Title
Inductive reasoning influences perception of interspecies disease transmission risk

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 39(0)

Authors
Goldwater, Micah B.
Ireland, Molly E.
Gaylord, Nick
et al.

Publication Date
2017

Peer reviewed

Inductive reasoning influences perception of interspecies disease transmission risk

Micah B. Goldwater (micah.goldwater@sydney.edu.au)
School of Psychology
University of Sydney

Molly E. Ireland (molly.ireland@ttu.edu)
Department of Psychological Sciences
Texas Tech University

Nick Gaylord (nlgaylord@gmail.com)
Independent researcher
Oakland, CA USA

Jason Van Allen (jason.vanallen@ttu.edu)
Department of Psychological Sciences
Texas Tech University

Tyler Davis (tyler.h.davis@ttu.edu)
Department of Psychological Sciences
Texas Tech University

Abstract

Zoonoses (diseases that enter the human population via animal contact) are a major global health concern. Because of how zoonoses emerge, understanding human reasoning about the risk factors associated with animal contact is central to combating their spread. However, little is known about the factors that influence perception of these risks. We present an inductive account of zoonosis risk perception, suggesting that it is influenced by beliefs about the range of animals that are able to transmit diseases to each other. In Study 1, we find that participants who endorse higher likelihoods of cross-species disease transmission have stronger intention to report animal bites. In Study 2, adapting real world descriptions of Ebola virus from the WHO and CDC, we find that communications conveying a broader range of animals as susceptible to a disease increase intentions to report animal bites and decrease perceived safety of wild game meat. These findings suggest that cognitive factors may be harnessed to modulate zoonosis risk perception and combat emerging infectious diseases.

Keywords: Induction; categorization; risk perception; public health; premise number; premise diversity

Introduction

Emerging infectious diseases are a major economic and public health concern. A majority of such diseases are of zoonotic origin (i.e. come from animals, Jones et al., 2008), with drivers including animal bites, consumption of wild game meat, and contact with livestock (Daszak, Cunningham, & Hyatt, 2000). Human-animal interaction is central to all these drivers, but little is known about how people reason about potential risks in such scenarios (Janes, Corbett, Jones, & Trostle, 2012). Similarly, research on cognitive factors is largely absent from public health initiatives targeting zoonoses, including interdisciplinary approaches such as One Health (Heymann & Dar, 2014). The present work aims to bridge this gap by examining cognitive principles that influence zoonosis risk perception and how they can be harnessed to shape communications regarding disease transmission risk.

The literature on zoonoses lacks extensive research on the role of human reasoning, though several recent studies have examined factors that determine whether people will eat wild game meat (Kamins et al., 2015) and report adverse animal contact, such as bites, to a health professional. One particularly suggestive study (Bingham, Budke, & Slater, 2010) found that survey respondents were more likely to report dog bites if they knew that bats could transmit rabies to humans. At first glance, this seems surprising – people's inferences about the risk associated with one species appear to be influenced by their knowledge of a completely different species.

The finding that knowlege about one animal can affect beliefs about other animals may be partly accounted for by two principles from the literature on inductive reasoning, namely *premise number* and *premise diversity* (Hayes, Heit, & Swendsen, 2010; Osherson, Smith, Wilkie, Lopez, & Shafir, 1990). According to the premise number principle, people are more confident in inferences that apply to a large number of category members (Li, Cao, Li, Li, & Deak, 2009; McDonald, Samuels, & Rispoli, 1996), where for example a property known to hold for both lions *and* giraffes will be more likely to hold for rabbits as well. According to the premise diversity principle, people find inferences sound to the extent that they hold for a wider *range* of category members (Heit & Feeney, 2005; Lopez, 1995), where for example a property known to hold for lions *and giraffes* is more likely to generalize to rabbits, compared to one that holds for lions *and tigers*. In terms of zoonosis risk perception, knowing that both dogs and bats can transmit rabies may increase perceptions of human risk because they are often viewed as very different members of the mammal category.

Although premise number and diversity are plausibly related to the previous observations surrounding bite reporting intentions, research on inductive reasoning has not been extended to many concrete domains such as work on risk perception in health or real-world decision making about health behaviors. Similarly, while people's judgments regarding contagion have been studied in social and health psychology research (Nemeroff, 1995), these studies have focused on affective and cultural factors as opposed to underlying cognitive processes such as inductive reasoning.

In the present work, we test two specific hypotheses from our theory that inductive reasoning principles influence zoonosis risk perception. First, consistent with the aforementioned rabies study, individual differences in perceived risk from animal contact should be associated with individual differences in beliefs about interspecies disease transmission. Second, perceptions of risk to humans should increase as a result of being presented with communcations depicting transmissibility amongst a wider range of species.

Study 1

The goal of Study 1 was to examine whether perceived disease risk (measured by intentions to report animal bites) is associated with beliefs about interspecies disease transmission likelihood. Based on the premise number principle, we hypothesized that individuals who endorse stronger likelihoods of disease transmission between a number of different animal species would be more likely to perceive human risks from animal bites. To test this hypothesis, we conducted a survey measuring intentions to report bites from common mammals and birds along with judgments of interspecies disease transmission likelihood for a ficticious novel disease.

Method. Participants were 289 adults (55% men; mean age = 33.6, *SD* = 10.2) who completed an online survey and were recruited through the Mechanical Turk crowdsourcing platform. The survey was available to Mechanical Turk workers in the following countries where English is the primary language: USA, Australia, Canada, Great Britain, Ireland, New Zealand, and the Bahamas. The majority of participants had undergraduate (48.8%) or advanced degrees (8.7%). The sample was predominantly White (80.6%), with 5.9% Asian, 3.8% Black, 6.9% Hispanic, 1% Native American or Alaska Native, and 1.7% other ethnicities. A majority of the sample (73.4%) reported currently owning a pet. Participants were compensated $2 for participation in the survey. Informed consent was obtained from all individual participants in the study, no participants were excluded from the survey results, and all protocols were approved by the Texas Tech University IRB.

Design. The study materials consisted of an electronic survey containing sections on demographics, bite reporting intentions, and species-to-species disease transmission beliefs. Demographics questions included sex, sexual orientation, ethnicity, education level, parents' education level, language(s) spoken, and pet ownership.

In the bite reporting section, participants were asked to judge their likelihod of reporting bites from various target animals to a health professional (of any type). Participants judged likelihood of reporting for each animal using a slider that could be adjusted in units of 1 from 0–100 and also contained descriptive labels ranging from "Very Unlikely" to "Very Likely". Mammal and bird reporting were presented in a random order on separate screens. Mammals included dogs, skunks, monkeys, bats, and squirrels. Birds included grackles, swans, robins, blue jays, and peacocks.

The species-to-species disease transmission beliefs section employed the same sliding scales as the bite reporting section, but participants were asked to rate the likelihood of between-animal disease transmission for a hypothetical new disease. Each question took the following form:

> Scientists discover that a new disease can infect the liver tissue of **[premise animal]**. How likely is it that this disease can infect the following animals?

The conclusion animals were listed on separate lines, each with their own response slider. Premise animals included bats, dogs, skunks, monkeys, grackles, blue jays, swans, and peacocks. Conclusion animals included bats, dogs, skunks, monkeys, squirrels, grackles, robins, blue jays, swans, and peacocks. Fewer premise animals were used so that less time would be required to complete the survey and to reduce participant attrition. Animals only appeared as conclusion categories when they were not the premise. Premises were presented in a random order on separate screens.

Results. Intentions to report bites were highly reliable within person (mammals: Cronbach's α = 0.86; birds α = 0.95), as were judgments of interspecies disease transmission likelihood (mammal-to-mammal: α = 0.96, bird-to-bird: α = 0.97; between birds and mammals: α = 0.99). Nonetheless, linear mixed effects models revealed that intentions to report bites varied considerably between different species [Mammals: $F(4,1152) = 111.1, p < .001, \eta_p{}^2 = 0.28$; Birds: $F(4,1152) = 35.23, p < .001, \eta_p{}^2 = .11$] and ratings of interspecies disease transmission likelihood varied between the different premise types [mammal-to-mammal, bird-to-bird, between birds and mammals; $F(2,576) = 356.3, p < .001, \eta_p{}^2 = 0.55$]. Intentions to report bites were stronger for mammals than for birds [$t(288) = 27.06, p < .001, d = 1.59$; Figure 1A], and diseases were rated as more likely to be transmissible within mammals or birds than between them [mammal-to-mammal vs. between birds and mammals, $t(288) = 18.77, p < .001, d = 1.10$; bird-to-bird vs. between birds and mammals, $t(288) = 23.42, p < .001, d = 1.38$]. Consistent with previous work suggesting bats are viewed as similar to both mammals and birds (Davis et al., 2013), bats were rated as more likely than other mammalsto share diseases with birds [$t(288) = 7.03, p < .001, d = 0.41$].

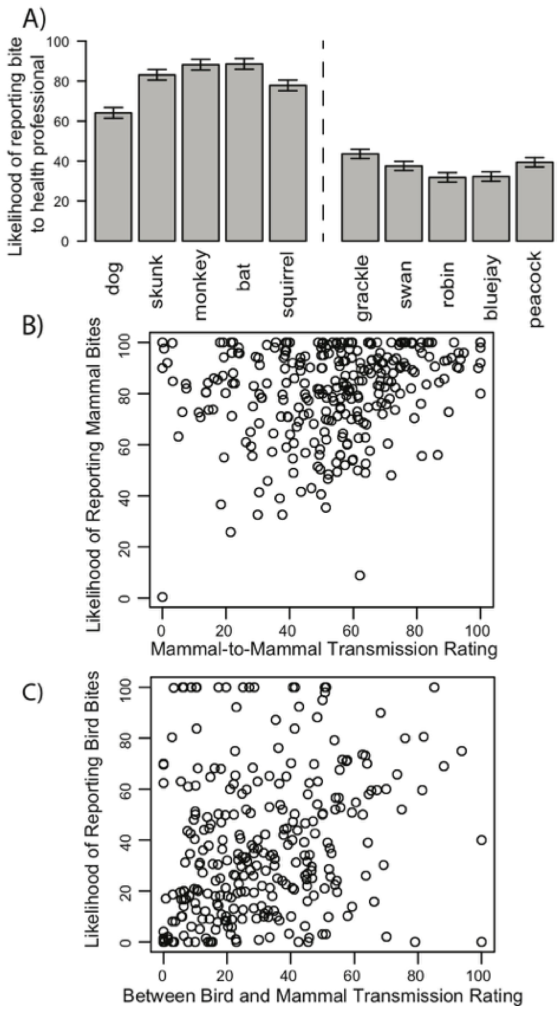

Figure 1: (A) Intentions to report animal bites. (B) Association between intentions to report mammal bites and mammal-to-mammal disease transmission ratings. (C) Association between intentions to report bird bites and between bird and mammal disease transmission ratings. Error bars reflect 95% within-subject confidence intervals.

In support of our primary hypotheses, we found that individual differences in endorsement of bird-to-bird and mammal-to-mammal disease transmission were both positively associated with individual differences in intentions to report mammal bites [Mammal-to-mammal: Kendall's $\tau = .147, p < .001$ (Figure 1B); Bird-to-bird, $\tau = .140, p < .001$; Between birds and mammals: $\tau = .009$ (Pearson's r of .21, .21 and .009 respectively)].

Consistent with the premise number principle, endorsing greater odds of interspecies disease transmission was associated with stronger intentions to report mammal bites. For bird bites, only ratings of disease transmission between birds and mammals were associated with reporting intentions [Mammal-to-mammal $\tau = .043$, Bird-to-bird $\tau = .077$, Between birds and mammals $\tau = .219, p < .001$ (Pearson's r of .04, .05, and .26 respectively) (Figure 1C)]. Coupled with weaker intentions to report bird bites overall, these results suggest that people may only judge birds as risky to the extent that they believe birds and mammals can share diseases.

Discussion. Study 1's results suggest that inductive reasoning principles may underlie people's perceptions of zoonosis risk. Although the correlations are between a small and medium correlation given Cohen's (1992) criteria, they are within those expected between general health attitudes and behaviors (Azien & Timko, 1986; Glasman & Albarracin, 2006). However, because the results are correlational, it is difficult to infer the causal direction between the beliefs about interspecies disease transmission risk and bite reporting. It is possible that both are influenced by a common underlying factor, such as beliefs about contagion (Haidt, McCaluey, & Rozin, 1994) or risk attitudes (Dohmen et al., 2011). Moreover, because the results examine individual differences, it is not clear from Study 1 whether such inductive reasoning principles could be harnessed to influence people's beliefs about the risks associated with animal contact.

Study 2

The goal of Study 2 was to test whether it is possible to influence people's perceptions of zoonosis risk through framing communications to portray a greater number of animals as susceptible to a disease. As a case study, real-world communications about Ebola virus vary in terms of how they describe the range of animals susceptible to the disease. The Centers for Disease Control's factsheet (CDC, 2016) lists contact with fruit bats and nonhuman primates (apes and monkeys) as sources of human Ebola infection. Contrastingly, the World Health Organization's factsheet (WHO, 2016) lists a much wider range of animals: chimpanzees, gorillas, fruit bats, monkeys, forest antelope, and porcupines.

According to the premise diversity principle, the WHO's factsheet should lead to stronger perceptions of Ebola risk from animal conact because it lists a broader range of animals as sources of human Ebola infection. To test this hypothesis, in Study 2 we gave particpants two different communications about Ebola derived from the CDC and WHO factsheets (tailored to control all other differences in wording).

Method. Participants were 152 adults recruited from Mechanical Turk in the same manner as for Study 1. Sample demographics were comparable to those in Study 1; additionally 94.7% of the sample in Study 2 reported eating meat. No participants were excluded from the results, and all protocols were approved by the Texas Tech University IRB.

Design. The study materials consisted of an electronic survey containing a demographics section, an experimentally manipulated reading prompt about Ebola (derived from CDC and WHO factsheets), an Ebola susceptibility section, a bite reporting intentions section, and a meat safety section.

For the reading prompt, participants were given the following description about Ebola and asked to fill in a blank box by detailing the animals listed in the description:

> The Ebola virus causes an acute, serious illness which is often fatal if untreated. Ebola virus disease (EVD) first appeared in 1976 in 2 simultaneous outbreaks, one in what is now Nzara, South Sudan, and the other in Yambuku, Democratic Republic of Congo. The latter occurred in a village near the Ebola River, from which the disease takes its name. Ebola is introduced into the human population through close contact with the blood, secretions, organs, or other bodily fluids of infected animals such as **[animal 1], [animal 2], [animal 3], and [animal 4]**.

The animals listed in the description were experimentally manipulated between participants. Participants were randomly assigned to read either a CDC-inspired set of animals with lower premise diversity (fruit bats, gorillas, monkeys, and chimpanzees; n=81) or a WHO-inspired set with higher premise diversity (fruit bats, monkeys, forest antelope, and porcupines; n=70). To verify that these prompts did indeed differ in premise diversity, we had a separate group of participants (N=53) provide pairwise similarity judgments between each of the premise animals. Consistent with our expectations, participants judged the CDC prompt animals to be significantly more similar (i.e. less diverse, t(52) = 14.56, p ¡ .001).

Next participants completed the Ebola susceptibility questionnaire. For each question, participants were asked "How likely is it that **[animal]** can get Ebola?" (1 = Very Unlikely, 7 = Very Likely). Animals included both mammals and birds: bats, monkeys, zebras, meerkats, anteaters, giraffes, gazelles, storks, flamingos, cranes, vultures, and parrots.

Next participants completed the bite reporting questionnaire. Participants were told to "imagine that you are on safari and get bitten by an animal, but the bite just barely breaks the skin" when considering whether they would report a bite to a health professional. Each question asked them to rate (1 = Very Unlikely, 7 = Very Likely), "how likely would you be to report being bitten by a **[animal]**?"

Last, participants completed the meat safety questionnaire. Participants were asked to rate (1 = Very Unsafe, 7 = Very Safe), "how safe you think it is for people in general to eat meat from each animal" and to "consider only immediate health risks from disease transmission."

Results. The results were consistent with predictions based on the premise diversity principle. Participants in the WHO (diverse) wording condition rated individual mammals as more susceptible to Ebola [$t(150) = 3.70, p < .001, d = 0.6$; Figure 2A], were more likely to report mammal bites [$t(150) = 2.85, p = .005, d = .46$; Figure 2B], and perceived mammal meat as less safe [$t(150) = 2.66, p = .009, d = .434$; Fiture 2C].

The WHO (diverse) wording condition also increased perception of birds' susceptibility to Ebola [$t(150) = 2.06, p = .040, d = 0.33$] but did not significantly increase intentions to report bird bites [$t(150) = 1.10, d = 0.18$] or lower perceptions of meat safety [$t(150) = 1.28, d = 0.21$].

We additionally used linear regression to test whether the effect of wording condition on bite reporting and perceptions of meat safety was mediated by its effect on Ebola susceptibility ratings. First, we found that Ebola susceptibility was significantly associated with bite reporting and meat safety perceptions for both mammals and birds, even after taking into account the effect of wording condition [Mammal bites: standardized $b = 0.47; t(149) = 6.40; p < .001$; Mammal meat: standardized $b = -0.43; t(149) = 5.67, p < .001$; Bird bites: standardized $b = 0.51; t(149) = 7.32, p < .001$; Bird meat: standardized $b = -0.45; t(149) = 6.01, p < .001$]. Next, we found that including Ebola susceptibility in the regression model with the effect of wording condition made the effect of condition non-significant for all models [Mammal bites: $b = 0.18, t(149) = 1.20$; Mammal meat: $b = -.18, t(149) = -1.16$; Bird bites: $b = .009; t(149) = 0.063$; Bird meat: $b = -0.06; t(149) = 0.43$], suggesting that the effects of condition on meat safety and bite reporting were fully mediated by the effect of the different wordings on participants' perceptions of Ebola susceptibility. Finally, using a bootstrapping procedure (Preacher & Hayes, 2008), we found that the indirect pathways between wording condition and the bite reporting and meat safety ratings were significant for both birds and mammals.

General Discussion

Results from both studies indicate an important role that cognitive research can play in combating emerging zoonoses. Although rarely studied in the public health literature, humans' inferences about risk are central to their interactions with potential disease vectors. We found that cognitive principles related to premise number and diversity impact perceptions of zoonotic disease transmission risk and associated health behaviors. To the extent that people believe it is possible for many diverse species to transmit diseases to one another, they become more wary of their own risk of infection.

An experiment based on CDC and WHO Ebola factsheets further revealed that individuals' inductive reasoning strategies can be harnessed to make communications about disease risk more effective. Through the use of cognitive framing strategies, it may be possible to reduce adverse contact with animals and increase rapid reporting of potential disease exposure. Such approaches may be particularly effective for rural communities that are difficult to reach with other interventions. These results have the potential to contribute goals of identifying low-cost strategies for reducing emerging disease risk before outbreaks occur (Heymann & Dar, 2014).

To our knowledge, the present results are the first to suggest that inductive reasoning processes studied in cognitive psychology also influence health behaviors. With such connections established, future studies on disease transmission risk perception would benefit from even stronger connections with cognitive research. One question is how people judge risks from different species. Here we focused on person-level characteristics that relate to perceived risk of animal contact

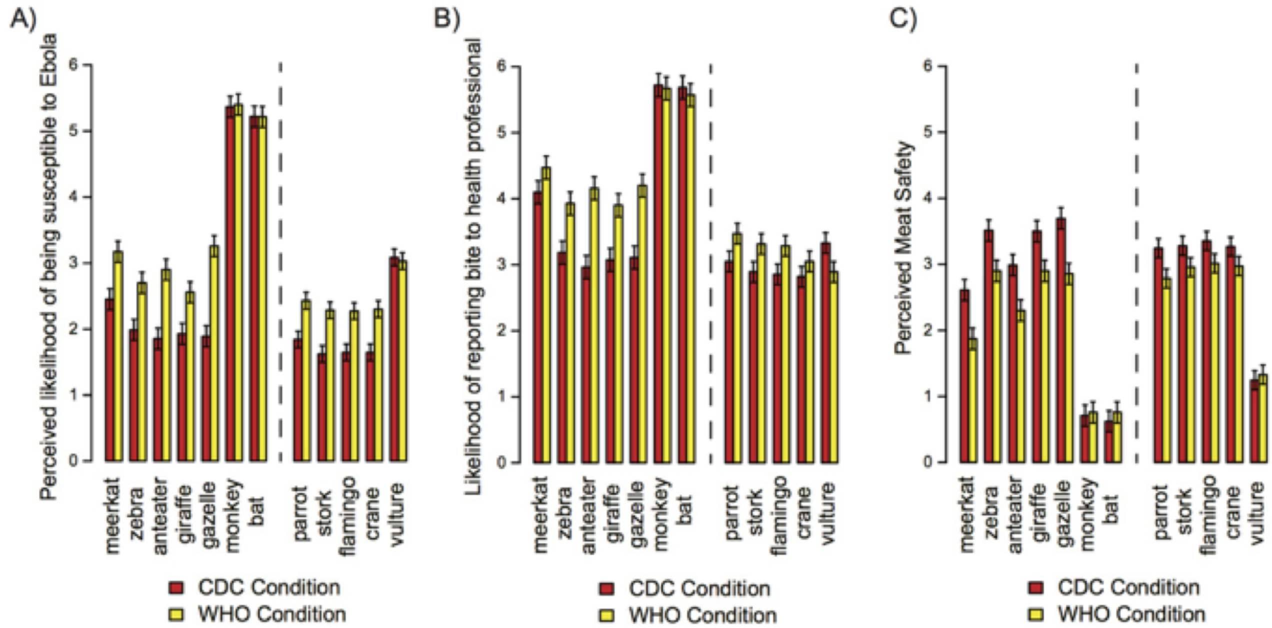

Figure 2: Effect of communication wording on (A) Perceived susceptibility of animals to Ebola, (B) Intentions to report animal bites, and (C) Perceived meat safety. Error bars reflect 95% within-subject confidence intervals.

(bites and game meat), averaging over differences between species. However, not all animals are associated with the same zoonosis risk, and it will be important to understand how to tailor communications to impact species selectively. For example, bats have a very strong association to emerging zoonosis (Calisher, Childs, Field, Holmes, & Schountz, 2006), and it may be useful to tailor messages to focus on bats specifically. Although bats were associated with high levels of intended bite reporting and were perceived as being unsafe to eat, participants also may have underestimated the risks bats pose to other animals – indeed, participants rated disease transmission risk between bats and other mammals as lower than for more typical mammals. Because wildlife-livestock interactions are a major driver of emerging zoonosis (Jones et al., 2008), this finding suggests that people may underestimate the risk of keeping livestock near bat habitats.

One limiation of our second study is that much of the sample is not at high risk for Ebola virus. However, because zoonoses are common within the countries surveyed and can be transmitted via many different interactions with animals all of our participants were at some risk of zoonosis exposure. Still, future research should examine whether risk level or other variables may moderate the effect of inductive reasoning principles on risk perception. We anticipate that people's personal experience with zoonosis, as opposed to pure risk level per se, may strengthen the relationship between beliefs and health intentions. Indeed, in the broader attitudes and public health literatures, many associations between attitudes and behaviors are rather weak in the general population, but are much stronger in groups with direct experience (Fazio & Zanna, 1978; Glasman & Albarracin, 2006). Thus while many people in these studies do not have direct experience with Ebola virus, we would expect attitudes and health intentions to be even stronger in those who do.

The present research is primarily aimed at building interdisciplinary connections between public health research (particularly inerdisciplinary efforts such as One Health) and cognitive psychology. Still, the current results may have implications for basic psychological research on contagion and induction as well. The law of contagion is a prominent social psychology construct that describes people's tendencies to believe that negative (and positive) properties, including diseases and social ills, can be transmitted to objects or people through mere contact (e.g. Rozin and Royzman (2001)). Current theories of sympathetic magical thinking often make distinctions between the law of contagion and the law of similarity, a separate construct that describes the belief that objects that share surface features also share deeper common essences (e.g., leading to disgust with fudge shaped like dog feces, and beliefs that voodoo dolls can affect the person they resemble; Rozin, Markwith, and Ross (1990)).

The present results suggest that the laws of contagion and similarity may not be fully separate, and similarity-based effects may influence perceptions of contagion. Indeed, theories suggest that inductive reasoning principles like premise number and diversity can increase generalization of properties (such as disease susceptibility) via similarity relationships between known and novel/unknown examples. For example, the diverse prompts in our second experiment may have increased perceptions of Ebola susceptibility by increasing the likelihood that the unknown examples would match the known examples in some respect. A major question in cognitive psychology is how different respects in which items can be similar (Medin, Goldstone, & Gentner, 1993) impact generalization of novel/unknown properties. Although our data does not distinguish between different candidate theories for similarity-based transfer of contagion, the results are suggestive that beliefs about contagion can be transferred via such similarity relationships.

In conclusion, emerging diseases from animals pose a substantial public health concern, yet little is known about how people judge risks associated with different drivers of zoonosis. The present studies illustrate that basic cognitive principles related to inductive reasoning not only impact individuals' perceptions of disease risk and associated health behaviors, but also can be harnessed for tailoring messages to properly convey risks associated with emerging diseases.

References

Azien, I., & Timko, C. (1986). Correspondence between health attitudes and behavior. *Basic and Applied Social Psychology*, *7*, 259–276.

Bingham, G. M., Budke, C. M., & Slater, M. R. (2010). Knowledge and perceptions of dog-associated zoonoses: Brazos County, Texas, USA. *Preventative Veterinary Medicine*, *93*, 211–221.

Calisher, C. H., Childs, J. E., Field, H. E., Holmes, K. V., & Schountz, T. (2006). Bats: Important reservoir hosts of emerging viruses. *Clinical Microbiology Reviews*, *19*, 531–545.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *1*, 155–159.

Daszak, P., Cunningham, A. A., & Hyatt, A. D. (2000). Emerging infectious diseases of wildlife – threats to biodiversity and human health. *Science*, *287*, 443–449.

Davis, T., Goldwater, M. B., Gaylord, N., Worthy, D., Otto, A. R., & Glass, B. D. (2013). The cognitive psychology of human-bat interactions: Implications for ecological policy and zoonotic disease transmission. In *Bats: Phylogeny and evolutionary insights, conservation strategies and role in disease transmission* (pp. 1–17). Hauppage: Nova.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, *9*, 522–550.

Fazio, R. H., & Zanna, M. P. (1978). On the predictive validity of attitudes: The roles of direct experience and confidence. *Journal of Personality*, *46*, 228–243.

for Disease Control, C. C., & Prevention). (n.d.). *About ebola virus disease.* (Retrieved from http://www.cdc.gov/vhf/ebola/about.html)

Glasman, L. R., & Albarracin, D. (2006). Forming attitudes that predict future behavior: A meta-analysis of the attitude-behavior relation. *Psychological Bullletin*, *132*, 778–822.

Haidt, J., McCaluey, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, *16*, 701–713.

Hayes, B. K., Heit, E., & Swendsen, H. (2010). Inductive reasoning. *Wiley interdisciplinary reviews: Cognitive Science*, *1*, 278–292.

Heit, E., & Feeney, A. (2005). Relations between premise similarity and inductive strength. *Psychonomic Bulletin and Review*, *12*, 340–344.

Heymann, D. L., & Dar, O. A. (2014). Prevention is better than cure for emerging infectious diseases. *The BMJ*, *348*, g1499.

Janes, C. R., Corbett, K. K., Jones, J. H., & Trostle, J. (2012). Emerging infectious diseases: the role of social sciences. *The Lancet*, *380*, 1884–1886.

Jones, K. E., Patel, N. G., Levy, M. A., Storeygard, A., Balk, D., Gittleman, J. L., & Daszak, P. (2008). Global trends in emerging infectious diseases. *Nature*, *451*, 900–993.

Kamins, A. O., Rowcliffe, J. M., Ntiamoa-Baidu, Y., Cunningham, A. A., Wood, J. L., & Restif, O. (2015). Characteristics and risk perceptions of Ghanaians potentially exposed to bat-borne zoonoses through bushmeat. *EcoHealth*, *12*, 104–120.

Li, F., Cao, B., Li, Y., Li, H., & Deak, G. (2009). The law of large numbers in children's diversity-based reasoning. *Thinking and Reasoning*, *15*, 388–404.

Lopez, A. (1995). The diversity principle in the testing of arguments. *Memory & Cognition*, *23*, 374–382.

McDonald, J., Samuels, M., & Rispoli, J. (1996). A hypothesis-assessment model of categorical argument strength. *Cognition*, *59*, 199–217.

Medin, D., Goldstone, R. L., & Gentner, D. (1993). Respects for similarity. *Psychological Review*, *100*, 254–278.

Nemeroff, C. J. (1995). Magical thinking about illness virulence: conceptions of germs from "safe" versus "dangerous" others. *Health Psychology*, *14*, 147–151.

Organization), W. W. H. (n.d.). *Ebola virus disease (fact sheet no. 103).* (Retrieved from http://www.who.int/mediacentre/factsheets/fs103/en/)

Osherson, D. N., Smith, E. E., Wilkie, O., Lopez, A., & Shafir, E. (1990). Category-based induction. *Psychological Review*, *97*, 185–200.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879–891.

Rozin, P., Markwith, M., & Ross, B. (1990). The sympathetic magical law of similarity, nominal realism and neglect of negatives in response to negative labels. *Psychological Science*, *1*, 383–384.

Rozin, P., & Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review*, *5*, 296–320.