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Anchoring-and-Adjustment Bias in Communication of Disease Risk

Ibrahim Senay, Ph.D. and **Kimberly A. Kaphingst, Sc.D.**
Social and Behavioral Research Branch, National Human Genome Research Institute, National Institutes of Health, Bethesda, MD

Abstract

Over the next decade, advances in genomics will make it increasingly possible to provide patients with personalized, genetic-based risks of common diseases, allowing them the opportunity to take preventive steps through behavioral changes. However, previous research indicates that people may insufficiently adjust their subjective risk to the objective risk value communicated to them by a healthcare provider, a phenomenon called anchoring-and-adjustment bias. In this narrative review, we analyze existing research on how patients process disease-risk information, and the processing biases that may occur, to show that the bias observed in disease-risk communication is potentially malleable to change. We recommend that, to reduce this bias and change patients' misperceptions of disease risk in clinical settings, future studies investigate the effects of forewarning patients about the bias, tailoring risk information to their numeracy level, emphasizing social roles, increasing motivation to form accurate risk perception, and reducing social stigmatization, disease worry and information overload.

Keywords

risk communication; information processing; genetic counseling; anchoring and adjustment heuristic; health-protective behavior

Background and Significance of Risk Communication

Over the next decade, communication to patients about their disease risk based on genetic susceptibility is likely to become increasingly important in the clinical context. Rapid advances in genomics will make it increasingly possible to provide patients with personalized, genetic-based risks of common diseases, allowing them the opportunity to take preventive steps through behavioral changes.[1,2] It is also possible to estimate disease risk based on patients' family and medical history and nutritional life-styles, and communication of this type of risk information is becoming more and more common.[3,4] Therefore, communication of disease risk to patients is relevant to both present and future healthcare contexts, highlighting the importance of ensuring people's accurate understanding of their disease risk. Existing research on how patients process disease-risk information, and the processing biases that may occur, may help to illuminate how best to provide this risk information to patients.

The present paper explores one such bias, anchoring-and-adjustment, which is the insufficient adjustment of one's subjective risk to an objective risk communicated by a healthcare provider, and investigates whether and/or how this bias can be diminished. As will be discussed below

Address correspondence and reprint requests to Ibrahim Senay, PhD, Department of Psychology University of Illinois at Urbana Champaign, 603 E. Daniel Street, Champaign, IL 61820; telephone: 217-333-4724; fax: 217 244 5876; e-mail: senay@illinois.edu.

in more detail, the investigation of this bias in other experimental contexts has shown that a certain type of this bias can be diminished. The literature reviewed in this paper suggests that the bias, as it exists in disease-risk communication, resembles the type that was shown to be malleable to change. Therefore, it becomes possible to make research recommendations to examine how this bias might be reduced in disease-risk communications. Below we discuss the importance of this bias for health outcomes (Effects of Insufficient Adjustment of Disease Risk on Patient Outcomes section), its definition and prevalence in disease-risk communication (Definition and Prevalence of Anchoring and Adjustment Bias section), factors reported to be affecting this bias in controlled experimental settings (Factors Affecting Anchoring-and-Adjustment Bias section), factors that may affect the bias in provider-patient communications of disease risk (Factors Affecting Adjustment of Disease-Risk Perception section), and recommend future research towards diminishing this bias in provider-patient communication (Recommendations for Future Research and Conclusion sections).

Effects of Insufficient Adjustment of Disease-Risk on Patient Outcomes

Previous research suggests that eliminating patients' biases in disease-risk perception may decrease disease worry and lead to better informed decisions about health-protective behavior change. It also suggests that changing risk perception towards a more accurate risk value is positively associated with either actual or intended health-protective behavior change or a decrease in disease worry.

Bowen and her colleagues' randomized trial in 211 women demonstrated that when women's risk perception became more accurate in a genetic counseling session due to a decrease in their overestimated perception of breast cancer risk, their interest in having genetic testing for breast cancer decreased accordingly.[5] Similarly, in a controlled trial[6] that compared the effectiveness of genetic counseling of individuals versus groups on breast cancer risk, women's overestimated risk perceptions decreased together with their interest in genetic testing for breast cancer for both types of counseling. These findings suggest that more accurate risk perceptions lead people to make more informed decisions.[7]

In addition, where perceived risk increases toward a higher objective risk, people engage in more health protective behavior. The Health Belief Model, Protection Motivation Theory, and Extended Parallel Process Model identify perceived risk as an important predictor of change in health behaviors. In trials of interventions based on these theories, changes in risk perception have been associated with actual or intended health-protective behavior change or a decrease in disease worry. The Health Belief Model[8] highlights the importance of perceived risk as a predictor of health behavior change. It predicts that people will engage in a health-protective behavior (e.g., quitting smoking) to avoid a disease (e.g., lung cancer) if they perceive their risk for that disease to be high (Perceived Susceptibility); the consequences of contracting the disease as severe (Perceived Severity); the health-protective behavior to be effective in decreasing the susceptibility for and severity of the disease (Perceived Benefits), and the barriers to engage in health-protective behavior to be low (Perceived Barriers).

For example, in a controlled trial of 295 women,[9] an intervention designed to increase mammography use increased perceived susceptibility (i.e., perceived risk). Participants were interviewed at 3-month follow-up and those who had not obtained a mammogram by then were interviewed again at 6-month follow-up. It was observed that the rate of obtaining a mammogram increased at both of these time points compared to the baseline. The effect of the increase in risk perception on obtaining a mammogram was modified by how much participants believed in the benefits of a mammogram and the perceived severity of breast cancer. These findings indicate that other factors should be considered as mediating or moderating the effect of risk perception on health-protective behaviors.

More recent health behavior change models such as Protection Motivation Theory (PMT)[10] and Extended Parallel Process Model (EPPM)[11] also predict that people will engage in a health protective behavior to a greater extent if they perceive their risk for the disease to be high; consequences of contracting the disease to be severe; and the health-protective behavior as effective. In addition, PMT and EPPM predict that the more confidence people have to engage in a health-protective behavior (self-efficacy), the more they will actually engage in this behavior.. EPPM also predicts that high perceived risk might sometimes lead to avoidance of health protective behavior, especially when people have low self-efficacy. In a recent study[12] based on these two models, smokers were asked to report their intention to quit smoking if they were hypothetically found to have a risk-increasing gene for heart disease. Increased risk perceptions as a result of having this gene led to an increase in intentions to quit smoking. Although this effect was not moderated by smokers' self-efficacy, as EPPM would predict, self-efficacy had an independent effect on intentions to quit.

Changed risk perception is not only associated with a change in health-protective behaviors but also in disease worry. In four studies of breast cancer counseling outcomes, the decrease in women's overestimation of breast cancer risk towards a more accurate risk value as a result of counseling was associated with a decrease in their cancer worry.[5,6,13,14]

It also has to be noted here that the relationship between risk perception and patient outcomes discussed above in this section usually concerns relatively low levels of risks (i.e., 15%–35% absolute life time risks). However, according to prospect theory,[15] when people face relatively higher levels of risk they become less likely to carefully weigh the risk information and more likely to think in terms of certainties (e.g., I will/will not get the disease). Therefore, when disease-risk information concerns high risk values, it is possible that changing risk perception will have a relatively lesser impact on subsequent health-protective behavior and disease-worry than in the context of lower risk values.

As will be discussed below in more detail, participants in genetic counseling sessions tend to insufficiently adjust their perceived disease risk to the objective risk. It is therefore very likely that in such contexts the related changes in disease worry and health protective behaviors would be less than the possible magnitude of change if individuals adjusted their perceived risk more sufficiently. Therefore, identifying factors that lead to greater adjustments becomes an important step towards achieving better informed decisions about health protective behaviors.

Definition and Prevalence of Anchoring and Adjustment Bias

A number of heuristics are important in healthcare contexts.[16,17,18] One heuristic that seems to be particularly important in the context of provider-patient communication is the anchoring-and-adjustment heuristic. This heuristic is utilized when patients receiving information about their objective risk of disease anchor their risk perception on their subjective risk, and, therefore, do not sufficiently move toward the objective risk. As a result, their final perceived risk falls somewhere in-between the initial subjective estimate and the objective risk, leading them to continue under- or over-estimating their disease risk.

This bias is common in communication in general and in health-care contexts in particular. Since it can be a demanding process to guess what is in the mind of one's communication partner, individuals take short-cuts to guess what their partner means by an ambiguous utterance.[19] They initially interpret a message from their own perspective, and then try to adjust to their communication partner's perspective, showing an anchoring-and-adjustment bias.[20,21,22] In healthcare settings, too, findings from a number of research studies can be interpreted as indicating that the anchoring-and-adjustment heuristic operates in such settings. Healthcare providers, for example, insufficiently adjust what they know about medical issues

to the level of knowledge among patients, thus overestimating patients' ability to understand medical concepts and terminology.[23,24]

In addition, prior research has shown that patients insufficiently adjust their perception of numeric risk when they are provided with their objective risk for breast cancer. Such studies use the breast cancer risk models of Gail et al.[25] or Claus et al.[26] to calculate participants' objective cancer risk based on participants' self-reported risk factors (e.g., family history). Participants are also asked in those studies to report their subjective risk estimates for breast cancer before being given the objective risk estimates in a genetic counseling session. Thus, it becomes possible to see how people adjust their subjective risk estimates to the objective risk.

In a study conducted with 450 of women who had a family history of breast cancer and were referred to breast cancer counseling, women who overestimated their numeric breast cancer risk prior to genetic counseling did not sufficiently decrease their risk estimate in the direction of the objective risk. Therefore, they still overestimated it after counseling.[27] The same study also reported that those women who underestimated their numeric risk prior to counseling did not increase it enough to match the counseled risk figure. A similar study of 108 women visiting a cancer clinic to receive counseling on breast cancer risk showed an insufficient adjustment of their perceived risk for breast cancer.[28] Although genetic counseling led these patients to decrease their subjective estimate from 61% to 44% on average in the direction of the objective risk provided to them (i.e., 22.4% on average), post-counseling risk estimates were still significantly higher than the objective risk. These women also incorrectly recalled the objective risk values they were given, and the incorrect values were biased toward their initial estimates.

Other studies' findings can also be interpreted as suggesting an insufficient adjustment of perceived disease-risk, although these studies did not report whether the post-counseling risk estimates were significantly different from the objective risk value. In a study[29] of 193 women visiting 10 familial cancer clinics to receive genetic counseling for breast cancer, more than two-thirds of the women who underestimated their risk prior to counseling continued to underestimate it after the counseling. About half of the women who overestimated their risk prior to counseling continued to overestimate it after counseling. In another controlled trial of 732 men and women, participants were given their risk for heart attack based on objective risk factors, such as cholesterol level, blood pressure, weight and smoking behavior. [30] More than two-thirds of the participants did not change their perceived risk for heart attack. A randomized trial of 340 patients comparing the effectiveness of telephone versus in-person genetic counseling for breast cancer reported a decrease in average risk perception from 30% prior to counseling to 20% after counseling for in-person counseling and a decrease from 30% to 21 % for telephone-counseling.[6] However, the post-counseling risk estimates were still more than twice as high as the objective risk provided during the counseling (i.e., 9.9 % for in-person counseling and 9.5% for group counseling, on average).

One may propose that disbelief in an objective risk estimate due to various reasons, such as self-serving biases that lead people to discard communicated risk information, might be responsible for such insufficient adjustment. However, evidence suggests that this is not the case. In a controlled trial, 121 women recruited from newspaper advertisements were provided with their breast cancer risk. It was found that they insufficiently adjusted their perceived risk for breast cancer after breast-cancer risk counseling.[31] It was also found that the degree to which the objective risk estimate was perceived as credible, trustworthy and accurate was not related to the amount of adjustment. In another study[29] of 108 female patients visiting a cancer clinic to receive breast-cancer counseling, the patients incorrectly recalled their objective breast-cancer risk given to them by providers. Most importantly, their incorrectly recalled risk values were biased toward their initial subjective estimates independent of their disbelief in the recalled risk value. This finding shows that the bias relates to processing of the risk

information. Therefore, in line with research on how people make sense of messages in communication, [19,20,22,22] it is reasonable to conclude that the insufficient adjustment of risk perception observed in disease-risk communication is, at least partly, a result of the anchoring-and-adjustment heuristic.

In sum, the anchoring-and-adjustment bias seems to be present in a number of healthcare contexts, and particularly, in the communication of disease risk information in genetic counseling. Thus, the question becomes, how can this bias be reduced and what are the effects of reducing it?

Factors Affecting Anchoring-and-Adjustment Bias

Until recently, investigation of the anchoring-and-adjustment heuristic in decision making research had shown that the bias is very robust and almost impossible to diminish.[32,33] However, recent studies have distinguished adjustment from self-generated versus externally provided anchors, and have found that the former type is malleable to change. Thus, if the adjustment of disease risk perception is similar to the adjustment from self-generated anchors, it might be possible to mitigate this bias in disease-risk communication.

The classical investigation of anchoring-and-adjustment bias tested adjustments from externally provided anchors. People were first given an anchor by the experimenter, and then asked to make their decisions.[34] For example, people were asked to estimate the average number of babies born in the U.S. per day either after they considered whether it was higher or lower than 100 or after they considered whether it was higher or lower than 50,000. The median responses were estimates of 1,000 in the former case and 40,000 in the latter case, clearly showing that the provided anchor puts a drag on the final estimate. The results did not change after explaining to participants that the anchor values were randomly chosen and had nothing to do with the correct answer. Forewarning participants about the bias, giving them incentives for accuracy, and extremity of the anchor also did not lead to any difference in the biased responses.[35,36,37]

However, more recently, Epley and Gilovich noted that anchors can be self-generated, rather than being externally provided.[32,33] For example, without being prompted, people use Earth's orbiting time as an anchor in guessing Mars's orbiting time around the sun. Externally provided anchors seem to prime automatically and make accessible values near the anchor,[38] thereby not allowing for effortful adjustment, whereas self-generated anchors do not involve such processes.[32 above, 33] Recent experiments have shown that when people were given financial incentives for accuracy or were forewarned that their estimates might be biased, they were more likely to show improved adjustment with self-generated, but not externally provided, anchors.[32] Motivation to engage in effortful thinking has also been related to increased adjustment.[33] Thus, effortful thinking and motivation to be accurate seems to be able to diminish the anchoring-and-adjustment bias for self-generated anchors.

In disease-risk communication contexts, it is possible that people do not self-generate their initial disease-risk estimates (i.e., anchor values), but instead, rely on estimates provided in media or by other people around them. However, in the next section, we demonstrate that people's subjective estimates of disease risk resemble self-generated rather than externally provided anchors.

Factors Affecting Adjustment of Disease-Risk Perception

Prior research has shown that externally provided risk values have an effect on people's estimation of risk for a health condition.[39] On the other hand, the factors affecting adjustment of risk perception in the context of disease-risk communication show that the adjustment can

be modified. This suggests that such adjustments are from self-generated, rather than externally provided, anchors. Although we do not yet know exactly what factors modify the adjustment of perceived disease-risk, the existing literature suggests that effortful thinking and motivation to adjust underlie the amount of adjustment.

Effortful thinking refers to the level of attention that is devoted to a task. For example, people who have sufficient time to complete a task or who are not under the influence of alcohol are more likely to engage in effortful thinking.[33] The involvement of effortful thinking in adjustment of disease-risk perception can be seen in studies reporting an effect of disease worry on how much people change their disease-risk perception. Previous experimental studies have found that strong negative affect leads to decreased systematic processing or effortful thinking,[40] suggesting that increased worry may decrease systematic processing, and hence, adjustment. In a randomized trial of 400 women that compared general health counseling with individualized breast-cancer risk counseling, women who were more worried about breast cancer prior to a genetic counseling session were less likely to change their perceived risk for breast cancer after the counseling.[41] This result seems to be consistent with the effect of effortful thinking on adjustments from self-generated anchors.[32,33]

Disease worry also seems to mediate the insufficient adjustment of risk perception among individuals at high risk for breast cancer. There is evidence to suggest that women who are at a higher risk for breast cancer due to their family history worry about breast cancer to a greater extent.[42] There is also evidence showing that high-risk women with an individual or family history of breast cancer are also less likely to change their perceived risk for breast cancer after receiving counseling compared to those at lower risk.[14] Thus, it is possible that high risk individuals worry about breast cancer more. As a result, this worry might lead them to adjust their perceived risk for breast cancer to a lesser extent.

The effects of worry and level of risk as moderators of another factor, time, on disease-risk adjustment also indicate a role for effortful thinking. In a study of 283 women with a family history of breast cancer, their perceived risk was more accurate, and over-estimations were more reduced, right after the counseling than at the twelve-month follow-up,[43] suggesting the role of time. Another study[42] with 203 women who had a family history of breast cancer found that time effects were greater for those at high risk or for affected patients than for those at moderate or low risk. This study also found that high-risk and affected people worried about cancer more than the other groups. Thus, it might be the case that individuals with higher risk perceptions and higher worry engaged in less systematic processing, which, together with time, prevented them from adjusting to the objective risk.

Another factor affecting people's engagement in effortful thinking might be numeracy, which is the ability to process basic probability and numerical concepts. There is evidence to suggest that people low in numeracy, compared to those high in numeracy, are less likely to attend to the numeric risk information and more likely to be affected by how the numeric risk information is framed.[44] For example, people in general think that a patient poses a greater threat to others when they are told that 20 out of 100 similar patients commit an act of violence compared to when they are told that the patient has 20% risk of committing a violent act. It was shown that low numeracy people are more likely to be affected by such framing effects. They were also found to adjust their risk perception consistent with provided numeric risk information to a lesser extent compared to those with high numeracy skills.[45] A sample of 500 women randomly drawn from a registry of female veterans were given numeric risk information about how much mammography screening decreased their chances of death from breast cancer. After receiving this information, women tended to overestimate how much mammography screening can reduce their risk. However, those with higher numeracy skills were less likely to overestimate and more likely to adjust their risk perception toward objective risk. In this study, processing

the numeric risk information more attentively (i.e., more effortful processing) may have led those high in numeracy to adjust their risk perception toward the communicated risk information to a greater extent. It is also possible that numeracy led to a better understanding of numeric risk values. Further research is needed to uncover the mediating mechanism between numeracy and adjustment of perceived risk.

The second set of studies that will be reviewed in this section seems to indicate a role for motivation in the adjustment of disease-risk perception. For example, change in risk perception has been reported to be moderated by whether or not the risk counseling was personalized. In Green and his colleagues' randomized controlled trial, 211 women with individual or family history of breast cancer were either given individualized estimates in a standard genetic counseling session or were given general information about the risk of breast cancer for different populations in a computer-based intervention.[14] The overestimation of risk was much more reduced in the former compared to the latter condition. It is possible that, in this study, the personalized risk counseling might have motivated participants more to engage in adjustment. However, other factors such as lack of face-to-face communication in computer-based counseling might have also played a role in the adjustment. In another controlled trial,[30] 732 men and women were classified as to whether they were below average, average or above average risk for heart-disease based on their risk factors, such as cholesterol level, blood pressure, weight and smoking behavior. Four different risk appraisal instruments were used in that study; and, feedback from one instrument, compared to the other three, was better in changing people's perceived risk of heart attack toward a more objective risk value. The authors commented that this might have been due to the fact that the most effective feedback told the participants which risk group they were in more clearly and directly.

The effect of social characteristics on disease-risk adjustments might also be mediated by motivation to adjust. There is some evidence that having strong identification with one's social or racial group is associated with greater and more accurate changes in risk perception as a result of genetic counseling in breast cancer patients.[13,46] The psychological processes that underlie these effects need further study. The findings may, however, be related to individuals' motivation to make adjustments from their anchor. For example, one possibility is that patients' level of identification with their social group might be related to their motivation to view themselves from a societal perspective, and by extension, their motivation to evaluate their risks from the perspective of society's experts, leading to increased change in their risk perception.

However, the link between social identity and adjustment of risk perception is not yet clear. In a randomized trial with 211 Ashkenazi Jewish women, those who more strongly identified with their ethnic group showed a lesser change in their perceived risk for breast cancer as a result of counseling.[5] In this study, women's feeling of stigmatization also increased as a result of the genetic counseling intervention. As noted by the authors, women might have felt stigmatized due to their ethnic identity as a result of learning the connection between their ethnic group and breast cancer risk during counseling. This might have reduced their motivation to be accurate, which, in turn, might have led to insufficient adjustment. Thus, social identity's effect on the anchoring-and-adjustment bias seems to be mediated by motivation to adjust to the expert's perspective. However, empiric research about ethnic identity, motivation, and adjustment of risk perception is needed in order to draw conclusions about these relationships. A future study explicitly showing the mediating role of motivation for the effect of social identification would also directly show the disease-risk adjustments to be adjustments from self-generated anchors.

One might think that all the factors enumerated above are affecting disbelief in the communicated risk information, which, in turn, leads people to adjust differently. However,

disbelief in communicated risk information does not seem to affect the degree to which people change their risk perception as a result of risk counseling.[31] Therefore, based on available evidence, it is reasonable to posit that the factors that impact change in risk perception are not affecting disbelief in the objective risk information, but rather, the anchoring-and-adjustment process that underlies how people interpret messages in communication. [19,20,21,22]

In summary, even though the exact psychological processes involved are not clear, past research has shown that the adjustment of disease-risk perception can be modified. This suggests that the anchoring-and- adjustment bias in disease-risk perception is similar to the anchoring-and-adjustment bias with self-generated anchors, which is malleable to change. The factors affecting the adjustment of disease-risk perception in genetic counseling settings (i.e., worry, numeracy, individualized counseling, social identification, stigma) are consistent with how the anchoring-and-adjustment heuristic is affected by effortful thinking and motivation in the context of self-generated anchors.

Recommendations for Future Research

The findings presented here, and the similarity of anchoring and adjustment in disease-risk communication to adjustment observed from self-generated anchors, make it possible to suggest some ways in which the anchoring-and-adjustment bias might be mitigated. Here we identify possible future areas for research in the communication of disease risk information:

1. Does forewarning patients about the bias of insufficient adjustment help ensure better adjustment to counseled risk estimates?
2. What is the role of effortful thinking in this process? Does giving patients more time during counseling to process risk information lead to better adjustment? What is the optimal amount of information provided in order not to overwhelm patients? Does parsing up the information to several counseling sessions and reminding people of their objective risk in each session reduce the cognitive load and the negative effect of time?
3. How does motivation work in reducing bias? Does increasing patients' motivation help improve adjustment? For example, does explaining the benefits of forming an accurate understanding of their disease risk for better informed decisions motivate patients to spend more effort in processing risk information and, perhaps, lead to more accurate risk perceptions?
4. Does tailoring risk information to people's numeracy levels lead to better adjustment?
5. How does level of worry affect risk adjustment? Does a high level of worry lead to insufficient adjustment of perceived risk? Do lower levels of worry help patients better adjust, given that mild negative affect has been linked with increased systematic processing?[47]
6. Does emphasizing patients' social roles as family or community members during counseling motivate them to move away from their own risk anchor in the direction of the counseled risk?
7. Is feeling stigmatized as a result of belonging to a certain racial or ethnic group related to being less motivated and, hence, to more insufficient adjustment?

In addition to these questions, it is also important to broaden the evidence base to conditions other than breast cancer and to investigate factors that mediate or moderate the predicted effects outlined here. For example, as discussed earlier, people's beliefs about the disease and about protective behaviors might also affect how much people adjust their risk perceptions. It is also

important to investigate how the anchoring and adjustment bias might interact with other biases of disease-risk perception such as heuristics of availability, affect and framing.

Furthermore, more research is needed to determine how these processes might operate in the context of risk information calculated based on genetic susceptibility. The breast cancer counseling research described above was based on communication of disease risk calculated from patients' family and medical history. One randomized trial with 162 adult children of Alzheimer's Disease patients directly compared the provision of disease-risk information based on family history with information based on genetic testing. It was found that the genetic test information changed people's perceived risk for Alzheimer's Disease to a greater extent.[48] This study raises the possibility that the anchoring-and-adjustment bias might work differently in the context of genetic risk perception.

Conclusion

Ensuring that people understand the risk of a disease is likely to lead to better decisions about health-protective behaviors and lower levels of worry. Thus, research on understanding this type of risk communication is critical in order to be able to provide comprehensible disease risk messages to patients. In this paper, we explored one important communication bias, anchoring and adjustment, as a useful tool for understanding the persistence of over- and under-estimation of disease risk after provision of risk information in provider-patient interactions, such as genetic counseling, and the factors affecting this process. In addition to the recommendations above, new findings as to how the anchoring-and-adjustment heuristic works in other decision making and interpersonal communication contexts might further help illuminate how this bias works in disease-risk communication.

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