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Laws about bodily damage originate from shared intuitions about the value of body parts

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From the biblical *lex talionis* to the medieval wergild system and modern workers' compensation laws, laws about bodily damage may originate from cognitive mechanisms that capitalize on an enduring regularity: Different body parts vary in their incremental contributions to human functionality. To evaluate this hypothesis, we conducted a preregistered study with materials based on five legal codes from highly diverse cultures and historical eras: the Law of Æthelberht (Kent, approximately 600 CE), the Guta lag (Gotland, approximately 1220 CE), and workers' compensation laws from the United States, the Republic of Korea, and the United Arab Emirates; and 614 laypeople from the United States and India. The data indicate ordinal agreement in the values attached to body parts by ancient and modern lawmakers, as well as by laypeople in the United States and India. The observed agreement across time, space, and levels of legal expertise suggests that laws about bodily damage originate from shared intuitions about the value of body parts.

INTRODUCTION

Since ancient times, laws have sought to establish appropriate compensation for the loss of body parts (or life). These laws about bodily damage may derive their core structure and content from shared intuitions about the value of different parts of the human body. This hypothesis has a distinct entailment: There will be correspondences in the values placed on different body parts across time, space, and levels of legal expertise (laypeople and lawmakers). This contrasts with theories that view laws and institutions as cultural constructions based on local social norms and thus as highly variable in space and time (*1*, *2*).

Different body parts and functions contribute differently to the odds that an individual will thrive. Life without a toe is a nuisance, but life without the head is impossible. The regulatory processes that support life may echo this fact. For instance, oxygen is essential for cellular activity, and bouts of decreased oxygen availability—hypoxia—elicit a cascade of systemic adjustments that deal with this dangerous condition. Some of these, such as the dilation of blood vessels supplying the brain and heart and the constriction of vessels supplying muscular and cutaneous tissues, appear to redistribute blood flow and oxygen from less to more vital organs (*3*). These reallocations occur automatically and mandatorily, beyond the actor's control (*3*). However, do humans (also) incorporate knowledge about the value of body parts that can guide voluntary action?

Success in various tasks depends on recognizing, implicitly or explicitly, that different body parts make different contributions to the functionality of an individual and thus are differentially valuable. Such tasks include deciding which parts of an enemy to target in close-range combat, prioritizing the treatment of injuries in cases of multiple injuries, and seeking compensation when others cause death or bodily harm. Consider the latter case. If person A damages a body part of person B, then B (or B's allies) might seek compensation from A (or A's allies). Underclaiming compensation is ineffective for B. Likewise, aggressively overclaiming is inefficient for B because that can invite retaliation from A. Rather, B would balance the competing demands of effectiveness and efficiency if B claimed compensation in a Goldilocks manner (*4*): just right—in proportion to the consensual value that A and B and third parties attach to that body part. We suggest that such tasks rely (in part) on mechanisms that compute the value of body parts and that the core of laws concerning bodily damage is based on the outputs of these mechanisms.

Much of human anatomy can be readily induced through observation (e.g., that people have one nose). In contrast, the values that people subjectively attach to their body parts are not directly available to the senses. Such values could be inferred inductively. However, the observation time required to adequately infer the valuations of a target individual (let alone those of all fellow group members or all humans) might exceed a lifetime. Nevertheless, different body parts likely vary in their incremental contributions to human functionality, and humans may, in some way, develop the corresponding prior expectations and evaluative knowledge.

Body parts are an attractive object of study because (i) there are many consensually recognizable types of parts in the human body; (ii) the incremental contributions of body parts to human functionality appear to vary from one part to the next (e.g., ring finger versus eye); (iii) body parts are nonsocial objects that nevertheless can participate in social events (e.g., someone damaging someone else's hand) and thus can shed light on how Theory-of-Mind (or folk psychology) inferences (*5*, *6*) (e.g., predicting how much anger someone else might feel if one damaged their hand) interact with intuitions about the value of body parts; and (iv) some institutions, such as those that rely on workers' compensation laws, set prices for body parts, which allows one to investigate correspondences between institutional valuations and lay valuations.

Various lines of evidence suggest that people generally attach a positive value to their bodies and their body parts. First, the human body and its parts are saturated with affect and symbolism across cultures. Examples include the Venus figurines, Olmec colossal heads, the heart, the Eye of Ra, the hand-shaped Hamsa amulet against the evil eye, the moutza gesture, the middle finger, the fingers offered to deities for assistance (*7*), and the scalp and other parts taken as trophies in war (*8*) (Fig. 1).

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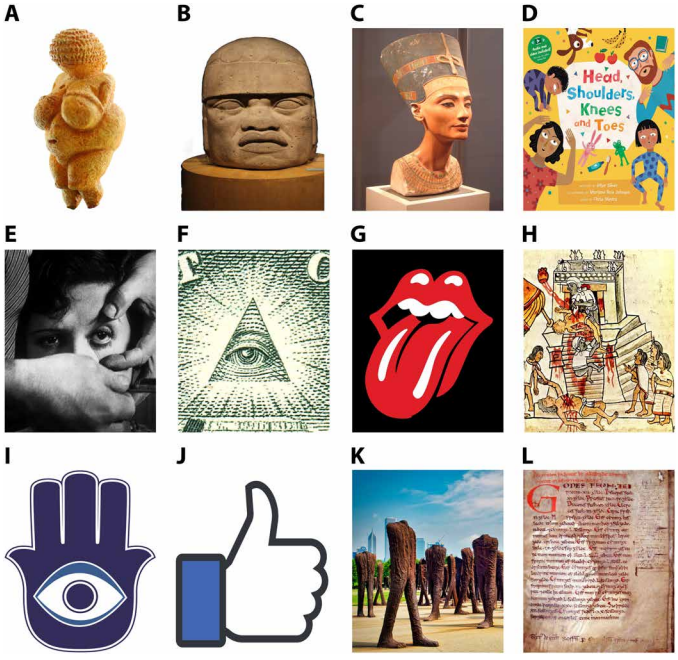

Fig. 1. Human body and its parts in human thought and culture. (**A**) Body: Venus of Willendorf, ~29,500 years ago, found near Willendorf, a village in Austria, Natural History Museum, Vienna, Austria. Photo by M. Kabel (Multi-license with GFDL and Creative Commons CC BY 2.5). (**B**) Head: Olmec colossal head, San Lorenzo, Veracruz, Mexico, 1200 to 600 BCE, National Museum of Anthropology, Mexico City, Mexico. (**C**) Torso: Bust of Nefertiti, Egypt, 14th century BCE, Neues Museum, Berlin, Germany. (**D**) Head, shoulders, knees, and toes: Head, Shoulders, Knees, and Toes: children's song, illustrated by M. R. Johnson, written by S. Silver, published by Barefoot Books. (**E**) Eye: Movie still of L. Buñuel's *An Andalusian Dog* (*67*), photo by A. Duverger and J. Berliet. (**F**) Eye: Eye on the reverse side of the US $1 bill. (**G**) Mouth: Rolling Stones logo, designed by J. Pasche, The Rolling Stones. Image credit: Shutterstock. (**H**) Heart: Aztec Codex Magliabechiano, approximately mid-16th century CE, National Central Library, Florence, Italy. (**I**) Hand and eye: Hamsa amulet against the evil eye, North Africa and Middle East. (**J**) Thumb: Facebook Like button. Image credit: Wikimedia Commons. (**K**) Legs: Agora, by M. Abakanowicz, Grant Park, Chicago, United States, photo by R. Mines. (**L**) Opening folio of the Law of Æthelberht, Kingdom of Kent, approximately 600 CE, Kent County Archives, Maidstone, England; this legal code establishes full or fractional wergild for various offenses relevant to bodily harm.

A second line of evidence involves people's ideations and behavior. Death, injury, and mutilation are major themes in nightmares (*9*) and phobias (*10*). Furthermore, people attach different subjective values to different quantities and types of body parts and functions. For example, in an episode of conflict among criminals in a gulag, "[t]he criminal 'prosecutor' demanded all five [fingers of the 'defendant'], but the 'court' settled for three" [(*11*), p. 347]. In a qualitative study of 13 young-to-middle-aged male British soldiers with lower limb trauma, participants reported that genital injuries were particularly bad, often worse than leg loss (*12*). Poll data from 2044 US adults from the general population indicate that sight loss is a greater concern than, for example, hearing loss or limb loss (*13*).

A third line of evidence refers to institutions relevant to bodily damage. People worldwide are prone to holding the following package of ideas: (i) The body and its parts have positive value to the actor, (ii) damage to those represents a cost to the victim, (iii) different body parts have different value, and (iv) damage to the parts (or the whole) merits countermeasures in proportion to the disutility to the victim (or the victim's family). This package may be common across cultures because the interlinked ideas are intuitive and compelling (*14*, *15*). An iconic instance of the package is found in the Torah's *lex talionis*—"Eye for eye, tooth for tooth, hand for hand, foot for foot" [(*16*), Exod. 21:24]—and in the Codes of Ur-Nammu and Hammurabi (*17*).

In many populations, it was customary for the family of an offender to pay restitution to the family of a slain or injured person in the form of money or other goods (aka blood money, wergild—literally "man price"). There is evidence of this practice among indigenous groups in the Pacific Northwest (*18*), the Northern Paiute (*19*), the Enga of Papua New Guinea (*20*), the Nuer of South Sudan (*21*), tribal Montenegrins (*22*), ancient Mesopotamians (*17*), the Tang Chinese (*4*), the Anglo-Saxons (*23*), and others. Damages can be formulated in a precise, Goldilocks-like manner. For instance, in Frisia approximately 785 CE, penalties for skull injuries depended on how deep the injury was: 12 solidi if the skull bone was pierced; 18 if the membrane (probably the dura mater) was touched; and 24 if the brain showed (*24*). Furthermore, if wergild means that goods can make up for damage to the body, then the reciprocal inference is licensed too: Damage to the body can make up for theft and unpaid debts, as seen in *The Merchant of Venice* (*25*)—wherein Shylock demands a pound of flesh as collateral for a loan he extends to Antonio—and in nonfiction (*26*). Payment of wergild within the community can stymie cycles of lethal vengeance (*22*, *27*) and the concomitant military weakening of the community vis-à-vis neighboring communities and thus be favored in cultural evolution.

The existing evidence indicates that people act on the basis of shared valuations of body parts. However, systematic analyses of lay and institutional valuations of body parts have not been conducted to date. Therefore, to evaluate the hypothesis that laws about bodily damage originate from shared intuitions about the value of body parts, we aim to answer three questions. First, do laypeople impute different subjective values to different body parts? If so, are there correspondences in valuations from one individual and population to the next? Second, are Theory-of-Mind inferences (e.g., estimating the intensity of anger another person would feel if you damaged a body part of theirs) generated lawfully based on subjective valuations of body parts (e.g., proportional to the value you attach to that body part)? Third, do lay valuations of different body parts track (or retrodict) institutional valuations such as the benefits that legal codes in diverse cultures and historical eras establish for individuals who lose those body parts? The previous argument suggests that the answers to these questions are: yes (yes), yes, and yes.

To test these predictions, we conducted a preregistered study with 614 participants from two populations and study materials based on legal statutes from five codes from diverse cultures and historical eras. We tested laypeople—participants without college training in medicine or law—from the United States and India. The study materials referred to aspects of the human body featured in some or all of five legal codes: modern workers' compensation laws from the State of Indiana (*28*) (henceforth, US code), the Republic of Korea (South Korea) (*29*) (henceforth, Korean code), and the United Arab Emirates (*30*) (henceforth, UAE code) and two medieval codes that establish full or fractional wergild for various offenses relevant to bodily harm: the Law of Æthelberht (*27*) (Kent, approximately 600 CE; henceforth, Æthelberht's code) and the Guta lag (*31*) (Gotland, approximately 1220 CE). The single exception

was that the analyses pertaining to the Guta lag were not preregistered and should therefore be regarded as exploratory.

We performed two sets of tests. Test Set 1 tests whether laypeople can discriminate the value of items highly variable in form and function. In Test Set 1, participants evaluated over 30 items. These items included singletons (e.g., "one foot" and "one canine tooth") and sets (e.g., "both hands" and "all ten toes"). Most of the items referred to anatomical parts, but a few referred to functions (e.g., "[loss of] the hearing in one ear"). Test Set 2 tests whether laypeople can make finer-grained evaluative discriminations across items highly similar in form and function. In Test Set 2, participants evaluated five items corresponding to the five fingers (e.g., ring finger and little finger). Participants were shown descriptions of body parts and functions but not the benefits (or fines) provided by the legal codes for the loss of those items.

We blocked the items in each test set and randomized the order of presentation of the two blocks as well as the items within the blocks. In a between-subjects design, we randomly assigned participants to one of seven conditions designed to investigate inferences that depend on knowledge of the value of body parts, including Theory-of-Mind inferences: (i) Difficulty, (ii) My Anger, (iii) My Gratitude, (iv) Their Anger, (v) Their Gratitude, (vi) Price, and (vii) Compensation. In each condition, participants were asked to imagine a background event (e.g., in Difficulty, that they lose a body part in an accident) and answered one question about each item.

The questions in each condition were as follows, with the imagined background event in brackets. (i) Difficulty: [You lose various body parts in an accident]. How difficult, if at all, would it be for you to keep doing the things that you need to do to be a functioning person? (ii) My Anger: How much anger, if any, would you feel toward your acquaintance if, because of their recklessness, you lose various body parts? (iii) My Gratitude: [You lose body parts in an accident but someone is able to reattach them or restore their functionality]. How much gratitude, if any, would you feel toward that person? (iv) Their Anger: [Because of recklessness, you cause an acquaintance of yours to lose body parts]. How much anger, if any, do you think your acquaintance would feel toward you? (v) Their Gratitude: [An acquaintance of yours loses body parts in an accident, but then you are able to reattach them or restore their functionality]. How much gratitude, if any, do you think your acquaintance would feel toward you? (vi) Price: [Imagine there is a country with a market for body parts]. What are the market prices of various body parts in this market? (vii) Compensation: [Imagine that you are a lawmaker; your task is to determine how much money, if any, an employee should receive as compensation if they lose a body part in a workplace accident]. How much money, if any, should employees be compensated with? In Difficulty, My Anger, My Gratitude, Their Anger, and Their Gratitude, participants gave their responses using 0 to 100 sliding bars: 0, lowest value of the variable; 100, highest value of the variable. In Price and Compensation, participants gave their responses using 0 to 10 sliding bars in the US: 0, $0; 10, $10,000,000; and 0 to 11 sliding bars in India: 0, 0 rupees; 11, 100,000,000 rupees.

In all conditions of Test Set 1, participants evaluated 34 items, except that female participants evaluated 32 items in the first-person conditions (Difficulty, My Anger, and My Gratitude)—that is, female participants in those three conditions were not asked to respond about them losing "one testicle" or "both testicles." Participants completed those 34 (or 32) items (Test 1) plus 5 additional items corresponding to the five fingers (Test 2), for a total of 39 items (or 37 items for female participants in the Difficulty, My Anger, and My Gratitude conditions).

RESULTS

Test Set 1

Descriptive statistics of item-level ratings of Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation are displayed on tables S6.1 and S6.2. Ratings of Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation against the corresponding benefits (or fines) dictated by the five legal codes are displayed in Fig. 2.

Do participants agree with one another on how they evaluate different body parts and functions? Yes, participants generally agree with one another on how they evaluate the items relative to one another. This was the case regarding ratings of Difficulty, My Anger, Their Anger, My Gratitude, Their Gratitude, Price, and Compensation. Mean intraclass correlation (ICC) for Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation: ICC $(2,n) = 0.98$ (US); ICC $(2,n) = 0.72$ (India) (table S7).

Are participants' evaluative intuitions positively correlated with one another within countries? Yes. Within each country, the ratings of Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation are positively correlated with one another. In the US: mean $r = 0.95$ (minimum $r = 0.86$; maximum $r = 0.98$; number of correlation coefficients $(N) = 21$; all P values < 0.001). In India: mean $r = 0.8$ (minimum $r = 0.68$; maximum $r = 0.85$; $N = 21$; all P values < 0.001) (table S1; see also table S12). Recall that the seven sets of ratings were given by different participants. Therefore, these high correlations cannot be due to participants aiming to give consistent responses across different sets of ratings.

Are participants' evaluative intuitions in one country positively correlated with participants' evaluative intuitions in the other country? Yes. The ratings of Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation are positively intercorrelated also across countries: mean $r = 0.86$ (minimum $r = 0.73$; maximum $r = 0.96$; $N = 49$; all P values < 0.001). This includes correlations between the same variables (e.g., Difficulty in the US positively correlated with Difficulty in India) and correlations between different variables (e.g., Difficulty in the US positively correlated with My Anger in India) (table S1; see also table S12).

Do participants' evaluative intuitions regarding different body parts track (or retrodict) the benefits (or fines) that the five legal codes establish for the loss of those body parts? Yes. The more participants from the US and India regard the loss of a body part or function as severe, the higher the benefits provided by the US code, the Korean code, the UAE code, and Æthelberht's code for individuals who lose that body part or function and the higher the fines prescribed by the Guta lag for individuals who cause the loss of that body part or function in others (Fig. 2 and table S1; see also table S12).

The higher the benefits provided by the US code for the loss of a body part or function, the higher US participants' ratings of Difficulty ($r = 0.90$, $P < 0.001$), My Anger ($r = 0.78$, $P < 0.001$), My Gratitude ($r = 0.77$, $P < 0.001$), Their Anger ($r = 0.77$, $P < 0.001$), Their Gratitude ($r = 0.73$, $P < 0.001$), Price ($r = 0.83$, $P < 0.001$), and Compensation ($r = 0.86$, $P < 0.001$) relevant to that part or function. Likewise, the higher the benefits provided by the US code

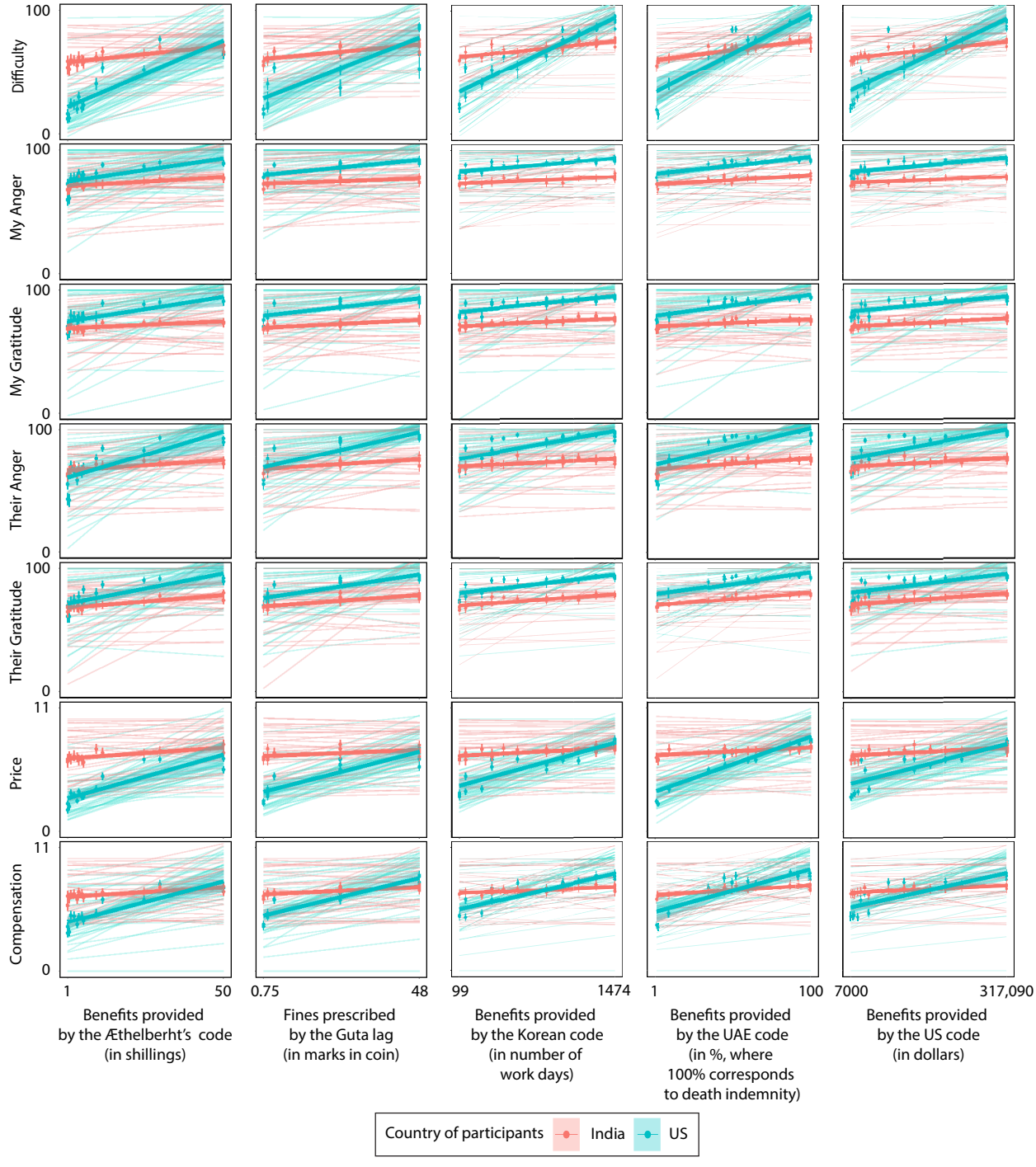

Fig. 2. Test Set 1. Ratings of Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation relevant to various body parts and functions against the corresponding benefits (or fines) dictated by five legal codes for the loss of those parts and functions. Thick lines: lines of best fit at the item level. Thin lines: lines of best fit at the participant level. Dots represent item-level means; error bars represent the SEM. The statistics for all panels are displayed in table S1.

for the loss of a body part or function, the higher Indian participants' ratings of Difficulty ($r = 0.90$, $P < 0.001$), My Anger ($r = 0.68$, $P = 0.001$), My Gratitude ($r = 0.81$, $P < 0.001$), Their Anger ($r = 0.69$, $P = 0.001$), Their Gratitude ($r = 0.80$, $P < 0.001$), Price ($r = 0.65$, $P = 0.003$), and Compensation ($r = 0.82$, $P < 0.001$) relevant to that part or function. Also, the higher the benefits provided by the Korean code, the higher the ratings given by US participants (mean $r = 0.87$; minimum $r = 0.78$; maximum $r = 0.95$; $N = 7$; all P values < 0.001) and Indian participants (mean $r = 0.79$; minimum $r = 0.73$; maximum $r = 0.88$; $N = 7$; all P values < 0.001). Furthermore, the higher the benefits provided by the UAE code, the higher the ratings given by US participants (mean $r = 0.85$; minimum

$r = 0.76$; maximum $r = 0.93$; $N = 7$; all P values < 0.001) and Indian participants (mean $r = 0.82$; minimum $r = 0.76$; maximum $r = 0.90$; $N = 7$; all P values < 0.001). In addition, the higher the fines provided by the Guta lag, the higher the ratings given by US participants (mean $r = 0.86$; minimum $r = 0.81$; maximum $r = 0.91$; $N = 7$; all P values < 0.001) and Indian participants (mean $r = 0.77$; minimum $r = 0.54$; maximum $r = 0.87$; $N = 7$; P values = 0.022 to <0.001). Last, the higher the benefits provided by Æthelberht's code, the higher the ratings given by US participants (mean $r = 0.82$; minimum $r = 0.69$; maximum $r = 0.88$; $N = 7$; P values = 0.004 to <0.001) and Indian participants (mean $r = 0.77$; minimum $r = 0.70$; maximum $r = 0.86$; $N = 7$; P values = 0.004 to <0.001). Recall that participants were shown descriptions of body parts and functions but not the benefits (or fines) dictated by the legal codes for the loss of those parts and functions.

Is there agreement among lawmakers (legal codes) of different cultures and historical eras regarding the benefits (or fines) that they establish for the loss of different body parts and functions? Yes. The benefits (or fines) dictated for the loss of different body parts and functions are positively intercorrelated across the five codes (e.g., payment dictated by the US code versus percentage dictated by the UAE code, where 100% amounts to death indemnity); mean $r = 0.87$ (minimum $r = 0.73$; maximum $r = 0.95$; $N = 10$; P values = 0.164 to <0.001—9 of 10 of these correlations, or 90% of them, have P values < 0.05) (table S1; see also table S12). For further analyses with the other metrics used by the US and Korean codes, see tables S8 and S9.

Laypeople and lawmakers alike attach more value to multiples of a body part or function than to singles (e.g., both hands > one hand). This raises the question: Do the findings reported above reflect simply a one-versus-many quantitative discrimination? No. Preregistered reanalysis of Test Set 1 excluding items featuring more than one part or function (e.g., excluding the item "both hands") reveals a pattern of correspondences similar to the one reported above.

Five items in Test Set 1 ("one big toe," "one second toe," "one third toe," "one fourth toe," and "one fifth toe") might lead to similar inferences as the five items in Test Set 2 corresponding to each of the five fingers. However, preregistered reanalysis of Test Set 1 excluding those five toe items reveals a pattern of correspondences similar to the one reported above.

Last, preregistered reanalysis of Test Set 1 excluding the five toe items as well as items featuring more than one part or function (e.g., excluding the item "both hands") reveals a pattern of correspondences similar to the one reported above. See reanalyses in tables S14 to S17.

Test Set 2

Test Set 1 indicates consensus among laypeople (and lawmakers) regarding how much they subjectively value items that vary widely in form and function, such as a leg, a canine tooth, or hearing in one ear. Test 2 assesses whether this consensus extends to items that are highly similar in form and function, such as the five fingers. In general, the answer is yes, and the pattern of results is similar to that observed in Test Set 1. There is general agreement among participants on how they evaluate the loss of each finger relative to the other fingers (table S2). Moreover, the seven sets of evaluative intuitions (Difficulty, My Anger, etc.) generally correlate positively with one another within countries (tables S3 and S13) and between countries (tables S3 and S13), often significantly. In addition, participants' evaluative intuitions regarding each of the five fingers generally track (or retrodict) the benefits (or fines) that the US code, the Korean code, the UAE code, the Guta lag, and Æthelberht's code establish for the loss of those fingers, sometimes significantly (tables S3 and S13). Last, the benefits (or fines) established by the codes for the loss of each finger are positively intercorrelated across the five codes, often significantly (tables S3, S11, and S13).

The statutes relevant to the fingers are displayed in tables S5.1, S5.2, S5.3, S5.4, and S5.5. The results of Test Set 2 are reported in detail in Supplementary Text. The descriptive statistics relevant to the five fingers are displayed in tables S6.1 and S6.2.

We also conducted preregistered correlation analyses of Test Sets 1 and 2 between code-dictated severity and participants' ratings using Spearman's rank correlations. These results, reported in tables S12 and S13, are qualitatively similar to the ones reported above.

DISCUSSION

People with no specialized training in medicine or law in the United States and India tend to agree ordinally on the subjective values that they attach to different parts and functions of the human body. Agreement in lay valuations can be seen both from one individual to the next and between the United States and India. These evaluations are precise: There is agreement about body features that vary highly in form and function (e.g., one leg versus one fingernail; Test Set 1) and even about features that vary little in form and function (e.g., ring finger versus little finger; Test Set 2).

Interindividual consistency in the relative values placed on molars, legs, and eyes likely requires a common means to translate the value of grinding food, walking, and seeing into one another or into a more abstract metric. Neuroscientific evidence consistent with a common neural currency of value (*32*–*34*) suggests one way in which the brain may contrast the relative worth of different body parts.

Laypeople and lawmakers alike attach more value to multiples of a body part than singles (e.g., both hands > one hand). However, there is also a qualitative effect: More value is attached to some body parts than to others—observed in Test Set 1 when excluding from analysis items with more than one count (e.g., one eye > one molar) and in Test Set 2 (e.g., thumb > little finger). In addition, all seven sets of ratings (Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation) tend to covary highly within and between the US and India in both test sets.

Together, this suggests that, in addition to knowledge about their forms, functions, names, and relative locations (*35*, *36*), humans develop detailed intuitive knowledge about the value of body parts. This knowledge is used to make a host of inferences, including Theory-of-Mind inferences about, for example, the emotional states of other people in response to events involving their body parts.

Critically, consensus in valuations is observed not only among laypeople but also between laypeople and lawmakers (legal codes) as well as among lawmakers (legal codes). Thus, this consensus spans highly diverse cultures, historical eras, and degrees of legal expertise: legislative bodies in the modern United States, Republic of Korea, and United Arab Emirates; ancient King Æthelberht and the ancient author(s) of the Guta lag; and laypeople. This suggests that (i) humans develop knowledge about the value of body parts and functions; (ii) this knowledge is fairly stable over time and space, and (iii) this knowledge plays a role in institutions relevant to bodily damage, including those regulated by medieval wergild laws and modern workers' compensation laws.

The agreement between laypeople and lawmakers is worth emphasizing. This finding aligns with previous arguments that lawmaking requires not only cultural norms and technical expertise, but also intuitions that are shared with laypeople. As two scholars of psychology and criminal law have concluded from their empirical studies, "Discrepancies between the [legal] code and the community have the potential to undercut the law's moral credibility and thereby its effectiveness" [(*37*), p. 202; see also (*38*)].

Are consensual valuations of body parts accurate? Although data about the actual contribution of body parts to human functionality are, to our knowledge, not available, there are some hints of accuracy. First, as noted above, laypeople and lawmakers regard the loss of a single part as less severe than the loss of multiples of that part. Second, laypeople and lawmakers regard the loss of parts as less severe than the loss of the wholes to which the parts belong (e.g., thumb < hand < arm < life). We note, however, that, in some cases, valuations seem warped. For example, the eye was appraised at 50% of the wergild in Ripuarian Francia (approximately 623 CE) (*24*) or 100% of the wergild for the loss of both eyes, as if there were zero residual functionality—although it could be that loss of both eyes effectively amounted to loss of life in that time and place. Third, in Barbarian Europe, "wounds that may cause permanent incapacitation or disability are fined higher than those which may eventually heal" [(*24*), p. 135]. Whether there is accuracy beyond this (e.g., one eye versus one molar) remains to be determined.

The making of laws about bodily damage takes more than intuitions about the value of body parts. Writing, along with deliberative bodies and technical expertise, are major aspects of lawmaking. However, the institution of wergild can be present even in societies without writing systems and bureaucracies (*18*, *21*). In contrast, it is difficult to imagine how societies mutually remote in space and time would produce similar laws about bodily damage if their lawmakers did not share their valuations of different body parts at least to some extent. This suggests that shared intuitions about the value of body parts are the preeminent constituent of laws about bodily damage.

We note that norm-based explanations of societal institutions tend to focus on human diversity, which is well documented in the fields of human biology and social science [e.g., (*39*–*41*)]. However, recent research has revealed notable regularities in values (*42*–*44*), emotion [(*45*–*49*); see also (*50*)], and institutions (*4*, *51*–*53*) across space and time [see also (*54*, *55*)]. The present findings contribute to the idea that human psychology and societal institutions exhibit such regularities and differences across space and time.

This study has limitations. Although we aimed for substantial cultural and historical variation in our samples of legal codes, these samples are still few relative to the population of legal codes concerning human bodily damage. More research with more samples is thus desirable. We note that we sought greater geographic and temporal diversity in our ancient codes but faced the challenge that ancient codes older than those from medieval Europe, or from different cultural regions, often list very few body parts (e.g., the Laws of Eshnunna), potentially yielding results that would be difficult to interpret, or use compensation/punishment metrics that cannot be easily contrasted (e.g., the *lex talionis*). Although this issue in the historical record is challenging to overcome, future investigations with complementary methods may help offset it to some extent.

One important question concerns the characteristics of the psychology that evaluates body parts. How specialized is this psychology? One possibility is that it is functionally specialized to appraise body parts. Appraising body parts may have been an evolutionarily enduring adaptive problem capable of crafting specialized evaluative adaptations. Indeed, some of the brain's evaluative mechanisms have inputs, operations, and outputs that are tailored to solving highly specific adaptive problems (*56*). Neuropsychological studies of folk-anatomical knowledge also suggest specialization. For example, in the disorder autotopagnosia, the ability to recognize human body parts can be impaired whereas the ability to recognize the body parts of nonhuman animals is spared (*57*). In addition, impairment in the ability to point to body parts on oneself (autotopagnosia) versus on other people (heterotopagnosia) can occur independently of each other (*58*, *59*). This and other evidence of fractionation suggests functional specialization in people's folk knowledge of human anatomy and possibly in their valuations of body parts.

However, another possibility is that valuations of body parts are generated by a content-general psychology. This is suggested by the fact that people can agree on the relative value of, for example, different cars or cleaning tools, although the brain likely lacks machinery specialized to evaluate such things. These findings might be accounted for by a content-general evaluative psychology shared across humans if different body parts are functionally distinct in similar ways across individuals and cultures; the weightings of bodily functions necessary for human thriving are likewise consistent across individuals and cultures, and people across cultures learn the relevant values through experience.

A third possibility is heterogeneity. For instance, invariant evaluative principles at one end of the spectrum (e.g., the breathing function is highly valuable) may coexist with content-general evaluative procedures at the other end of the spectrum. We note that variables such as the density of nerve endings, features of somatotopic organization, and experiences of use, pain, and injury are possibly relevant to elucidating how individuals appraise their own body parts and, perhaps, those of others. For example, part-specific pain signaling might be internally rendered into differential value under the hypothesis that value is proportional to pain per unit of damage—the computation of value information from pain information may improve behavior regulation by enabling the actor to, for example, take precautionary measures cost-effectively [see (*60*)]. Future research will clarify the structure of this psychology.

Relatedly, the observed consensus across space and time suggests the possibility that valuations of body parts are generated by an evolved evaluative psychology that is part of human nature, but alternative hypotheses include such drivers as convergent cultural evolution and cultural inheritance from a common ancestor—although the latter hypotheses may struggle to explain the observed consensus across levels of legal expertise.

Some have argued that societal institutions are massively underdetermined by human psychology (*61*). However, an alternative view is worth considering in light of the present findings: There is a rich and complex human nature (*54*, *62*–*64*), humans develop much intuitive knowledge about it, and this knowledge constitutes the foundation of institutions relevant to bodily damage.

MATERIALS AND METHODS

Experimental design

This study was approved by the Institutional Review Board at Oklahoma State University (IRB-23-55). We preregistered the procedure, stimuli, sample sizes, exclusion criteria, predictions, and

analysis plan before data collection began. The single exception was that the analyses pertaining to the Guta lag were not preregistered and should therefore be regarded as exploratory.

Participants

We conducted correlation analyses over a sample of body parts, fixed in size, and so standard power analyses could not be conducted. However, pilot data suggested that 35 participants per condition per country would result in adequate power. We assumed 20% of data loss due to exclusions, so we set recruitment to 44 participants in each of the seven conditions in each of the two countries or a total of 616 participants in both countries. We recruited 306 participants in the US and 308 participants in India using CloudResearch (linked to Amazon Mechanical Turk). As per the preregistration protocol, participants were excluded from analyses if they met one or more of the following three exclusion criteria: (i) failing a bot check, (ii) failing an attention check, and (iii) having college-level (from "some college" to "completed advanced degree") education in medicine or law or both. Following exclusion of participants who met one or more exclusion criteria, the effective samples consisted of 282 participants in the US (age: $M = 41.5$, SD = 11.8; 150 females, 132 males) and 227 participants in India (age: $M = 33.4$, SD = 7.2; 60 females, 167 males).

Materials

The study materials refer to a diverse set of consensually recognizable body parts and functions featured in some or all of five legal codes: the US code, the Korean code, the UAE code, the Guta lag, and Æthelberht's code. The US, Korean, and UAE codes, as well as Æthelberht's code, establish benefits for individuals who lose body parts or functions; the Guta lag establishes fines for individuals who cause the loss of body parts or function in others. In the US code, damage to the body is appraised using two different metrics: (i) Grade, from least (1) to most severe (100), and (ii) payment (in dollars) to individuals who lose body parts or functions. In the Korean code, damage to the body is appraised using two different metrics: (i) Grade, from least (14) to most severe (1), and (ii) number of work days. Compensation for employees who lose body parts or functions is calculated by multiplying number of work days by the injured employee's average daily salary. In the UAE code, damage to the body is appraised using a single metric: a percentage, where 100% amounts to death indemnity or 24 months' salary. In the Guta lag, damage to the body is appraised using a single metric: fines (in marks in coin) for individuals who cause the loss of body parts or functions in others. In Æthelberht's code, damage to the body is appraised using a single metric: payment (in shillings) to individuals who lose body parts or functions. Table S4 lists the 39 items used in Test Set 1 and Test Set 2 as well as which codes feature which item. Here, we report analyses relevant to the payment metric (US code) and the number of work days metric (Korean code). The payment metric (US code) and the number of work days metric (Korean code) are almost perfectly correlated with the grade metric (US code) and the grade metric (Korean code), respectively. Nevertheless, for completeness, we report analyses with the grade metric (US code) and the grade metric (Korean code) in tables S8 to S13. We note that, for ease of interpretation, we report our results based on the grades of the Korean code reverse-coded—in our analyses, we imputed "1" as the least severe grade and "14" as the most severe grade. We did not sample items corresponding to the least severe grade in the Korean code. Therefore, in our data, our (reverse-coded) Korean grades range from 2 (effectively least severe) to 14 (most severe).

Methods

Participants provided informed consent and were paid $0.35 for their participation. The stimuli shown to the participants featured descriptions of various body parts and functions but not the benefits (or fines) provided by the laws for the loss of those body parts and functions. We presented the stimuli in English in the US and India. We randomly assigned participants, in a between-subject design, to one of seven conditions: Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation. Participants indicated their sex at the outset. On the basis of this, the first-person conditions (Difficulty, My Anger, and My Gratitude) of Test Set 1 displayed the items "one testicle" and "both testicles" to male participants but not to female participants. We presented the remaining items to all participants. The items in Test Set 1 were blocked and so were the items in Test Set 2. We randomized the order of presentation of each block and the items within each block.

Statistical analysis

To assess agreement among participants in their evaluations of the items (body parts or functions) relative to one another, we computed ICCs. Specifically, we used a mean-rating ($k = n$), consistency-agreement, two-way random effects model. Missing data in the Difficulty, My Anger, and My Gratitude conditions were handled using listwise deletion; recall that, in those three conditions, male participants responded to the items "one testicle" and "both testicles," whereas female participants did not.

We calculated the mean ratings across participants for each item (body part or function) in each of the seven conditions: Difficulty, My Anger, My Gratitude, Their Anger, Their Gratitude, Price, and Compensation. We used these item-level data to compute both Pearson correlations and Spearman's rank correlations between those measures, between those measures and the benefits (or fines) established by the five legal codes , and between the benefits (or fines) established by the five legal codes. We conducted the abovementioned analyses with SPSS version 29.

We averaged correlation coefficients by applying Fisher's z-transformation to each coefficient, calculating the mean of the transformed values, and then converting the mean back to a correlation coefficient using the inverse transformation.

We used the ggplot2 package version 3.5.1 (*65*) in RStudio (*66*) to visualize the relationships between the seven measured variables and the benefits (or fines) provided by the five legal codes at the participant level and the item level.

Supplementary Materials

This PDF file includes:

Supplementary Text
Tables S1 to S17

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