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Full-length Article

I see sick people: Beliefs about sensory detection of infectious disease are largely consistent across cultures

Joshua M. Ackerman [a,*], Theodore Samore [b], Daniel M.T. Fessler [c,d,e], Tom R. Kupfer [f], Soyeon Choi [g], Wilson N. Merrell [h], Lene Aarøe [i], Toivo Aavik [j], Stephen Acabado [c,d,e], Grace Akello [k], Ilham N. Alfian [l], Laith Al-Shawaf [m,da], Marinés M. Alvarez [n], Jeanine Ammann [o], Gizem Arikan [p], Saiyeda A. Asha [q], Anibal M. Astobiza [r], Carmen G. Baeza-Ugarte [cr], Pat Barclay [s], Fiona Kate Barlow [t], Lisiane Bizarro [u], Paola Bressan [v], Andres Castellanos-Chacón [w], Bryan K.C. Choy [x], Achmad Chusairi [l], Jorge Contreras-Garduño [z], Brenda L. Chávez Cosamalón [y], Bernardo Costa-Neves [bu,bv], Mallika De [q], Tiago J.S. de Lima [aa], Piyanjali de Zoysa [ab], Ieva Dryžaitė [ac,ad], Christian T. Elbæk [ae], Peter Fedor [af], Ana M. Fernández [ag], Regina Fernandez-Morales [bq], Márta Fülöp [ah,ai], Vladimer Lado Gamsakhurdia [aj], Leonor Garcia-Gómez [ak,al], Leonel Garcia-Marques [am], Jimena Garduño-Franco [an], María del Pilar Grazioso [ao], Fanny Habacht [ap], Youssef Hasan [aq], Camila P. Haugestad [ar], Christian A.P. Haugestad [as], Jan Havlíček [at], Earl J. Hernandez [au], Vu M. Hoang [f], Minsung Hong [av], Ivana Hromatko [aw], Dzintra Iliško [ax], Hirotaka Imada [ay,az], Ivana Jakšić [ba], Tomasz Jarmakowski [bb], Harpa L. Hjördísar Jónsdóttir [bc], Kotrina Kajokaite [bd], Šárka Kaňková [be], Nicolas Kervyn [bf], Jinseok P. Kim [av], Jonas R. Kunst [cx], Michael Laakasuo [bg], Juan David Leongómez [w], Norman P. Li [bh], Junsong Lu [bi], Nathan Lynch [bj], María A. Maegli [bk], Harry Manley [bl,bm], Gabriela Marcu [bn], Thea McAfee [bo], Panagiotis Mitkidis [bp], Nándor B. Molnár [l], Coby Morvinski [br], Haslina Muhamad [bs], Pegah Nejat [bt], Hoang Nguyen Huy [bw], Angelica N. Oliveira [s], Mats J. Olsson [bx], Charity N. Onyishi [by], Ike E. Onyishi [bz], Reegan Orozco [ca], Tobias Otterbring [cb], Ida S. Ottersen [as], Gustavo Pacheco-López [cc], Penny Panagiotopoulou [cd], Walter Paniagua [bk], Roksana Parvin [q], Zoran Pavlović [ce], Pavol Prokop [af,cz], Emma Raffman [cf], Muhammad Rizwan [cg], Sheila Rojas [ch], Joanna Różycka-Tran [ci], Oscar R. Sánchez [w], Heyla Selim [cj], Barış Sevi [ck], Yaniv Shani [cl], Madhulika S. Shastry [a], Stefan Stieger [ap], Eunkook M. Suh [av], Melati Sumari [cm], Kosuke Takemura [cn], Arnaud Tognetti [bx,db], Roberta Z.R. Trombetta [u], Joshua M. Tybur [co,cw], Eylul B. Ucak [cp], Yukiko Uchida [cq], Jaroslava V. Valentova [cs], Hugo Viciana [ct], Amandine Visine [cy], Jin Wang [cu], XT (XiaoTian) Wang [cu], Illia I. Yahiiaiev [cv], Rizqy A. Zein [l], Iris Žeželj [ce]

[a] Department of Psychology, University of Michigan, Ann Arbor, MI, United States
[b] Religion Programme, University of Otago, Dunedin, New Zealand
[c] Department of Anthropology, University of California, Los Angeles, Los Angeles, CA, United States
[d] Center for Behavior, Evolution, & Culture, University of California, Los Angeles, Los Angeles, CA, United States
[e] Bedari Kindness Institute, University of California, Los Angeles, Los Angeles, CA, United States

* Corresponding author at: Department of Psychology, 530 Church Street, Ann Arbor, MI 48109-1043, United States.
E-mail address: joshack@umich.edu (J.M. Ackerman).

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[f] Department of Psychology, Nottingham Trent University, Nottingham, England, UK
[g] Department of Psychology, University of Wisconsin-Madison, Madison, WI, United States
[h] Center for the Experimental-Philosophical Study of Discrimination, Aarhus University, Aarhus, Denmark
[i] Department of Political Science, Aarhus University, Aarhus, Denmark
[j] Institute of Psychology, University of Tartu, Tartu, Estonia
[k] Department of Mental Health, Faculty of Medicine, Gulu University, Gulu, Uganda
[l] Department of Psychology, Universitas Airlangga, East Java, Indonesia
[m] Department of Psychology, University of Colorado Colorado Springs, Colorado Springs, CO, United States
[n] Department of Psychology, Universidad del Valle Guatemala, Guatemala City, Guatemala
[o] Agroscope, Research group Economic Modelling and Policy Analysis, Ettenhausen, Switzerland
[p] Department of Political Science, Trinity College Dublin, Dublin, Ireland
[q] Department of Psychology, International University of Business Agriculture and Technology, Dhaka, Bangladesh
[r] Department of Philosophy, University of Granada, Granada, Spain
[s] Department of Psychology, University of Guelph, Guelph, Ontario, Canada
[t] School of Psychology, University of Queensland, Brisbane, Queensland, Australia
[u] Graduate Program in Psychology, Universidade Federal do Rio Grande Do Sul, Porto Alegre, RS, Brazil
[v] Department of General Psychology, University of Padova, Padova, Italy
[w] Faculty of Psychology, Universidad El Bosque, Bogotá, Colombia
[x] Ministry of Defence, Singapore
[y] Sustainability and Education Policy Network, Saskatoon, SK, Canada
[z] Escuela Nacional de Estudios Superiores, unidad Morelia, Universidad Nacional Autonama de México, Mexico
[aa] Department of Social and Work Psychology, University of Brasília, Brasília, Brazil
[ab] Department of Psychiatry, University of Colombo, Colombo, Sri Lanka
[ac] Department of Sociology, Vytautas Magnus University, Kaunas, Lithuania
[ad] PB Kaunas County Public Library (Oak Grow Library), Lithuania
[ae] Department of Management, Aarhus University, Aarhus, Denmark
[af] Department of Environmental Ecology and Landscape Management, Comenius, Bratislava, Slovakia
[ag] Laboratory of Evolution and Interpersonal Relationships, LERI, Universidad de Santiago de Chile, Santiago, Chile
[ah] Department of Social and Cultural Psychology, HUN-REN Institute of Cognitive Neuroscience and Psychology, Budapest, Hungary
[ai] Institute of Psychology, Károli Gáspár University of Reformed Church, Budapest, Hungary
[aj] Faculty of Psychology and Educational Sciences, Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia
[ak] Department of Research on Smoking and COPD, Instituto Nacional de Enfermedades Respiratorias Ismael Cosio Villegas, Mexico City, Mexico
[al] Doctorate of Biological and Health Sciences, Metropolitan Autonomous University, Lerma, Mexico
[am] CICPSI, Faculty of Psychology, University of Lisbon, Lisbon, Portugal
[an] Bachelor Program in Psychology, Intercontinetal University, Mexico City, Mexico
[ao] Proyecto Aigle Guatemala, Guatemala City, Guatemala
[ap] Department of Psychology and Psychodynamics, Division Psychological Methodology, Karl Landsteiner University of Health Sciences, Krems an der Donau, Austria
[aq] Psychology Program, Department of Social Sciences, College of Arts and Sciences, Qatar University, 2713 Doha, Qatar
[ar] Universidad de Cuenca, Cuenca, Ecuador
[as] Department of Psychology, University of Oslo, Oslo, Norway
[at] Department of Zoology, Charles University, Prague, Czechia
[au] Department of Archeology, University of California, Los Angeles, Los Angeles, CA, United States
[av] Department of Psychology, Yonsei University, Seoul, South Korea
[aw] Department of Psychology, University of Zagreb, Zagreb, Croatia
[ax] Institute of Humanities and Societal Sciences, Daugavpils University, Daugavpils, Latvia
[ay] Department of Psychology, Royal Holloway, University of London, Egham, England, UK
[az] School of Psychology, University of Kent, Canterbury, UK
[ba] Faculty of Political Sciences, University of Belgrade, Belgrade, Serbia
[bb] Institute of Psychology, Nicolaus Copernicus University, Toruń, Poland
[bc] Faculty of Psychology, University of Iceland, Reykjavík, Iceland
[bd] Department of Human Behavior, Ecology and Culture, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany
[be] Department of Philosophy and History of Science, Charles University, Prague, Czechia
[bf] Louvain School of Management, Université Catholique de Louvain, Ottignies-Louvain-la-Neuve, Belgium
[bg] Department of Social Research, Faculty of Social Sciences, University of Turku, Finland
[bh] School of Social Sciences, Singapore Management University, Singapore
[bi] Department of Psychology, University of California San Diego, San Diego, CA, United States
[bj] College of Music, Mahidol University, Salaya, Thailand
[bk] Department of Psychology, Universidad Francisco Marroquin, Guatemala City, Guatemala
[bl] Department of Psychology, Faculty of Behavioural Sciences, HELP University, Malaysia
[bm] Faculty of Psychology, Chulalongkorn University, 254 Phayathai Road, Pathumwan, Bangkok 10330, Thailand
[bn] Department of Psychology, Universitatea Lucian Blaga din Sibiu, Sibiu, Romania
[bo] Department of Psychiatry, Yale School of Medicine, New Haven, CT, United States
[bp] Department of Management, Aarhus University, Aarhus, Denmark
[bq] Department of Psychology, Universidad Francisco Marroquin, Guatemala City, Guatemala
[br] Department of Management, Ben-Gurion University of the Negev, Israel
[bs] Department of Anthropology and Sociology, Universiti Malaya, Kuala Lumpur, Malaysia
[bt] Department of Psychology, Faculty of Education and Psychology, Shahid Beheshti University, Tehran, Iran
[bu] Faculty of Medicine, University of Lisbon, Lisbon, Portugal
[bv] Hospital Júlio de Matos, Lisboa, Portugal
[bw] University of Social Sciences and Humanities, Vietnam National University, Hanoi, Viet Nam
[bx] Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden
[by] School of General Studies, State University of Medical and Applied Sciences Igbo Eno, Enugu State, Nigeria
[bz] Department of Psychology, University of Nigeria, Enugu, Nigeria
[ca] Department of Economics, Pontifical Catholic University of Peru, Lima, Peru
[cb] Department of Management, University of Agder, Kristiansand, Norway
[cc] Department of Health Sciences, Campus Lerma, Metropolitan Autonomous University, Lerma, Mexico
[cd] Department of Educational Sciences and Social Work, University of Patras, Pátras, Greece
[ce] Department of Psychology, University of Belgrade, Belgrade, Serbia
[cf] Feinberg School of Medicine, Northwestern University, Chicago, IL, United States
[cg] Department of Clinical Psychology, National University of Medical Sciences, Rawalpindi Pakistan

[ch] Centro de Estudios para el Arte y la Cultura de la Universidad Autónoma de Chiapas, Mexico
[ci] Institute of Psychology, University of Gdansk, Gdański, Poland
[cj] School of Psychology, King Saud University, Riyadh, Saudi Arabia
[ck] Department of Psychology, MEF University, Istanbul, Turkey
[cl] Department of Marketing, Coller School of Management, Tel Aviv University, Tel Aviv, Israel
[cm] Department of Educational Psychology and Counselling, Universiti Malaya, Kuala Lumpur, Malaysia
[cn] Faculty of Economics, Shiga University, Hikone, Japan
[co] Department of Experimental and Applied Psychology, Vrije Universiteit Amsterdam, Amsterdam, the Netherlands
[cp] Faculty of Science and Engineering, Maastricht University, Maastricht, the Netherlands
[cq] Institute for the Future of Human Society, Kyoto University, Japan
[cr] Escuela de Psicología, Universidad Tecnológica Metropolitana (UTEM), Santiago, Chile
[cs] Department of Experimental Psychology, Institute of Psychology, University of Sao Paulo, Sao Paulo, Brazil
[ct] Departamento de Filosofía, Lógica y Filosofía de la Ciencia, Universidad de Sevilla, Seville, Spain
[cu] School of Humanities and Social Science, The Chinese University of Hong Kong, Shenzhen, Shenzhen, China
[cv] Department of Experimental and Applied Psychology, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
[cw] Institute Brain and Behaviour Amsterdam, Amsterdam, Netherlands
[cx] BI Norwegian Business School, Oslo, Norway
[cy] Psychology Department, Durham University, Durham, United Kingdom
[cz] Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia
[da] Department of Biology, University of Colorado Colorado Springs, Colorado Springs, CO, United States
[db] CEE-M, University of Montpellier, CNRS, INRAE, Institut Agro, Montpellier, France

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ABSTRACT

Identifying cues to contagious disease is critical for effectively tracking and defending against interpersonal infection threats. People hold lay beliefs about the types of sensory information most relevant for identifying whether others are sick with transmissible illnesses. Are these beliefs universal, or do they vary along cultural and ecological dimensions? Participants in 58 countries (N = 19,217) judged how effective, and how likely they were to use, cues involving each of the five major sensory modalities in an imagined social interaction during a flu outbreak. Belief patterns were strongly consistent across countries (sight > audition > touch > smell > taste), suggesting a largely universal conceptualization of the role of sensory information for interpersonal respiratory disease detection. Results also support a safe senses hypothesis, with perceivers reporting that they would use senses that function at a distance—and thus reduce pathogen transmission risk—more than would be expected given participants' beliefs as to the efficacy of these senses for disease detection. Where societal variation did emerge, it was captured by a cohesive set of socio-ecological factors, including human development, latitude, pathogen prevalence, and population density. Together, these findings reveal a shared lens through which contagious respiratory disease is assessed, one that prioritizes minimizing risk to perceivers, and may offer leverage for designing interventions to improve public health.

1. Introduction

How do people know whether someone is suffering from a contagious illness? Identifying and defending against the threat of pathogens and parasites have been fundamental challenges throughout human evolution, as infections have likely killed more people than all wars, noninfectious diseases, and natural disasters combined (Inhorn & Brown, 1990). Efforts to understand the psychology of pathogen-threat management exploded following the COVID-19 pandemic. Here, we explore the initial stages of this management process in interpersonal contexts, asking how people judge the infectiousness of others.

Overt communication is important in efforts to avoid contagion, as people often simply say they are ill. However, such information is imperfect: sick people may not know whether their illness is transmissible (accurate diagnoses being historically recent, and, even today, medical care being limited for many), they may not believe they are sick, or they may be unwilling to disclose such information (e.g., Merrell et al., 2024). Importantly, overt communication is not the sole avenue for determining whether others might be ill, as sick individuals often evince a variety of cues detectable through sensory channels.

Research into the natural (i.e., unassisted by technology or training) use of sensory cues for contagious disease detection has generally followed two approaches. The first focuses on identification accuracy: perceivers attempt to determine targets' illness status from sets of sick (broadly defined) and non-sick stimuli (e.g., Arshamian et al., 2021; Axelsson et al., 2018; Hansson et al., 2023; Tognetti et al., 2023a). These stimuli commonly involve facial photographs or videos, making vision the sole sensory modality investigated. For example, participants judged photos of currently ill individuals to be sicker, more affectively unpleasant, and less attractive in an eye-tracking task (Leung et al., 2023). Research targeting other sensory modalities is less common and has shown inconsistent results. Perceivers were no better than chance at identifying contagious targets based on cough and sneeze sounds (Michalak et al., 2020), but the scent of sickness does appear detectable (Tognetti et al., 2023b) or at least more aversive (Moshkin et al., 2012; Sarolidou et al., 2020a).

A second approach, one we take here, examines lay beliefs about which sensory modalities afford disease detection. Notably, lay beliefs regarding how illnesses present can shape responses in contexts where disease transmission is possible. Beliefs likely influence the cues to which individuals attend, the ways they interact with others, and their subsequent behavior (Cameron & Moss-Morris, 2004). Such beliefs also have implications for those judged to be sick. Believing that others constitute disease threats may lead to avoidance, exhibition of intergroup prejudices, and support for restrictive policies as opposed to healthcare delivery (Choi et al., 2022; Ji et al., 2019; van Leeuwen and Petersen, 2018). Further, understanding lay beliefs about illness cues could inform public health knowledge gaps and misconceptions, and guide behavioral strategies for effective disease prevention.

1.1. Lay beliefs about infectious disease detection

A recent investigation of beliefs had U.S. participants judge the efficacy of information from the five major senses for identifying infection threats in others. Perceivers believed sight and audition to be the most

[1] Independent scholar.

effective modalities, followed by touch, smell, and taste, respectively (Ackerman et al., 2020). Critically, this sensory ordering was specific to interpersonal disease detection. Perceivers listed different sense orders for the effectiveness of pathogen identification in food (see also Ammann et al., 2019), and for the identification of non-transmittable personal characteristics (e.g., cleanliness, attractiveness). Thus, perceivers *believe* that cues processed through certain senses are better for accurately diagnosing disease hazards.

Evidence of adaptive design consistent with error management biases (Haselton & Nettle, 2006) was also present in the reported beliefs. When comparing perceived effectiveness with likelihood of use, perceivers reported being *more* likely to use sight and audition than they believed those cues to be effective, and they reported being *less* likely to use touch, smell, and taste than they believed those cues to be effective. A *safe senses hypothesis* was proposed to interpret this pattern. We clarify here two features of this hypothesis. First, sensory modalities vary in the spatial proximity required to obtain information, and proximity is a risk factor for pathogen transmission. As a result, in the context of potential interpersonal infection hazards, perceivers are biased to prefer senses that function at a presumably safe distance. Second, these beliefs are not substitutable. The bias toward more distal senses is specific to *use* of sensory modalities for detection. Even if a modality is believed to be effective for identifying sickness in others, the motivation to avoid close proximity will reduce intended use of that modality. As such, we should see downward pressure on use judgments relative to efficacy judgments for senses requiring close proximity.

Despite clear patterns in the Ackerman et al. studies, those data were collected only in the United States. This is a common limitation in the psychological literature (Henrich et al., 2010), as the vast majority of participant samples in published research are drawn from Western, Educated, Industrialized, Rich, Democratic (WEIRD) societies. This sampling bias also exists in related but separate literatures, including research on the behavioral immune system, which explores psychological mechanisms associated with detection and defense against infection threats (Ackerman et al., 2020; Gurven & Lieberman, 2020; van Leeuwen & Petersen, 2018; Schaller, 2011), and research on human sickness behavior, which investigates psychological, behavioral, and physiological changes during active infections (Dantzer & Kelley, 2007; Shattuck & Muehlenbein, 2015). Because previous work is limited to WEIRD samples, it is difficult to determine whether the documented lay beliefs are the product of panhuman, biologically evolved psychological mechanisms, parochial cultural/historical processes, or some combination. The cultural, educational, and ecological landscape of the U.S. may dictate people's understanding of infectious disease processes and the cues that best afford threat identification. For instance, it may be that models of contagious disease taught in the U.S., unlike some other countries, focus primarily on visual and auditory aspects of germ transmission (e.g., Centers for Disease Control and Prevention, 2023). Similarly, the unique physical and social ecologies (perhaps related to pathogen prevalence) of the U.S. could either evoke particular patterns of infection identification, or shape cultural beliefs about disease detection, that, respectively, are dissimilar to those in other parts of the world (e.g., Murray & Schaller, 2010; Oaten et al., 2011; Wormley & Cohen, 2022). For example, traditions linking fresh air to health, such as lüften in Germany and *havalandırma* in Türkiye (Hernández-Morales, 2021; Önder, 2007), may be associated with relatively greater emphasis on smell as an effective detection modality.

Consistent with the potential for cross-cultural differences in lay beliefs, aspects of folk biology and psychology vary across cultures (Boyer & Petersen, 2018; Gelman & Legare, 2011; Medin & Atran, 2004). For example, depending on the culture, people may rely primarily on morphological, ecological, biological, and/or relational similarities to represent categories of living kinds (Atran, 1998; Busch et al., 2018). Of particular relevance, cognitive models of contamination show cultural distinctions, as in the belief that a given object is more material or spiritual in its contaminating properties (Hejmadi et al., 2004). Social norms may influence sensory beliefs even when those norms are only indirectly connected to disease, as in preferences for interpersonal distance (Sorokowska et al., 2017). Finally, linguistic indicators of sensory concepts vary between language families: though vision terminology overshadows use of verbs connoting other senses, no universal ordering of sense modalities exists (San Roque et al., 2015). Cultures thus differentially emphasize sense concepts, and hence sensory beliefs regarding infection detection may vary, aligning with culturally- or ecologically-specific features of each society.

An alternate, universalist account predicts a more consistent pattern of lay beliefs across societies. This could arise for multiple reasons, including the manner in which evolution has prioritized various senses. For example, across primates, more of the brain is devoted to visual processing than processing of other sensory information (Van Essen et al., 1990), and, in humans, vision typically dominates other senses experientially (Stokes & Biggs, 2014). However, a fixed sensory processing hierarchy is unlikely to account for a universal pattern of infection-detection lay beliefs. For one thing, the affordances for detection vary across categories of threats, and perceivers appear sensitive to these affordances, prioritizing different senses when identifying interpersonal versus food-based pathogen dangers versus non-pathogenic characteristics (Ackerman et al., 2020). Therefore, if a relatively universal pattern of lay beliefs regarding interpersonal disease detection exists, this may reflect either a shared mental model of infectious disease symptomology (perhaps informed by sensory affordances), an evolved cognitive bias (Haselton et al., 2015) consistent with the safe senses hypothesis, or both. Consistent with a universalist account, evidence suggests that specific physical cues motivate interpersonal avoidance and may be associated with identification of acute inflammatory activity across many cultures (Arshamian et al., 2021; Oaten et al., 2011).

1.2. Current research

Which account better characterizes beliefs about sensory detection of interpersonal infection threats, a relativist or universalist perspective? Recognizing the dearth of cross-cultural research on cognitive models of disease and its avoidance (Oaten et al., 2011), we examined this and related questions among participants from approximately 30 % of the world's countries, spanning all major world regions. Although we employed convenience samples—and acknowledge they are not representative—we nevertheless sought to avoid biasing our samples toward highly Western-oriented participants by employing the most prevalent local language (for countries where English is not widely used) and using recruitment methods preferred by local collaborators. We replicated methods from Ackerman and colleagues (2020) to examine two types of lay beliefs about the five major senses in the context of disease detection, namely (1) effectiveness and (2) likelihood of use. A relativist account would predict substantive variation in these beliefs, whereas a universalist account would predict relatively little variation. Lastly, we sought to explore potential correlates of (possible) cross-cultural variation, including factors such as societal-level pathogen prevalence, population density, human development, and latitude (all of which could affect both disease risk and knowledge thereof; Van de Vliert & Van Lange, 2019), as well as possible differences in sample characteristics across study sites.

2. Method

This study is one of five distinct, preregistered components of an omnibus survey. Each component featured unique measures, hypotheses, and exclusion criteria.

Project collaborators were invited on a convenience basis and through snowball recruitment. At each collaborating site, investigators were asked to ensure adherence to institution-specific regulatory guidelines for human research (e.g., informed consent), presuming those existed. Collaborators at all sites reported either obtaining site-specific approval, or that this process was not applicable at their institution. In two countries, multiple sites were sampled by multiple teams.

We report all data exclusions and measures relevant to the current study. Survey materials in English, translations, datasets, analysis code, original preregistration, and a preregistration amendment are at: https://osf.io/9vj6t/?view_only=e67cc933a20841ec86dec87e44c988cc. (See Supplement Table S1 for the amendment's updates to the original preregistration.)

2.1. Participants

Adults (18 and over) in 62 countries participated between September 3, 2021 and March 21, 2022. Collaborators were asked to recruit at least 300 participants at their site, though this number was reached (following preregistered exclusions) at only 44 sites, with 10 other sites exceeding 150 participants, and 8 sites recruiting less than 150 participants. For the current project component, a power analysis for a sensory modality by rating type interaction (based on effect sizes from Ackerman et al., 2020) indicated that samples of less than 80 would be inadequately powered (80 %, $\alpha = 0.05$), hence data from 4 countries were excluded (Argentina, Ethiopia, India, Russia).

Participation occurred either online or at local study locations per collaborator preference. Participants included unpaid volunteers, credited students, and paid workers, with compensation depending on the study site. See Table S2 for a list of study sites, recruitment procedures, and participant demographics. Overall, 31,644 participants started the survey.

2.2. Measures and procedure

Participants were recruited for a study titled "Reactions to Sight, Sounds, and Events" which included all project components. They accessed the study through a web page presenting basic information, followed by the Qualtrics-hosted survey, both of which employed the site-specific language. Participants completed the survey in a single session.

Where deemed appropriate by collaborators, survey materials were translated from English and back-translated to English by separate, fluent bilingual speakers. Back-translations were checked by the principal investigator team. Table S3 lists departures from the original due to the absence of corresponding terms in the target language.

The measures reported here appeared at the beginning of the survey, before other facets of the project (results of which will be reported elsewhere). Participants read the following vignette text.

Imagine that over the last couple of weeks, a very bad flu outbreak has occurred (not COVID-19). People infected with this illness have gotten extremely sick, and vaccinations have been useless against this particular disease. Public health officials have urged people to be cautious about their behavior and take appropriate steps to prevent infection.
Now imagine you will be speaking with another person. You will be in a closed room (or other close interaction) with this person for at least an hour. However, you are unsure if this person has the flu or not. They may not even know themselves.

Participants then addressed each of the five major senses (sight, audition, smell, taste, touch) on measures assessing beliefs about senses in the vignette situation. First, they rated how "effective or useful" each sense would be in determining whether the person is sick, using a scale from 1 (not useful at all) to 7 (extremely useful). Second, they rated how "likely you are to use" each sense in determining whether the person is sick, using a scale from 1 (not at all likely to use) to 7 (extremely likely to use).

Participants then responded to demographic items, reported any technical problems, provided feedback, were debriefed, and, if applicable, compensated.

Socio-ecological variables were later coded for each country (see Supplementary Methods for source details).

2.3. Data approach

Following preregistered criteria, data were screened for minimum timing, completeness, and correct answers to attention checks. Participants were excluded if they did not answer all lay belief items (accounting for most of the exclusions). Excluding countries with fewer than 80 participants per the preregistration amendment, 58 countries remained (see Fig. 1), with a final total sample of 19,217 participants (65 % women, 31 % men, 4 % other; $M_{age} = 27.59$, $SD_{age} = 11.20$). The Supplementary Materials includes details on exclusion criteria and per-country information on the 12,427 exclusions (Table S2). For all major analyses, comparable results were found when including all participants (i.e., no exclusions; see Supplementary Methods, p. 16).

Analyses were conducted in R, version 4.4.0. For the primary tests of sensory ratings (Results 3.1 & 3.4), ratings were regressed on the interaction between sense type and rating type using restricted maximum likelihood linear mixed regression, with random effects set for participants nested within study sites to account for the non-independence of ratings both within individuals and within countries. Consistency across countries (Results 3.2 & 3.5) was assessed through descriptive comparison of sense rankings and means, and also quantified by calculating Kendall's coefficient of concordance (Field, 2005) and the adjusted intraclass correlation coefficient. Finally, as an exploratory analysis of variation across countries (Results 3.3), we calculated site-specific mean sense ratings for each unique combination of sensory modality and rating type and conducted Bayesian linear regressions using the *brms* package in R (Bürkner, 2017), which allows for control of cultural and geographic proximity (potential sources of non-independence). Table 1 presents the full set of model variables.

3. Results

3.1. Question 1: What are people's lay beliefs about sensory efficacy and likelihood of use for detecting disease?

Using a pooled sample across all study sites, we examined beliefs about the effectiveness of, and likelihood of using, each of the five senses in detecting disease. Based on estimated means from the restricted maximum likelihood linear mixed regression model, sight was rated the most efficacious sense, followed by audition, touch, smell, and taste. Estimated means significantly differed across all five senses ($Bs = 0.46$–3.58, $ps < 0.0001$); the estimated mean for sight efficacy (5.90) was 3.58 units higher than that for taste efficacy (2.32). The same ordering of senses obtained for likelihood ratings, with all pairwise differences being statistically significant ($Bs = 0.64$–4.52, $ps < 0.0001$). These results replicate the pattern previously found in the U.S. (Ackerman et al., 2020). See Fig. 2 and Table 2 for a plot and list of estimated means, respectively.

Demographic variables did not meaningfully moderate or impact the effects of sense type and rating type on sense ratings (see Supplementary Results 1).

3.2. Question 2: Are sensory patterns consistent across study sites?

Though predicted global means of the sense ratings are readily visualized, cross-cultural differences in the patterning of sense ratings are not as easily summarized. Therefore, we present several visualizations of these ratings across study sites to explore possible cross-cultural variation. See Supplementary Table S4 for site-specific estimates.

We examined the relative importance of the five senses by plotting the rank order of efficacy and likelihood of use ratings at each study site individually (i.e., ordering the senses based on mean ratings within each site). The sense with the highest efficacy or likelihood of use rating was

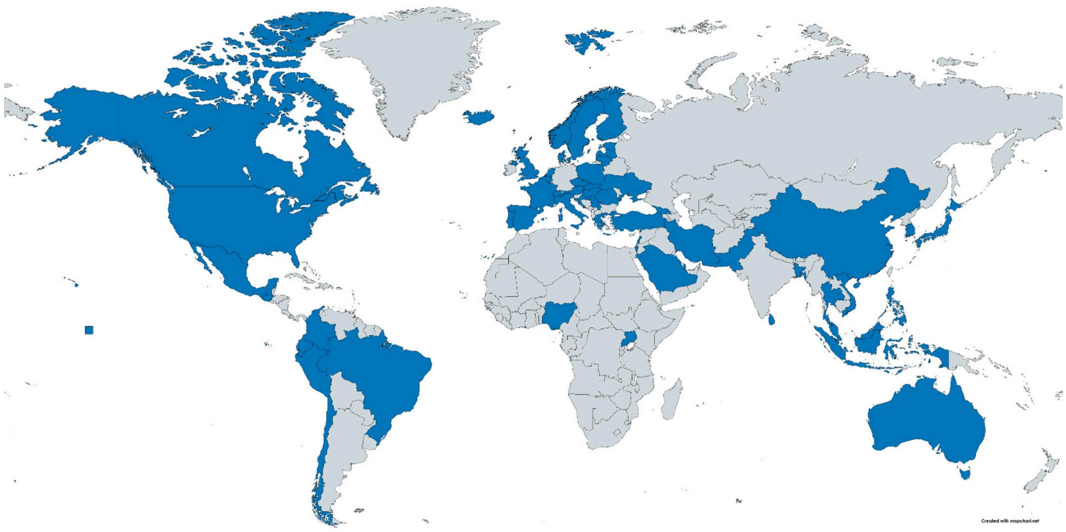

Fig. 1. Map of countries with sampled study sites (blue).

Table 1
Analytic model details.

Results section	Model description	Independent variables	Dependent variable	Random effects
3.1 & 3.4	Individual-level effects of rating type and sense type on sense ratings	Rating TypeSense TypeRating * Sense Interaction	Individual-level sense ratings (1–7 scale)	ParticipantCountry
3.3	Effects of geospatial flourishing index on sense ratings	Rating TypeSense TypeGSIRating * Sense * GSI Interaction (and all two-way interactions) Geographic Subregion	Country-level sense averages (1–7 scale)	Linguistic ProximityGeographic Proximity

ranked 1, and the sense with the lowest rating was ranked 5. We then plotted these rankings for efficacy and likelihood ratings separately (see Fig. 3).

To quantify variation in sense rankings, we used two approaches. First, Kendall's coefficient of concordance (*W*), where 0 represents no agreement across sites and 1 represents total agreement, was 0.95 for the efficacy rankings and 0.97 for the likelihood of use rankings, indicating near-perfect agreement (Field, 2005). Converting these values to Spearman correlation coefficients for ease of interpretation gives identical values ($r_s = 0.95, 0.97$). Second, the adjusted intraclass correlation at the country grouping level was very low (0.014), indicating that the ratings of individuals across all senses within countries were essentially no more similar than the ratings of individuals across countries. As visualized in Fig. 3, sight was ranked most effective in 54 out of 58 study sites, and most likely to be used in 57. Audition was rated as second most efficacious in 44 sites, and as second most likely to be used in 53. Touch was rated as third most efficacious in 46 sites, and as third most likely to be used in 53. Smell was ranked second to last for efficacy at all sites, and second to last for likelihood of use ratings at all but one site. Across all sites, taste was rated as least efficacious and least likely to be used. The overall ranking consistency is particularly strong when considering the number of possible rank orders that exist (120 per country). Where variation occurred, it was predominately between touch and audition rankings. Across senses, variation also was more likely in efficacy ratings (14 sites) than in likelihood of use ratings (6 sites). Of the six sites that had non-typical likelihood of use rankings, five also had non-typical efficacy rankings.

3.3. *Question 3: What predicts variation in sensory patterns across study sites?*

We next examined whether country-level factors accounted for deviations in sense rankings (see Fig. 3). We stress that these analyses were exploratory, and the high degree of consistency across sites suggests that results should be interpreted with caution. Socio-ecological factors, including pathogen prevalence, population density, human development index (HDI), and latitude, could plausibly associate with variation in responses to disease (e.g., Thornhill & Fincher, 2014; Tybur et al., 2016; but see Bromham et al., 2018; Currie & Mace, 2012). These factors shape environmental affordances involving disease exposure and transmission (e.g., Wong & Li, 2020), affordances involving sense use (e.g., high population density may force relatively greater use of close proximity modalities), many cultural outcomes in general (Wormley et al., 2023), and they may also play a role in education about contagion processes. Additionally, variation in rankings is likely to cluster as a function of cultural and geographic proximity between countries (Bromham & Yaxley, 2023; Claessens et al., 2023).

For each study site, we calculated mean sense ratings for each unique combination of sense and rating type. Like the individual-level data, we then lengthened this country-level data such that there was a single sense rating variable with ten observations per study site, and indicator variables corresponding to each unique combination of sense and rating type. We regressed the sample-mean ratings on the interaction between rating type and sense type. Models were fit using Bayesian linear regressions, because the *brms* package in R (Bürkner, 2017) has features that can be used to control for cultural and geographic proximity, two primary sources of potential non-independence across countries (Claessens et al., 2023). For cultural proximity, we specified a covariance matrix for study site-level intercepts based on linguistic phylogenetic proximity. For geographic proximity, we modeled a Gaussian Process over study site latitudes and longitudes. A series of models tested: (1) the effects of four socio-ecological variables (pathogen prevalence, population density, HDI, latitude), and (2) the effects of various sample demographics, including mean sample age, mean sample socioeconomic status, and use of student versus non-student samples (dichotomous).

We aggregated the four socio-ecological variables based on the

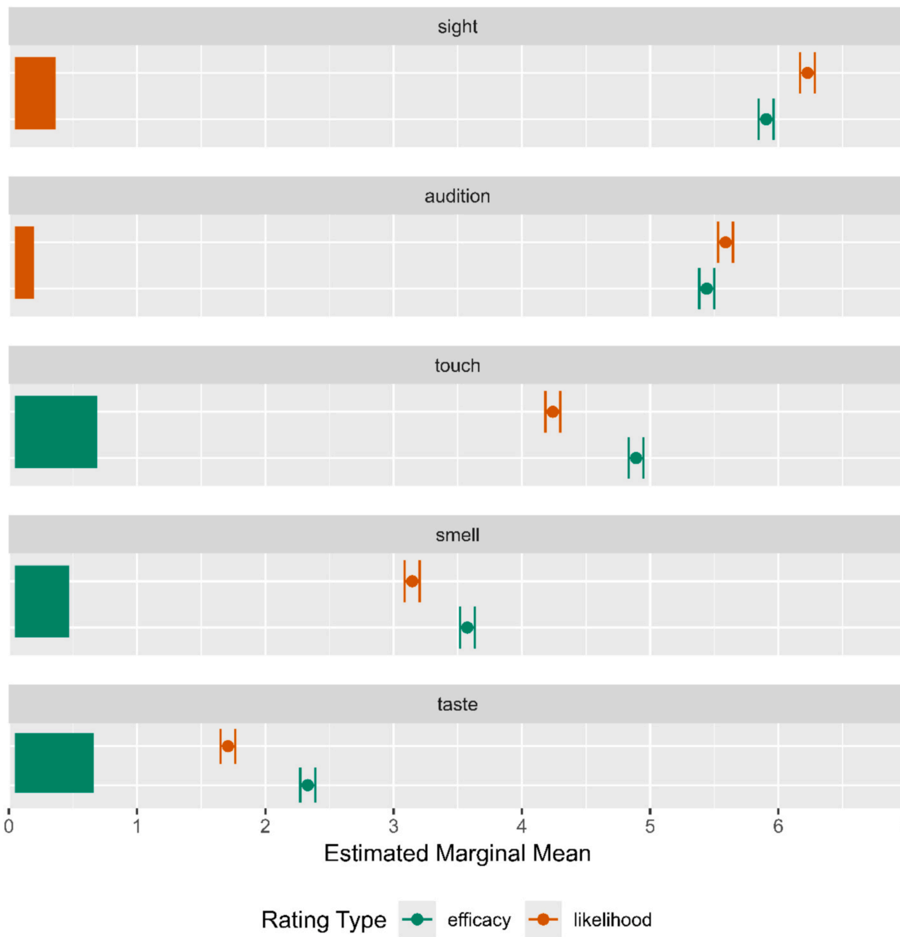

Fig. 2. Estimated efficacy and likelihood ratings for the five senses. Plot showing the predicted values, 95% CIs, and simple effects from a moderated mixed regression in which ratings were regressed on the interaction between sense type and rating type in a pooled sample across all 58 countries. Bars indicate the raw difference (starting linearly at zero) between the estimated efficacy and likelihood ratings for each sense, with colors corresponding to whether efficacy or likelihood ratings were higher. See Table 2 for estimated means and Table 3 for simple effects.

Table 2
Estimated means for efficacy and likelihood of use sense ratings.

Sense	Efficacy				Likelihood			
	Estimated Mean	SE	Lower 95 % CI	Upper 95 % CI	Estimated Mean	SE	Lower 95 % CI	Upper 95 % CI
Sight	5.90	0.01	5.87	5.92	6.22	0.01	6.20	6.24
Audition	5.43	0.01	5.41	5.46	5.58	0.01	5.56	6.60
Touch	4.88	0.01	4.86	4.91	4.23	0.01	4.21	4.26
Smell	3.57	0.01	3.54	3.59	3.14	0.01	3.11	3.16
Taste	2.32	0.01	2.30	2.35	1.70	0.01	1.68	1.73

Note. Estimates are unstandardized and are along a 1–7 scale. SE = standard error, CI = confidence interval.

results of a principal component analysis (see Supplementary Results 3), resulting in a composite we label the Geospatial Flourishing Index (GFI). Higher scores on the GFI represent greater HDI and latitude, and lesser pathogen prevalence and population density. Including this as a moderator of the rating type X sense type interaction, there was an effect on sense ratings, controlling for geographic and linguistic proximity (see Fig. 4). As GFI increased, participants rated sight and audition more positively and other senses more negatively. The simple slopes for GFI were modest (*B*s = −0.37 – 0.29); except for sight and smell efficacy ratings and smell likelihood ratings, the 95 % credible intervals were non-overlapping with zero (see Supplementary Results 4 for simple slope coefficients and their posterior distributions). This pattern was invariant across efficacy and likelihood ratings ($B = 0.00$, 95 % credible interval [−0.06, 0.06]), although the magnitude of the slopes for some senses varied across efficacy and likelihood ratings (see Supplementary Results 4). Overall, based on information criteria and an examination of the contrasts between the simple slopes, model results indicate that GFI meaningfully moderated the effects of sense and rating type on sense ratings (see Supplementary Results 4).

As reversals between audition and touch ratings were the most common source of cross-cultural variation, we probed whether GFI explained those reversals by comparing simple slopes and contrasts from the prior moderation model. When GFI was −2 SD from the mean, there was no difference between audition and touch ratings for both efficacy ($B = -0.08$, 95 % CI[−0.36, 0.20]) and likelihood ($B = 0.00$, 95 % CI [−0.28, 0.28]) ratings. However, as GFI increased, the difference between audition and touch ratings also progressively increased such that, when GFI was + 2 SD above the mean, there were relatively large

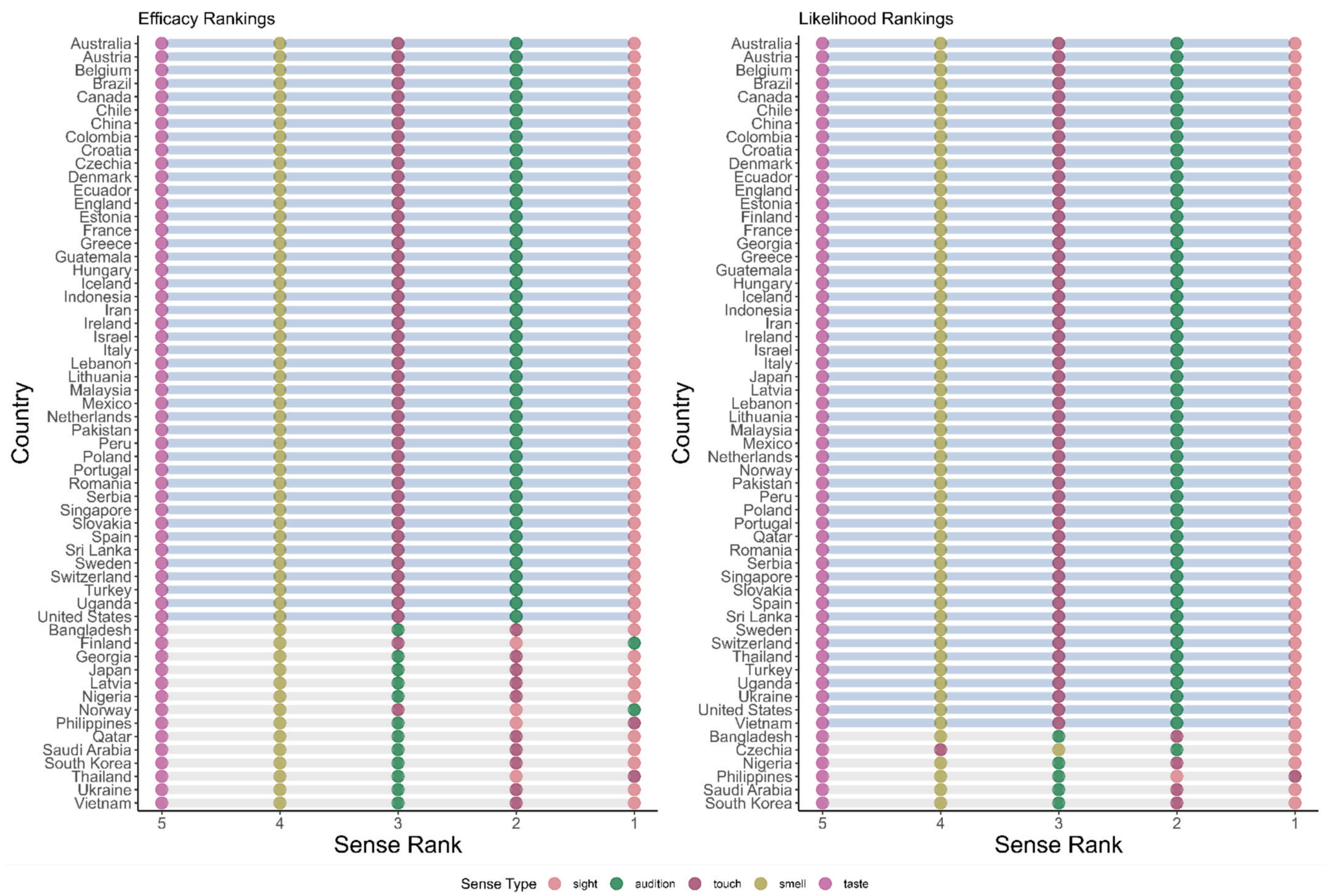

Fig. 3. Sense rankings across study sites. Chart visualizing the relative efficacy and likelihood of use rankings of the five senses across study sites. A ranking of 1 indicates that that sense had the highest mean response at a given study site, while a ranking of 5 indicates the lowest mean. The left panel shows rankings for the efficacy ratings, while the right panel shows rankings for the likelihood of use ratings. Gray lines indicate that the rank order for that country deviated from the modal pattern for at least 1 sense.

differences for both efficacy ($B = 1.15$, 95 % CI[.88, 1.43]) and likelihood of use ($B = 2.67$, 95 % CI[2.39, 2.96]) ratings. (See Supplementary Results 5 for estimates of pairwise differences between audition and touch ratings across the range of GFI.) In sum, low GFI scores were associated with more similarity between audition and touch ratings, indicating that reversals were more likely to happen when HDI/latitude were relatively low and pathogen prevalence/population density were relatively high.

Unlike GFI, sample-level demographic variables did not explain meaningful variation in sense ratings across sites (see Supplementary Results 6).

3.4. *Question 4: Do people prioritize safe senses?*

Senses that can be used to detect disease at a sufficient distance (i.e., sight, audition) entail less risk of contagion compared to senses requiring greater proximity. Do perceivers prioritize "safer" senses at rates higher than their expected disease-detection efficacy would imply, and deprioritize "less safe" senses relative to their expected efficacy? We tested this in our global sample using the mixed effects model described earlier.

Examining the pairwise comparisons from the interaction model reported in section 3.1, efficacy and likelihood of use ratings significantly differed across all five senses ($Bs = -0.32 - 0.65$, $ps < 0.0001$, see Table 3, panel B). Supporting the safe senses hypothesis, and consistent with prior U.S. research (Ackerman et al., 2020), participants reported being more likely to use sight and audition in detecting disease relative to the perceived efficacy of these senses. In contrast, participants rated touch, smell, and taste as more efficacious than would be expected given the reported likelihood of using said senses.

Finally, we tested whether an interaction between rating type and sense type emerged, such that the magnitude of the difference between likelihood and efficacy ratings significantly differed across all five senses. A likelihood ratio test was conducted comparing the model with the interaction term between sense type and rating type to a reduced model without the interaction. The test ($\chi^2(4) = 3333.80$, $p < 2.2e{-16}$) indicated that there was a significant interaction between sense type and rating type. Note that models were refit using maximum likelihood in order to conduct the likelihood ratio test. See Fig. 2 and Table 3 for a plot and list of simple effects, respectively. Results were not affected when adjusting for demographic covariates (see Supplementary Results 1).

3.5. *Question 5: Are differences between efficacy and likelihood of use ratings consistent across study sites?*

To test the safe senses hypothesis by country, we assessed differences between efficacy and likelihood of use ratings for each sense across study sites. Fig. 5 shows average efficacy and likelihood ratings for all five senses by site, as well as the raw mean difference between efficacy and likelihood ratings. Predicted values in the pooled sample suggested that efficacy ratings tended to be higher than likelihood ratings for smell, taste, and touch, whereas likelihood ratings were relatively higher for audition and sight. The descriptive data plotted in Fig. 5 suggests this pattern is generally consistent across sites.

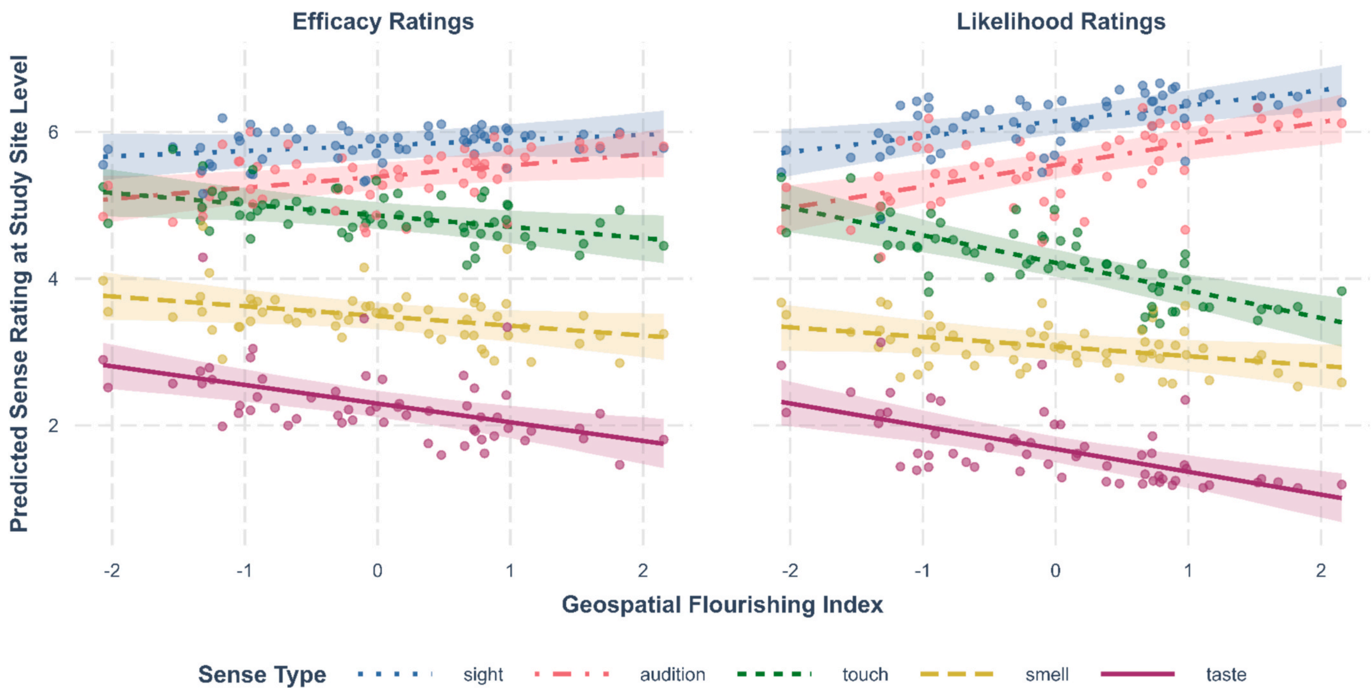

Fig. 4. Predicted sense ratings as a function of socio-ecological differences. Simple slopes taken from a Bayesian linear regression in which sample-mean sense ratings were regressed on the three-way interaction between sense type, rating type, and our Geospatial Flourishing Index (human development index, pathogen prevalence, latitude, and population density; positive GFI values indicate that human development index and latitude are high, and population density and pathogen prevalence are low). Model included covariance controls for geographic and cultural proximity. X-axis represents standard deviations of GFI, and y-axis represents the original 1–7 scale participants used to rate senses. Lines represent estimates of the relationship between GFI and sense ratings for each combination of sense type and rating type; shaded areas represent their 95% credible intervals. Dots are partial residuals: each dot corresponds to the country-level predicted values for sense rating and GFI for each unique combination of sense type and rating type, accounting for geographic and cultural proximity. Additionally, to address geocultural confounds with the socio-ecological variables, a fixed effect control for global region (Global South or Global North) was added. Results are not conceptually affected by modeling the socio-ecological variables individually (see Fig. S3).

For sight ratings, mean likelihood responses were higher than mean efficacy responses in 55 out of 58 sites, although the magnitude of the difference varied from 0 to 0.89 across sites. For audition ratings, more cross-cultural variation was present, with likelihood means higher than efficacy means at 43 sites; the mean difference ranged between 0 and 0.74. For touch ratings, efficacy was higher than likelihood at 57 of the 58 sites; the mean difference ranged from 0.12 to 1.73. For smell ratings, efficacy was higher than likelihood at all study sites; the mean difference ranged from 0.05 to 1.02. For taste ratings, efficacy was higher than likelihood at all sites; the mean difference ranged from 0.07 to 1.33. Thus, the safe senses hypothesis was supported across countries, with variation (in a minority of sites) occurring primarily with regard to audition.

Table 3
Simple effects for sense rating comparisons.

Sense comparisons	Efficacy ratings		Likelihood ratings	
	Simple Effect	SE	Simple Effect	SE
A				
sight – audition	0.46	0.02	0.64	0.02
sight – touch	1.02	0.02	1.99	0.02
sight – smell	2.33	0.02	3.08	0.02
sight – taste	3.58	0.02	4.52	0.02
audition – touch	0.55	0.02	1.35	0.02
audition – smell	1.87	0.02	2.44	0.02
audition – taste	3.11	0.02	3.88	0.02
touch – smell	1.32	0.02	1.10	0.02
touch – taste	2.56	0.02	2.53	0.02
smell – taste	1.24	0.02	1.44	0.02

	Efficacy-likelihood comparisons	
	Simple Effect	SE
B		
Sight	−0.32	0.02
Audition	−0.15	0.02
Touch	0.65	0.02
Smell	0.43	0.02
Taste	0.62	0.02

Note. Estimates are unstandardized, along a 1–7 scale. All effects are significant at $p < 0.0001$. Panel A represents individual sensory modality comparisons; Panel B represents rating type comparisons within each sensory modality (negative values indicate relatively stronger likelihood ratings). SE = standard error.

4. General discussion

Many infectious diseases spread interpersonally, making attunement to interpersonal infection threats vital. What do people believe about the use of sensory information in detecting these threats, and are these beliefs shared globally? Across 58 nations, we found support for a generally universal pattern of lay beliefs regarding both the effectiveness and likelihood of using specific senses to identify infection in others. This cross-national consistency emerged in mean ratings, rankings of the five major senses (sight > audition > touch > smell > taste), and comparisons between judgments of efficacy and reports of likelihood of use. Consistency in sense rankings across countries ranged from 0.95 to 0.97, indicating almost perfect agreement. Common demographic variables did not meaningfully moderate this consistency.

When response variation in sense rankings did emerge, it occurred primarily with regard to audition and, to a lesser extent, touch. Relative to the modal ranking of modalities, audition was devalued in 12 societies on perceived effectiveness, and in 5 societies on likelihood of use. Further, efficacy-likelihood comparisons for audition showed reversals (though not necessarily significant ones) in 17 societies.

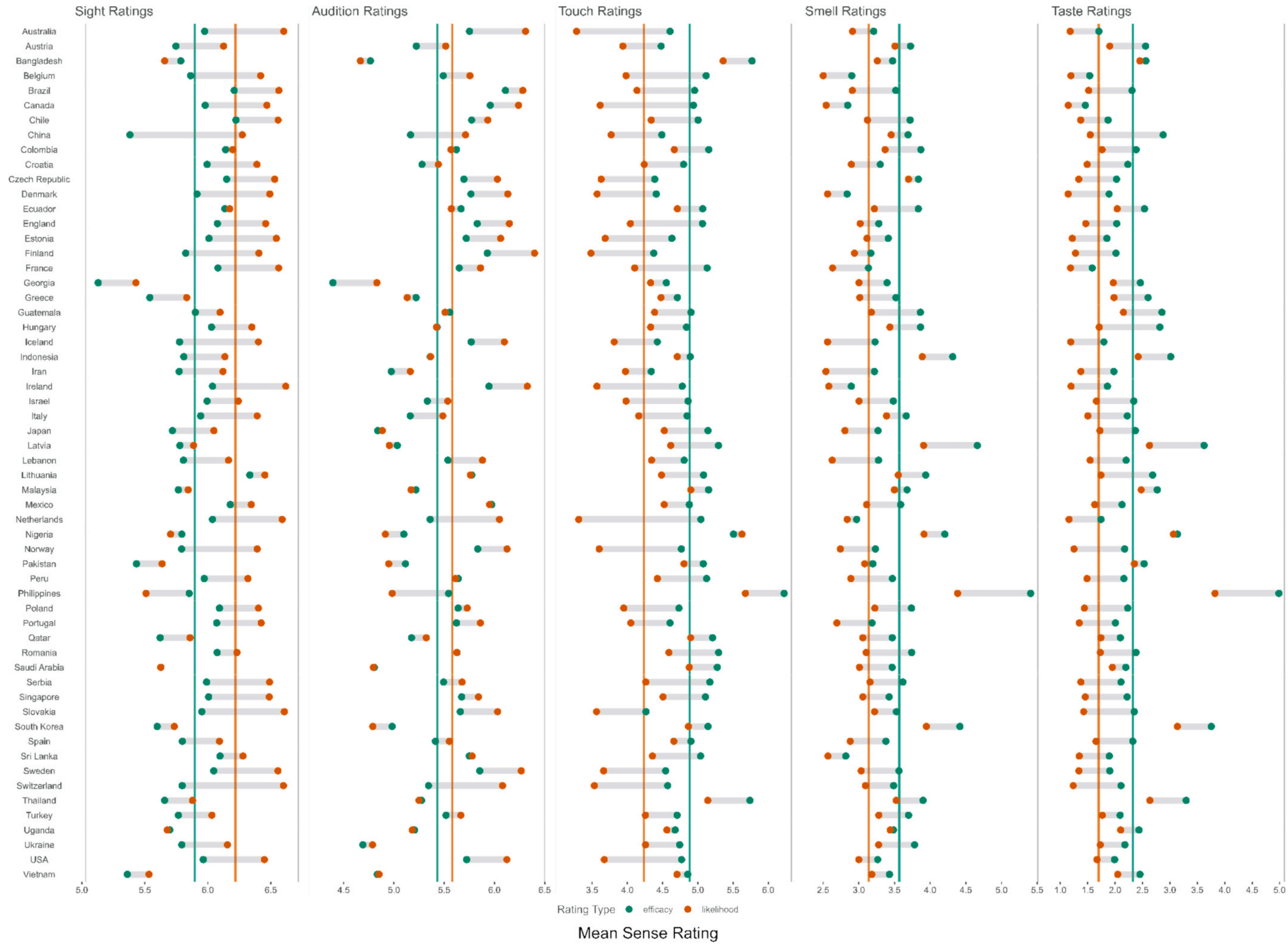

Fig. 5. Mean difference between efficacy and likelihood ratings for all five senses. Green and orange dots correspond to mean efficacy and likelihood of use ratings, respectively, at each study site. Green and orange vertical lines correspond with the global mean across all study sites combined. Efficacy and likelihood of use were both rated on 1–7 scales.

We identified one source of relevant variation—socio-ecological differences across sites. Countries higher in latitude and the human development index but lower in pathogen prevalence and population density showed greater valuation of sight and audition and lower valuation of the other senses as cues to interpersonal infection. Conversely, countries characterized by the opposite pattern on this Geospatial Flourishing Index drew fewer distinctions between audition and touch in particular, making ranking reversals for those modalities more likely. Speculatively, these characteristics may reflect patterns of education about infectious disease (though quantity of formal education was not a meaningful predictor) or cultural traditions about disease and/or context-specific sensory prioritization. Intriguingly, these patterns are the inverse of what would be predicted by accounts explaining cross-cultural differences as outputs of biologically evolved mechanisms that adjust prophylaxis in light of pathogen prevalence (e.g., Thornhill & Fincher, 2014), suggesting other factors are at play. One possibility is that extensive disease avoidance (plausibly manifested as greater disgust sensitivity) is a luxury most readily afforded—and least subject to erosion by habituation—among people in prosperous societies with low disease burdens (cf. Cepon-Robins, 2024); as a result, the senses entailing the lowest risk of pathogen transmission may be more preferred in such countries. While a definitive explanation for this socio-ecological variation remains to be determined, it nonetheless pales in comparison with the extensive cross-cultural uniformity in lay beliefs we observed.

4.1. Theoretical implications

To the extent that lay beliefs influence behavior, and given the impact of disease transmission on both individual and collective welfare, it is plausible that these beliefs are associated with socially and biologically functional outcomes. It is unlikely that a majority of societies simply happened upon a virtually identical ordering of sensory modalities, especially given that sensory beliefs change depending on the inferential characteristic in question (Ackerman et al., 2020). Cultural transmission of disease-relevant information through exposure to common sources of medical knowledge (the internet; formal schooling; etc.) may account for some of the overlap. Alternatively, an evolutionary ecological perspective suggests that specific problems may afford specific solutions (Schaller, 2020).

For multiple reasons, when a hazard manifests similarly across human groups, we can expect that the senses used to identify that hazard will be similar. First, beliefs regarding the disease-detection utility of a given sense could reflect evoked culture (Tooby & Cosmides, 1992)—similarities in ideation and behavior that reflect the outputs of panhuman psychological mechanisms responding to similar inputs (e.g., disgust reactions to signs of illness, etc.). Second, the responses of such mechanisms could constitute cultural attractors in cultural evolutionary processes (Sperber, 1996), making some ideas more intuitively appealing than others, and thus leading to the success of particular beliefs in cultural marketplaces of ideas. Lastly, because disease detection and avoidance can impact group welfare, cultural evolution may result in convergence of efficacious beliefs and biases across cultures, as societies with effective beliefs will grow faster and persist longer (via both reproduction and recruitment) than societies without such beliefs (Fessler et al., 2014; Henrich & Henrich, 2010). As one result, if influenza infection often causes visually detectable physical changes, then, across many societies, people may hold beliefs prioritizing the use of vision.

Save for the cultural group selection account, the previous possibilities do not imply that beliefs necessarily reflect *accurate* identification of hazards. Our participants believed audition to be effective, but independent evidence suggests that (U.S.) perceivers do not accurately discriminate between infectious and noninfectious coughs and sneezes, instead being biased to presume that all disgust-eliciting sounds signal danger (Michalak et al., 2020). Such signal-detection biases have utility and are likely adaptive, as the costs of missing an infection threat are typically higher than the costs of false alarms (Haselton & Nettle, 2006). Here, the prioritization of audition may reflect a bias toward use of "safe senses" which function at greater interpersonal distance than other senses, decreasing infection risk. Consistent with this interpretation, participants reported using distal senses more than would be expected if their use was based solely on perceptions of those senses' efficacy, whereas the opposite was true for more proximal senses. Thus, people may share a type of disease detection bias, suggesting shared inaccuracies in how we connect sensory information to infection manifestation.

These patterns of sensory beliefs may help explain certain stigmas. Stigmas against disfigurement and disability, among others, are tied to pathogen avoidance by motivating interpersonal aversion, thereby decreasing proximity and close contact (Cottrell & Neuberg, 2005; Kurzban & Leary, 2001; Oaten et al., 2011). Lay beliefs about disease detection may feed into psychological mechanisms that calculate and track such responses: stigmas associated with pathogen threat would be more likely to develop toward individuals exhibiting features that approximate true infection cues, are relatively easy to detect, and can be assessed without close contact. Moreover, such stigmas should exhibit biases toward false positive identification errors (Kurzban & Leary, 2001). Correspondingly, the average magnitude of false positive errors in intentional disease detection may be greater for sight and audition compared to smell, touch, and taste.

Given that scientifically derived medical diagnoses are an evolutionarily recent innovation, for most of our species' existence, sensory cues have been the default forms of evidence used to determine whether others pose a risk of disease transmission. Many models of illness (including cultural traditions and practices) have leveraged sensory beliefs, as in the notion of noxious air characterizing miasma theory (Karamanou et al., 2012). Today, medical diagnoses provide more accurate conceptual information, information that is often independent of sensory cues. Presumably, people who have access to conceptual information—through, for example, formal education, or even via others' self-disclosure of their illness status—should prioritize such information over that derived from sensory cues. However, this prioritization requires a superordinate belief, namely that said conceptual information is valid. Therefore, we might expect that people's privileging of conceptual information over sensory cues is greater in societies marked by high trust in others and in social institutions. Importantly, there is considerable variation both between and within countries in the extent and direction of such trust (Ferrin & Gillespie, 2010). Public health authorities' recommendations concerning effective prophylactic behaviors are often disregarded by groups that distrust scientists and/or authorities in general. Tragically, even during the recent devastating pandemic, compliance with such directives was not always high (Ackerman et al., 2023; Haston et al., 2020; Lieberoth et al., 2021), and was actively opposed by some (Choi et al., 2023; Schmelz & Bowles, 2022). Importantly, the impact of trust (or the lack thereof) may be heightened when sensory cues believed by laypeople to be associated with infection are absent or unexpected (e.g., with some strains of COVID-19), as this likely reduces attunement to, and motivation to avoid, pathogen threats (Ackerman et al., 2021).

4.2. Limitations and future directions

Though the present study featured a relatively large number of countries, variations in recruitment and setting (e.g., community members versus students; online versus classrooms) were present across study sites due to the convenience sampling approach used at most locations. Similarly, as noted, our sampling tactics greatly constrained the representativeness of the samples, limiting how broadly the findings should be interpreted. Despite this, the near-universal pattern of results (even when controlling for many demographic features) suggests that our key findings are robust.

An additional limitation concerns the scope of the disease context examined here. This context was described in a vignette, limiting the ecological validity of the stimulus. Further, participants considered a severe flu outbreak, with this likely bringing to mind specific characteristics and symptoms. Lay beliefs about detection of non-respiratory afflictions should reflect prioritization of different sensory modalities depending on whether relevant symptoms are gastrointestinal, neurological, psychiatric, or dermatological in nature (e.g., Kupfer & Fessler, 2018). This may include use of multisensory cues (e.g., Regenbogen et al., 2017; Sarolidou et al., 2020a), a possibility not examined here. Future research could examine detection beliefs in real social interactions, thereby simultaneously presenting cues associated with multiple sensory modalities and eliminating the need to imagine reactions. This approach could also help bridge research within the generally disconnected behavioral immune system and sickness behavior literatures.

We also note that the timing of the study—conducted 18–24 months following the onset of the COVID-19 pandemic—could raise questions regarding the pandemic's influence on lay beliefs. However, two points somewhat mitigate this concern. First, participants were told to disregard COVID-19 when considering the study vignette. Second, the global belief patterns replicate those found with U.S. samples prior to the emergence of COVID-19 (Ackerman et al., 2020). Nevertheless, experiences during the pandemic likely play an important role in other aspects of disease detection, such as trust in others to reveal current illnesses. Finally, the title of the study referenced sight and sound, but not other senses. However, the title was only presented to participants at the time of recruitment and was followed by extensive information before participants responded to the key measures, thus the title wording was unlikely to meaningfully influence responses.

Our findings raise questions about how lay beliefs concerning the use of sensory input might guide disease detection. As mentioned earlier, recent research finds that perceivers can correctly detect sickness above chance levels using certain senses (vision, olfaction), but finds no evidence of accuracy for others (audition). A complete mapping of detection beliefs to detection accuracy would illuminate how lay beliefs about disease predict action, and would identify leverage points for interventions to mitigate disease spread. Relatedly, methodological differences in prior studies highlight the need to better define the concept of detection accuracy. Recent sickness-detection research has perceivers judge sick versus non-sick targets, with the "sick" designation often involving controlled immune stimulation rather than actual infection (e.g., Arshamian et al., 2021; Axelsson et al., 2018; Hansson et al., 2023). Studies examining naturally ill targets have similarly focused on sick versus non-sick comparisons (Leung et al., 2023). Though useful, these approaches suffer limitations. Findings based on endotoxin-triggered immune responses may not fully replicate those based on natural illness (Sarolidou et al., 2020b). Further, sick/non-sick discrimination does not answer the question of infection detection. As discussed earlier, perceivers showed no ability to distinguish contagious versus non-contagious sneezes and coughs (Michalak et al., 2020), and infection detection accuracy may be low for other sensory modalities as well.

Instead, both prior accuracy findings and our results involving lay beliefs about sensory cues may reflect error management biases (where the costs of false alarms are relatively low).

A second promising direction concerns the perceiver-target relationship. The degree to which perceivers value relationships with specific others can modulate willingness to engage in close contact, even when that contact affords potential pathogen transmission (Curtis et al., 2004; Poirotte & Charpentier, 2020; Tybur et al., 2020; but see Bressan, 2021). Although interpersonal closeness should not influence judgments of how effective senses are for disease detection, closeness may affect likelihood of sense use. If so, the safe senses hypothesis supported here may not apply when considering family members, intimate partners, or close friends. For these individuals, care-based motives may be prioritized (Kessler, 2020; Park & Akello, 2017; Pick et al., 2022; Sng et al., 2024), leading to increased willingness to use sensory cues that involve close proximity. Generally high levels of trust with these partners could also facilitate use of conceptual knowledge, including self-disclosed health information. Likewise, familiarity in close relationships could heighten sensitivity to subtle sensory cues, leading to overestimation of disease presence.

Finally, a fruitful avenue for future research would be to examine lay beliefs held by the targets of disease detection—the sick individuals themselves. Because people tend to react negatively toward, and avoid, those exhibiting signs of sickness, many individuals suffering infectious illnesses conceal their condition in order to continue pursuit of social goals (Merrell et al., 2024). If sick people believe that others rely on specific sensory information to detect sickness, they may strategically prioritize masking certain symptoms, e.g., by applying makeup or suppressing coughs (e.g., Ackerman et al, 2018; Tan et al., 2023). Future research could explore how individuals' beliefs about sensory detection influence their methods of concealing illness.

4.3. Conclusion

The psychology of pathogen threat management has received substantial attention in recent years. To fully illuminate how people manage these threats, we must first understand how such threats are detected. The present study demonstrates that folk beliefs about the use of sensory information to detect flu-like pathogen hazards display strong cross-cultural consistency, setting the stage for future conceptual and translational research, and entailing broad public health implications.

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CRediT authorship contribution statement

Joshua M. Ackerman: Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Theodore Samore:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Conceptualization. **Daniel M.T. Fessler:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Tom R. Kupfer:** Writing – review & editing, Writing – original draft, Conceptualization. **Soyeon Choi:** Conceptualization, Writing – review & editing. **Wilson N. Merrell:** Writing – review & editing, Conceptualization. **Lene Aarøe:** Resources, Investigation. **Toivo Aavik:** Resources, Investigation. **Stephen Acabado:** Resources, Investigation. **Grace Akello:** Resources, Investigation. **Ilham N. Alfian:** Resources, Investigation. **Laith Al-Shawaf:** Resources, Investigation. **Marinés M. Alvarez:** Resources, Investigation. **Jeanine Ammann:** Resources, Investigation. **Gizem Arikan:** Resources, Investigation. **Saiyeda A. Asha:** Resources, Investigation. **Anibal M. Astobiza:** Resources, Investigation. **Carmen G. Baeza-Ugarte:** Resources, Investigation. **Pat Barclay:** Resources, Investigation. **Fiona Kate Barlow:** Investigation, Resources. **Lisiane Bizarro:** Resources, Investigation. **Paola Bressan:** Resources, Investigation. **Andres Castellanos-Chacón:** Resources, Investigation. **Bryan K.C. Choy:** Resources, Investigation. **Achmad Chusairi:** Resources, Investigation. **Jorge Contreras-Garduño:** Resources, Investigation. **Brenda L. Chávez Cosamalón:** Resources, Investigation. **Bernardo Costa-Neves:** Resources, Investigation. **Mallika De:** Resources, Investigation. **Tiago J.S. de Lima:** Resources, Investigation. **Piyanjali de Zoysa:** Resources. **Ieva Dryžaitė:** Resources, Investigation. **Christian T. Elbæk:** Resources, Investigation. **Peter Fedor:** Resources, Investigation. **Ana M. Fernández:** Resources, Investigation. **Regina Fernandez-Morales:** Resources, Investigation. **Márta Fülöp:** Resources, Investigation. **Vladimer Lado Gamsakhurdia:** Resources, Investigation. **Leonor Garcia-Gómez:** Resources, Investigation. **Leonel Garcia-Marques:** Resources, Investigation. **Jimena Garduño-Franco:** Resources, Investigation. **María del Pilar Grazioso:** Resources, Investigation. **Fanny Habacht:** Resources, Investigation. **Youssef Hasan:** Resources, Investigation. **Camila P. Haugestad:** Resources, Investigation. **Christian A.P. Haugestad:** Resources, Investigation. **Jan Havlíček:** Resources, Investigation. **Earl J. Hernandez:** Resources, Investigation. **Vu M. Hoang:** Resources, Investigation. **Minsung Hong:** Resources, Investigation. **Ivana Hromatko:** Resources, Investigation. **Dzintra Iliško:** Resources, Investigation. **Hirotaka Imada:** Resources, Investigation. **Ivana Jakšić:** Resources, Investigation. **Tomasz Jarmakowski:** Resources, Investigation. **Harpa L. Hjördísar Jónsdóttir:** Resources, Investigation. **Kotrina Kajokaite:** Resources, Investigation. **Šárka Kaňková:** Resources, Investigation. **Nicolas Kervyn:** Resources, Investigation. **Jinseok P. Kim:** Resources, Investigation. **Jonas R. Kunst:** Resources, Investigation. **Michael Laakasuo:** Resources, Investigation. **Juan David Leongómez:** Resources, Investigation. **Norman P. Li:** Resources, Investigation. **Junsong Lu:** Resources, Investigation. **Nathan Lynch:** Resources, Investigation. **María A. Maegli:** Resources, Investigation. **Harry Manley:** Resources, Investigation. **Gabriela Marcu:** Resources, Investigation. **Thea McAfee:** Software, Project administration, Data curation. **Panagiotis Mitkidis:** Resources, Investigation. **Nándor B. Molnár:** Resources, Investigation. **Coby Morvinski:** Resources, Investigation. **Haslina Muhamad:** Resources, Investigation. **Pegah Nejat:** Resources, Investigation. **Hoang Nguyen Huy:** Resources, Investigation. **Angelica N. Oliveira:** Resources, Investigation. **Mats J. Olsson:** Resources, Investigation. **Charity N. Onyishi:** Resources, Investigation. **Ike E. Onyishi:** Resources, Investigation. **Reegan Orozco:** Resources, Investigation. **Tobias Otterbring:** Resources, Investigation. **Ida S. Ottersen:** Resources, Investigation. **Gustavo Pacheco-López:** Resources, Investigation. **Penny Panagiotopoulou:** Resources, Investigation. **Walter Paniagua:** Resources, Investigation. **Roksana Parvin:** Resources, Investigation. **Zoran Pavlović:** Resources, Investigation. **Pavol Prokop:** Resources, Investigation. **Emma Raffman:** Software, Project administration, Data curation. **Muhammad Rizwan:** Resources, Investigation. **Sheila Rojas:** Resources, Investigation. **Joanna Różycka-Tran:** Resources, Investigation. **Oscar R. Sánchez:** Resources, Investigation. **Heyla Selim:** Resources, Investigation. **Barış Sevi:** Resources, Investigation. **Yaniv Shani:** Resources, Investigation. **Madhulika S. Shastry:** Writing – review & editing, Software, Project administration, Data curation. **Stefan Stieger:** Resources, Investigation. **Eunkook M. Suh:** Resources, Investigation. **Melati Sumari:** Resources, Investigation. **Kosuke Takemura:** Resources, Investigation. **Arnaud Tognetti:**

Resources, Investigation. **Roberta Z.R. Trombetta:** Resources, Investigation. **Joshua M. Tybur:** Resources, Investigation. **Eylul B. Ucak:** Resources, Investigation. **Yukiko Uchida:** Resources, Investigation. **Jaroslava V. Valentova:** Resources, Investigation. **Hugo Viciana:** Resources, Investigation. **Amandine Visine:** Resources, Investigation. **Jin Wang:** Resources, Investigation. **XT (XiaoTian) Wang:** Resources. **Illia I. Yahiiaiev:** Resources, Investigation. **Rizqy A. Zein:** Resources, Investigation. **Iris Žeželj:** Resources, Investigation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bbi.2025.04.020.

Data availability

Data, code, and materials are provided in a repository through a link in the manuscript

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Supplementary Materials

for

I see sick people:
Beliefs about sensory detection of infectious disease
are largely cross-culturally consistent

Table S1. Preregistration updates

Category	Change
Data collection stopping rule	Timeline extended due to site-specific recruitment difficulties.
Exclusions: General	Identical responses to all sound clip ratings, traditionalism measure, and/or sensations scales.
Exclusions: General	Due to wide variation in study completion time across countries, new timing exclusions = completing in < 120 seconds or > 5000 seconds.
Exclusions: Missing data	Below thresholds for component-specific completion rate (80% for auditory disgust, otherwise 100% for other components).

Note. The preregistration update was filed on OSF on September 26, 2022. Both the original and updated version are found on the OSF repository. The updates here include ones relevant to the lay beliefs component of the project only.

Table S2. Study sites, recruitment procedures, and sample demographics

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
Australia	12/08/2021-12/09/2021	English	General population	Online workers (Prolific)	2 Pounds	355	32.94 (11.88)	56/40/4	5.32 (1.73)	9.2
Austria	10/15/2021-10/20/2021	German	General population	Online workers (Respondi)	2-3 Euros	359	38.96 (13.79)	33/66/1	5.36 (1.66)	22.4
Bangladesh	12/11/2021-12/27/2021	Bangla	General population; students	Online workers; university subject pools	Volunteer	312	21.11 (1.43)	35/64/1	6.55 (2.08)	54.6
Belgium	10/12/2021-12/02/2021	French	Students	University subject pools; direct recruitment	Volunteer	365	23.26 (7.3)	53/47/0	6.45 (1.3)	30.9
Brazil	01/05/2022-03/16/2022	Portuguese	General population; students	Social media; snowball sampling; direct recruitment; university subject pools	Volunteer	110	28.85 (11.3)	72/25/3	5.42 (1.74)	34.5
Canada	10/25/2021-03/14/2022	English	Students	University subject pools	Course credit	96	19.42 (4.01)	88/9/2	5.52 (1.6)	13.5
Chile	10/18/2021-03/20/2022	Spanish	Students	Social media; snowball sampling; university subject pools	Volunteer	242	31.19 (11.31)	69/29/2	5.37 (1.72)	34.1
China	09/22/2021-02/22/2022	English	Students	Social media; university subject pools; direct recruitment	Volunteer	139	20.73 (2.5)	84/16/0	5.95 (1.23)	56.4
Colombia	10/16/2021-03/02/2022	Spanish	General population; students	Social media; snowball sampling; university subject pools	Course credit	497	31.01 (11.95)	66/34/1	5.71 (1.65)	47.2

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
Croatia	03/07/2022-03/11/2022	Croatian	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Course credit	326	23.6 (9.66)	52/48/0	5.65 (1.46)	25.1
Czech Republic	02/01/2022-03/19/2022	Czech	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer	309	34.92 (12.72)	61/37/2	5.7 (1.45)	36.6
Denmark	11/04/2021-11/30/2021	English	Students	University subject pools	20 DKR	256	25.13 (5.46)	56/42/2	5.38 (1.68)	7.2
Ecuador	10/11/2021-01/16/2022	Ecuadorian Spanish	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer	289	27.16 (8.45)	47/52/1	5.76 (1.41)	44.7
England	10/05/2021-10/31/2021	English	Students	University subject pools	Course credit	303	19.67 (4.17)	84/15/1	5.09 (1.56)	5.9
Estonia	02/14/2022-03/17/2022	Estonian	General population; students	Social media; snowball sampling; university subject pools	Volunteer	114	32.38 (11.62)	88/12/1	6.09 (1.49)	20.3
Finland	10/19/2021-12/06/2021	Finnish	General population; students	Social media; snowball sampling; university subject pools	Volunteer	296	35.85 (12.71)	62/34/3	5.46 (2.02)	39.9

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
France	10/31/2021-03/21/2022	French	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer	288	28.6 (11.93)	71/29/1	5.95 (1.53)	36.2
Georgia	10/01/2021-10/07/2021	Georgian	General population; students	Social media; snowball sampling; university subject pools	Volunteer	394	22.82 (7.21)	77/21/2	5.2 (1.83)	36.8
Greece	10/16/2021-11/30/2021	Greek	General population	Social media; snowball sampling	Volunteer	304	29.8 (10.59)	67/33/0	5.76 (1.6)	32.2
Guatemala	10/09/2021-02/28/2022	Spanish	General population; students	Social media; snowball sampling; university subject pools;	Volunteer	393	26.49 (11.19)	66/34/1	6.5 (1.78)	50.9
Hungary	12/01/2021-01/15/2022	Hungarian	Students	University subject pools	Course credit	312	25.22 (7.99)	75/25/0	5.92 (1.4)	11.4
Iceland	10/25/2021-02/01/2022	Icelandic	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer	294	27.2 (9.16)	71/27/2	5.46 (1.74)	29.5
Indonesia	11/19/2021-12/31/2021	Bahasa Indonesia	General population; students	Social media; university subject pools; direct recruitment	Participants entered in a raffle for e-wallet credit	288	21.52 (3.57)	84/16/0	5.23 (1.47)	53.6

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
Iran	10/21/2021-11/05/2021	Farsi	General population; students	Social media; snowball sampling; university subject pools	Volunteer	448	23.03 (5.82)	75/23/1	5.66 (1.7)	44.7
Ireland	09/29/2021-12/08/2021	English	Students	University subject pools	Participants entered in raffle for 50 Euro gift cards	294	19.86 (3.5)	53/45/2	6.07 (1.67)	19.5
Israel	10/31/2021-12/02/2021	Hebrew	Students	University subject pools	Course credit	310	22.45 (2.05)	49/51/0	6.01 (1.59)	11.7
Italy	10/20/2021-02/24/2022	Italian	General population	Social media; direct recruitment	Volunteer	296	32.11 (13.83)	78/22/0	5.67 (1.49)	38.7
Japan	12/11/2021-12/11/2021	Japanese	General population	Online workers	150 Japanese Yen	416	42.33 (10.21)	36/64/0	4.2 (1.7)	7.4
Latvia	11/01/2021-03/03/2022	Latvian	General population; students	Social media; university subject pool; snowball sampling; direct recruitment	Volunteer	239	37.17 (12.1)	83/15/2	5.68 (1.57)	46.4
Lebanon	10/22/2021-02/20/2022	English	General population	Social media; direct recruitment	Volunteer	134	26.34 (5.65)	86/14/0	5.67 (1.64)	61.2
Lithuania	10/29/2021-03/09/2021	Lithuanian	General population; students	Social media; university subject pool; snowball sampling; direct recruitment	Volunteer	159	36.67 (12.58)	76/24/0	6.36 (1.49)	41.5
Malaysia	11/17/2021-11/30/2021	Malay, English	General population; students	Social media; snowball sampling; university subject	Volunteer	269	25.08 (8.07)	83/17/0	5.25 (1.62)	48.3

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
				pools; direct recruitment						
Mexico	01/28/2022-03/19/2022	Spanish	General population	Social media; snowball sampling; direct recruitment	Volunteer	331	39.76 (15.21)	73/24/2	5.88 (1.75)	44.4
Netherlands	12/08/2021-12/11/2021	Dutch	General population	Online workers (Prolific)	1.5 British Pounds	300	28 (9.8)	54/43/3	5.73 (1.72)	3.5
Nigeria	10/23/2021-03/20/2022	English	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer; Data provided for Internet access	233	22.87 (6.19)	60/39/2	5.62 (1.92)	44.4
Norway	10/17/2021-03/14/2022	Norwegian	General population; students	Social media; snowball sampling; university subject pools	Volunteer	120	29.63 (11.32)	75/23/2	5.37 (1.72)	37.8
Pakistan	09/24/2021-03/20/2022	English	General population; students	Social media; snowball sampling; university subject pools	Volunteer	270	26.67 (11.4)	50/48/2	6.01 (1.88)	63.0
Peru	10/07/2021-03/07/2022	Spanish	General population	Social media; snowball sampling; direct recruitment	Volunteer	242	33.46 (9.89)	58/42/0	6.12 (1.57)	46.8
Philippines	12/27/2021-03/14/2022	Filipino	General population; students	Social media; direct recruitment; university subject pools	Volunteer	169	22.02 (4.74)	73/23/3	5.02 (1.52)	46.5

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
Poland	10/12/2021-10/22/2022	Polish	General population	Social media; snowball sampling	Volunteer	2807	22.56 (5.38)	83/14/3	4.95 (1.62)	42.6
Portugal	10/27/2021-03/15/2022	European Portuguese	General Population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer or entered raffle for 20 Euro voucher	286	24.31 (10.43)	80/18/2	5.67 (1.45)	18.2
Qatar	02/23/2022-03/19/2022	Arabic	General population; students	Snowball sampling; university subject pools	Volunteer	177	26.14 (8.17)	91/9/0	5.84 (1.67)	57.5
Romania	11/15/2021-01/26/2022	Romanian	Students	Social media; university subject pools	Volunteer	312	26.92 (10.27)	80/19/1	5.75 (1.55)	41.8
Saudi Arabia	10/29/2021-12/03/2022	Arabic	Students	Social media; university subject pools; snowball sampling	Volunteer or course credit	486	25.14 (8.43)	62/38/0	5.79 (1.89)	49.1
Serbia	10/10/2021-10/31/2021	Serbian	Students	Snowball sampling; university subject pools	Course credit	298	21.75 (4.22)	81/19/1	5.71 (1.4)	17.5
Singapore	10/24/2021-12/17/2021	English	Students	University subject pools	2-3 SGD	322	22.1 (1.74)	69/31/0	5.63 (1.52)	8.0
Slovakia	10/06/2021-12/31/2021	Slovak	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer	377	25.86 (8.57)	74/25/1	6.01 (1.4)	40.1

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
South Korea	03/07/2022-03/08/2022	Korean	General population	Online workers	50 Cents	338	40.01 (11.21)	47/53/0	5.12 (1.73)	19.0
Spain	10/15/2021-02/07/2022	Spanish	General population; students	Social media; snowball sampling; university subject pools; direct recruitment	Volunteer	390	29.36 (12.75)	63/36/1	5.58 (1.52)	29.3
Sri Lanka	10/16/2021-12/22/2022	English	Students	University subject pools	Volunteer	104	22.45 (1.78)	59/41/0	5.85 (1.55)	49.5
Sweden	10/15/2021-12/26/2021	Swedish	General population; students	Social media; university subject pools; direct recruitment	Volunteer	300	38.14 (12.58)	66/33/1	5.62 (1.75)	24.3
Switzerland	10/14/2021-03/16/2022	German	General population; students	Social media; snowball sampling; university subject pools;	Volunteer	250	37.1 (13)	63/35/1	6.4 (1.35)	30.2
Thailand	12/08/2021-01/26/2022	Thai	General population; students	Social media; university subject pool; snowball sampling; direct recruitment	Volunteer	361	20.59 (4.21)	44/55/1	5.6 (1.63)	30.4
Turkey	11/30/2021-03/21/2022	Turkish	General population; students	Social media; university subject pool; snowball sampling; direct recruitment	Volunteer	218	34.87 (14.74)	67/32/0	6.14 (1.54)	45.1
Uganda	10/07/2021-11/09/2021	English	General population; students	Snowball sampling; university subject	Volunteer; Compensation for	264	25.44 (7.28)	32/68/0	4.81 (1.77)	72.5

Study Site	Survey Dates	Survey Language	Sample type	Recruitment Method	Compensation	N	Mean (SD) Age	Women/ men/other %	Mean (SD) SES	Exclusion %
				pools; direct recruitment	Internet access					
Ukraine	11/22/2021-12/01/2021	Ukrainian	Students	Snowball sampling; university subject pools	Course credit	353	25.01 (10.19)	75/25/0	5.55 (1.69)	48.8
United States	09/03/2021-12/20/2021	English	General population	Social media; snowball sampling; online workers (CloudResearch and MTurk)	Volunteer or 80 Cents	412	42.56 (13.51)	54/45/1	4.92 (1.81)	14.4
Vietnam	10/20/2021-12/18/2021	Vietnamese	General population; students	Social media; snowball sampling; university subject pools	Volunteer	291	23.05 (8.75)	71/27/3	5.46 (1.58)	49.3
Total Sample	NA	NA	NA	NA	NA	19217	27.59 (11.20)	65/31/4	5.54 (1.70)	39.3

Note. Brazil and Mexico sites each included two teams of researchers. Data were combined within sites for analyses. SES = socioeconomic status. Total sample details are post-participant exclusions.

Table S3. Translation Deviations from the Original Survey

Study Site	Original English Phrase	Back-Translated Phrase	Survey Component
Bangladesh	Sound (examples - hearing any noises they make)	Sound (example - hearing their words)	Sense Ratings
Belgium/France	Now rate the same senses according to how likely you are to use them	Now, assess these same senses based on the probability that you will use them	Sense Ratings
China	This sensory information is sometimes useful and accurate, and sometimes it is not.	The data collected can be sometimes useful and accurate, but sometimes not.	Sense Ratings
China	Not at all useful 1 Extremely useful 7	Useless 1 Extremely useful 7	Sense Ratings
China	Now rate the same senses according to how likely you are to use them (not just how effective you think they are). That is, how much do you think you would actually use each sense when determining whether someone else is sick?	Now please rate the possibility of you using these senses (not only the effectiveness/usefulness you think these senses are); i.e. before being certain of whether one is ill, how possible will you actually use these senses? As compared to the previous rating, this rating may or may not be the same.	Sense Ratings
China	When rating these,	Again, when rating each organ,	Sense Ratings
Georgia	Now imagine you will be speaking with another person. You will be in a closed room (or other close interaction) with this person for at least an hour.	Now imagine talking to another person and being indoors with that person for at least an hour.	Sense Ratings
Georgia	How effective/useful is each sense when deciding whether the person you are interacting with is sick?	How effective/beneficial is each feeling when you decide whether the person interacting with you is ill?	Sense Ratings
Georgia	How likely are you to use each sense when deciding whether the person you are interacting with is sick?	What is the probability that you will use each of these sensations to find out if this person is sick?	Sense Ratings

Study Site	Original English Phrase	Back-Translated Phrase	Survey Component
Georgia	Not at all likely to use 1 Extremely likely to use 7	Completely excluded 1 Probability is extremely high 7	Sense Ratings
Guatemala	Imagine that over the last couple of weeks, a very bad flu outbreak has occurred (not COVID-19)	Imagine that, in the last couple of weeks, a strong outbreak of a cold (not COVID-19) has occurred.	Sense Ratings
Iceland	Touch (examples - feeling their skin, temperature, and other qualities)	Touch (e.g. touch their skin, feel their body heat, etc.)	Sense Ratings
Indonesia	Taste (examples - tasting utensils they had in their mouth, licking their skin, kissing them)	Taste (examples – tasting their used cutlery, licking skin, kissing)	Sense Ratings
Indonesia	When rating these, again try to imagine that you can use only one sense at a time.	When judging, again, please try to imagine that you can only use one sense at a time.	Sense Ratings
Indonesia	Sweeping with a broom	Sweeping with a floor broom	Sense Ratings
Iran	Not at all likely to use 1 Extremely likely to use 7	1: Not at all likely that I use them. 7: Extremely likely that I use them.	Sense Ratings
Italy	a very bad flu outbreak	very ugly flu epidemic	Sense Ratings
Japan	You will be in a closed room (or other close interaction)	You are with this person for at least one hour in an enclosed space (or alternatively a densely packed gathering place).	Sense Ratings
Japan	how likely you are to use them (not just how effective you think they are)	likely you would be to use the above senses (not how effective you think using them would be)	Sense Ratings
Latvia	When rating these, try to imagine that you can use only one sense at a time.	When evaluating them, try to imagine that you can only use one feeling at a time.	Sense Ratings
Malaysia	Not at all useful 1 Extremely useful 7	Absolutely useless 1 Very Useful 7	Sense Ratings

Study Site	Original English Phrase	Back-Translated Phrase	Survey Component
Malaysia	Taste (examples - tasting utensils they had in their mouth,	Taste (example - feeling the utensils in their mouths,	Sense Ratings
Malaysia	Sounds	Voice	Sense Ratings
Poland	Public health officials have urged people to be cautious about their behavior and take appropriate steps to prevent infection.	Medical services appeal for extreme care to try and prevent infections.	Sense Ratings
Poland	You will be in a closed room (or other close interaction)	(or you are going to be in a close interaction, e.g. staying with somebody in a car)	Sense Ratings
Poland	Now rate the same senses according to how likely you are to use them (not just how effective you think they are).	Now please evaluate how likely are you to use a given sense while evaluating if a person is sick.	Sense Ratings
Saudi Arabia	interacting with	dealing with	Sense Ratings
Saudi Arabia	Taste (examples - tasting utensils they had in their mouth, licking their skin, kissing them)	Taste (examples – use their toothbrush)	Sense Ratings
Saudi Arabia	Not at all useful 1 Extremely useful 7	1 Extremely likely to be used 7 Cannot be used at all	Sense Ratings
Slovakia	Public health officials have urged people to be cautious about their behavior and take appropriate steps to prevent infection.	People responsible for public health asked people to be very cautious regarding their behaviour and for them to take appropriate steps to prevent contamination.	Sense Ratings
Slovakia	One of the main ways we detect whether someone is infected with a disease is by using our senses.	One of the main ways we detect whether someone is contaminated by disease is by using our senses.	Sense Ratings
Sweden	Taste (examples - tasting utensils they had in their mouth, licking their skin, kissing them)	Taste (e.g. -share a spoon, lick the skin, kiss them)	Sense Ratings
Ukraine	You will be in a closed room	You will be in a locked room	Sense Ratings

Study Site	Original English Phrase	Back-Translated Phrase	Survey Component
Ukraine	Not at all likely to use 1 Extremely likely to use 7	Definitely won't use it 1 It's extremely likely that I will use it 7	Sense Ratings

Note. The first line for a given study site is bolded for clarity. The survey component column specifies the location of the translation deviation within the survey.

Supplementary Methods

Participants read the following scenario:

> Imagine that over the last couple of weeks, a very bad flu outbreak has occurred (not COVID-19). People infected with this illness have gotten extremely sick, and vaccinations have been useless against this particular disease. Public health officials have urged people to be cautious about their behavior and take appropriate steps to prevent infection.
>
> Now imagine you will be speaking with another person. You will be in a closed room (or other close interaction) with this person for at least an hour. However, you are unsure if this person has the flu or not. They may not even know themselves.

They then rated sensory information for the purpose of identifying whether the person from the scenario is sick. The instructions provided to participants were:

> One of the main ways we detect whether someone is infected with a disease is by using our senses. This sensory information is sometimes useful and accurate, and sometimes it is not. Thinking about the situation you just read about, rate the senses on the next page according to how effective or useful you think the senses are when determining whether the person you are interacting with is sick.
>
> When rating these, try to imagine that you can use only one sense at a time. For example, when thinking about "sound," ignore anything else about this person such as what they look like, smell like, and so on.

Additional measures:

The four socio-ecological variables tested in the paper were identified from different sources. The Human Development Index was downloaded from the United Nations Development Programme, 2023-2024 Human Development Report (https://hdr.undp.org/data-center/human-development-index#/indicies/HDI). Population density was calculated following the process used in Rotella and colleagues (2021; midyear population divided by land area in square kilometers). Latitude was taken from Supplemental Material, Table S1 in Van de Vliert and Van Lange (2019). Pathogen prevalence scores were drawn from the Appendix in Murray and Schaller (2010).

We also attempted to analyze other measures of pathogen prevalence (Bromham et al., 2018) and cultural distance (Muthukrishna et al., 2020), but too few country-specific scores were included in these indices.

Accounting for high exclusion rates:

As explained in the paper, participants were excluded from the focal analyses for 5 reasons.

1. Not meeting the age requirements
2. Evidence of straightlined responses
3. Failing an attention check
4. Completing the entire survey in less than 120 seconds (2 minutes) or in more than 5000 seconds (~83 minutes).
5. Not answering all ten lay belief items (likelihood and efficacy ratings for each of the five senses)

Applying these criteria resulted in a large number of exclusions – 12,427. Most of these filtered participants (9,173) were excluded because they did not complete all ten sense ratings. We speculate that exclusions were high because participants were volunteering their time and may have abandoned the survey in high numbers given the lack of compensation. This is bolstered by the fact that 7,292 of these excluded participants did not provide a single rating.

Although we preregistered the above stringent exclusion criteria in order to improve data quality in a primarily volunteer sample, we wanted to address whether the large number of exclusions may have conceptually affected the results. Therefore, we re-ran the main analyses using a sample without any exclusions. As a result, any participant who answered at least one rating was included in the analysis. We acknowledge that unmeasured differences between participants who completed no items (that is, the abandoned the survey before reaching the items assessed in this study) and participants who answered at least one item may nevertheless still bias the results.

Including the excluded participants did not conceptually affect the results. First, the estimated mean ratings in the pooled sample were conceptually unaffected, see Figure S5. Second, the relative rankings of the senses across study sites were identical in both samples, see Figure S6. Third, the relationship between the GFI and sense ratings was conceptually unaffected by use of the full sample, see Figure S7. Fourth, the relative relationships between efficacy and likelihood ratings across different study sites were also conceptually unaffected by use of the full sample, see Figure S8.

Supplementary Results

1. Effects of Demographic Variables on Sense Type X Rating Type Interactions

In the main text (3.1), we claimed that demographic variables did not meaningfully moderate or impact the effects of sense type and rating type on sense ratings. Here, we show those results. First, controlling for gender, age, education, and SES did not affect the pattern of results shown in Figure 2 in the main text, compare to Figure S1.

Second, to test moderation, we regressed sense ratings on the three-way interactions between sense type, rating type, and each demographic variable independently. We then assessed whether sense ratings covaried with the demographic variable for each combination of sense type and rating type. For education, most of the simple slopes had confidence intervals that overlapped with zero, with the exceptions of taste and smell likelihood ratings, and sound and smell efficacy ratings. Specifically, as education increased, participants were more likely to rate these senses as more likely to use, or as more efficacious, respectively. However, these effects were very small (Bs = .03 - .07). For example, the strongest effect was for taste likelihood ratings; for every one unit increase in education (along a 1-5 scale), there was a .07 point increase in the likelihood rating along its original 1-7 scale. For SES, likelihood and efficacy ratings tended to increase with SES for all senses, however again, the effects were negligible (Bs = .02 - .03, where SES is measured on a 1-10 scale). The effects of age were generally negligible, with the exception of smell ratings. Each 10-year increase in age was associated with a .12 and .9 unit increase in smell ratings for likelihood and efficacy ratings respectively. Finally, the pattern of results for sense type and rating type were consistent across gender, with only small differences in estimated ratings (see Figure S2).

The lack of gender effects on sense ratings may seem surprising, as one could imagine that cultural norms might bias the type of sensory modalities more commonly used by one gender over another. For instance, in the U.S., female-female touch may be viewed as more socially acceptable than male-male touch (Derlega et al, 2001). However, in the domain of touch, actual behaviors vary widely across gender and settings (LaFrance Vial; 2016), and cross-culturally, norms vary in how contact-oriented societies and individuals are (e.g., Remland et al., 1995). Similar variation is likely present for other sensory modalities as well. Critically, research on sensory use in domains such as touch have largely focused on situations other than disease detection. As a result, though specific gender differences may be present within a given society, across societies, gender does not appear to play a substantial role in the use of different senses in identifying sickness in others."

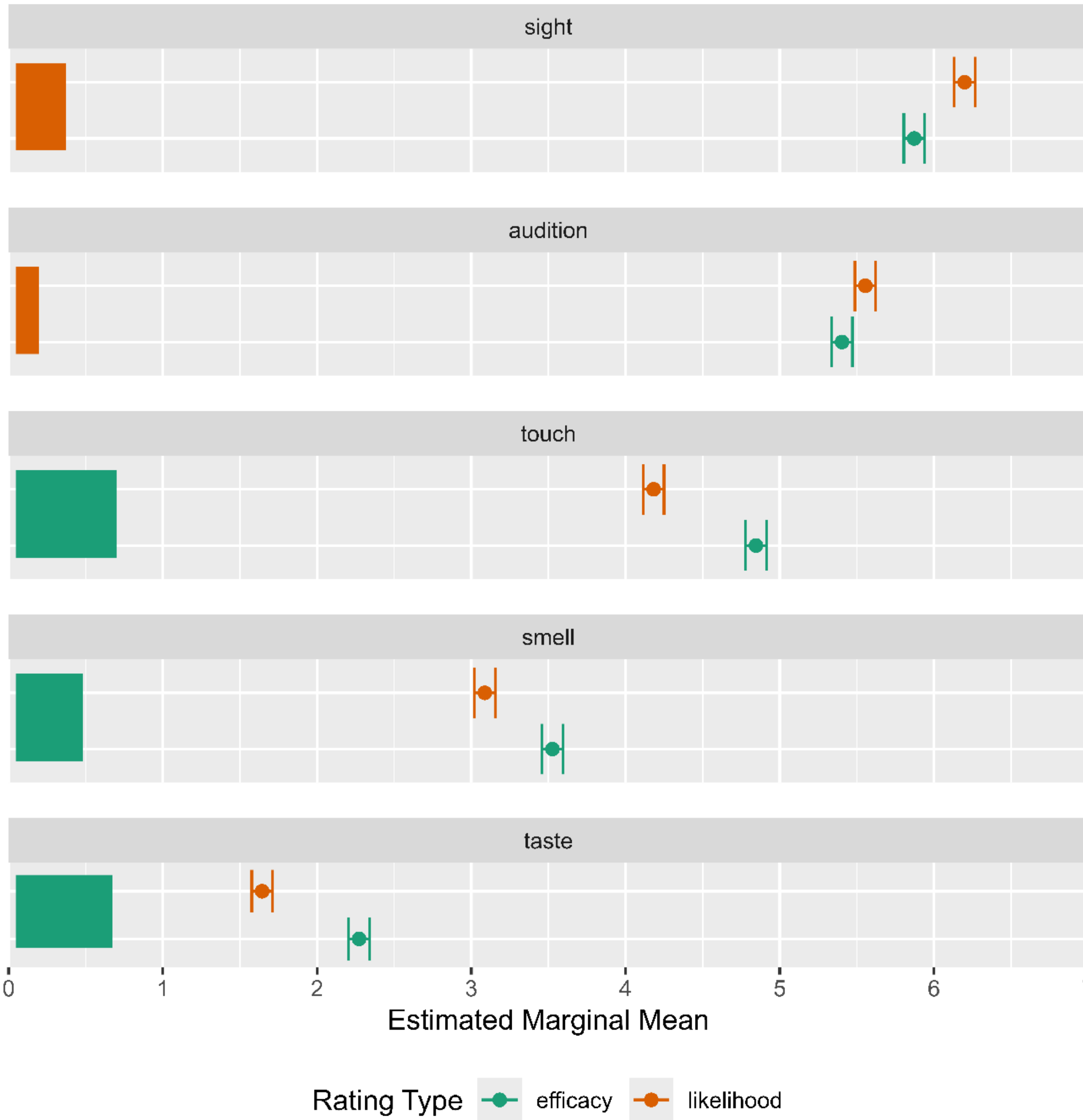

Figure S1. Effects of sense type and rating type on sense ratings, controlling for gender, age, education, and SES. Compare to Figure 2 in the main text.

Figure S2. Effects of sense type and rating type on sense ratings across gender. Compare to Figure 2 in the main text.

2. Site-Specific Estimated Marginal Means for Sense Ratings

In the main text (3.2), we described a model (see Figure 2 and Table 2) that regressed sense ratings on the interaction between sense type and rating type in a sample pooling across all countries in the study. We claimed that the same model was run in each study site separately. Here, we show the estimated marginal means for each unique combination of sense type and rating type in each study site separately (based on the results of study-site specific regressions, using the same model described in the main text), see Table S4.

Table S4. Estimated marginal means of sense ratings for each unique combination of rating type and sense type, estimated in each study site individually.

Country	Sight Efficacy	Audition Efficacy	Touch Efficacy	Smell Efficacy	Taste Efficacy	Sight Likelihood	Audition Likelihood	Touch Likelihood	Smell Likelihood	Taste Likelihood
australia	5.97 [5.83, 6.12]	5.75 [5.61, 5.90]	4.61 [4.46, 4.75]	3.21 [3.06, 3.35]	1.70 [1.56, 1.85]	6.60 [6.46, 6.75]	6.31 [6.16, 6.46]	3.28 [3.13, 3.43]	2.91 [2.77, 3.06]	1.18 [1.03, 1.33]
austria	5.75 [5.57, 5.93]	5.22 [5.04, 5.40]	4.48 [4.30, 4.66]	3.72 [3.55, 3.90]	2.56 [2.38, 2.74]	6.13 [5.95, 6.30]	5.52 [5.34, 5.69]	3.94 [3.76, 4.11]	3.51 [3.33, 3.69]	1.90 [1.72, 2.08]
bangladesh	5.79 [5.56, 6.01]	4.77 [4.54, 4.99]	5.77 [5.54, 5.99]	3.47 [3.25, 3.70]	2.56 [2.34, 2.79]	5.66 [5.43, 5.88]	4.67 [4.44, 4.89]	5.36 [5.13, 5.58]	3.26 [3.03, 3.49]	2.45 [2.23, 2.68]
belgium	5.86 [5.71, 6.01]	5.49 [5.34, 5.64]	5.12 [4.97, 5.27]	2.90 [2.75, 3.05]	1.54 [1.39, 1.69]	6.42 [6.27, 6.57]	5.76 [5.61, 5.90]	3.98 [3.83, 4.13]	2.50 [2.35, 2.65]	1.19 [1.05, 1.34]
brazil	6.21 [5.90, 6.52]	6.11 [5.80, 6.42]	4.95 [4.65, 5.26]	3.52 [3.21, 3.82]	2.31 [2.00, 2.62]	6.56 [6.26, 6.87]	6.28 [5.98, 6.59]	4.14 [3.83, 4.44]	2.91 [2.60, 3.22]	1.52 [1.21, 1.82]
canada	5.98 [5.70, 6.26]	5.96 [5.68, 6.24]	4.94 [4.66, 5.22]	2.84 [2.56, 3.13]	1.46 [1.18, 1.74]	6.47 [6.19, 6.75]	6.24 [5.96, 6.52]	3.61 [3.33, 3.90]	2.54 [2.26, 2.82]	1.15 [0.86, 1.43]
chile	6.22 [6.03, 6.42]	5.77 [5.58, 5.97]	5.00 [4.81, 5.20]	3.72 [3.52, 3.92]	1.87 [1.68, 2.07]	6.56 [6.36, 6.75]	5.93 [5.74, 6.13]	4.34 [4.14, 4.54]	3.12 [2.92, 3.32]	1.37 [1.18, 1.57]
china	5.38 [5.13, 5.64]	5.17 [4.91, 5.42]	4.49 [4.23, 4.74]	3.69 [3.44, 3.95]	2.88 [2.62, 3.13]	6.27 [6.02, 6.53]	5.71 [5.46, 5.97]	3.77 [3.51, 4.02]	3.45 [3.20, 3.71]	1.55 [1.29, 1.80]
colombia	6.14 [5.99, 6.29]	5.62 [5.47, 5.77]	5.15 [5.00, 5.31]	3.87 [3.72, 4.02]	2.38 [2.23, 2.54]	6.20 [6.05, 6.35]	5.57 [5.42, 5.72]	4.67 [4.51, 4.82]	3.37 [3.22, 3.52]	1.76 [1.61, 1.91]
croatia	5.99 [5.83, 6.16]	5.28 [5.11, 5.45]	4.80 [4.63, 4.96]	3.30 [3.13, 3.47]	2.23 [2.07, 2.40]	6.39 [6.22, 6.56]	5.44 [5.27, 5.61]	4.24 [4.07, 4.41]	2.90 [2.73, 3.06]	1.49 [1.32, 1.66]
czech_republic	6.15 [5.97, 6.32]	5.70 [5.52, 5.87]	4.39 [4.21, 4.56]	3.83 [3.66, 4.01]	2.03 [1.85, 2.20]	6.53 [6.36, 6.71]	6.03 [5.85, 6.20]	3.63 [3.45, 3.80]	3.70 [3.52, 3.87]	1.34 [1.16, 1.51]
denmark	5.91 [5.74, 6.09]	5.77 [5.59, 5.94]	4.41 [4.24, 4.58]	2.84 [2.66, 3.01]	1.89 [1.72, 2.06]	6.49 [6.32, 6.66]	6.13 [5.96, 6.30]	3.57 [3.40, 3.74]	2.56 [2.39, 2.73]	1.14 [0.97, 1.32]
ecuador	6.13 [5.94, 6.33]	5.67 [5.47, 5.86]	5.07 [4.87, 5.27]	3.83 [3.64, 4.03]	2.54 [2.34, 2.73]	6.17 [5.98, 6.37]	5.57 [5.37, 5.77]	4.71 [4.51, 4.91]	3.22 [3.02, 3.41]	2.04 [1.84, 2.23]
england	6.08 [5.91, 6.24]	5.83 [5.66, 5.99]	5.07 [4.90, 5.23]	3.28 [3.11, 3.45]	2.03 [1.86, 2.20]	6.46 [6.29, 6.62]	6.15 [5.98, 6.31]	4.04 [3.88, 4.21]	3.02 [2.85, 3.19]	1.47 [1.30, 1.63]
estonia	6.01 [5.75, 6.27]	5.72 [5.46, 5.98]	4.63 [4.37, 4.89]	3.41 [3.15, 3.67]	1.85 [1.59, 2.11]	6.54 [6.29, 6.80]	6.06 [5.80, 6.32]	3.68 [3.43, 3.94]	3.11 [2.86, 3.37]	1.22 [0.96, 1.48]
finland	5.82 [5.66, 5.99]	5.93 [5.76, 6.10]	4.38 [4.21, 4.54]	3.17 [3.00, 3.34]	2.02 [1.85, 2.18]	6.41 [6.24, 6.57]	6.40 [6.23, 6.57]	3.48 [3.32, 3.65]	2.94 [2.77, 3.11]	1.28 [1.11, 1.44]
france	6.08 [5.91, 6.25]	5.65 [5.48, 5.82]	5.13 [4.96, 5.30]	3.14 [2.97, 3.30]	1.58 [1.42, 1.75]	6.56 [6.39, 6.73]	5.86 [5.69, 6.03]	4.10 [3.94, 4.27]	2.63 [2.46, 2.80]	1.19 [1.02, 1.36]
georgia	5.13 [4.93, 5.33]	4.39 [4.20, 4.59]	4.55 [4.36, 4.75]	3.40 [3.20, 3.59]	2.46 [2.27, 2.66]	5.43 [5.23, 5.62]	4.83 [4.63, 5.03]	4.33 [4.13, 4.53]	3.00 [2.81, 3.20]	1.97 [1.77, 2.16]
greece	5.54 [5.34, 5.74]	5.22 [5.02, 5.42]	4.71 [4.51, 4.91]	3.52 [3.32, 3.72]	2.60 [2.40, 2.80]	5.83 [5.63, 6.03]	5.13 [4.93, 5.33]	4.48 [4.28, 4.68]	3.01 [2.81, 3.21]	1.98 [1.78, 2.18]

guatemala	5.90 [5.72, 6.08]	5.56 [5.37, 5.74]	4.90 [4.72, 5.09]	3.86 [3.68, 4.05]	2.85 [2.67, 3.04]	6.10 [5.91, 6.28]	5.51 [5.33, 5.69]	4.39 [4.20, 4.57]	3.18 [2.99, 3.36]	2.15 [1.97, 2.34]
hungary	6.03 [5.85, 6.21]	5.43 [5.25, 5.61]	4.84 [4.66, 5.02]	3.87 [3.69, 4.04]	2.82 [2.64, 3.00]	6.35 [6.17, 6.53]	5.42 [5.24, 5.60]	4.33 [4.15, 4.51]	3.44 [3.26, 3.61]	1.71 [1.53, 1.89]
iceland	5.78 [5.61, 5.94]	5.77 [5.60, 5.94]	4.43 [4.26, 4.59]	3.23 [3.06, 3.40]	1.80 [1.63, 1.96]	6.40 [6.23, 6.57]	6.10 [5.93, 6.27]	3.81 [3.64, 3.98]	2.56 [2.39, 2.73]	1.19 [1.02, 1.36]
indonesia	5.81 [5.61, 6.01]	5.36 [5.16, 5.56]	4.89 [4.69, 5.09]	4.32 [4.12, 4.52]	3.01 [2.81, 3.21]	6.14 [5.93, 6.34]	5.36 [5.16, 5.57]	4.71 [4.51, 4.91]	3.89 [3.69, 4.09]	2.42 [2.22, 2.62]
iran	5.77 [5.62, 5.92]	4.97 [4.82, 5.12]	4.34 [4.19, 4.49]	3.22 [3.07, 3.37]	1.98 [1.83, 2.13]	6.12 [5.97, 6.27]	5.16 [5.01, 5.31]	3.97 [3.82, 4.12]	2.54 [2.39, 2.69]	1.38 [1.22, 1.53]
ireland	6.04 [5.88, 6.19]	5.95 [5.79, 6.10]	4.78 [4.62, 4.94]	2.89 [2.74, 3.05]	1.86 [1.70, 2.02]	6.62 [6.46, 6.78]	6.33 [6.17, 6.48]	3.57 [3.41, 3.72]	2.58 [2.42, 2.73]	1.20 [1.04, 1.35]
israel	5.99 [5.81, 6.17]	5.33 [5.15, 5.51]	4.86 [4.68, 5.04]	3.48 [3.30, 3.66]	2.34 [2.16, 2.52]	6.24 [6.06, 6.42]	5.54 [5.36, 5.72]	3.98 [3.80, 4.16]	3.00 [2.82, 3.18]	1.66 [1.48, 1.84]
italy	5.94 [5.75, 6.13]	5.16 [4.97, 5.35]	4.85 [4.66, 5.04]	3.67 [3.48, 3.85]	2.22 [2.04, 2.41]	6.39 [6.20, 6.58]	5.49 [5.30, 5.67]	4.16 [3.97, 4.35]	3.39 [3.20, 3.58]	1.50 [1.32, 1.69]
japan	5.72 [5.57, 5.86]	4.84 [4.69, 4.98]	5.14 [5.00, 5.29]	3.27 [3.12, 3.41]	2.37 [2.23, 2.52]	6.05 [5.90, 6.19]	4.88 [4.74, 5.03]	4.52 [4.38, 4.67]	2.81 [2.66, 2.95]	1.72 [1.58, 1.87]
latvia	5.78 [5.54, 6.01]	5.03 [4.80, 5.27]	5.29 [5.06, 5.53]	4.66 [4.42, 4.90]	3.62 [3.39, 3.86]	5.89 [5.65, 6.12]	4.95 [4.72, 5.19]	4.62 [4.38, 4.85]	3.91 [3.67, 4.14]	2.63 [2.39, 2.86]
lebanon	5.81 [5.54, 6.07]	5.54 [5.27, 5.80]	4.81 [4.54, 5.07]	3.28 [3.01, 3.54]	2.20 [1.94, 2.46]	6.16 [5.90, 6.43]	5.88 [5.62, 6.14]	4.34 [4.08, 4.61]	2.63 [2.36, 2.89]	1.54 [1.28, 1.81]
lithuania	6.33 [6.07, 6.60]	5.77 [5.51, 6.04]	5.08 [4.81, 5.35]	3.94 [3.67, 4.20]	2.69 [2.42, 2.95]	6.45 [6.19, 6.72]	5.76 [5.49, 6.03]	4.48 [4.22, 4.75]	3.55 [3.29, 3.82]	1.74 [1.48, 2.01]
malaysia	5.77 [5.56, 5.97]	5.22 [5.01, 5.43]	5.15 [4.95, 5.36]	3.68 [3.47, 3.88]	2.77 [2.56, 2.98]	5.84 [5.64, 6.05]	5.17 [4.96, 5.38]	4.90 [4.69, 5.11]	3.50 [3.29, 3.70]	2.48 [2.27, 2.68]
mexico	6.18 [6.00, 6.36]	5.97 [5.80, 6.15]	4.88 [4.70, 5.06]	3.59 [3.41, 3.76]	2.13 [1.95, 2.30]	6.34 [6.17, 6.52]	5.95 [5.77, 6.13]	4.52 [4.35, 4.70]	3.11 [2.93, 3.29]	1.63 [1.45, 1.81]
netherlands	6.04 [5.88, 6.19]	5.36 [5.20, 5.52]	5.04 [4.89, 5.20]	2.97 [2.81, 3.13]	1.74 [1.59, 1.90]	6.59 [6.43, 6.75]	6.05 [5.89, 6.21]	3.31 [3.15, 3.47]	2.84 [2.68, 2.99]	1.16 [1.00, 1.32]
nigeria	5.79 [5.55, 6.03]	5.10 [4.86, 5.34]	5.51 [5.27, 5.75]	4.21 [3.97, 4.45]	3.14 [2.90, 3.38]	5.70 [5.46, 5.94]	4.91 [4.67, 5.15]	5.63 [5.39, 5.87]	3.91 [3.67, 4.15]	3.06 [2.83, 3.30]
norway	5.79 [5.54, 6.05]	5.83 [5.58, 6.09]	4.77 [4.51, 5.02]	3.23 [2.98, 3.49]	2.18 [1.92, 2.43]	6.39 [6.14, 6.65]	6.13 [5.87, 6.38]	3.60 [3.34, 3.86]	2.74 [2.49, 3.00]	1.25 [0.99, 1.51]
pakistan	5.43 [5.22, 5.65]	5.11 [4.90, 5.33]	5.08 [4.86, 5.29]	3.20 [2.98, 3.41]	2.53 [2.31, 2.75]	5.64 [5.42, 5.85]	4.95 [4.73, 5.16]	4.80 [4.59, 5.02]	3.08 [2.86, 3.30]	2.35 [2.14, 2.57]
peru	5.97 [5.76, 6.18]	5.64 [5.43, 5.85]	5.12 [4.91, 5.33]	3.47 [3.26, 3.68]	2.16 [1.95, 2.37]	6.32 [6.11, 6.53]	5.61 [5.40, 5.82]	4.43 [4.22, 4.64]	2.89 [2.68, 3.10]	1.49 [1.28, 1.70]
philippines	5.85 [5.58, 6.13]	5.54 [5.27, 5.82]	6.22 [5.95, 6.50]	5.41 [5.13, 5.68]	4.99 [4.71, 5.26]	5.51 [5.24, 5.78]	4.98 [4.71, 5.26]	5.67 [5.40, 5.95]	4.38 [4.11, 4.66]	3.82 [3.55, 4.10]

poland	6.09 [6.03, 6.15]	5.64 [5.58, 5.70]	4.73 [4.67, 4.79]	3.74 [3.68, 3.80]	2.23 [2.17, 2.29]	6.40 [6.34, 6.46]	5.73 [5.67, 5.79]	3.95 [3.89, 4.01]	3.22 [3.17, 3.28]	1.44 [1.38, 1.50]
portugal	6.07 [5.89, 6.25]	5.62 [5.44, 5.80]	4.60 [4.42, 4.79]	3.19 [3.00, 3.37]	2.01 [1.83, 2.19]	6.42 [6.24, 6.60]	5.86 [5.68, 6.04]	4.05 [3.87, 4.23]	2.69 [2.51, 2.87]	1.35 [1.16, 1.53]
qatar	5.62 [5.35, 5.89]	5.18 [4.91, 5.44]	5.21 [4.94, 5.48]	3.47 [3.20, 3.74]	2.10 [1.83, 2.36]	5.86 [5.59, 6.13]	5.32 [5.05, 5.59]	4.90 [4.63, 5.17]	3.06 [2.79, 3.32]	1.74 [1.47, 2.01]
romania	6.07 [5.88, 6.27]	5.63 [5.43, 5.82]	5.29 [5.10, 5.49]	3.74 [3.55, 3.93]	2.38 [2.19, 2.58]	6.23 [6.04, 6.43]	5.62 [5.43, 5.82]	4.59 [4.40, 4.78]	3.10 [2.91, 3.30]	1.73 [1.54, 1.93]
saudi_arabia	5.63 [5.45, 5.80]	4.80 [4.63, 4.98]	5.28 [5.10, 5.45]	3.47 [3.29, 3.64]	2.20 [2.02, 2.37]	5.63 [5.45, 5.80]	4.80 [4.62, 4.97]	4.88 [4.70, 5.05]	3.01 [2.83, 3.18]	1.95 [1.77, 2.13]
serbia	5.99 [5.81, 6.17]	5.49 [5.31, 5.67]	5.17 [4.99, 5.35]	3.62 [3.44, 3.80]	2.11 [1.93, 2.29]	6.49 [6.31, 6.67]	5.68 [5.50, 5.86]	4.26 [4.08, 4.44]	3.16 [2.98, 3.34]	1.38 [1.19, 1.56]
singapore	6.01 [5.84, 6.17]	5.67 [5.51, 5.84]	5.11 [4.94, 5.27]	3.43 [3.26, 3.59]	2.22 [2.05, 2.39]	6.49 [6.32, 6.65]	5.84 [5.68, 6.01]	4.51 [4.34, 4.67]	3.06 [2.89, 3.22]	1.46 [1.29, 1.62]
slovakia	5.95 [5.80, 6.11]	5.66 [5.50, 5.82]	4.27 [4.11, 4.42]	3.53 [3.37, 3.68]	2.35 [2.19, 2.51]	6.61 [6.45, 6.76]	6.03 [5.88, 6.19]	3.56 [3.41, 3.72]	3.22 [3.06, 3.38]	1.43 [1.27, 1.58]
south_korea	5.60 [5.41, 5.78]	4.98 [4.80, 5.17]	5.14 [4.96, 5.33]	4.42 [4.23, 4.60]	3.75 [3.57, 3.94]	5.73 [5.55, 5.92]	4.79 [4.60, 4.98]	4.87 [4.68, 5.05]	3.95 [3.76, 4.13]	3.14 [2.95, 3.32]
spain	5.80 [5.64, 5.95]	5.41 [5.26, 5.57]	4.90 [4.75, 5.06]	3.38 [3.22, 3.53]	2.32 [2.17, 2.48]	6.09 [5.94, 6.25]	5.55 [5.40, 5.71]	4.66 [4.50, 4.81]	2.88 [2.72, 3.03]	1.65 [1.50, 1.81]
sri_lanka	6.10 [5.81, 6.38]	5.75 [5.47, 6.03]	5.04 [4.76, 5.32]	2.82 [2.53, 3.10]	1.89 [1.61, 2.18]	6.28 [6.00, 6.56]	5.78 [5.50, 6.06]	4.36 [4.07, 4.64]	2.57 [2.28, 2.85]	1.35 [1.06, 1.63]
sweden	6.05 [5.87, 6.22]	5.85 [5.68, 6.03]	4.54 [4.37, 4.72]	3.56 [3.39, 3.74]	1.90 [1.73, 2.08]	6.56 [6.38, 6.73]	6.27 [6.09, 6.44]	3.66 [3.49, 3.84]	3.03 [2.86, 3.21]	1.34 [1.17, 1.51]
switzerland	5.80 [5.62, 5.98]	5.34 [5.16, 5.52]	4.57 [4.39, 4.75]	3.49 [3.31, 3.67]	2.11 [1.93, 2.29]	6.60 [6.42, 6.78]	6.08 [5.90, 6.26]	3.53 [3.35, 3.71]	3.09 [2.91, 3.27]	1.24 [1.06, 1.42]
thailand	5.66 [5.48, 5.84]	5.27 [5.09, 5.45]	5.74 [5.56, 5.92]	3.90 [3.72, 4.08]	3.30 [3.12, 3.48]	5.88 [5.70, 6.06]	5.25 [5.07, 5.43]	5.14 [4.96, 5.32]	3.52 [3.34, 3.70]	2.63 [2.45, 2.81]
turkey	5.77 [5.55, 5.98]	5.52 [5.30, 5.73]	4.71 [4.49, 4.92]	3.70 [3.48, 3.91]	2.09 [1.88, 2.31]	6.03 [5.82, 6.25]	5.67 [5.45, 5.88]	4.26 [4.04, 4.47]	3.28 [3.06, 3.50]	1.77 [1.55, 1.98]
uganda	5.70 [5.45, 5.94]	5.20 [4.96, 5.45]	4.68 [4.43, 4.92]	3.48 [3.24, 3.73]	2.44 [2.19, 2.68]	5.68 [5.43, 5.92]	5.18 [4.94, 5.43]	4.56 [4.31, 4.81]	3.44 [3.19, 3.69]	2.10 [1.86, 2.35]
ukraine	5.79 [5.62, 5.97]	4.69 [4.51, 4.87]	4.74 [4.56, 4.92]	3.78 [3.60, 3.96]	2.18 [2.00, 2.36]	6.16 [5.98, 6.33]	4.79 [4.61, 4.96]	4.26 [4.08, 4.44]	3.28 [3.10, 3.46]	1.73 [1.55, 1.91]
us	5.96 [5.81, 6.12]	5.72 [5.57, 5.88]	4.77 [4.61, 4.92]	3.26 [3.11, 3.42]	1.99 [1.84, 2.14]	6.45 [6.29, 6.60]	6.12 [5.97, 6.28]	3.67 [3.52, 3.83]	3.00 [2.85, 3.15]	1.67 [1.52, 1.82]
vietnam	5.36 [5.16, 5.56]	4.84 [4.63, 5.04]	4.86 [4.65, 5.06]	3.43 [3.23, 3.63]	2.45 [2.25, 2.66]	5.53 [5.33, 5.74]	4.85 [4.65, 5.06]	4.70 [4.50, 4.91]	3.18 [2.98, 3.39]	2.05 [1.84, 2.25]

3. Principal Component Analysis for the Geospatial Flourishing Index

In the main text (3.3), we describe creating a Geospatial Flourishing Index (GFI) comprised of four socio-ecological variables based on the results of a principal component analysis. Here, we describe that process. First, we assessed the appropriate number of components to extract. First, we tested the suitability of the data for performing a PCA. A KMO test indicated that the data was suitable (MSA = .75). Using the *parameters* package in R (Lüdecke et al., 2020), the choice of one component was most supported with 6 out of 13 methods in agreement, including Kaiser criterion, scree, parallel analysis, and optimal coordinates. Therefore, we extracted only a single socio-ecological component. All four socio-ecological variables loaded onto the component (HDI = .82, pathogen prevalence = -.92, population density = -.55, latitude = .91). Note that the population density variable was on log scale, and latitude was squared, and hence reflected distance from the equator regardless of hemisphere. We then extracted the factor scores for each country and joined this GFI to the country-level dataset.

This same pattern of results obtained when testing each socio-ecological variable independently (see Figure S3). However, we reported the factor scores results in the main text because a) the socio-ecological factor explained 67% of the variance across the four variables; b) the model with the factor score (ELPD = -240.7, SE = 25.0) was more parsimonious than the models with the individual variables (ELPDs = -259.4 – 315.0, SEs = 22.5 – 25.0); and c) because the results are easier to interpret for a single composite.

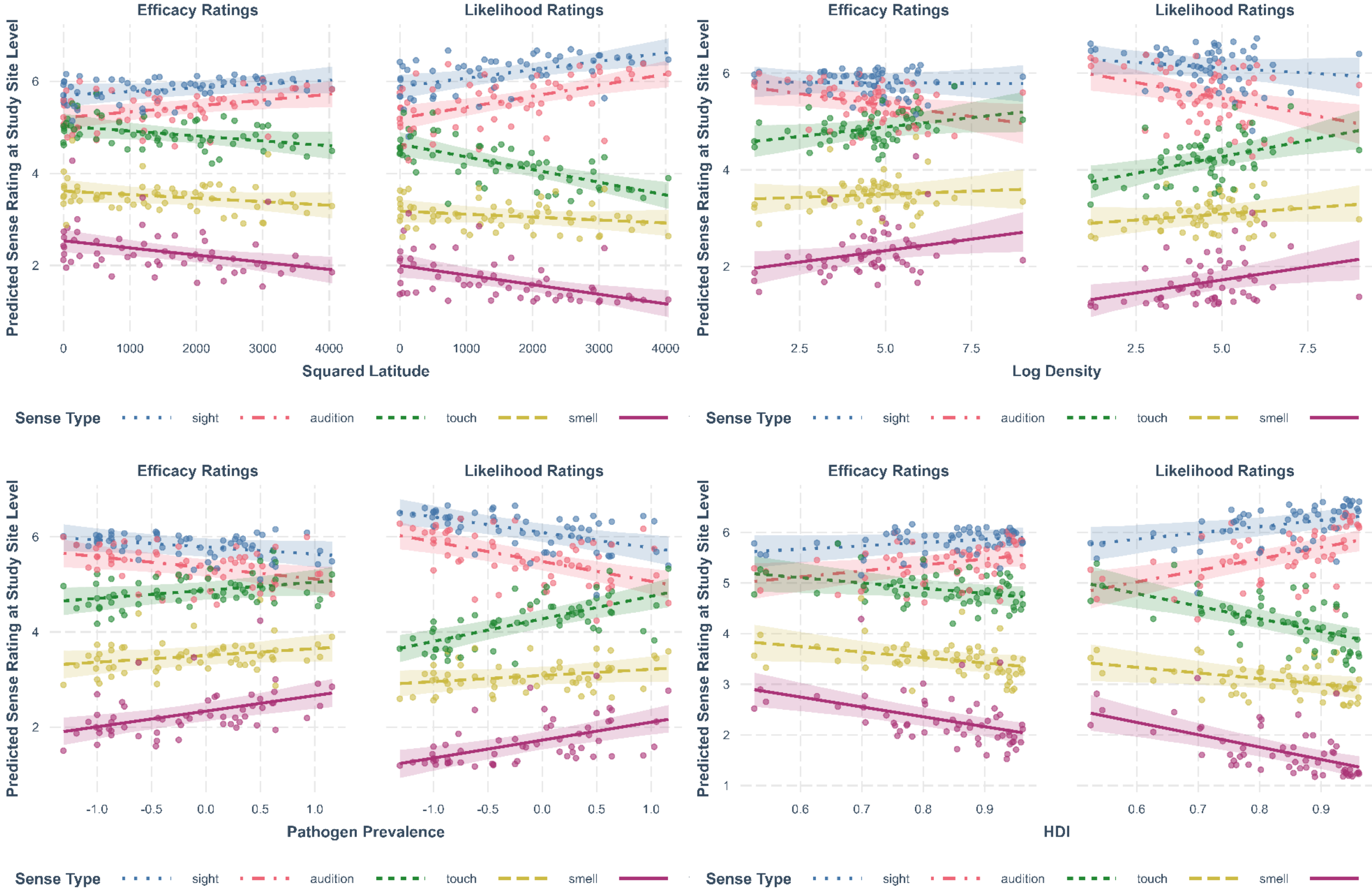

Figure S3. Interactions between sense type, rating type, and each of the four socio-ecological variables individually. Compare to Figure 4 in main text. Note that variables that negatively load onto the socio-ecological factor (pathogen prevalence and population density) show the opposite visual pattern in the above plots given the reversal.

4. Additional Information Regarding the Socio-Ecological (GFI) Model

In the main text (3.3), we referenced several details concerning the country-level socio-ecological model that would be included in the Supplement. Here, we provide that information.

First, we said that simple slopes and highest posterior density intervals would be provided for the relationships plotted in Figure 4. See Figure S4 for these.

Second, we claimed that the magnitude of the slopes for some senses varied across efficacy and likelihood ratings. We tested this by examining all pairwise comparisons between estimated sense ratings for each combination of sense type and rating type. The 95% HPDIs for contrasts between efficacy and likelihood ratings for smell and taste overlapped with zero (estimates = 0 - .06). However, the slope of GFI for sound likelihood ratings was meaningfully stronger than the slope for sound efficacy ratings (estimate = -.14, 95% HPDI[-.27 - -.01]), likewise for sight ratings (estimate = -.14, 95% HPDI[-.26 - -.01]), while the slope for touch efficacy ratings was steeper than the slope for likelihood ratings (estimate = .22, 95% HPDI[.10 - .35]).

Third, we claimed that GFI meaningfully moderated the effects of sense and rating type on sense ratings. Here, we break down this interaction. First, interactions between sense type and GFI emerged for both efficacy (B = .31, 95% CI[.19, .44]) and likelihood (B = .67, 95% CI[.55, .80]) ratings. Further, we compared the leave-one-out cross-validation information criteria of the full interaction model (ELPD = -240.7, SE = 25.0) with a decomposed model lacking the interaction with GFI (ELPD = -334.9, SE = 22.7), as well as a baseline model just with the interaction between sense type and rating type and the controls for geographic and linguistic proximity (ELPD = -335.0, SE = 22.8). The full interaction model was the most parsimonious. Further, we examined the simple slopes of the relationship between GFI and sense ratings across each combination of sense type and rating type. Finally, when comparing the contrasts between the simple slopes for GFI, the credible intervals for the majority (38 of 45) of the pairwise contrasts were non-overlapping with zero, suggesting a meaningful interaction between GFI and both sense type and rating type (see Table S5).

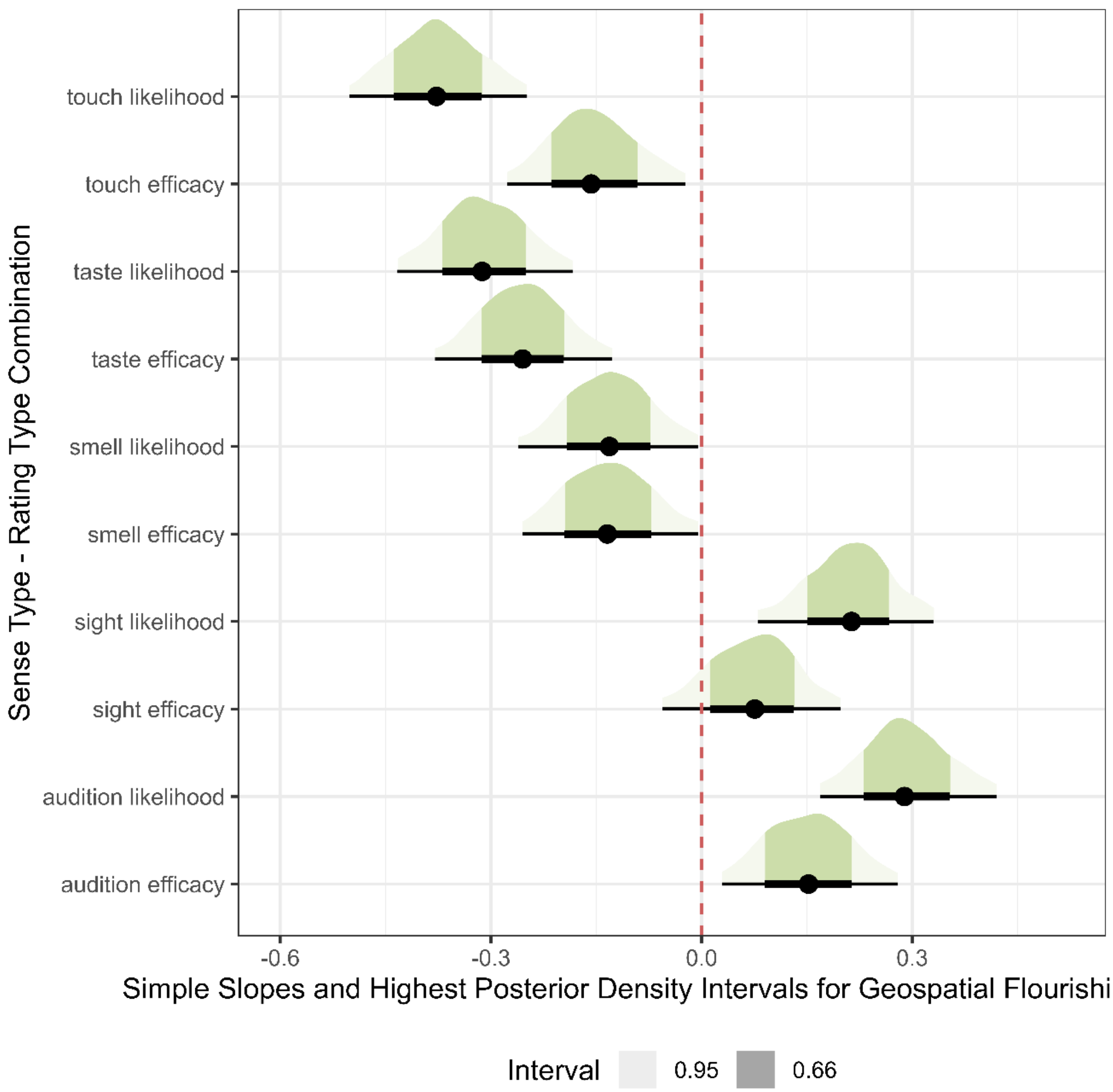

Figure S4. Simple slopes and highest posterior density intervals for the model plotted in Figure 4 in the main text. Both 95% and 66% HPDIs plotted. The dotted red vertical line indicates zero.

Table S5. All pairwise comparisons between simple slopes plotted in Figure 4 in main text.

Pairwise Comparison	Estimate	Lower HPD	Upper HPD
sight efficacy - audition efficacy	-0.08	-0.20	0.05
sight efficacy - touch efficacy	0.23	0.11	0.37
sight efficacy - smell efficacy	0.21	0.08	0.34
sight efficacy - taste efficacy	0.33	0.20	0.45
sight efficacy - sight likelihood	-0.14	-0.26	-0.01
sight efficacy - audition likelihood	-0.22	-0.35	-0.09
sight efficacy - touch likelihood	0.45	0.32	0.57
sight efficacy - smell likelihood	0.20	0.08	0.33
sight efficacy - taste likelihood	0.39	0.26	0.51
audition efficacy - touch efficacy	0.31	0.17	0.44
audition efficacy - smell efficacy	0.28	0.16	0.41
audition efficacy - taste efficacy	0.41	0.27	0.52
audition efficacy - sight likelihood	-0.06	-0.19	0.06
audition efficacy - audition likelihood	-0.14	-0.27	-0.01
audition efficacy - touch likelihood	0.53	0.40	0.65
audition efficacy - smell likelihood	0.28	0.17	0.41
audition efficacy - taste likelihood	0.46	0.33	0.58
touch efficacy - smell efficacy	-0.02	-0.14	0.11
touch efficacy - taste efficacy	0.10	-0.03	0.23
touch efficacy - sight likelihood	-0.37	-0.48	-0.23
touch efficacy - audition likelihood	-0.45	-0.57	-0.32
touch efficacy - touch likelihood	0.22	0.10	0.35
touch efficacy - smell likelihood	-0.02	-0.15	0.10
touch efficacy - taste likelihood	0.16	0.03	0.28
smell efficacy - taste efficacy	0.12	0.00	0.25
smell efficacy - sight likelihood	-0.35	-0.47	-0.21
smell efficacy - audition likelihood	-0.43	-0.56	-0.30
smell efficacy - touch likelihood	0.24	0.11	0.37

smell efficacy - smell likelihood	0.00	-0.12	0.12
smell efficacy - taste likelihood	0.18	0.04	0.31
taste efficacy - sight likelihood	-0.47	-0.60	-0.34
taste efficacy - audition likelihood	-0.55	-0.67	-0.43
taste efficacy - touch likelihood	0.12	0.00	0.26
taste efficacy - smell likelihood	-0.12	-0.24	0.01
taste efficacy - taste likelihood	0.06	-0.08	0.17
sight likelihood - audition likelihood	-0.08	-0.21	0.05
sight likelihood - touch likelihood	0.59	0.46	0.71
sight likelihood - smell likelihood	0.34	0.21	0.46
sight likelihood - taste likelihood	0.52	0.40	0.66
audition likelihood - touch likelihood	0.67	0.54	0.80
audition likelihood - smell likelihood	0.43	0.30	0.55
audition likelihood - taste likelihood	0.60	0.48	0.73
touch likelihood - smell likelihood	-0.24	-0.37	-0.12
touch likelihood - taste likelihood	-0.07	-0.21	0.05
smell likelihood - taste likelihood	0.18	0.06	0.31

Note:

HPD = Highest Posterior Density.

5. Comparing Sound and Touch Ratings

In the main text (3.3), we claimed that the difference between sound and touch ratings increased as GFI increased. Here, we show pairwise comparisons between sound and touch ratings across the full range of GFI (from two standard deviations below the mean, to two standard deviations above the mean), see Table S6.

Table S6. Pairwise differences between sound and touch ratings across different levels of GFI.

Pairwise Comparison	Global Flourishing Index Score	Estimate	Lower HPD	Upper HPD
audition efficacy - touch efficacy	-2	-0.08	-0.38	0.19
audition efficacy - touch efficacy	-1	0.23	0.06	0.41
audition efficacy - touch efficacy	0	0.53	0.40	0.65
audition efficacy - touch efficacy	1	0.84	0.67	1.03
audition efficacy - touch efficacy	2	1.14	0.86	1.45
audition likelihood - touch likelihood	-2	0.00	-0.30	0.29
audition likelihood - touch likelihood	-1	0.66	0.49	0.85
audition likelihood - touch likelihood	0	1.33	1.21	1.46
audition likelihood - touch likelihood	1	2.00	1.83	2.18
audition likelihood - touch likelihood	2	2.67	2.39	2.96

6. Demographic Moderators at the Country Level

In the main text (3.3), we claimed that sample-level demographic variables did not meaningfully explain variation in sense ratings across study sites. Here, we show those results. We tested whether the following sample-level characteristics moderated the effect of rating type and sense type on sense ratings: sample mean SES, sample mean age, sample mean education, the sample-level gender breakdown, and whether or not the sample was comprised of students. None of these models were more parsimonious than a baseline model without the additional demographic moderators given that the differences in ELPD were less than twice the product of the differences in the standard errors (Δ ELPD = -4.5 - 1.8, ΔSE = -4.6 – 3.8). In contrast, the Δ ELPD between GFI and baseline models was -94.3 (ΔSE = 14.7).

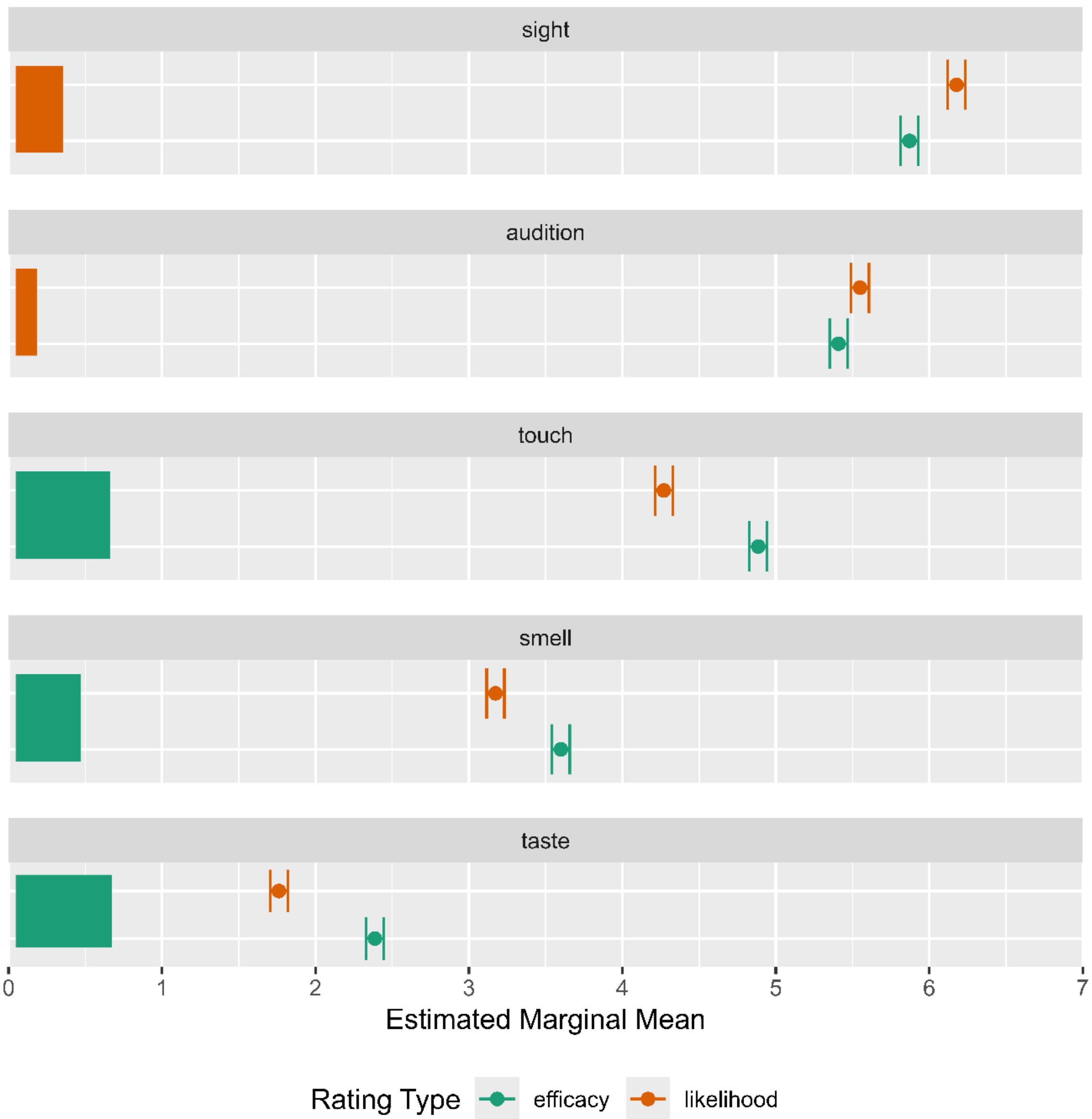

Figure S5. Estimated marginal means for sense ratings without any exclusion criteria applied. Compare to Figure 2 in the paper. Note that the relative relationships between efficacy and likelihood ratings, and the relative ordering of senses, are conceptually unaffected compared to the filtered sample used in the paper.

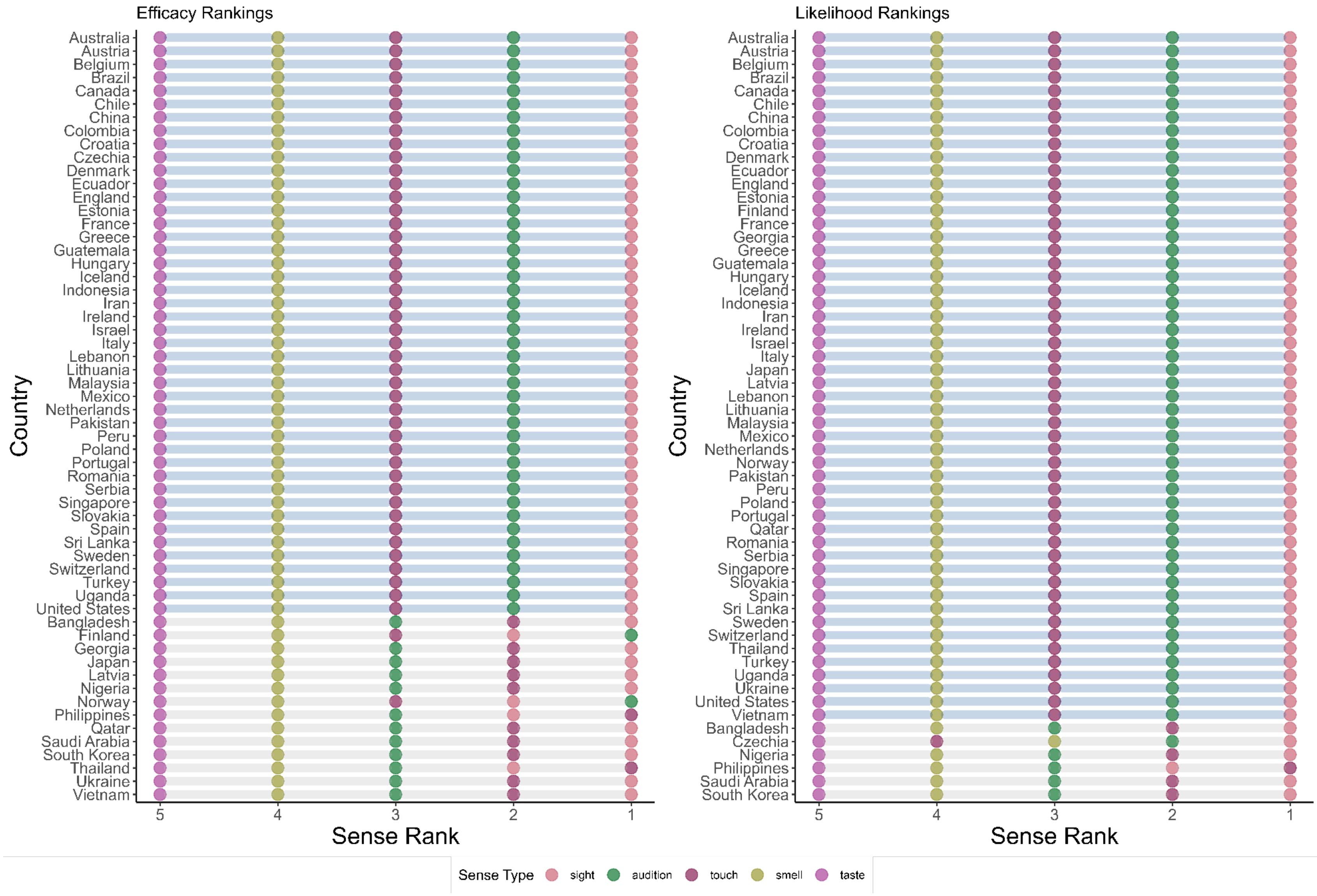

Figure S6. Relative rankings of sense ratings across sites in the sample without exclusions. Compare to Figure 3 in the paper.

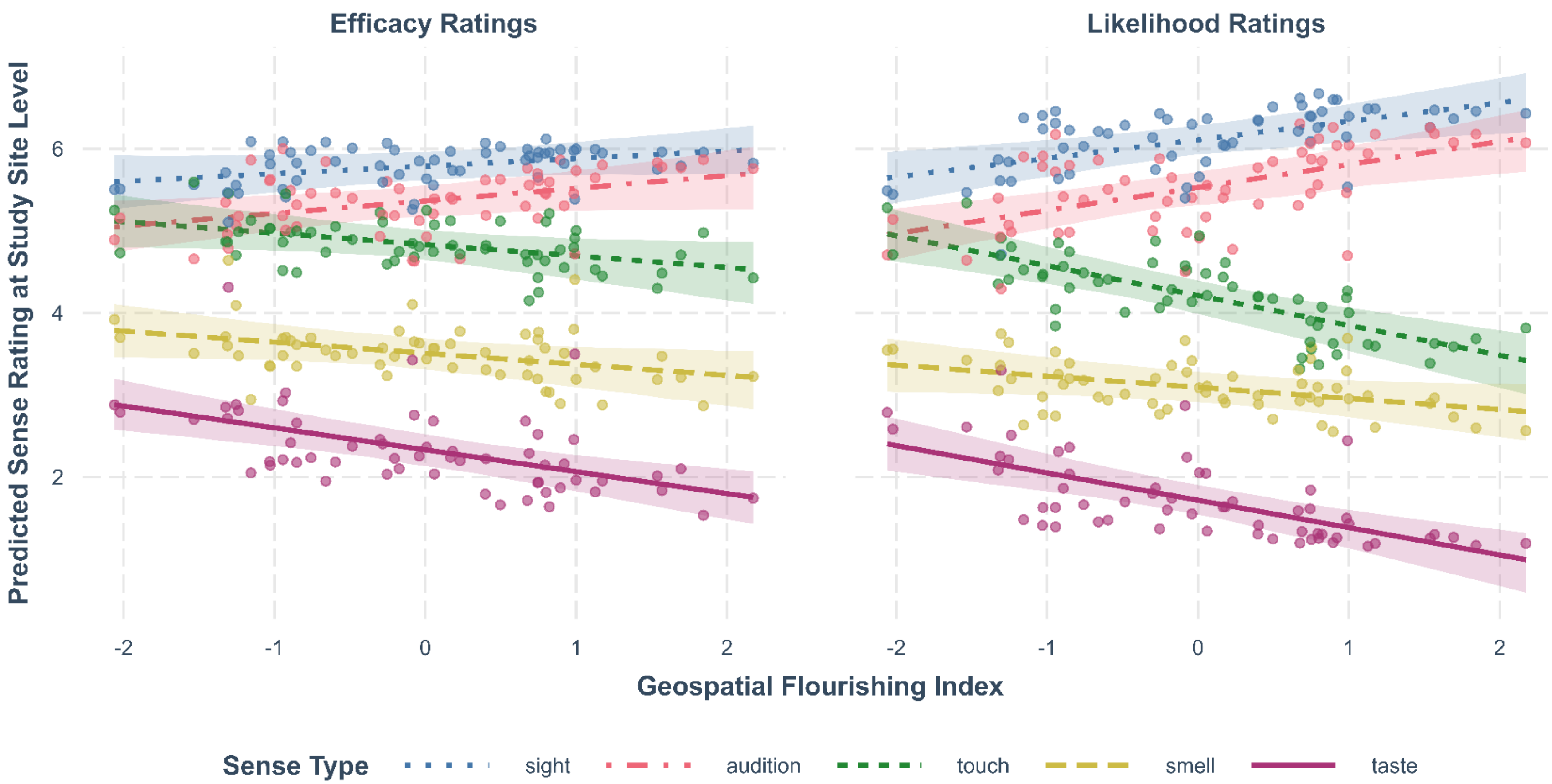

Figure S7. Results from a model in which mean sense ratings were regressed on the interaction between rating type, sense type, and the geospatial flourishing index. Identical to the model reported in the paper, except for the mean sense ratings were calculated using a sample with all participants (no exclusion criteria applied). Compare to Figure 4 in the paper.

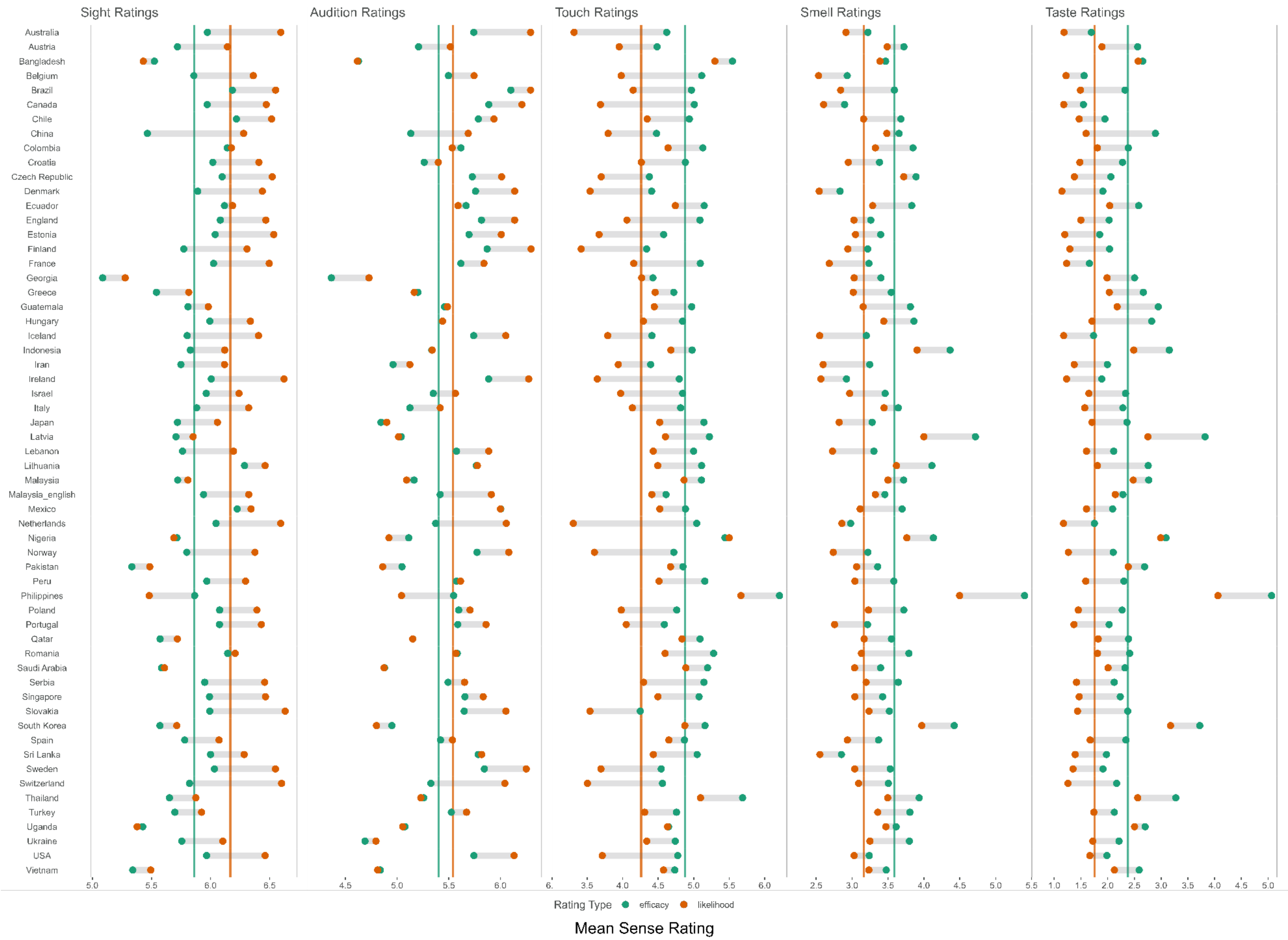

Figure S8. Mean sense ratings for efficacy and likelihood ratings across sites without exclusions. Compare to Figure 5 in the paper.

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