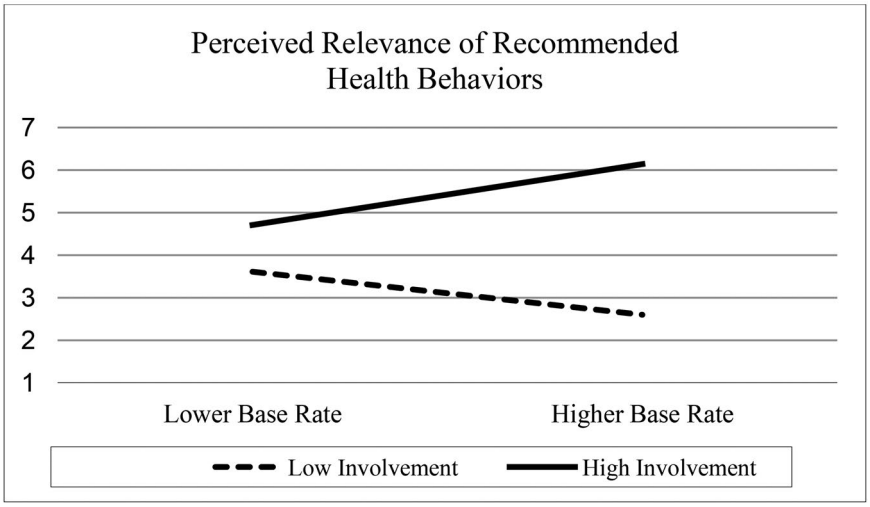


Figure 4. (a) Study 2 effects of information base rates and involvement on perceived relevance of base rate information. (b) Study 2 effects of information base rates and involvement on health risk estimates. (c) Study 2 effects of information base rates and involvement on perceived relevance of recommended health behaviours and (d) Study 2 effects of information base rates and involvement on healthy behavioural intentions.

(c)



(d)

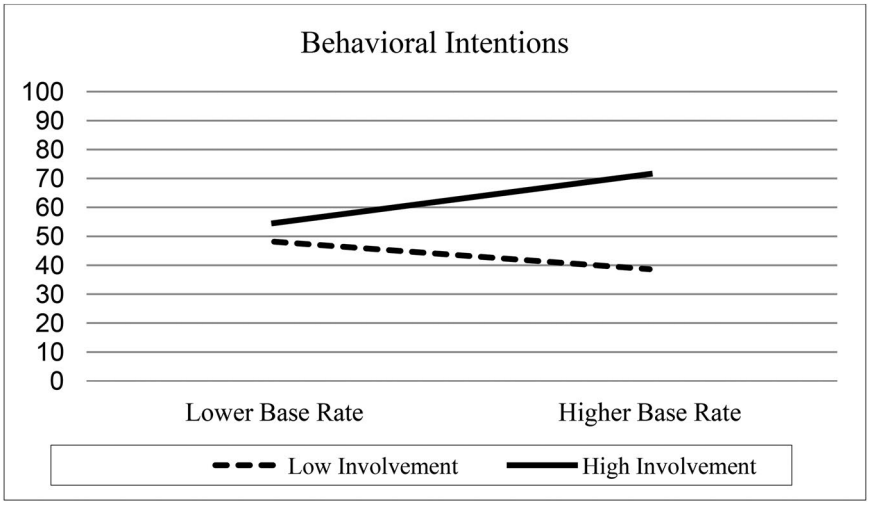


Figure 4. **(continued)**

risk estimates, which in turn positively affect important health-related behavioural intentions.

Our Study 2 findings then revealed a more complex process underlying the impact of higher base rates on consumers' intentions to comply with behaviours recommended in health messages. Critically, though, we further showed that this indirect effect of base rates in health communications is conditional on individuals' message involvement: higher base rates had a positive impact on consumers' compliance intentions when involvement was higher, but conversely exerted a *negative* influence when involvement was *lower*. These findings, especially the latter unintended boomerang effect, are of high importance to health advertisers, policy makers, public health officials, and consumer welfare advocates, as we discuss below.

Table 2. Study 2 test of the mediating roles of perceived relevance of base rate information, perceived health risk, and perceived relevance of recommended health behaviours on healthy behavioural intentions.

	Model 1 Perceived relevance of base rate information (Mediator)		**Model 2 Perceived health risk (Mediator)**		**Model 3 Perceived relevance of recommended health behaviours (Mediator)**		**Model 4 Healthy behavioural intentions (Outcome)**	
Independent variables	Coefficient	*T*-values	Coefficient	*T*-values	Coefficient	*T*-values	Coefficient	*T*-values
Base rate (BR)	.33	1.91	5.05	2.43*	.12	.65	4.29	1.54
Involvement (I)	−2.44	−14.05***	−24.00	−8.66***	−1.78	−6.42***	−26.92	−5.93***
BR×I	−2.84	−8.18***	−36.50	−7.83***	−1.83	−4.03***	−34.62	−4.86***
Risk propensity	−.01	−.17	.29	.42	−.02	−.25**	−.16	−.17
Perceived relevance of base rate information	–	–	3.02	3.97***	.38	5.55***	.40	.36
Perceived health risk	–	–	–	–	−.01	−1.88	−.11	−1.28
Perceived relevance of recommended health behaviours	–	–	–	–	–	–	−1.80	−1.85

Note. All coefficients are unstandardized. Involvement, the involvement×base rate interaction term, and risk propensity were used as covariates (Hayes 2015). * $p <.05$; ** $p < .01$, *** $p <.001$.

Theoretical contributions

The current research makes several key theoretical contributions. First, we identified health risk estimates as an important mechanism underlying the effects of base rates on consumers' intentions to undertake healthy (i.e. risk attenuating) behaviours. Our findings suggest that higher base rates attenuate individuals' self-positivity bias by elevating their risk estimates and positively impacting their associated behavioural intentions. These findings build upon prior marketing research which initially showed how base rates affect consumers' health risk perceptions (Raghubir 2008). They also address prior calls for research on how individuals form health risk estimates (Yan and Sengupta 2013) and how such estimates affect behavioural intentions (Raghubir 2008).

We then identified a more complex serial process driving the impact of base rates on intentions to comply with recommended behaviours in health messages. Specifically, we showed that the perceived relevance of both the base rate information and the recommended health behaviours are important factors that additionally account for the effects of base rates (beyond risk estimates). This finding offers more detailed insight into the perceptual process underlying message recipients' responses to statistical health information in health communications.

Lastly, we demonstrated that the impact of base rates described earlier is conditional on individuals' involvement with a given health message. Drawing from assimilation-contrast theory (Sherif and Hovland 1961), we used an anchor and adjustment perspective to predict and show how higher base rates enhance message persuasiveness and lead to positive outcomes when involvement in higher (i.e. when recipients are more similar to the targeted segment described by the base rate). Conversely, we also documented a novel boomerang effect such that higher base rates *decrease* message persuasiveness and lead to *negative* outcomes

when involvement is *lower* (i.e. when recipients are *less* similar to the targeted group referred to by the rate). This critical effect reversal complements the positive effects of higher rates previously documented in the health information processing literature.

Together, these divergent effects inform extant research surrounding comparative optimism by demonstrating that higher base rates attenuate (enhance) the self-positivity bias under conditions of higher (lower) involvement (Keller and Lehmann 2008; Menon, Block, and Ramanathan 2002; Raghubir and Menon 1998). More broadly, they also help better explain when, and why, individuals emphasize or discount health messages (e.g. Keller 1999).

Implications for public policy and consumer welfare

We focused on two timely health issues (obesity and motor vehicle accidents) that are of interest to policy makers, public health officials, and consumer welfare advocates (Berry et al. 2019; Bublitz et al. 2013; Newman, Howlett, and Burton 2016; Sar and Anghelcev 2015). Policy makers and health marketers are directly interested in creating more persuasive communications about these issues (and others), as unhealthy behaviours and diseases have detrimental economic and societal impacts at broader levels (Burton et al. 2015; Newman et al. 2018). It is particularly vital that they reduce consumers' self-positivity biases, which may otherwise diminish the efficacy of health messages aimed at promoting healthy behaviours (Raghubir and Menon 1998).

Our findings inform policy and health communication strategies to this end. They suggest that communicating higher, rather than lower, base rates will better bring *targeted* consumers' perceived health risks in line with their actual risks, thus positively impacting their health behaviours. Though we initially only document this positive impact in a social marketing context, there is certainly hope that similar positive effects would emerge across a variety of other settings where consumers are exposed to statistical health information (e.g. health/nutrient claims, prescription drug advertising, commercial marketing, public service announcements). Exploring these possibilities is certainly warranted to further inform policy and practice.

As discussed, however, base rates can serve as a 'double edged sword' by potentially discouraging *untargeted* (low involvement) consumers from engaging in recommended health behaviours in some cases. This is troublesome from a consumer welfare standpoint, as many untargeted consumer segments can also be at some level of risk for a given communicated health issue (albeit lower most likely). Like the target audience, they too would benefit to varying degrees from undertaking the recommended behaviours. For example, nearly any consumer segment would arguably benefit from eating healthier foods, limiting portion sizes, and being more active; yet, our Study 2 findings suggest that higher base rates actually *decrease* intentions to follow these very recommendations when they view the communication as less relevant.

Thus, our research challenges traditional approaches to assessing the efficacy of health communication programs that primarily focus only on changes in the target

audience's attitudes and behaviours (see Cho and Salmon 2007). We highlight the need to additionally assess the (potentially negative unintended) effects of health communications on other audiences exposed to them. Only then will a given health message's overall impact and net effect on consumer welfare be truly realized. To help accomplish this, we suggest based on our findings that careful consideration be paid to the following when using base rates in health communications: 1) the magnitude of the base rate (higher vs. lower), 2) the composition of the segment described by the rate (age, gender, etc.) and 3) the channel(s) chosen to disseminate the base rate information.

The first two aspects of health messages outlined above (base rate magnitude and referent group composition) inherently affect each another. That is, the magnitude of the base rate is determined to a great extent by the specificity (and resulting size) of the chosen referent group. Thus, when choosing target audiences, policy makers and health marketers should explicitly consider how using different population characteristics will result in different base rates for a given communicated health issue. Doing so will give them more control over the magnitude of the subsequent rate, as well as the collective size and scope of untargeted individuals (which should, at least partly, help predict among whom the boomerang effect most likely may occur). Ideally, policy makers and health marketers should utilize referent groups that are encompassing enough to make a message relevant to as many consumers as possible, while still allowing for the provision of higher base rates. They should also try to ensure that targeted consumers view the recommended health behaviours as relevant to best achieve compliance (Janz and Becker 1984). Our results suggest that higher rates should help facilitate these perceptions. Overall, these recommendations align with the Relevance Accessibility Model which posits that communications must be relevant to recipients in order to be effective (Baker and Lutz 1988).

The Relevance Accessibility Model also suggests that health communications must be *accessible* to be effective (Baker and Lutz 1988). Accordingly, traditional marketing and advertising strategies have focused primarily on choosing channels that offer the most accessibility and exposure to *targeted* consumers. However, our recommendation is that health communicators should also explicitly consider the extent to which *untargeted* consumers are exposed to health messages in a given channel. More careful channel selection and ad placement should decrease opportunities for low involvement consumers to engage in the documented message discounting process (and likely simultaneously increase the efficacy of health messages among target audiences). However, technological advancements have made consumer search for, and sharing of, health information easier than ever, making the spillover of health messages to untargeted individuals a real threat to consumer welfare. Targeting consumers electronically based on their digital footprint may reduce these spillover effects relative to more public mediums that can be seen or heard by many different people (e.g. billboards, television, radio).

Lastly, it is worth noting briefly again that the use of (accurate) base rates in health communications is not prohibited. Still, policy makers may consider encouraging, or mandating, disclosures in health communications that caution individuals about drawing inferences about their own health risks based on base rates that are not necessarily applicable to them. Disclosures could highlight the potential for significant variation in base rate health information, reminding consumers that higher rates reported for

other (dissimilar) segments does not necessarily imply lower rates or risk for themselves. By urging consumers to more carefully assess their own risk using more pertinent information, policy makers, health officials, and social marketers may be able to limit the potentially negative unintended effects of higher rates on untargeted individuals.

Implications for health-related commercial marketing and advertising

Marketers frequently use numerical claims and comparisons to highlight the superiority of their offerings across various promotional channels, including ads, product packaging, and personal selling (Xie and Johnson 2015). For example, many consumer packaged goods manufacturers incorporate numerical health claims in product advertisements (e.g. 'Recommended by 90% of Dentists') and on food packages (e.g. '25% less fat'). When appropriately framed, this information can enhance the persuasiveness of health messages, influence consumers' judgments, and increase sales (Chen 2016). Our findings here suggest that marketers may be able to positively influence consumers' brand preferences and/or purchasing behaviour by strategically choosing referent groups which result in higher rates (e.g. a previous version of the advertised product; a competitor's product).

Similarly, direct-to-consumer drug advertisers and pharmaceutical marketers often use statistical claims (e.g. '52% of men over 40 experience erectile dysfunction. Ask your doctor about Viagra today') (Russell et al. 2017). These messages are designed to convince consumers to request specific drug brands and treatments, thereby potentially altering patient-provider relationships, physicians' prescribing decisions and, consequently, consumer health. To this end, our findings suggest that base rate manipulations can affect consumers' health risk perceptions, potentially leading them to not pursue advertised products that might otherwise alleviate the risk (or conversely, lead them to purchase products they do not really need). Better understanding how base rates affect consumers' risk estimates and subsequent purchasing behaviour is vital to improving consumer health and welfare.

Limitations and future research

Overall, this research answers prior calls for more insight on how risk estimates affect behavioural intentions (Youn and Shin 2020), and more specifically, in health advertising contexts (Kees, Burton, and Tangari 2010). It also addresses previous calls for insight on how involvement influences consumers' interpretation of base rate information (Xie and Johnson 2015) and their health decisions (Scammon et al. 2011). However, it also has limitations that offer potentially fruitful avenues for future research.

For example, we did not measure potentially relevant aspects of respondents' behaviours such as their body mass index (Study 2) or the amount of time they spend driving or their access to vehicles (Study 1). These could affect the influence of base rates and should be explored. Similarly, more research is needed on how consumers respond to different types of base rate manipulations (e.g. absolute sizes of rates,

relative differences in rates, etc.). For example, future studies can manipulate the referent group (and thus the base rate) while holding the health issue constant (e.g. '14.51% of boys aged 15–17 use harmful smokeless tobacco' vs. '10.22% of boys aged 12–14 use harmful smokeless tobacco'). Conversely, researchers could manipulate the health issue while holding the referent group constant (e.g. '16.43% of boys aged 15–17 have reported having suicidal thoughts' vs. '12.89% of boys aged 15–17 have reported using illicit drugs'). A particularly interesting topic to explore centres around whether individuals respond differently to one base rate, as compared to multiple base rates, in a single health communication (and if so, how). Since we did not have a baseline control condition in either study, it was impossible for us to examine how the provision of higher vs. lower base rates affected individuals' responses relative to situations in which they had no base rate information at all. Thus, documenting reactions to different types and numbers of base rates and then comparing them to a control condition is strongly encouraged to overcome this current potential limitation. Responses to different types of recommended health behaviours should also be examined. A strong focus should be placed on individuals' self-efficacy beliefs about successfully completing recommend behaviours (see Janz and Becker 1984). In addition, while intentions are commonly considered to be the most proximal determinant of behaviours, it should be noted that health-related intentions do not always necessarily translate into actual health behaviours (e.g. Kees 2010). Future work should use behavioural measures for enhanced generalizability.

Due to the online nature of Study 2, we relied on self-reported demographics to create the two involvement groups and were not able to completely verify their accuracy. We also only considered certain descriptors of the referent group (age and ethnicity), and were not able to discern if one trait affected involvement more than the other. Involvement may also vary based on the nature and/or number of traits used to describe a referent group. Accordingly, future research could assess whether, and under what conditions, certain descriptors may be more or less influential. Specific attention should also be paid to other factors that may enhance or attenuate the documented boomerang effect. For example, priming certain aspects of one's identity may affect involvement, and thus, the nature of base rate impact (see Puntoni, Sweldens, and Tavassoli 2011). Other practical factors, such as channel selection and ad placement, should similarly be considered.

Conclusion

Health advertisers, policy makers, public health officials, and consumer welfare advocates have a high interest in effectively communicating health risks to the public. To this end, the current research examined a widely used, yet understudied, communication tool (base rates), highlighting some of its key advantages and drawbacks. Overall, we identify both base rates and referent groups as key aspects of health messages that affect the persuasiveness of health communications. Though base rates are easily manipulated and reported, our findings show that their effects can be extremely complex and worthy of deeper consideration by many constituencies. Additional research should test and extend our framework across other policy-relevant domains (e.g. financial communications; sustainability efforts) in order to better

understand, and ultimately reduce, potential boomerang effects of base rates on a larger scale.

Notes

1. As discussed in greater detail later, information base rates are calculated by dividing the incident level of a certain event (e.g., number of people who have lung cancer) by the size of a chosen referent group (e.g., Asian Americans) and are often reported as percentages (e.g., "20% of all women over 65 have high blood pressure").
2. It should be acknowledged that accurate base rate manipulations in (health) communications are not illegal nor considered false advertising, though some can (and do) implicitly mislead consumers (see Hastak and Mazis 2011).
3. Involvement refers to "message involvement" throughout for the sake of clarity and consistency.

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