WORKING PAPERS

N° 1543

June 2024

"Do institutions evolve like material technologies?"

Catherine Molho, Jorge Peña, Manvir Singh and Maxime Derex

Toulouse School of Economics

Do institutions evolve like material technologies?

Catherine Molho[1,2]*

Jorge Peña[3,4]

Manvir Singh[5]

Maxime Derex[3,4]

[1] Department of Experimental and Applied Psychology, *Vrije Universiteit Amsterdam*

[2] Institute for Brain and Behavior (IBBA), *Vrije Universiteit Amsterdam*

[3] Department of Social and Behavioral Sciences, *Toulouse School of Economics*

[4] *Institute for Advanced Study in Toulouse*

[5] Department of Anthropology, *University of California, Davis*

* Corresponding author: Catherine Molho, c.molho@vu.nl, Van der Boechorststraat 7, 1081 BT Amsterdam, *Vrije Universiteit Amsterdam*.

Abstract

Norms and institutions enable large-scale human cooperation by creating shared expectations and changing individuals' incentives via monitoring or sanctioning. Like material technologies, these social technologies satisfy instrumental ends and solve difficult problems. However, the similarities and differences between the evolution of material technologies and the evolution of social technologies remain unresolved. Here, we review evidence suggesting that, compared to the evolution of material technologies, institutional and normative evolution exhibits constraints in the production of variation and the selection of useful variants. These constraints stem from the frequency-dependent nature of social technologies and limit the pace and scope of normative and institutional evolution. We conclude by reviewing research on the social transmission of institutions and norms and highlighting an experimental paradigm to study their cultural evolution.

Keywords: institutions, norms, technology, social learning, cultural evolution

1. Introduction

Norms and institutions organize much of human cooperation [1,2]. By establishing common expectations of good behavior and by monitoring and punishing free riders, they reconfigure the incentives of cooperation, enabling human-unique forms of sociality, from the maintenance of common pool resources in small-scale societies to the large-scale cooperation exemplified in modern states [1–3]. The diversity of human institutions reflects our varied social ecologies, and includes age sets [4], kinship systems [5], justice systems [6], and sharing norms [7].

Like all technologies, norms and institutions are "means to fulfill a human purpose" [8]. That is, they are devised to satisfy people's instrumental ends, including incentivizing new forms of cooperation [9]. Yet do norms and institutions, as social technologies, evolve similarly to material technologies? [10] A robust literature on cultural evolution has demonstrated that complex, adaptive material technologies can evolve through the accumulation of beneficial changes over time [11]. Laboratory experiments have shown that such evolution can occur quickly and in the absence of individuals' causal understanding of how such technologies function [12] (although see [13]). Yet the parallels with normative and institutional evolution remain unresolved.

Perhaps most at stake in the comparison between the evolution of social and material technologies is optimality. Research has demonstrated an impressive capacity for cultural evolution to generate complex, well-functioning material technologies on relatively short timescales [11,14]. Indeed, humans' rapid dispersal around the globe, including into environments that are both harsh and vastly different from our ancestral African home, seems to have been facilitated by fast-evolving toolkits and knowledge [11]. Can the cultural evolution of social technologies discover and retain adaptive solutions as effectively as the cultural evolution of material technologies?

Here, we argue that it likely cannot. After introducing the cultural evolution of material technologies, we propose that two key processes of adaptive evolution—generating and filtering variation—are less effective for the evolution of institutions and norms, reflecting their inherent social nature. We conclude by reviewing recent empirical research on the social transmission of norms and institutions and highlight a paradigm to study institutional evolution experimentally.

2. The cultural evolution of material technologies

Material technologies evolve through the selective retention of beneficial modifications, alongside nonselective processes such as drift. In recent years, empirical and theoretical research has examined the conditions fostering this cultural evolutionary process [14,15]. The pace of this process is faster when populations produce more variation, as greater variation increases the likelihood of beneficial modifications. This relationship is best illustrated in studies exploring the pace of cumulative cultural evolution within closed groups. For instance, experiments in which participants are tasked with creating visual artifacts in groups of varying sizes reveal that larger groups produce more variation and thus arrive at more efficient solutions [16].

Variation is necessary but insufficient for an adaptive evolutionary process of material technologies. Selective forces play a pivotal role in retaining advantageous modifications and filtering out detrimental ones. In experiments, participants produce, evaluate, and selectively retain variants that appear to best achieve instrumental aims, resulting in short-term adaptive evolution [17]. Technologies can evolve into increasingly complex forms as such selection processes are iterated across generations of learners [18], particularly when individuals can learn from the best cultural demonstrators. This is best illustrated by experiments showing that complex solutions frequently become extinct in populations where learners are assigned cultural demonstrators randomly [19]. In contrast, complex solutions can persist in groups of comparable sizes when learners can use cues such as success to choose whom to learn from [19].

Selective forces can operate well in the case of material technologies due to objective performance criteria. Research on the diffusion of innovations has long established that innovations spread faster when their advantages are observable and easier to evaluate [20] and, *a priori*, this seems more the case for material than for social technologies. Simply, the laws of physics, chemistry, and biology create inherent constraints that determine which solutions are efficient and which are not. Given such objective constraints, cultural evolution can operate even when social learning is imperfect. When populations are large enough, individuals' propensity to learn from successful cultural demonstrators results in a directional force that promotes the transmission of the most beneficial solutions and outweighs the degrading effects of learning errors [21,22].

When these conditions are met, cultural evolution can produce solutions that individuals cannot produce on their own [11]. The efficiency of material technologies results from the interaction between many parameters, which makes any piece of technology a multi-dimensional problem that is hard to solve individually. Experimental work has shown that the gradual retention of improvements across generations can give rise to highly optimized solutions, even in the absence of understanding about how these solutions work. An example comes from an experiment where human participants were asked to optimize a wheel that had four radial spokes and one weight that could be moved along each spoke [12]. Across successive artificial generations of participants, wheels became progressively faster at covering a given distance, while participants' understanding remained poor throughout. Corroborating these experimental findings, anthropologists found that Hadza bowmakers understand some mechanical trade-offs but not others, suggesting that regular users of complex tools similarly have incomplete causal understandings of their technologies [23].

In sum, previous work demonstrates that cultural evolution can result in the emergence of complex solutions when learners can observe multiple cultural demonstrators, with selective social learning being instrumental in preserving beneficial cultural traits and facilitating further enhancements.

3. The cultural evolution of social technologies

Social technologies such as institutions and norms share many similarities with material technologies. They vary over space and time, serve instrumental purposes, and possess complexity such that their efficacy hinges on the interplay between multiple parameters with hard-to-predict consequences. Like material technologies, social technologies can be subject to cultural evolution, where socially learned and transmitted solutions undergo selection, potentially leading to the emergence of more efficient institutions and norms over time [14,24,25].

However, we expect institutional evolution to differ significantly from the evolution of material technologies. This is because, in contrast to most examples of material technology evolution, the evolutionary process underlying institutional evolution is frequency-dependent [26]. By this, we mean that the payoffs (and associated fitness consequences) of adhering to a given rule depend on whether other individuals also adhere (or are expected to adhere) to the same rule [27]. In a nutshell, while the evolution of material technologies is akin to non-strategic decision-making, institutional and normative evolution is akin to strategic decision-making by a set of actors with conflicting interests [28]. As a result, the evolution of institutions may lack the kind of directional selection that sustains the gradual accumulation of beneficial changes in material technology evolution.

The frequency-dependent nature of institutional evolution often results in different groups coordinating on different equilibria—that is, on different institutional solutions to the same collective action problems. Institutional evolution then takes the form of the movement from one equilibrium to another or the displacement of one norm by another. Scholars have likened this equilibrium selection process to Sewall Wright's shifting balance theory [29] and suggested that it proceeds in three phases. During the first phase, sufficiently many individuals *within* a group behave idiosyncratically (i.e., against their immediate self-interest) until a societal 'tipping point' is reached. During the second phase, rational behavior moves the group from the tipping point to a new norm. During the third and final phase, different processes *between* groups (e.g., selective imitation [29,30], selective migration [31], or intergroup conflict [32]) can export the new norm to the rest of the population, thus inciting a global institutional shift. Theoretical models of cultural group selection [33] have explored ways this evolutionary process can take place, especially during phase three, while more recent work has focused on the importance of various kinds of idiosyncratic behavior [34] and foresight [30] on the change of within-group norms during phases one and two. Several factors, such as the size of groups within a population [34–36], the balance between drift and selection [37], and the ways that collective action makes groups reach tipping points [34] can influence the process of moving to new norms and institutions.

In other words, for normative or institutional change to occur, individuals need to coordinate with others in their group and remain observant of cultural models provided by other groups in their population. These requirements place significant constraints on the evolution of norms and institutions, making it slower and less efficient than the evolution of material technologies.

Another constraint involves the generation of variation. New variants of material technologies can be produced and adopted individually, allowing people to explore solutions themselves and copy solutions from diverse cultural demonstrators within their group. In contrast, this is not possible for norms and institutions. To explore new norms and institutions requires coordination within groups [38], and it is often only possible to observe alternative institutional solutions by looking outside one's own group. As a result, the amount of variation in institutions will be lower than in material technologies, reducing the efficacy of the selection process.

Judging what constitutes a good solution is also substantially more challenging for norms and institutions compared to material technologies. When it comes to material technologies, learners can use objective indicators of performance when deciding to adopt a given solution, which promotes the rapid spread of efficient solutions [20]. Experiments investigating the evolution of material technologies have shown that the ability of individuals to evaluate the success of solutions strongly affects cultural evolution, with weak evidence of successive improvement when participants could not easily evaluate performance, and clear improvement over time when they could [39]. In contrast, several factors make evaluating the effectiveness of institutions more difficult. First, individuals with different characteristics or interests may easily reach different conclusions about the appeal of a given institutional solution. Second, the effects of implementing a given institutional solution typically take longer to be felt and observed. Third, in the absence of a clear signal of what constitutes good solutions, group members might have to deliberate until most group members are convinced that a given solution must be adopted [38]. Thus, compared to material technologies, it is likely that these features of institutions will slow down the selection process.

The differences we have identified do not entail that cultural evolution across generations plays a smaller role for norms and institutions than it does for material technologies. To the contrary, experiments have shown that unpredictable payoffs such as those associated with institutions accentuate cultural inertia because individuals are more likely to rely on social information when they are uncertain [39]. Instead, these differences suggest that institutional evolution will take longer to produce adaptive outcomes while exploring fewer alternative solutions.

4. Experimental methods to study the evolution of social technologies

A large body of experimental work has examined how groups create, negotiate, and vote on the institutional rules that govern their social interactions [40]. Such institutional rules include systems that reward cooperators, sanction free-riders, or exclude norm breakers from group interactions. This toolkit of experimental methods can fruitfully be used to tackle outstanding questions regarding how institutional rules and norms emerge, proliferate, and evolve over time [41,42].

When it comes to norm emergence, prior work has shown that norms sometimes emerge organically from social interactions. Experiments demonstrate that common behaviors can gain normative power simply because of their ubiquity. To illustrate, frequently observed behaviors are judged as more moral and less worthy of punishment, and this applies to both selfish and altruistic behaviors [43]. Established conventions exert an influence on people's behavior, such that many individuals stick to these conventions even in the presence of clear incentives to deviate [44]. In repeated symmetric or asymmetric volunteer's dilemma games, different conventions (solitary volunteering and turn-taking, respectively) emerge spontaneously and become normative, with deviations from them condemned even outside the context where they emerged [45].

At the same time, norms and institutions can shift dynamically in response to changing incentive structures and social information. Several studies have examined how groups coordinate on distinct conventions, and how established norms can be displaced by new ones. When changes in incentives are large enough to render previous norms inefficient, group members successfully coordinate on new behavioral patterns (though some norms—such as turn-taking—are more resistant to change) [45]. When groups face higher risks, they develop stronger norms [46–48] which resist erosion even when risk subsides. The stability of norms is precarious, though, because observing examples of norm breakers has a larger impact on norm adherence than observing followers [49]. This asymmetric influence of "bad apples" on compliance can be counteracted by knowledge of group membership [50]—which increases the relevance of good examples—or by strong sanctioning norms—which ensure norm breakers are met with condemnation [51].

To better understand institutional and normative change, it is crucial to study how people socially learn and culturally transmit institutional rules. Influential experiments where subjects "vote with their feet" to interact under different institutional regimes have shown that people use social information about payoffs when choosing to interact with or without a sanctioning institution [52,53]. Over time, most people move to the sanctioning regime, under which payoffs are higher, and they conform to contribution and sanctioning norms under that regime [52]. When provided with social information on the institutional choices and payoffs of previous subjects, people use it to adjust their own institutional choices, and their cooperative and sanctioning behaviors [54].

Still, several questions regarding the production of variation in norms and institutions, and selection among variants of these social technologies remain unanswered and could be addressed experimentally. We believe that one generative avenue for future research on normative and institutional evolution lies in adapting the transmission chain design that has been used to study the cultural evolution of material technologies in experimental settings [12,55]. As explained earlier, this design allows researchers to study how successive generations of participants devise solutions to problems such as the wheel optimization in ref. [12]. Participants' solutions, along with their causal theories of how these solutions work, are transmitted to subsequent participants along a chain to examine technological change over time. Applying a similar design to social technologies, researchers could study the cultural transmission of norms and institutions across several generations and more directly test the similarities and differences between the evolutionary process of material technologies compared to social ones.

5. Conclusions

Norms and institutions make possible the unique large-scale cooperation observed in humans. Understanding the emergence and change of these social technologies is, therefore, a crucial task for the social sciences. Here, we have argued that the evolution of norms and institutions, by its frequency-dependent and group-based nature, involves constraints that make this process slower and less efficient than the evolution of material technologies. By capitalizing on transmission chain designs that have been used to study the evolution of material technologies, future research can test these ideas experimentally and shed light on processes of normative and institutional evolution.

Conflict of Interest Statement

The authors declare no conflict of interest.

Funding

J. P. and M. D. acknowledge funding from the French National Research Agency (ANR) under the Investments for the Future (Investissements d'Avenir) program, grant ANR-17-EURE-0010; M. D. also acknowledges ANR funding through the ANR-21-CE28-0019-01 OPTILEARN project.

References

[1] S.T. Powers, C.P. van Schaik, L. Lehmann, How institutions shaped the last major evolutionary transition to large-scale human societies, Phil. Trans. R. Soc. B 371 (2016) 20150098. https://doi.org/10.1098/rstb.2015.0098.

[2] M. Singh, R. Wrangham, L. Glowacki, Self-Interest and the Design of Rules, Hum Nat 28 (2017) 457–480. https://doi.org/10.1007/s12110-017-9298-7.

[3] S.T. Powers, C.P. Schaik, L. Lehmann, Cooperation in large-scale human societies — What, if anything, makes it unique, and how did it evolve?, Evolutionary Anthropology 30 (2021) 280–293. https://doi.org/10.1002/evan.21909.

[4] L. Glowacki, The emergence of locally adaptive institutions: Insights from traditional social structures of East African pastoralists, Biosystems 198 (2020) 104257. https://doi.org/10.1016/j.biosystems.2020.104257.

[5] J.F. Schulz, D. Bahrami-Rad, J.P. Beauchamp, J. Henrich, The Church, intensive kinship, and global psychological variation, Science 366 (2019) eaau5141. https://doi.org/10.1126/science.aau5141.

[6] L. Fitouchi, M. Singh, Punitive justice serves to restore reciprocal cooperation in three small-scale societies, Evolution and Human Behavior 44 (2023) 502–514. https://doi.org/10.1016/j.evolhumbehav.2023.03.001.

[7] P. Wiessner, C.H. Huang, A 44-y perspective on the influence of cash on Ju/'hoansi Bushman networks of sharing and gifting, Proceedings of the National Academy of Sciences 119 (2022) e2213214119. https://doi.org/10.1073/pnas.2213214119.

[8] W.B. Arthur, The Nature of Technology: What It Is and How It Evolves, Reprint edition, Free Press, 2011.

[9] J. Lie-Panis, L. Fitouchi, N. Baumard, J.-B. André, The social leverage effect: Institutions transform weak reputation effects into strong incentives for cooperation, (2023). https://doi.org/10.31234/osf.io/uftzb.

[10] A. Greif, Do institutions evolve?, J Bioecon 16 (2014) 53–60. https://doi.org/10.1007/s10818-013-9173-5.

[11] J. Henrich, The Secret of Our Success: How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter, Princeton University Press, 2016. https://doi.org/10.2307/j.ctvc77f0d.

[12] M. Derex, J.-F. Bonnefon, R. Boyd, A. Mesoudi, Causal understanding is not necessary for the improvement of culturally evolving technology, Nat Hum Behav 3 (2019) 446–452. https://doi.org/10.1038/s41562-019-0567-9.

[13] F. Osiurak, E. Reynaud, The elephant in the room: What matters cognitively in cumulative technological culture, Behavioral and Brain Sciences 43 (2020) e156. https://doi.org/10.1017/S0140525X19003236.

[14] P.J. Richerson, R. Boyd, Not By Genes Alone: How Culture Transformed Human Evolution, University of Chicago Press, 2008.

[15] R. Boyd, P.J. Richerson, J. Henrich, The Cultural Evolution of Technology: Facts and Theories, (2013). https://doi.org/10.7551/mitpress/9894.003.0011.

[16] M. Derex, R. Boyd, The foundations of the human cultural niche, Nat Commun 6 (2015) 8398. https://doi.org/10.1038/ncomms9398.

[17] K.R. Allen, K.A. Smith, J.B. Tenenbaum, Rapid trial-and-error learning with simulation supports flexible tool use and physical reasoning, Proc. Natl. Acad. Sci. U.S.A. 117 (2020) 29302–29310. https://doi.org/10.1073/pnas.1912341117.
[18] M. Singh, Subjective selection and the evolution of complex culture, Evolutionary Anthropology: Issues, News, and Reviews 31 (2022) 266–280. https://doi.org/10.1002/evan.21948.
[19] B. Thompson, B. Van Opheusden, T. Sumers, T.L. Griffiths, Complex cognitive algorithms preserved by selective social learning in experimental populations, Science 376 (2022) 95–98. https://doi.org/10.1126/science.abn0915. **

** This large-scale experiment used a transmission chain design to study the cultural evolution across generations of complex cognitive algorithms to solve a difficult decision problem. Selective social learning allowed efficient yet complex strategies to persist in the population.

[20] E.M. Rogers, Diffusion of Innovations, Free Press, 2003.
[21] J. Henrich, Demography and Cultural Evolution: How Adaptive Cultural Processes Can Produce Maladaptive Losses—The Tasmanian Case, American Antiquity 69 (2004) 197–214. https://doi.org/10.2307/4128416.
[22] L. Lehmann, J.Y. Wakano, The handaxe and the microscope: individual and social learning in a multidimensional model of adaptation, Evolution and Human Behavior 34 (2013) 109–117. https://doi.org/10.1016/j.evolhumbehav.2012.11.001.
[23] J.A. Harris, R. Boyd, B.M. Wood, The role of causal knowledge in the evolution of traditional technology, Curr Biol 31 (2021) 1798-1803.e3. https://doi.org/10.1016/j.cub.2021.01.096.
[24] S. Bowles, Microeconomics: Behavior, Institutions, and Evolution, Princeton University Press, 2004. https://doi.org/10.2307/j.ctvcm4gc3.
[25] T.E. Currie, P. Turchin, J. Bednar, P.J. Richerson, G. Schwesinger, S. Steinmo, R. Wacziarg, J. Wallis, Evolution of institutions and organizations, in: MIT Press, 2016. https://ore.exeter.ac.uk/repository/handle/10871/29294 (accessed April 30, 2024).
[26] F.J. Ayala, C.A. Campbell, Frequency-Dependent Selection, Annual Review of Ecology, Evolution, and Systematics 5 (1974) 115–138. https://doi.org/10.1146/annurev.es.05.110174.000555.
[27] C. Bicchieri, The Grammar of Society: The Nature and Dynamics of Social Norms, Cambridge University Press, 2005.
[28] D. Fudenberg, J. Tirole, Game Theory, MIT Press, 1991.
[29] R. Boyd, P.J. Richerson, Group Beneficial Norms Can Spread Rapidly in a Structured Population, Journal of Theoretical Biology 215 (2002) 287–296. https://doi.org/10.1006/jtbi.2001.2515.
[30] S. Gavrilets, M. Duwal Shrestha, Evolving institutions for collective action by selective imitation and self-interested design, Evolution and Human Behavior 42 (2021) 1–11. https://doi.org/10.1016/j.evolhumbehav.2020.05.007.
[31] R. Boyd, P.J. Richerson, Voting with your feet: Payoff biased migration and the evolution of group beneficial behavior, Journal of Theoretical Biology 257 (2009) 331–339. https://doi.org/10.1016/j.jtbi.2008.12.007.
[32] C. Efferson, H. Bernhard, U. Fischbacher, E. Fehr, Super-additive cooperation, Nature 626 (2024) 1034–1041. https://doi.org/10.1038/s41586-024-07077-w. *

* A recent model showing how intergroup processes in a subdivided population can drive institutional evolution and select efficient conventions for reciprocal altruism in a repeated game with continuous strategies.

[33] P. Richerson, R. Baldini, A.V. Bell, K. Demps, K. Frost, V. Hillis, S. Mathew, E.K. Newton, N. Naar, L. Newson, C. Ross, P.E. Smaldino, T.M. Waring, M. Zefferman, Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence, Behav Brain Sci 39 (2016) e30. https://doi.org/10.1017/S0140525X1400106X.
[34] S.-H. Hwang, S. Naidu, S. Bowles, Social Conflict and the Evolution of Unequal Conventions, Journal of the European Economic Association (2024) jvae004. https://doi.org/10.1093/jeea/jvae004. **

** Based on a mathematical model of institutional evolution in an asymmetric game that allows for the idiosyncratic rejection of the status quo convention to be partially intentional, this study shows that if idiosyncratic behavior is sufficiently intentional and the subordinate class is sufficiently large, unequal risk-dominated conventions can persist in the long run.

[35] S.T. Powers, C. Perret, T.E. Currie, Playing the political game: the coevolution of institutions with group size and political inequality, Philosophical Transactions of the Royal Society B: Biological Sciences 378 (2023) 20220303. https://doi.org/10.1098/rstb.2022.0303. *

* Formalizing the formation of institutional rules as a consensus formation model, this study shows how increasing the cost of forming a consensus selects for hierarchical organizations and more political inequality within groups.

[36] J. Peña, G. Nöldeke, Group size effects in social evolution, Journal of Theoretical Biology 457 (2018) 211–220. https://doi.org/10.1016/j.jtbi.2018.08.004.
[37] J. Van Cleve, L. Lehmann, Stochastic stability and the evolution of coordination in spatially structured populations, Theoretical Population Biology 89 (2013) 75–87. https://doi.org/10.1016/j.tpb.2013.08.006.
[38] C. Boehm, C. Antweiler, I. Eibl-Eibesfeldt, S. Kent, B.M. Knauft, S. Mithen, P.J. Richerson, D.S. Wilson, Emergency Decisions, Cultural-Selection Mechanics, and Group Selection [and Comments and Reply], Current Anthropology 37 (1996) 763–793. https://doi.org/10.1086/204561.
[39] C.A. Caldwell, A.E. Millen, Conservatism in laboratory microsocieties: unpredictable payoffs accentuate group-specific traditions, Evolution and Human Behavior 31 (2010) 123–130. https://doi.org/10.1016/j.evolhumbehav.2009.08.002.
[40] A. Dannenberg, C. Gallier, The choice of institutions to solve cooperation problems: a survey of experimental research, Exp Econ 23 (2020) 716–749. https://doi.org/10.1007/s10683-019-09629-8.
[41] J. Gross, A. Vostroknutov, Why do people follow social norms?, Current Opinion in Psychology 44 (2022) 1–6. https://doi.org/10.1016/j.copsyc.2021.08.016.
[42] G. Andrighetto, E. Vriens, A research agenda for the study of social norm change, Phil. Trans. R. Soc. A. 380 (2022) 20200411. https://doi.org/10.1098/rsta.2020.0411.

[43] B. Lindström, S. Jangard, I. Selbing, A. Olsson, The role of a “common is moral” heuristic in the stability and change of moral norms, Journal of Experimental Psychology: General 147 (2018) 228–242. https://doi.org/10.1037/xge0000365.
[44] F. Guala, L. Mittone, How history and convention create norms: An experimental study, Journal of Economic Psychology 31 (2010) 749–756. https://doi.org/10.1016/j.joep.2010.05.009.
[45] W. Przepiorka, A. Szekely, G. Andrighetto, A. Diekmann, L. Tummolini, How Norms Emerge from Conventions (and Change), Socius: Sociological Research for a Dynamic World 8 (2022) 237802312211245. https://doi.org/10.1177/23780231221124556.
[46] A. Szekely, F. Lipari, A. Antonioni, M. Paolucci, A. Sánchez, L. Tummolini, G. Andrighetto, Evidence from a long-term experiment that collective risks change social norms and promote cooperation, Nat Commun 12 (2021) 5452. https://doi.org/10.1038/s41467-021-25734-w.
[47] M.J. Gelfand, J.L. Raver, L. Nishii, L.M. Leslie, J. Lun, B.C. Lim, L. Duan, A. Almaliach, S. Ang, J. Arnadottir, Z. Aycan, K. Boehnke, P. Boski, R. Cabecinhas, D. Chan, J. Chhokar, A. D’Amato, M. Ferrer, I.C. Fischlmayr, R. Fischer, M. Fülöp, J. Georgas, E.S. Kashima, Y. Kashima, K. Kim, A. Lempereur, P. Marquez, R. Othman, B. Overlaet, P. Panagiotopoulou, K. Peltzer, L.R. Perez-Florizno, L. Ponomarenko, A. Realo, V. Schei, M. Schmitt, P.B. Smith, N. Soomro, E. Szabo, N. Taveesin, M. Toyama, E. Van de Vliert, N. Vohra, C. Ward, S. Yamaguchi, Differences Between Tight and Loose Cultures: A 33-Nation Study, Science 332 (2011) 1100–1104. https://doi.org/10.1126/science.1197754.
[48] C. Molho, F. De Petrillo, Z.H. Garfield, S. Slewe, Cross-societal variation in norm enforcement systems, Philos Trans R Soc Lond B Biol Sci 379 (2024) 20230034. https://doi.org/10.1098/rstb.2023.0034.
[49] E. Dimant, Contagion of pro- and anti-social behavior among peers and the role of social proximity, Journal of Economic Psychology 73 (2019) 66–88. https://doi.org/10.1016/j.joep.2019.04.009.
[50] C. Bicchieri, E. Dimant, S. Gächter, D. Nosenzo, Social proximity and the erosion of norm compliance, Games and Economic Behavior 132 (2022) 59–72. *

* Qualifying the finding that bad examples have an asymmetrically strong influence on norm adherence, this experiment shows that even minimal cues of social similarity increase the relevance of observing good examples of norm following.

[51] E. Vriens, G. Andrighetto, L. Tummolini, Risk, sanctions and norm change: the formation and decay of social distancing norms, Phil. Trans. R. Soc. B 379 (2024) 20230035. https://doi.org/10.1098/rstb.2023.0035.
[52] Ö. Gürerk, B. Irlenbusch, B. Rockenbach, The Competitive Advantage of Sanctioning Institutions, Science 312 (2006) 108–111. https://doi.org/10.1126/science.1123633.
[53] S. Lo Iacono, W. Przepiorka, V. Buskens, R. Corten, M. Van Assen, A. Van De Rijt, The competitive advantage of sanctioning institutions revisited: A multilab replication, PNAS Nexus 2 (2023) pgad091. https://doi.org/10.1093/pnasnexus/pgad091.

** This multi-site experiment successfully replicated the findings in ref. [52] across seven European countries. Based on social information about payoffs under different institutional regimes, participants “voted with their feet” in favor of sanctioning regimes that outperformed regimes without sanctioning.

[54] Ö. Gürerk, Social learning increases the acceptance and the efficiency of punishment institutions in social dilemmas, Journal of Economic Psychology 34 (2013) 229–239. https://doi.org/10.1016/j.joep.2012.10.004.
[55] C.A. Caldwell, A.E. Millen, Studying cumulative cultural evolution in the laboratory, Phil. Trans. R. Soc. B 363 (2008) 3529–3539. https://doi.org/10.1098/rstb.2008.0133.