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Dismissing “don’t know” responses to perceived risk survey items threatens the validity of theoretical and empirical behavior change research

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Abstract

Since the middle of the 20th century, perceptions of risk have been critical to understanding engagement in volitional behavior change. However, theoretical and empirical risk perception research seldom considers the possibility that risk perceptions do not simply exist; they must be formed. Thus, some people may not have formulated a perception of risk for a hazard at the time a researcher asks them, or they may not be confident in the extent to which their perception matches reality. We describe a decade-long research program that investigates the possibility that some people may genuinely not know their risk of even well-publicized hazards. We demonstrate that indications of not knowing (hereafter *don't know responses*) are prevalent in the U.S. population, are systematically more likely to occur among marginalized socio-demographic groups, and are associated with less engagement in protective health behaviors. Don't know responses are likely indications of genuinely limited knowledge, and therefore may indicate populations in need of targeted intervention. This body of research suggests that not allowing participants to indicate their uncertainty may threaten the validity and generalizability of behavior change research. However, we provide concrete recommendations for scientists to allow participants to express uncertainty and to analyze the resulting data.

Introduction

Everyday life decisions are based, in part, on an assessment of potential risks relative to benefits. For example, how likely am I to cause a car crash if I'm texting and driving? Might I lose money if I invest in a stock? Am I less likely to get cancer if I stop drinking coffee?

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The assumption that risk perception drives behavior has been a centerpiece of psychological theorizing for nearly 60 years (Edwards, 1961). However, when asked about risks like the ones above, a surprisingly large proportion of people say that they *do not know* their risk (Waters, Hay, Orom, Kiviniemi, & Drake, 2013). In this paper, we challenge the current research practice of discouraging or ignoring “don’t know” responses by demonstrating that people who report not knowing their risk for health outcomes (a) are a meaningful portion of the population, even for common, well publicized problems; (b) may be conveying genuine experiences of epistemic uncertainty (i.e., limited knowledge); and (c) may represent a unique population in need of targeted intervention.

Importance of Perceived Risk for Behavioral Engagement

Many psychological and economic theories propose that the public’s subjective expectations about the likelihood of an outcome is a key influence on their judgments and decisions (e.g., (Bandura, 1977; Edwards, 1961; Fishbein & Ajzen, 1975)). These ideas have been incorporated into theories designed to understand how people make health decisions and why they do (or do not) engage in health promotion and disease prevention behaviors (e.g., (Griffin, Dunwoody, & Neuwirth, 1999; Rogers, 1975; Rosenstock, 1974; Schwarzer & Fuchs, 1995)). In fact, some theoreticians and empirical researchers have found that perceptions of risk about a health problem are a critical first step in the process of considering, and then initiating, volitional behavior change (Weinstein, 1988). There is also considerable empirical evidence supporting the notion that higher perceived likelihood of a negative health outcome (hereafter *perceived risk*) motivates risk-reducing decisions and behaviors (for recent meta-analyses and reviews, see (Atkinson, Salz, Touza, Li, & Hay, 2015; Sheeran, Harris, & Epton, 2014)).

Responding Don’t Know to Survey Items

Missing from much existing theoretical and empirical risk perception research is a concept that is central to our own work – that people might not have sufficient knowledge to judge their risk of developing a health problem. Because of insufficient knowledge, they may experience epistemic uncertainty about their risk (Han, Klein, & Arora, 2011). Yet, neither the presence nor the degree of epistemic uncertainty is well captured in current risk perception research, as surveys seldomly assess the presence or amount of uncertainty about risk.

One way of assessing the presence of epistemic uncertainty would be for survey developers to provide a “don’t know” (DK) response option. However, risk perception researchers seldom offer such an option. This may result from disciplines such as sociology, political science, psychology, public health, and marketing. Work in these disciplines have examined “don’t know” (DK) responding to survey items for a variety of domains other than risk perceptions (Dolnicar & Grün, 2014; Gilljam & Granberg, 1993; Mondak & Davis, 2001; Scoboria & Fisico, 2013; Sturgis, Roberts, & Smith, 2014). For example, some public health research has examined DK responding to items assessing knowledge and beliefs related to colon cancer and vaccination against the human papilloma virus (Ellis, Ferrer, & Klein, 2018; Ellis, Ferrer, Taber, & Klein, 2018). Although several studies have found that people respond DK for a variety of reasons, including the familiarity, knowledge, or beliefs

necessary to provide a reasoned response (Dolnicar & Grün, 2014; Durand & Lambert, 1988; Francis & Busch, 1975; Scoboria & Fisico, 2013; Stone, 1993), many researchers in these areas argue that providing a DK option could discourage participants from providing a thoughtful response and prompt underreporting of true beliefs and knowledge (e.g., (Krosnick et al., 2002; Mondak & Davis, 2001; Tourangeau et al., 2000)). Therefore, according to this perspective, providing a DK option should be avoided.

The body of literature reviewed in this paper, however, is consistent with survey methodologists who caution that failing to provide a DK option could lower data quality (Carpini & Keeter, 1993; Luskin & Bullock, 2011; Tourangeau, Maitland, & Yan, 2016). We show that failure to address the presence of uncertainty, as indicated by DK responses to items assessing the respondent's perceived risk, makes it very difficult to identify the proportion of the population who do not know their risk and to understand how the presence of epistemic uncertainty about risk affects outcomes including behavioral responses to risk. We also extend the current literature related to DK responding by proposing a conceptual framework that illustrates how socio-demographic and psychosocial factors can lead to epistemic uncertainty about risk that is manifested as DK responding.

Early research on DK responding to risk perception items has found that, in the absence of a DK response option, individuals may indicate their limited knowledge by using 50% as a substitute (Bruine de Bruin, Fischhoff, Millstein, & Halpern-Felsher, 2000). For example, in one study, 16.4% of participants who were asked to estimate their probability of dying in the next 10 years indicated 50% (Bruine de Bruin & Carman, 2012). However, responses to a follow-up question that probed the reasons for their responses showed that more than two-thirds of participants who indicated 50% (i.e., about 10% of the overall sample) did so because they had "no idea" about their risk or they indicated that "no one can know." Other studies that recruited convenience or clinic samples have found that, when provided an opportunity to do so, a large proportion of participants either indicate that they do not know their risk of developing common health problems or do not answer the question (Denman, Baldwin, Betts, McQueen, & Tiro, 2018; French & Hevey, 2008; LeMasters et al., 2014; Lipkus, Lyna, & Rimer, 2000; Santos, Lourenco, & Rossi, 2011; Sung et al., 2008). For example, a survey conducted in a health clinic that served an inner-city primary care population found that 49% to 69% of the sample marked the "no idea" response option in response to two items assessing their absolute perceived risk of developing colorectal cancer (Hay, Orom, Kiviniemi, & Waters, 2015).

Prevalence of Don't Know Responding

Don't know (DK) responding is a highly variable phenomenon. Its prevalence varies by the sampling strategy, whether a "don't know" response option is provided, the type of risk perception being assessed, the wording of the item, and the health problem for which perceived risk is being assessed. For example, for colon cancer, the prevalence of DK responding in samples designed to be representative of the non-institutionalized US population ranged from 6.9% to 8.7% in surveys without a DK response option (Waters et al., 2013) to 47% to 63% in surveys with a DK option (Orom et al., 2018). In convenience samples with a DK response, however, from 18.8% (Janssen, Ruiter, & Waters, 2018) to

69.3% (Hay et al., 2015) of respondents indicated they did not know their colon cancer risk (no convenience samples excluded a DK response option). DK responding to colon cancer risk perception items was generally higher for absolute than comparative likelihood items (Orom et al., 2020; Orom et al., 2018; Waters et al., 2013) and for cognitively-oriented perceived likelihood items than for affectively-oriented feelings of risk items (Janssen, Verduyn, & Waters, 2018). DK responding to colon cancer risk perception items was also consistently higher than DK responding to diabetes risk items (Hay et al., 2020; Orom et al., 2018). Notably, however, there were no instances in which DK responding was absent.

Don't know responses persist even when interviewers encourage respondents who indicate don't know to make their "best guess." For example, in one nationally representative sample, 9.5% of women indicated they did not know their breast cancer risk even after being reassured by the interviewer that there was no incorrect answer (Waters et al., 2011). Even after giving those who initially responded DK an explicit prompt encouraging them to use the response scale, 20% of participants in one study continued to respond DK (Denman et al., 2018). In addition, after accounting for those who say they don't know their risk (26% for diabetes and 21% for heart disease), a substantial additional proportion of respondents (16% and 52%, respectively) say they are uncertain about the estimate they made (Orom et al., 2020).

Pathways to Don't Know Responding

We developed a conceptual framework explaining the social and psychological factors that can lead individuals to provide a "don't know" response to a risk perception survey item (Figure). The two main psychological drivers of epistemic uncertainty about personal risk for a disease are limited health literacy and the tendency to avoid health information (hereafter *information avoidance*). Specifically, lower levels of formal education are associated with lower health literacy. Lower health literacy, in turn, is associated with lower knowledge of risk factors for the disease under study. Lower knowledge is then associated with higher DK responding. Health information avoidance is independently associated with DK responding through lower knowledge of disease risk factors. We found empirical support for this framework in the context of colorectal cancer and diabetes (Hay et al., 2020; Orom et al., 2018). In the sections below, we provide additional supporting evidence for each section of the framework.

Upstream Socio-Demographic Characteristics Don't Know Responding.—Our first indication that don't know responding to risk perception questions might be a meaningful phenomenon was our observation that it is not randomly distributed within a sample; instead, it occurs at different rates in different populations. In the context of cancer risk perceptions, for example, it occurs more often in people who have limited formal education, numeracy, and/or health literacy (Hay et al., 2015; Orom, Kiviniemi, Shavers, Ross, & Underwood, 2013; Waters et al., 2013; Waters et al., 2011), see also (Bruine de Bruin & Carman, 2012; Bruine de Bruin et al., 2000; LeMasters et al., 2014). It may also be overrepresented among members of marginalized racial or ethnic groups (Waters et al., 2011). In addition, we found that, although "don't know" responses to items assessing perceived HIV infection risk between 1993 and 2000 decreased as more scientific

information became publicly available, the decrease was much slower among people with very little formal education (Kiviniemi et al., 2018). This “knowledge gap” often occurs in the context of emerging hazards such as HIV, and indicates the need for more intensive and targeted health communication among less advantaged groups (Tichenor, Donohue, & Olien, 1970; Viswanath et al., 2006).

Psychological Mechanisms of Don’t Know Responding.—Our second indication that DK responding is meaningful was finding that limited knowledge of the health condition is a primary driver of DK responding. Our early work identified cross-sectional associations between limited colorectal cancer knowledge, lower cancer and health information seeking, and higher DK responding for colorectal cancer perceived risk items (Hay et al., 2015). This is similar to work reporting that women with limited knowledge about breast cancer were more likely to indicate DK in response to a perceived risk of breast cancer survey item (LeMasters et al., 2014). We then identified two possible antecedents of limited health knowledge: low health literacy (i.e., limited ability to understand and use health information) (Institute of Medicine, 2004) and health information avoidance (i.e., the tendency to avoid health information that may threaten one’s self-concept) (Kunda, 1990; McQueen, Vernon, & Swank, 2013; Sweeny, Melnyk, Miller, & Shepperd, 2010; van ‘t Riet & Ruiter, 2013).

We found support for both antecedents using data from a population-based survey that was representative of the U.S. population. For health literacy, we identified a path from limited formal education to lower health literacy, and from lower health literacy to lower health knowledge (Hay et al., 2020; Orom et al., 2018). We also found that providing basic health information to DK responders reduced DK responding by 61% for items related to diabetes and by 67% for items related to colorectal cancer (Hay et al., 2020). These reductions in DK responding were higher among individuals with higher health literacy and lower avoidance, providing further justification for the mechanisms identified in (Orom et al., 2018). We also found that people who engage in health information avoidance for colorectal cancer or diabetes also have lower knowledge of risk factors for that disease and are more likely to say they don’t know their risk (Orom et al., 2018).

Satisficing and Don’t Know Responding.—Our third indication that DK responding may be meaningful was an absence of evidence supporting satisficing as a primary explanation for DK responses. *Satisficing* (also referred to in recent research as *inattentive responding*) is a phenomenon whereby a survey respondent attempts to minimize their cognitive effort when answering a survey item (Krosnick et al., 2002). Survey methodologists have historically recommended against providing a “don’t know” response option, asserting that they reduce respondents’ motivation to provide a reasoned response and thereby lead to underreporting of true beliefs and knowledge (Krosnick et al., 2002; Tourangeau et al., 2000). Indeed, there is a body of research examining inattentive responding among survey respondents (Curran, 2016; Huang, Curran, Keeney, Poposki, & DeShon, 2012; Huang, Liu, & Bowling, 2015). Such research suggests that high levels of inattentive responding in a dataset can be related to poorer quality data. However, those studies do not examine inattentive responding when broader social and psychological factors

such as education, health literacy, knowledge, and defensive processes are accounted for (see Figure).

However, we have not indications that DK responding was due to participants' low motivation to respond. In one study, we asked participants to respond to eight perceived risk items (Kiviniemi et al., 2020). If DK responding was due to satisficing, respondents would likely mark DK for more than one item; after all, if DK responding was due to lack of motivation, it seems likely that respondents would be motivated to respond DK to more than only one or two items. However, 72.5% of respondents did not indicate DK for any of the items. Of the respondents who *did* mark DK, approximately two-thirds did so for only 1 or 2 items. Less than 3% of the sample responded DK for more than half of the items. This pattern of responses suggests that DK responding was performed strategically and was not a generalized response tendency that could indicate low motivation to respond. Similar findings were reported in a study examining knowledge and perceived risk of human papilloma virus; few respondents indicated DK to more than one item (Denman et al., 2018). In a second study, we assessed satisficing using a composite measure of four indicators of poor quality responding (haphazard responding, straightlining grid questions, inconsistent responding, and speeding) (Oron et al., 2018). We found that predicting DK responding from education, disease information avoidance, health literacy, and health information resulted in acceptable model fit. However, adding a direct effect of satisficing resulted in poor fit; this indicates that satisficing did not explain additional variance in DK responding.

Behavioral Correlates of Don't Know Responding.—Our fourth indication that DK responding is meaningful was our observation that it is associated with less engagement in a variety of health behaviors. Using data collected in 2005 and 2010 for nationally representative, population based surveys, we found that, compared to people who provided scaled responses to items assessing perceived risk of breast and colorectal cancer, those who indicated DK engaged in fewer minutes of physical activity per week (Waters et al., 2016). DK responders were also less adherent to breast and colon cancer screening behaviors (except for breast cancer screening in 2010). Similarly, individuals who, between 1993 and 2000, indicated they did not know their risk of having HIV were less likely to obtain an HIV test than those who provided a scale response (Kiviniemi, unpublished data). In addition, responding DK (vs. a scaled response) to items assessing perceived skin cancer risk was associated with lower likelihood of enrolling in a research study that provided skin cancer risk information (Hay et al., 2019). Furthermore, participants who indicated that they were uncertain about their conditioned perceived risk estimate had lower odds of reporting having engaged in protective dietary or physical activity behavior in the last 12 months, regardless of the level of perceived risk they indicated (Oron et al., 2020). As further evidence suggesting that people who respond DK may need interventions targeted specifically to their unique needs, we found that individuals who reported DK engaged in fewer minutes of physical activity behavior than were people who rated their risk as “low,” (Waters et al., 2016).

Methodological Characteristics and Don't Know Responding

Several researchers have found that the extent of DK responding in a sample – and potentially the conclusions researchers draw from their data – are associated with a survey's methodological characteristics. The most fundamental characteristic is the inclusion or exclusion of a DK response option. Our experimental work has examined how including or excluding a don't know response option affects the statistical conclusions that researchers may draw about perceived risk and its possible relationship to engagement in health behaviors. We found that, when a don't know option is not provided, most respondents will compliantly provide a scale point response. When an option *is* provided, however, a substantial proportion of the population will answer 'don't know.' Of critical importance, when a don't know option is not provided for items assessing absolute risk perceptions, respondents are more likely to use the lowest option on a scaled response format (Kiviniemi et al., 2020). Absolute estimates of risk perception are therefore systematically biased downward. This may mislead researchers into believing that an intervention is needed to increase perceived risk when, in reality, an intervention is needed to address people's lack of knowledge or uncertainty about their level of risk.

The absence of a DK response option did not systematically bias estimates of comparative risk perceptions downward in (Kiviniemi et al., 2020). However, in that study, the response scales for absolute and comparative risk perception items differed (i.e., 5-point vs. 3-point scale, respectively). Research is needed to investigate whether the absence of a downward bias for the comparative risk item was due to restricted range of response scale, or whether the conceptual differences between absolute and comparative risk means that the downward bias does not occur for comparative risk items (Klein, 1997, 2002; Lipkus, Kuchibhatla, et al., 2000). This is important because, if comparative risk estimates are susceptible to a downward bias based on the inclusion or exclusion of a DK response, it could raise questions about the importance of some established psychological phenomena. For example, comparative unrealistic optimism at the group level occurs when a sample's average comparative risk estimate for a negative outcome is below average (Shepperd, Klein, Waters, & Weinstein, 2013). This indicates that the group believes it is at lower risk than average; yet, not everyone can be below average. However, if participants are marking the lowest response option not because they perceive themselves to be at low risk, but instead because they are not able to mark DK, it would suggest that unrealistic optimism is less common than previously thought.

It is also possible that excluding a DK response option could add error to the measurement of risk perception, as individuals who would otherwise indicate DK search for an alternative response. Increased measurement error would compound the error variance in statistical models that attempt to predict behavior from perceived risk measures. Increased error variance, in turn, could reduce statistical power to detect a statistically significant relationship between perceived risk and behavior.

As described briefly in the prevalence section above, item wording and formatting is another methodological issue that may influence DK responding. For example, asking people to report their feelings of risk (rather than their cognitive likelihood perceptions) has elicited lower DK responding (Janssen, Verduyn, et al., 2018). This is likely because

asking about gist judgments or feelings does not require people to base their judgments on risk information. Cognitive risk perception items can also be designed to vary in the amount of information required to give a well-reasoned answer. Specifically, constraining the amount of information respondents need to consider can lower DK response rates. For example, conditioning items on behavior (e.g., “*if you didn’t have a colonoscopy* do you think your risk of getting colorectal cancer would be low/moderate/high”) can elicit fewer DK responses than items that are not conditioned on behavior (e.g., “Do you think your risk of getting colorectal cancer would be low/moderate/high”) (Orrom et al., 2020; Waters, Ackermann, & Wheeler, 2019). Similarly, constraining items in a way that requires the respondent to compare themselves to other people can also reduce DK responding (Orrom et al., 2020). Although several studies have suggested that item wording may alter the frequency of DK responding, those studies did not randomly assign participants to different conditions that varied the item format (e.g., (Waters et al., 2013)). Thus, results should be replicated in future experimental research. Finally, there is evidence that simple formatting changes, such as visually separating the DK response option from the scale responses, can reduce DK responding (Tourangeau, Couper, & Conrad, 2004). It is important to note, however, that DK responding was not eliminated in any of these studies, regardless which question format was used (e.g., conditioning a risk perception item on behavior reduced DK responding from 12.6% to 7.5%).

Another type of methodological consideration that may affect DK responding involves supplementing items that have a DK response option with items that probe the reasons for those responses (Krosnick et al., 2002). For example, one study reduced DK responding from 55.7% to 19.6% by reassuring participants that the researchers valued their opinions, repeating the item, and requesting a response (Denman et al., 2018). This suggests that participants may have believed that the investigators were seeking “correct” responses instead of beliefs and opinions. This strategy is similar to what some U.S. Government-funded national surveys have adopted, such as the National Health Interview Survey (National Center for Health Statistics, 2010). However, research is needed to investigate whether the responses given after such probes reflect the respondent’s true attitudes or a product of demand characteristics or social desirability bias.

A small number of researchers have explored analytic strategies for handling DK responses. The first set of strategies, which was developed based on the assumption that some people who indicate their risk is 50% are expressing the equivalent of a DK response, involves redistributing some of the 50% responses across the broader range of possible numeric responses (Bruine de Bruin, Fischbeck, Stiber, & Fischhoff, 2002). A second set of strategies involves either dropping participants who respond DK from the analytic dataset or replacing DK responses with either the scale midpoint or the computed item-level mean (Denman et al., 2018). However, both of these strategies seek to eliminate – rather than understand – DK responding. In contrast, our work demonstrates that DK responses are a meaningful response option that should be investigated rather than eliminated.

Summary and Recommendations

We have shown that DK responding: (a) is prevalent in the population; (b) is distributed disproportionately among populations that are marginalized and medically underserved in the U.S. (i.e., is not missing at random or missing completely at random); (c) is likely due, in part, to limited health knowledge brought about by limited health literacy and/or information avoidance; (d) is associated with lower engagement in some health behaviors; and (e) is unlikely to be due entirely to low motivation to provide a meaningful response). Furthermore, not providing a DK response option may systematically bias sample estimates in such a way to mislead researchers into believing that the sample's level of perceived risk is lower than it would be, had the researchers provided a DK response option (Kiviniemi et al., 2020). This combination of findings about the socio-demographic correlates of don't know responding, the psychological mechanisms underlying these responses, and the effects of methodological choices on estimates of don't know responding and of perceived risk lead to several recommendations for research in this area.

1. *Most fundamentally, the research reviewed above suggests that researchers should carefully consider including a don't know response option when assessing perceived risk for a health problem.* Researchers cannot simply assume that don't know responses are a minor subset of participants or that they are missing at random error variance. Moreover, failing to include a DK response option may cause us to lose valuable information about the way people interpret – or misinterpret – risk information (Bruine de Bruin & Carman, 2012; Hay et al., 2015; Waters et al., 2013). The additional analytic complexity created by including a DK response option, while important, should not be the determining factor in a researcher's decision about whether or not to include it.
2. *To accommodate individuals with limited literacy and health literacy, researchers should ensure that the survey instructions and items are written at a 6th grade reading level, that medical terminology is described in simple terms, and, if relevant, there are pictures, illustrations, or drawings* (Doak, Doak, & Root, 1985; Park & Zuniga, 2016). Health literacy (i.e., the ability to understand and use health information to make medical decisions) is limited in the U.S., particularly among marginalized socio-demographic populations (Kutner, Greenberg, Jin, & Paulsen, 2006; U.S. Department of Health and Human Services, 2010). Taking this first step will reduce the amount of DK responding due to respondents' confusion about what is being asked.
3. *Keep in mind that the methodological techniques described above are not intended to try to eliminate all don't know responses.* The choice of how to frame risk perception questions should be based on more than the rates of DK responding; each framing addresses a slightly different concept, and so researchers should keep in mind that they are not interchangeable (Kaufman et al., 2020). More importantly, the item researchers select should be the item that will test their hypothesis with the highest degree of validity – not that with the lowest rate of DK responding. It is also important to remember that there is still much to learn about why people respond DK (see Future Directions

below). Thus, efforts to reduce DK responding should do so in a way that yields valid assessments of risk perceptions, not in a way that increases error or biases responses with demand characteristics.

4. *Since DK responses are often conceptually meaningful, they should be incorporated into analyses and not simply treated as a source of missing data.* As an initial step for managing the complexity of DK analyses, researchers should seek to understand its distribution in their dataset and how it is related to other variables. For example, they could examine what characteristics of the population are associated with DK responding *versus* using a scaled response, and how DK responses relate to important outcome variables associated with risk perception in the domain being studied (e.g., in a study of how risk perceptions influence colorectal cancer screening, examine how DK responses are correlated with screening).

For multivariable analyses, researchers could use multinomial or ordinal logistic regression to examine both scaled and DK response options in the same analysis process (Waters et al., 2011). When conceptually and statistically appropriate, researchers should consider determining whether DK responding is a moderator of any relationships between experimental variables or social-cognitive variables other than risk perception and behavior (Janssen, Ruiter, et al., 2018). One strategy for approaching this is to create a dichotomous variable indicating whether respondents provided a DK or scaled response, and include that dichotomous variable in an interaction term with other variables of interest. However, this approach introduces two unique risk perception items in a single dataset; an interval-level variable (high to low risk perceptions), and a dichotomous variable (DK versus a response using the scale). There is also a lack of information about how to manage DK responding in studies that use multi-item perceived risk scales. Additional strategies for analyzing DK responses are needed.

5. *When developing interventions to change risk perceptions and/or health behavior, consider how to address don't know responders.* We know that DK responders have different demographic and psychosocial profiles, and DK responding is due to epistemic uncertainty about risk. Thus, the intervention targets who are DK responders are different from those who have inaccurate risk perceptions, and the psychological mechanisms that drive epistemic uncertainty are almost certainly separate and distinct from those driving confident but inaccurate risk perceptions. Given this, DK responders may need to be addressed with different or enhanced interventions than “traditional” risk perception interventions designed to heighten inaccurately low perceptions of risk.

Future Directions

Despite our clear recommendations for use and treatment of DK responding in risk perception research, compelling research directions in this area of study remain.

1. The research we and others have conducted to understand DK responding has focused on closed-ended risk perception questions. Cognitive interviewing (Willis, 2004) is a necessary next step that will clarify the underlying judgement processes that contribute to DK responding (e.g., how much knowledge is sufficient to prompt a scale response instead of a DK response). Understanding these processes will lead to a deeper understanding of the way in which knowledge, intuitions, and emotions regarding risk contribute to the formulation of risk perception responses.
2. The reasons driving some of the variability in DK responding between different methodological practices is unknown (e.g., type of risk perception item, the presence or absence of visual separator between DK responses and scaled responses). Therefore, experimental research is needed that identifies the methodological conditions under which DK responses signal genuine epistemic uncertainty due to lack of knowledge about the health problem, genuine epistemic uncertainty due to unclear item wording or structure. A research program focused on gaining additional understanding of DK responding, both in the context of risk perceptions and other contexts, such as interpersonal situations and political attitudes, would facilitate the development of a taxonomy describing the conditions under which providing a DK response option is most important. In addition, research that examines relationship between inattentive responding and DK responding to risk perception items would help clarify the reasons for DK responding. For example, a study might ask, compared to data from respondents who use a scaled response, do the data from DK responders fulfil more or fewer criteria for inattentive responding (e.g., straightlining, speeding, self-reported inattention)?
3. Research examining the role of DK responding in health behavior intervention enrollment, retention, and moderating and mediating processes will be critical to clarifying the need for targeting interventions to specific population groups.
4. Strategies are needed for capturing incorporating epistemic uncertainty with into measures of risk perception. Work developing such strategies should examine how to capture the continuous nature of uncertainty; although continuous measures of uncertainty exist, there is little guidance about incorporating them into risk perception measures (Orom et al., 2020; Taber & Klein, 2016). By treating uncertainty as a dimension of perceived risk, we may more accurately predict people's responses to health threats.
5. All of these research efforts must be conducted with samples comprised of socio-demographically diverse, medically underserved, and marginalized populations who may disproportionately use DK response options. Such research will facilitate researchers' ability to make interventions accessible to those who have the most to gain from targeted interventions that address their specific information needs.

Conclusion and Implication

Our body of research overwhelmingly supports a model where many people, if not the majority of people, have some degree of epistemic uncertainty about their risk for common diseases. People's degree of uncertainty can depend on 1) how much knowledge they have about the disease, and in particular, risk factors for the disease and 2) how much knowledge is required to make a reasoned risk appraisal, which can vary depending on how the question is asked. We have found limited evidence – in our own research or in others' research – that people say they don't know their risk because they are unmotivated to give a thoughtful answer or to minimize the effort it takes them to complete survey items.

It is well-established that people's responses to questions are shaped by the way the question is asked (Schwarz, 1999; Tourangeau et al., 2000), and, furthermore, that people are willing to respond to a question even when they genuinely do not have a response or explanation that is true for them (Nisbett & Wilson, 1977). Thus, compelling individuals who are highly uncertain about their risk to choose a scaled response option introduces bias, reduces measurement validity (Sturgis et al., 2014), and likely impedes the ability to model the relationship between risk perception and health behavior (Taber & Klein, 2016). Our body of research indicates it is more productive to treat epistemic uncertainty as an additional dimension of risk perception, to measure it, and to analyze it, rather than to attribute it to low motivation to respond. DK responding has been associated with lack of engagement in preventive behavior, and with routine measurement of the dimension we may identify ways we might better engage these individuals in behavior change.

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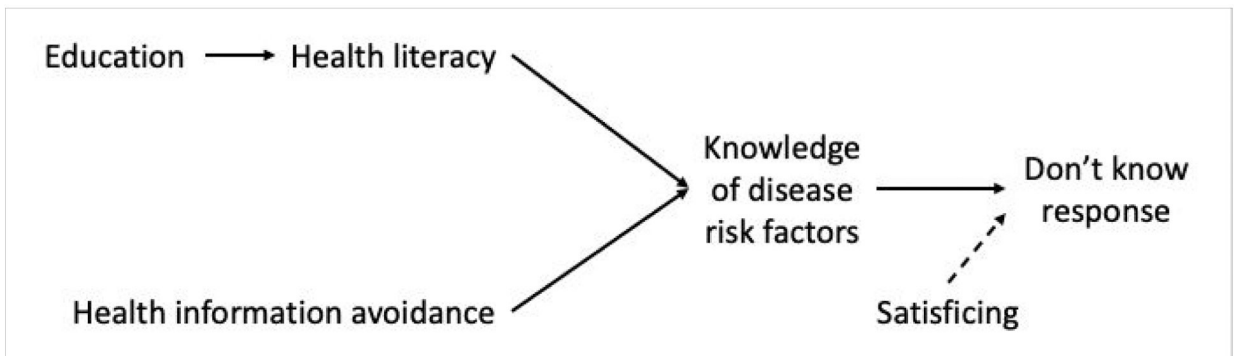
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**Figure.****Conceptual Framework of Don't Know Responding**

Note. Arrows with solid lines indicate relationships for which Orom et al. (2018) found empirical support. These relationships were replicated in Hay et al. (2020). Arrows with dashed lines indicate relationships for which other researchers have found support, but Orom et al. (2018) have not. Future research may uncover other social, psychological, or methodological factors that shape don't know responding.