aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Perspectives on Psychological Science
1–11

DOI: 10.1177/17456916211017860
www.psychologicalscience.org/PPS
SAGE

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 (i.e., "don't know" responses) are prevalent in the U.S. population, are systematically more likely to occur among marginalized sociodemographic 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. We provide concrete recommendations for scientists to allow participants to express uncertainty and to analyze the resulting data.

Keywords

quantitative methodology, risk perception, social cognition, socioeconomic status, thinking, reasoning, judgment

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 am 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? 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 et al., 2013). In this article, we challenge the current research practice of discouraging or ignoring "don't know" (DK) 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

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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 behaviors that promote health and prevent disease (e.g., Griffin et al., 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 et al., 2015; Sheeran et al., 2014).

DK Responding 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 et al., 2011). Yet neither the presence nor the degree of epistemic uncertainty is well captured in current risk-perception research because 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 DK response option. However, researchers who investigate risk perceptions seldom offer such an option. This may result from research in disciplines such as sociology, political science, psychology, public health, and marketing, which has examined 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 et al., 2014). Several studies have found that people give a DK response for a variety of reasons, including limited 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 article, 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 et al., 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 that does not know its 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 sociodemographic and psychosocial factors can lead to epistemic uncertainty about risk that is manifested as DK responding.

Early research on DK responding to items that assess perceived risk 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 et al., 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, many participants either indicate that they do not know their risk of developing common health problems or do not answer the question (Denman et al., 2018; French & Hevey, 2008; LeMasters et al., 2014; Lipkus, Lyna, & Rimer, 2000; Santos et al., 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 et al., 2015).

Prevalence of DK Responding

DK responding is a highly variable phenomenon. Its prevalence varies by the sampling strategy, whether a DK 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, in surveys of samples designed to be representative of the noninstitutionalized U.S. population, the prevalence of DK responding to items assessing perceived risk of colon cancer ranged from 6.9% to 8.7% in surveys without an explicit DK response option (Waters et al., 2013) to 47% to 63% in surveys with an explicit DK option (Orom et al., 2018). In surveys of convenience samples, from 18.8% (Janssen,

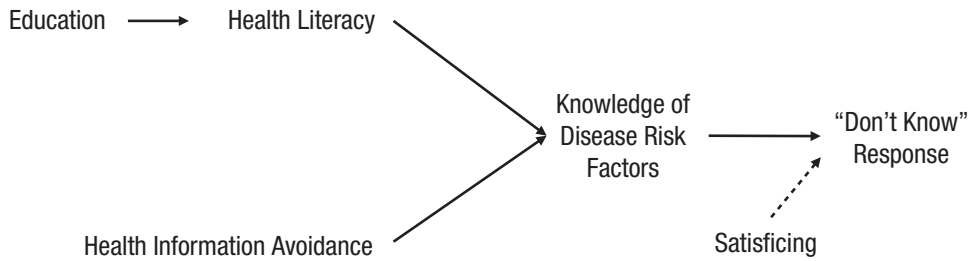

Fig. 1. Conceptual framework of "don't know" responding. Arrows with solid lines indicate relationships for which Orom et al. (2018) found empirical support. These relationships were replicated in Hay et al. (2021). Arrows with dashed lines indicate relationships for which other researchers have found support, but Orom et al. (2018) have not. Future research may uncover other social, psychological, or methodological factors that shape "don't know" responding.

Ruiter, & Waters, 2018) to 69.3% (Hay et al., 2015) of respondents indicated they did not know their colon-cancer risk when a DK response option was provided. No surveys of convenience samples excluded a DK response option. DK responding to items about perceived risk of colon cancer was generally higher for absolute-likelihood than for comparative-likelihood items (Orom et al., 2018, 2020; Waters et al., 2013) and for cognitively oriented likelihood items than for affectively oriented feelings-of-risk items (Janssen, Verduyn, & Waters, 2018). DK responding to items assessing perceived risk of colon cancer was also consistently higher than DK responding to items assessing perceived risk of diabetes (Hay et al., 2021; Orom et al., 2018). Notably, there were no instances in which DK responding was absent.

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

Pathways to DK Responding

We developed a conceptual framework explaining the social and psychological factors that can lead individuals to provide a DK response to a survey item assessing perceived risk (Fig. 1). The two main psychological drivers of epistemic uncertainty about perceived 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., 2021; Orom et al., 2018). In the sections below, we provide additional supporting evidence for each section of the framework.

Upstream sociodemographic characteristics of DK responding

Our first indication that DK responding to questions assessing risk perceptions 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, for example, DK responding occurs more often in people who have limited formal education, numeracy, and/or health literacy (Hay et al., 2015; Orom et al., 2013; Waters et al., 2011, 2013; 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 DK responses to items assessing perceived risk of HIV infection decreased from 1993 to 2000 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 et al., 1970; Viswanath et al., 2006).

Psychological mechanisms of DK 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 among (a) limited knowledge about colorectal cancer, (b) lower cancer and health information seeking, and (c) higher DK responding for items assessing perceived risk of colorectal cancer (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 survey item about perceived risk of breast cancer (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 et al., 2013; Sweeny et al., 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., 2021; 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., 2021). 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 avoided health information related to colorectal cancer or diabetes also had lower knowledge of risk factors for that disease and were more likely to say they did not know their risk (Orom et al., 2018).

Satisficing and DK 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 DK 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 et al., 2012, 2015). Such research suggests that high levels of inattentive responding 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 Fig. 1).

We have no indications that DK responding was due to participants' low motivation to respond. In one study, we asked participants to respond to eight items assessing perceived risk of different health outcomes (Kiviniemi et al., 2020). If DK responding were due to satisficing, respondents would likely give a DK response for more than one item; after all, if DK responding were due to lack of motivation, it seems likely that respondents would be motivated to give a DK response to more than only one or two items. However, 72.5% of respondents did not give a DK response for any of the items. Of the respondents who *did* give a DK response, approximately two thirds did so for only one or two items. Less than 3% of the sample gave a DK response 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 give a DK response 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, "straight-lining" grid questions, inconsistent responding, and speeding; Orom et al., 2018). We found that predicting DK responding from education, health literacy, and avoidance of disease 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 DK 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 with people who provided scaled responses to items assessing perceived risk of breast and colorectal cancer, those who gave a DK response engaged in fewer minutes of physical activity per week (Waters et al., 2016). DK responders were also more likely to be overdue for screening for breast cancer or colon cancer (except for

screening for breast cancer in 2010). Likewise, individuals who, between 1993 and 2000, indicated that 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 et al., 2018). In addition, DK responding (compared with a scaled response) to items assessing perceived risk of skin cancer was associated with lower likelihood of enrolling in a research study that provided information about the risk of skin cancer (Hay et al., 2019). Furthermore, participants who indicated that they were uncertain about their perceived risk had lower odds of eating a healthy diet or engaging in physical activity in the past 12 months, regardless of the level of perceived risk they indicated (Orom et al., 2020). Finally, we found that individuals who reported DK engaged in fewer minutes of physical activity than people who rated their risk as "low" (Waters et al., 2016); this, constitutes further evidence suggesting that people who give a DK response may need interventions targeted specifically to their unique needs.

Methodological Characteristics and DK Responding

Several researchers have found that the extent of DK responding in a sample—and potentially the conclusions researchers draw from the 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 DK 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 DK option is not provided, most respondents will compliantly provide a scale response. When a DK option *is* provided, however, a substantial proportion of the population will give a DK response. Of critical importance is that when a DK option is not provided for items assessing perceptions of absolute risk, 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 items assessing absolute risk and items assessing comparative risk differed (i.e., a 5-point scale vs. a 3-point scale, respectively). Research is needed to investigate whether (a) the absence of a downward bias for the comparative item was due to the restricted range of response scale or (b) the conceptual differences between absolute and comparative risk means that the downward bias does not occur for comparative items (Klein, 1997, 2002; Lipkus, Kuchibhatla, et al., 2000). This is important because if comparative estimates are susceptible to a downward bias on the basis of 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 et al., 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 give a DK response, 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, given that individuals who would otherwise give a DK response 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 cognitive estimates of likelihood) has elicited lower DK responding (Janssen, Verduyn, & Waters, 2018), probably because asking about gist judgments or feelings does not require people to base their judgments on risk information. Items assessing cognitive perceptions of likelihood 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"; Orom et al., 2020; Waters et al., 2019). Likewise, constraining items in a way that requires the respondent to compare themselves to other people can also reduce DK responding (Orom 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, researchers should attempt to replicate these results 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 et al., 2004). It is important to note, however, that DK responding was not eliminated in any of these studies, regardless of which question format was used (e.g., conditioning an item on behavior reduced DK responding from 12.6% to 7.5%, not 0%).

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 are 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 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 et al., 2002). A second set of strategies involves either dropping participants who give a DK response from the analytic data set 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 United States (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 if the researchers provided a DK response option (Kiviniemi et al., 2020). This combination of findings about the sociodemographic correlates of DK responding, the psychological mechanisms underlying these responses, and the effects of methodological choices on estimates of DK 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 DK response option when assessing perceived risk for a health problem.* Researchers cannot simply assume that DK responses are from 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, although 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, that there are pictures, illustrations, or drawings* (Doak et al., 1985; Park & Zuniga, 2016). Health literacy is limited in the United States, particularly among marginalized sociodemographic populations (Kutner et al., 2006; Office of Disease Prevention and Health Promotion, 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 DK responses.* The choice of how to frame questions assessing risk perceptions 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 give a DK response (see the Future Directions section). 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. *Because 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 analyzing DK responses, researchers should seek to understand their distribution in the data set 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 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, & Waters, 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 items assessing perceived risk in a single data set; an interval-level variable (high to low risk perceptions), and a dichotomous variable (DK vs. a response using the scale). There is also a lack of information about how to manage DK responding in studies that use multi-item 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 DK 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" interventions designed to heighten inaccurately low perceptions of risk.

Future Directions

Despite our clear recommendations for use and treatment of DK responses to items assessing risk perceptions, 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 questions. Cognitive interviewing (Willis, 2004) is a necessary next step that will clarify the underlying judgment 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 perceptions.
2. The reasons driving some of the variability in DK responding between different methodological practices is unknown (e.g., type of item, the presence or absence of a 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 or unclear item wording or structure. A research program focused on gaining additional understanding of DK responding in the context of risk perceptions and other contexts (e.g., 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 would help clarify the reasons for DK responding. For example, a study might ask whether the data from DK responders, compared with data from respondents who use a scaled response, fulfill more or fewer criteria for inattentive responding (e.g., "straight-lining," speeding, self-reported inattention).

3. Research examining the role of DK responding in enrollment into interventions designed to promote healthy behavior, retention of participants in such interventions, and moderating and mediating processes will be critical to clarifying the need for targeting interventions to specific population groups.
4. Strategies are needed for incorporating epistemic uncertainty 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 measures assessing risk perceptions (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 comprising 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 in which 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 (a) how much knowledge they have about the disease—and, in particular, risk factors for the disease—and (b) 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 do not 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; with routine measurement of the dimension we may identify ways we might better engage these individuals in behavior change.

Transparency

Action Editor: Laura A. King
Editor: Laura A. King
Declaration of Conflicting Interests
The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.
Funding
Research reported in this publication was supported by National Cancer Institute Grants R03-CA177775, R01-CA197351, and R01-CA190391 and National Center for Advancing Translational Sciences Grant UL1-TR002345. The content is solely the responsibility of the authors and does not necessarily represent the official view of the National Institutes of Health.

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Acknowledgments

We thank Caitlin Biddle, Kimberly Kaphingst, Yuelin Li, and Elizabeth Schofield for their critical insights into the causes and consequences of DK responding. Our work has greatly benefitted from their efforts. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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