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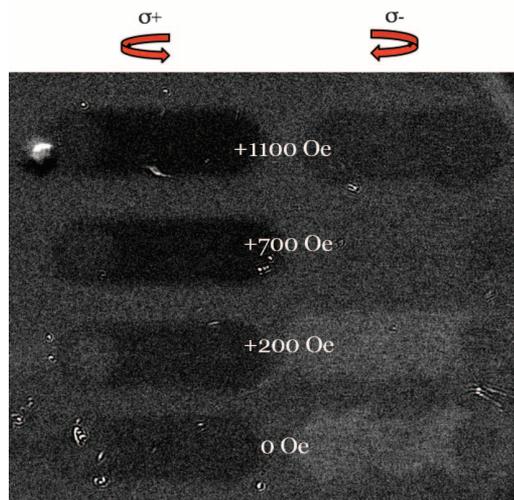
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Fig. 4. Magneto-optical response in various applied magnetic field of a 15-nm FePtAgC granular film sample starting with an initially demagnetized sample. Shown are line scans for σ^+ circularly polarized light in the left column and σ^- circularly polarized light in the right column. The laser power was 677 nW. The magnitude of the external magnetic field is given in the figures, and the orientation of the field supports σ^+ polarization and opposes the σ^- polarization.



the sample will demagnetize during cooling. For perpendicular magnetized films, there are strong dipolar fields within the film that support domain formation. The dipolar energy gain for domain formation is strongly suppressed in the ultrathin film limit and explains the observation of AO-HDS only in the thin-film limit (Figs. 1 and 2). Domain formation is also suppressed for low magnetization materials, consistent with AO-HDS measurements of ferrimagnetic materials (11).

The present results on ferromagnetic materials demonstrate a new and technologically important class of materials showing AO-HDS and opens new directions in integrated magneto-optical memory, data storage, and processing applications. This study further offers progress toward a better understanding of the interaction between pulsed polarized light and magnetic materials.

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SUPPLEMENTARY MATERIALS

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Figs. S1 to S7
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SOCIAL PSYCHOLOGY

Morality in everyday life

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The science of morality has drawn heavily on well-controlled but artificial laboratory settings. To study everyday morality, we repeatedly assessed moral or immoral acts and experiences in a large ($N = 1252$) sample using ecological momentary assessment. Moral experiences were surprisingly frequent and manifold. Liberals and conservatives emphasized somewhat different moral dimensions. Religious and nonreligious participants did not differ in the likelihood or quality of committed moral and immoral acts. Being the target of moral or immoral deeds had the strongest impact on happiness, whereas committing moral or immoral deeds had the strongest impact on sense of purpose. Analyses of daily dynamics revealed evidence for both moral contagion and moral licensing. In sum, morality science may benefit from a closer look at the antecedents, dynamics, and consequences of everyday moral experience.

How people distinguish between actions that are “right” and “wrong” affects many important aspects of life. Morality science— informed by philosophy, biology, anthropology, and psychology—seeks to understand how the moral sense develops (1, 2), how moral judgments are made (3, 4), how moral experiences differ among individuals, groups, and cultures (5–8), and what the psychological implications of the morally “good” or “bad” life are (9).

Insights from contemporary morality research have mostly been gained through the analysis of

moral vignettes, questionnaire data, and thought experiments such as trolley problems (10). As important as these approaches are, they are all limited to some extent by the artificial nature of the stimuli used and the non-natural settings in which they are embedded. Despite considerable scientific and practical interest in issues of morality, virtually no research has taken morality science out of these artificial settings and directly asked people about whether and how they think about morality and immorality in the course of their everyday lived experience. Here we present an attempt to capture moral events, experiences, and dynamics as they unfold in people’s natural environments.

Using ecological momentary assessment (11), we addressed a number of fundamental key issues in scientific and public debates about morality:

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(i) How often do people commit moral and immoral acts in their daily lives? How often are they the targets of moral and immoral acts? How often do they witness moral and immoral acts in their environment, or learn about them through indirect channels such as social media? (ii) What are these moral experiences about? In particular, we examined how well an influential taxonomy of moral dimensions, moral foundations theory [MFT (12–14)], can account for descriptive content, and whether everyday moral experiences highlight

understudied dimensions of morality. (iii) Given the ongoing debate about whether religion is a necessary foundation for morality (15, 16), is there evidence that religious people actually commit more moral or fewer immoral deeds than nonreligious people? And can we replicate evidence for a political morality divide between liberals and conservatives (6, 17)? (iv) What is the empirical connection between morality, momentary happiness, and meaning in life (i.e., sense of purpose)? For instance, does committing moral deeds like-

wise boost momentary happiness and sense of purpose? (v) Finally, our approach affords the possibility to study the temporal dynamics of morality. For instance, are people more likely to do something good if they have become the targets of a moral deed themselves (moral contagion)? And can we replicate moral self-licensing effects demonstrated in the lab (18) in the context of everyday social interaction, whereby committing a prior moral act leads people to relax their moral standards with regard to subsequent behavior?

We recruited a large, demographically and geographically diverse sample (1252 adults aged 18 to 68 years) from the United States and Canada. Each participant was randomly signaled five times daily on his or her smartphone for 3 days between 9 a.m. and 9 p.m. At each assessment, participants indicated whether they committed, were the target of, witnessed, or learned about a moral or immoral act within the past hour (they could also respond “none of the above”). For each moral or immoral event, participants described via text entry what the event was about. They also provided contextual information on the moral event (e.g., location) and completed state measures of nine distinct moral emotions such as guilt and disgust [on a scale from 0 (not at all) to 5 (very much)], momentary happiness [“How happy do you feel at the moment?” from -3 (very unhappy) to +3 (very happy)], and sense of purpose [“Do you feel that your life has a clear sense of purpose at the moment?” from 0 (not at all) to 4 (very much)]. Religiosity and political

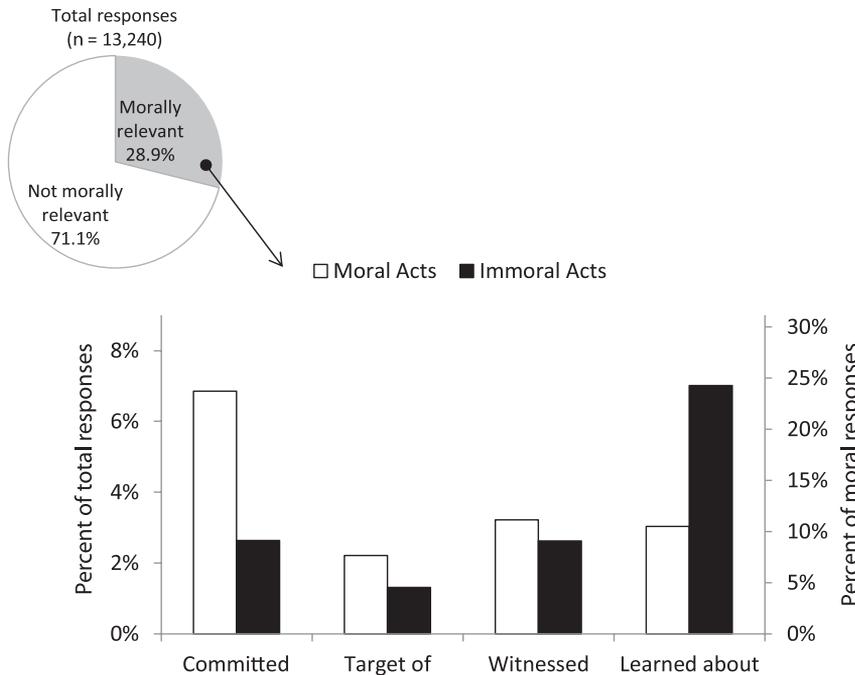


Fig. 1. Overall distribution of responses (pie chart) and of the eight moral event categories (bar graph) in relation to total responses (left axis) and morally relevant responses (right axis). Type of event and moral valence (moral versus immoral) were statistically associated; see main text.

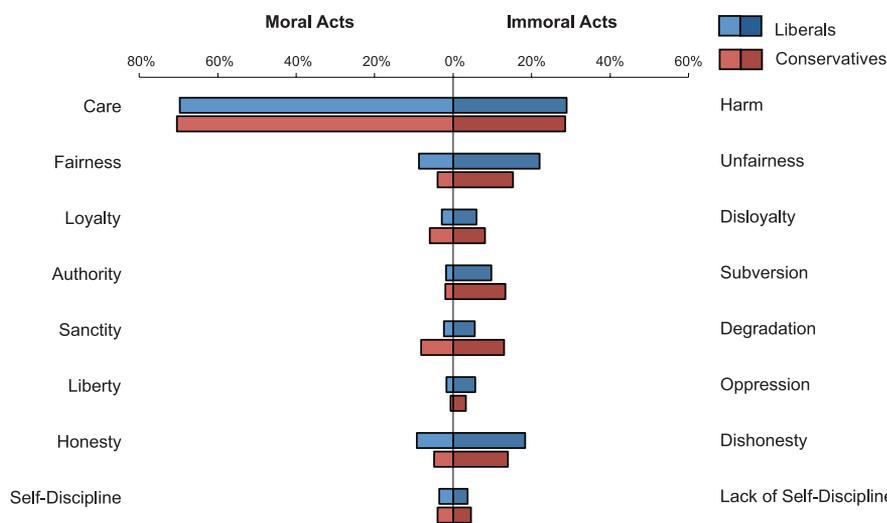


Fig. 2. Moral content and liberal versus conservative political ideology. Percentage distributions of moral and immoral event codings by political ideology (liberals versus conservatives) are shown on moral dimensions. Moral as well as immoral events within each political ideology add up to 100%. Moral content and political ideology were statistically associated; see main text.

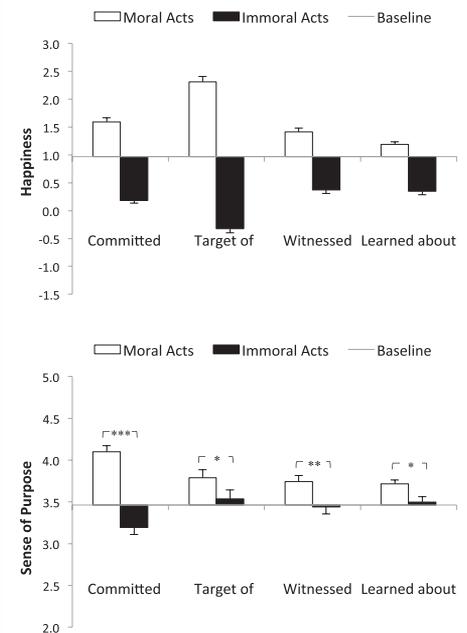


Fig. 3. Morality, happiness, and purpose. Moral acts were associated with relative gains in happiness relative to baseline, immoral acts with relative losses (upper panel). The happiness effect was strongest when people reported being the target of moral/immoral acts. Sense of purpose was most strongly affected by the commission of moral as compared to immoral acts (lower panel). * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

ideology were assessed during an intake survey upon study registration.

Participants furnished a total of 13,240 reports (at a median response rate of 80%). On 28.9% of responses ($n = 3828$), participants reported a moral or immoral event. Moral events (15.3%; $n = 2029$) and immoral events (13.6%; $n = 1799$) had similar overall frequencies. As shown in Fig. 1, type of event and moral valence were associated such that people were more likely to report committing or being the target of a moral versus an immoral act, and were more likely to learn about an immoral rather than a moral act [$\chi^2(3) = 483.6$, $P < 0.001$, Cramer's $V = 0.36$]. The finding that people were more than twice as likely to find out about immoral rather than moral acts through personal communication (e.g., gossiping) and other channels (see fig. S1 for more information on this category) fits well with social-psychological theories of the function of gossip and evolutionary theories of reputation management (19, 20). Excluding learned-about acts (for which location data are often unknown), most moral or immoral acts happened in public settings (64.3%), followed by participants' homes (23.4%), the homes of close others such as family and friends (6.5%), and other settings (5.7%). There was no statistical association between location and whether an act was moral or immoral [$\chi^2(3) = 3.3$, $P = 0.343$, Cramer's $V = 0.04$].

Building on MFT (14), we reliably classified moral events into five originally proposed core dimensions (Care/Harm, Fairness/Unfairness, Loyalty/Disloyalty, Authority/Subversion, Sanctity/Degradation) as well as a newly proposed Liberty/Oppression dimension (17) and two additional categories derived from our data (Honesty/Dishonesty, Self-Discipline/Lack of Self-Discipline) (supplementary materials and table S1). The first five core dimensions accounted for 80.1% of moral events mentioned in daily life (86.1% of moral acts, 73.5% of immoral acts). Care/Harm was by far the most frequently mentioned dimension (50.6%, in particular accounting for a large share of morally good acts; table S2), followed by Fairness/Unfairness

(13.9%), Honesty/Dishonesty (12.8%), Authority/Subversion (5.6%), Sanctity/Degradation (5.2%), Loyalty/Disloyalty (4.8%), Self-Discipline/Lack of Self-Discipline (3.8%), and Liberty/Oppression (3.3%). These results confirm MFT's original core dimensions in spontaneously generated participant responses from everyday life, but also suggest additional categories associated with honesty and self-discipline.

Political ideology was reliably associated with moral content [$\chi^2(7) = 81.9$, $P < 0.001$, Cramer's $V = 0.18$]. Descriptive percentage distributions (Fig. 2) show that liberals mentioned events related to Fairness/Unfairness, Liberty/Oppression, and Honesty/Dishonesty more frequently than did conservatives, whereas conservatives mentioned events related to Loyalty/Disloyalty, Authority/Subversion, and Sanctity/Degradation more frequently than did liberals. More focused tests established that these differences were most reliable for Fairness/Unfairness, Loyalty/Disloyalty, Sanctity/Degradation, Liberty/Oppression, and Honesty/Dishonesty, and remained largely stable when controlling for religiosity, which accounted for significant portions of variance on four of the eight dimensions (see table S3). Thus, our everyday-life approach largely corroborates the idea that political ideology relates to different moral emphases, even though real-world effects appear to be more a matter of nuance rather than stark contrast.

Comparing religious and nonreligious participants, there was no discernible difference in the frequency of positive moral experience (both overall and by event; table S4). Thus, we did not find evidence for religious people committing moral acts more frequently than nonreligious people. Religious people reported fewer immoral experiences overall, but this difference was mostly attributable to religious people reporting having learned about immoral acts less often—a possible result of selective exposure—rather than having committed immoral deeds less often than nonreligious people (table S4). Moreover, a second sample of independent judges ($N = 249$) who were presented with participants' open text descriptions

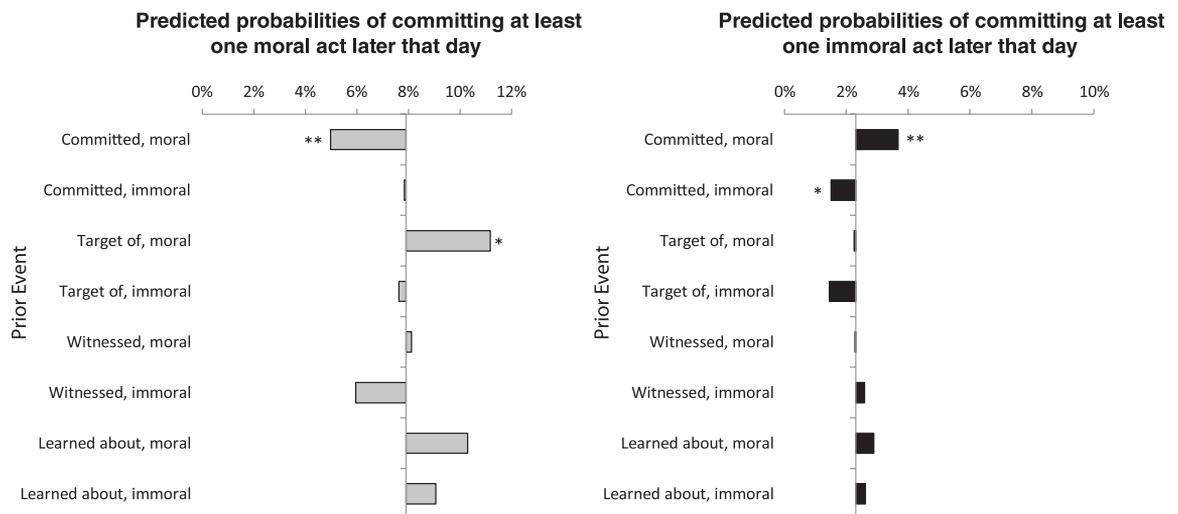
rated moral and immoral deeds committed by religious people as equally right and wrong, respectively (table S5). However, assessing the average emotional "footprints" of these acts revealed that, relative to nonreligious people, religious people experienced more intense self-conscious emotions such as guilt, embarrassment, and disgust in response to the immoral deeds they had committed, and more pride and gratefulness in response to moral deeds (fig. S3). Viewed in concert, these findings suggest that religious and nonreligious people commit comparable moral and immoral deeds and with comparable frequency. However, religious people respond more strongly in psychological terms to the immoral and moral deeds they commit.

Does morality have implications for happiness and sense of purpose? Figure 3 (upper panel) displays momentary happiness levels for the four types of events relative to the baseline level of happiness observed for nonmoral events. Moral acts were associated with higher levels of momentary happiness than immoral acts, as indicated by a large main effect ($F_{1,3441} = 758.4$, $P < 0.001$). This happiness effect was moderated by type of event ($F_{3,3382} = 22.7$, $P < 0.001$) such that the strongest gain and loss in happiness was observed when participants were the targets of moral and immoral acts, respectively (Cohen's $d = 1.34$). Happiness effect sizes were comparatively smaller when committing moral or immoral acts ($d = 0.85$), witnessing them ($d = 0.73$), or learning about them ($d = 0.57$). In contrast, sense of purpose (Fig. 3, lower panel) was most strongly affected by the commission of moral as compared to immoral acts (interaction effect $F_{3,2172} = 5.1$, $P = 0.002$). Hence, whereas benefiting from others' good deeds grants the highest observed levels of momentary happiness among types of events, doing good lends the most purpose to people's lives.

Finally, we investigated whether the likelihood of committing a moral or immoral deed can be predicted by moral events that happened earlier to a person on a given day (table S6). In support for moral contagion, becoming the target of a moral act was associated with an above-average likelihood

Fig. 4. Moral dynamics.

Predicted probabilities with which a prior event is followed by at least one committed moral act (left panel) or immoral act (right panel) on the same day, relative to the average sample probability (vertical axis), are shown. Having been the target of an earlier moral act was associated with an above-average likelihood of subsequent moral behavior. Having committed an earlier moral act was associated with an above-average likelihood of subsequent immoral behavior. * $P < 0.05$, ** $P < 0.01$.



of committing a moral act later (Fig. 4). In addition, a moral self-licensing pattern emerged (18), such that committing a moral act earlier in the day was associated with an above-average likelihood of a subsequent immoral act and a decreased likelihood of a subsequent moral act (Fig. 4). Together, the analysis of everyday moral dynamics revealed evidence both for moral contagion through other people's good deeds and moral self-licensing through one's own good deeds outside of the laboratory. Given these different mechanisms, it seems important to find out more about how the principles of moral contagion can be used in public policy interventions, and how moral slacking may be prevented.

By tracking people's everyday moral experiences, we corroborated well-controlled but artificial laboratory research, refined prior predictions, and made illuminating discoveries about how people experience and structure morality, as well as about how morality affects people's happiness and sense of purpose. A closer, ecologically valid look at how morality unfolds in people's natural environments may inspire new models and theories about what it means to lead the "good" or "bad" life.

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/345/6202/1340/suppl/DC1
Materials and Methods
Figs. S1 to S3
Tables S1 to S6
References (21–27)

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BIODIVERSITY LOSS

Loss of avian phylogenetic diversity in neotropical agricultural systems

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Habitat conversion is the primary driver of biodiversity loss, yet little is known about how it is restructuring the tree of life by favoring some lineages over others. We combined a complete avian phylogeny with 12 years of Costa Rican bird surveys (118,127 detections across 487 species) sampled in three land uses: forest reserves, diversified agricultural systems, and intensive monocultures. Diversified agricultural systems supported 600 million more years of evolutionary history than intensive monocultures but 300 million fewer years than forests. Compared with species with many extant relatives, evolutionarily distinct species were extirpated at higher rates in both diversified and intensive agricultural systems. Forests are therefore essential for maintaining diversity across the tree of life, but diversified agricultural systems may help buffer against extreme loss of phylogenetic diversity.

As human-converted habitats expand over Earth's surface, the fate of global biodiversity will depend increasingly on the quality and characteristics of farming landscapes (1, 2). Agricultural systems vary widely in their ability to support biodiversity, with many species extirpated from some but sustained in others (1, 3). Additionally, characteristics of the species themselves, evolved over millions of years, may predispose some lineages to benefit (or suffer) from human environmental impacts (4–6).

Phylogenetic diversity, the total evolutionary history or phylogenetic branch lengths of all species in a community (7), is recognized as having intrinsic conservation value (8, 9). Also, ecological experiments in small plots indicate that communities with more phylogenetic diversity are more stable (10), possess higher productivity (11), and support more species at other trophic levels (12). Despite the known impact of agriculture on species loss, how habitat conversion affects phylogenetic diversity remains unknown. Studies of plants and invertebrates have established that local environmental disturbances (e.g., lake acidification and species invasion) favor subsets of closely related clades and often result in phylogenetic diversity loss (13–15). Further, some studies that examine the global extinction risk of birds and mammals suggest that particular branches of the

tree of life are at greater risk than others (5, 6, 16), although whether evolutionarily distinct species are more at risk than species with many living relatives remains contested (6, 16, 17).

We quantified changes in phylogenetic diversity across multiple landscapes in Costa Rica, combining a recent complete avian phylogeny (18) with temporally and spatially extensive tropical bird censuses to assess how habitat conversion is restructuring the avian phylogeny (19). The data set comprised 44 transects, surveyed in wet and dry seasons over 12 years (2001 to 2012) across four regions in two biomes (fig. S1). Transects were located in three land-use types: forest reserves, diversified agricultural systems, and intensive monocultures. Compared with intensive monocultures, diversified agricultural systems had more crop types, complex configurations of vegetation, and substantial surrounding tree cover (1) (table S1). Our analysis focused on three unresolved questions. First, do certain bird clades thrive in agriculture, or is this capacity broadly distributed across the tree of life? Second, how much phylogenetic diversity is lost when native forest is replaced with agriculture? Last, are evolutionarily distinct species capable of persisting in agriculture?

We found that clades from across the bird phylogeny thrived in agriculture (Fig. 1). Affinity for different habitats showed phylogenetic signal, meaning that closely related species were more likely to share habitat preferences than species that were distantly related (table S2) (20). The phylogenetic signal was best described by using Pagel's lambda transformation of the phylogeny (21), which reduces the degree of correlation of traits between species below the Brownian motion expectation (across habitat types and seasons, $\lambda = 0.25$ to 0.48; table S3). Although most taxonomic families had species associated with all habitat types, some families tended to affiliate with particular habitats. For example, pigeons, seedeaters, swallows, and blackbirds were

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