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The global spread of misinformation on spiders

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In the internet era, the digital architecture that keeps us connected and informed may also amplify the spread of misinformation. This problem is gaining global attention, as evidence accumulates that misinformation may interfere with democratic processes and undermine collective responses to environmental and health crises[1,2]. In an increasingly polluted information ecosystem, understanding the factors underlying the generation and spread of misinformation is becoming a pressing scientific and societal challenge[3]. Here, we studied the global spread of (mis-) information on spiders using a high-resolution global database of online newspaper articles on spider–human interactions, covering stories of spider–human encounters and biting events published from 2010–2020[4]. We found that 47% of articles contained errors and 43% were sensationalist. Moreover, we show that the flow of spider-related news occurs within a highly interconnected global network and provide evidence that sensationalism is a key factor underlying the spread of misinformation.

Spiders are widely feared animals, and thus an ideal model system to study misinformation spread. The successful dissemination of online misinformation is indeed associated with cognitive attraction[3], namely the presence of quasi-universal stimuli that appeal to human emotions (such as disgust and fear), and for which there is a plausible evolutionary explanation

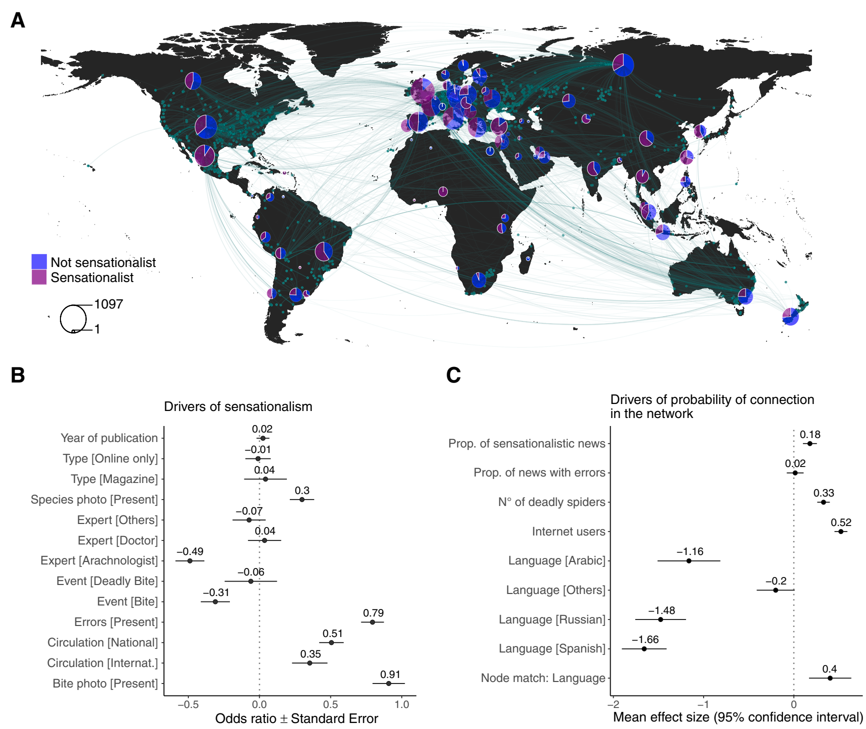

Figure 1. Global distribution of newspaper articles on spiders and drivers of misinformation spread.
(A) Global distribution of news articles on human-spider encounters. Bipartite directed network linking each country (pies; n = 79) with each spider-related event reported by the press (dots, n = 2,644). Note that two countries (Botswana and Iceland) for which we did not find any news are not displayed on the map. The size of each pie chart refers to the number of news articles published in the country between 2010 and 2020; the color of each pie represents the proportion of sensationalistic news. Direct connections among countries are shown in Figure S1. (B) Drivers of sensationalism in media articles on spiders. Estimated parameters for the model of sensationalism are based on a Bernoulli generalized linear mixed model. Baseline level for multilevel factor variables are: 'Traditional' (Type), 'Encounter' (Event), and 'Regional' (Circulation). (C) Estimated parameters for the probability of each country to form connections according to an exponential random graph model. Baseline level for Language is 'English'. Error bars indicate standard errors (B) and 95% confidence intervals (C). Exact estimated regression parameters and p-values are in Table S1 in the Supplemental information.

(e.g., the avoidance of ‘dangerous’ animals). Spiders fit perfectly into this scheme, and thus we can expect more misinformation and sensationalism to be associated with spider-related content compared to other topics[4–6].

For our analysis, we compiled 5,348 news items from 81 countries and 40 languages (Figure 1A). First, we asked: ‘What is the quality of spider-related information in the global press and which news-level factors are associated with sensationalistic contents?’ Across our dataset, the quality of global articles on spiders was exceedingly poor, with 47% of articles containing errors and 43% being scored as sensationalistic by spider experts (Supplemental information). Next, we used logistic regression to test for relationships between sensationalism and eight predictors at the news-article level, while controlling for the species involved in the human–spider encounter and the language and country of the news (Figure 1B). The probability of an article being sensationalistic increased in international and national newspapers compared with regional ones; it was higher when the article contained photos of spiders or bites, and it was lower when the reported event was a bite or a deadly bite compared to a human–spider encounter. Furthermore, sensationalism decreased when a spider expert was consulted in the news article; there was no evidence of a similar effect when other experts, such as medical professionals, were consulted. Finally, there was a strong covariation between sensationalism and the presence of errors. Overall, the regression model explained 53% of the variance (Conditional R^2: 0.525), 45% of which was attributable to the country, language and spider species involved. This suggests that the story subject and the cultural aspects are central in predicting article quality. The remaining unexplained variance (~47%) is likely to be related to harder-to-capture factors, including the writing style of the journalist and editorial policies of the news outlet.

After consolidating a quantitative understanding of the relationship between sensationalism and news-level attributes, we used network analyses to predict how information quality (sensationalism and errors), along with different country-level predictors, affect the global flow of information. Spider-related information flows through a highly connected network (33% of all possible connections among countries are realized; Figure S1 in Supplemental information). Yet, the influence that different countries have on this flow of information is not uniform. To test this, we identified 15 country-level factors (including news-related attributes, spider-related attributes and socio-economic descriptors) that are potentially relevant predictors for the country’s importance in the network. Because many of these variables were strongly intercorrelated, we consolidated variation to six main predictors and modeled their contribution in determining the probability of forming connections between any two nodes in the network (Figure 1C). The number of internet users, the number of deadly spider species, and the proportion of sensationalistic news published in the country strengthened its connection with other countries. English-speaking countries were more likely to be connected in the network compared to any other language, and countries publishing news in the same language were also more likely to be connected.

General implications pertaining to any type of information system, as well as discipline-specific considerations, emerge from our analysis. First, through these kinds of studies, we can identify the potential roots of poor-quality information and ultimately target and avoid bad practices (as writers) and sources (as readers). Second, our analysis emphasizes how quality matters in determining the spread of information. This effect was mostly associated with sensationalism, consistent with the idea that emotional language is a powerful driver of the spread of misinformation[3]. Importantly, there is an improvement in information quality when journalists engage with experts. Not all experts, however, provide equal value: consulting spider experts, but not doctors and other professionals, such as pest controllers, decreased sensationalism and factual errors. This corroborates previous observations that medical personnel and other authorities often provide incorrect identifications of spiders and information about bites[7].

Our network analysis also shows that even local-scale events published by regional newspapers can quickly become broadcast internationally (Figure 1A). This implies that improving the quality of the information produced in these local nodes could have a positive effect reverberating across the network — a typical example of a ‘think globally, act locally’ management strategy.

All of this is of central importance given that the spread of misinformation has real-world consequences. According to a recent estimate, the online proliferation of fake news accounts for an economic loss of ~$78 billion annually[8]. As far as spiders are concerned, misinformation foremost results in waste of money and resources by people and institutions. Emblematic cases include the closure of schools due to alleged ‘invasions’ by harmless false black widows (genus *Steatoda*)[4]; or the story of a man accidentally setting his house on fire while using a blowtorch to clear spider webs out of his backyard[4]. Furthermore, the content, tone and quality of these stories shape people’s perception of risk[6] and influence socio-political decisions concerning wildlife conservation[6,9,10].

Therefore, our results can be translated into efforts to promote higher-quality news and decrease the prevalence of inaccurate information — for instance, through closer collaboration between journalists and experts and by exploiting new online channels to communicate accurate science[10]. Our approach can be applied to other information systems, producing tangible benefits for resource management and public health and safety by limiting the costs associated with widespread misinformation.

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SUPPLEMENTAL INFORMATION

Supplemental information includes statements, experimental procedures, one figure and one table and can be found with this article online at https://doi.org/10.1016/j.cub.2022.07.026.

DECLARATION OF INTERESTS

The authors declare no competing interests.

REFERENCES

1. West, J.D., and Bergstrom, C.T. (2021). Misinformation in and about science. Proc. Natl. Acad. Sci. USA *118*, e1912444117.
2. Zarocostas, J. (2020). How to fight an infodemic. Lancet *395*, 676.
3. Acerbi, A. (2019). Cognitive attraction and online misinformation. Palgrave Commun. *5*, 15.
4. Mammola, S., Malumbres-Olarte, J., Arabesky, V., Barrales-Alcalá, D.A., Barrion-Dupo, A.L., Benamú, M.A., Bird, T.L., Bogomolova, M., Cardoso, P., Chatzaki, M., *et al*. (2022). An expert-curated global database of online newspaper articles on spiders and spider bites. Sci. Data *9*, 109.
5. Cushing, N., and Markwell, K. (2010). "Watch out for these KILLERS!": newspaper coverage of the Sydney funnel web spider and its impact on antivenom research. Health History *12*, 79–96.
6. Mammola, S., Nanni, V., Pantini, P., and Isaia, M. (2020). Media framing of spiders may exacerbate arachnophobic sentiments. People Nat. *2*, 1145–1157.
7. Vetter, R.S. (2009). Arachnids misidentified as brown recluse spiders by medical personnel and other authorities in North America. Toxicon *54*, 545–547.
8. CHEQ and University of Baltimore (2019). The economic cost of bad actors on the internet. https://www.cheq.ai/fakenews.
9. Knight, A.J. (2008). "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. J. Environ. Psychol. *28*, 94–103.
10. Nanni, V., Mammola, S., Macías-Hernández, N., Castrogiovanni, A., Salgado, A.L., Lunghi, E., Ficetola, G.F., Modica, C., Alba, R., Spiriti, M., *et al*. (2022). Global response of conservationists across mass media likely constrained bat persecution due to COVID-19. Biol. Conserv. *272*, 109591.

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