

Review

Cognitive fossils: using cultural artifacts to reconstruct psychological changes throughout history

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Psychology is crucial for understanding human history. When aggregated, changes in the psychology of individuals – in the intensity of social trust, parental care, or intellectual curiosity – can lead to important changes in institutions, social norms, and cultures. However, studying the role of psychology in shaping human history has been hindered by the difficulty of documenting the psychological traits of people who are no longer alive. Recent developments in psychology suggest that cultural artifacts reflect in part the psychological traits of the individuals who produced or consumed them. Cultural artifacts can thus serve as 'cognitive fossils' – physical imprints of the psychological traits of long-dead people. We review the range of materials available to cognitive and behavioral scientists, and discuss the methods that can be used to recover and quantify changes in psychological traits throughout history.

Psychology variability is crucial for understanding human societies

The expression of emotions (e.g., anger, fear), social behaviors (e.g., cooperation, altruism), and personality traits (e.g., openness to experience, agreeableness) varies across individuals and, on aggregate, across geographical locations and historical periods. These variable **psychological traits** (see [Glossary](#)) determine **individual preferences** that impact on how individuals interact with their societies (e.g., via voting behaviors and consumption patterns), thus shaping the dynamics of institutions, social norms, and cultures.

Psychological variability is typically measured through questionnaires and surveys, but recent evidence shows that individual differences in psychological traits are also expressed through preferences for different cultural artifacts. For instance, analysis of non-fiction texts can reflect social group representations and stereotypes [1,2] or attitudes toward deviance [3]. Works of fictions have also been shown to reflect individual preferences, and personality traits correlate with specific fiction consumption patterns [4–7]. More recently, the rise of social networks and streaming services has allowed scientists to study very large datasets. In one of these massive studies, 3 million Facebook users completed standard personality questionnaires, and these correlated with their preference for various genres or movies [8]. Agreeableness, characterized by affiliative behavior and conflict avoidance, correlated with liking movies with keywords related to family relationships ('grandmother–grandson relationship', marriage proposal) and altruistic actions ('action hero', 'mission') [7,9]. Other studies found an association between sensation-seeking and horror movies, or between dark triad personality traits and interest in stories with villains [10].

Similar observations have been made in visual arts and music. Individuals higher in openness to experience tend to be more interested in newer, more abstract, and less conventional art forms [11–13].

Highlights

A large body of work in psychology demonstrates that individual preferences and personality traits are reflected in contemporary cultural productions.

Human preferences have specific cognitive signatures in cultural productions, such as the baby schema (e.g., round face, high forehead, big eyes, small nose and mouth) in portraits, and pair-bonding elements (e.g., love at first sight, tragic separations) in romances.

These cognitive signatures share similar characteristics, which makes it possible to trace them across time and space, and quantify their evolution.

Cognitive signatures within cultural productions can therefore function as cognitive fossils, thereby paving the way for a new and exciting field of inquiry at the intersection of psychology and history.

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Individuals also seek musical environments that reflect their psychological traits [14,15], and individual differences in musical preferences are associated with a range of basic personality traits [7,14,16,17]. Extraverts, for example, prefer contemporary and vocal musical styles, whereas people high on agreeableness prefer mellow and serene musical styles. Another robust finding is that individuals with high levels of empathy are more likely to enjoy sad music (*cf* [18–20]), such as the minor mode in Western classical music which is generally associated with subdued, sad, or dark emotions [21].

Personal items such as portraits, clothing, hairstyles, cars, pets, and cosmetics can also shed light on individual psychological traits. Personal items are indeed partly used to make an impression on others and to signal specific qualities such as fertility [22], trustworthiness [23–25], dominance [23,26], masculinity [27], or juvenility [28–32]. Personal items thus indirectly reveal the type of qualities that people value in a given society. In societies where dominance is more valued, individuals tend to prefer leaders who appear to be more muscular and more dominant in their portraits [33], and make efforts to appear more muscular and more dominant in their portraits or selfies through the use of clothing, facial expressions, or specific shooting angles [34].

To better understand how individual differences manifest within cultural artifacts, let us examine three specific illustrative instances in which psychological variability is reflected in individual cultural preferences: romantic love, openness to experience, and prosociality. Empirical studies using psychometric scales and questionnaires have shown a strong relationship between individual interest in romantic fiction and the importance they place on long-term and mutually affectionate relationships [35]. Participants who show greater interest in romantic relationships in fiction are also more likely to be in a romantic relationship, to want to be in a romantic relationship, and to have longer, more satisfying, and emotionally closer relationships. Moving to openness to experience, experimental and observational studies on large datasets have shown that imaginary worlds (e.g., *Lord of The Rings*, *Star Wars*, *The Legend of Zelda*, and also *The Odyssey*) are more appealing to more curious individuals and to demographic groups known to be more interested in exploration. These include individuals with higher openness to experience, younger individuals, males, and individuals living in more affluent environments [9,36]. Finally, prosocial tendencies are reflected in cultural consumption. People with higher agreeableness prefer movies and books that depict positive social relationships and avoid angry and violent fiction [8]. Portraits are also particularly relevant to the study of cooperation because they reveal how much the sitter values being perceived as cooperative or dominant, indirectly reflecting the importance of cooperation in a specific society. Consistent with this idea, people tend to display more trustworthy selfies in places with higher interpersonal trust, in other words when they expect more cooperative interactions in the community [37].

To conclude, a range of works demonstrate that psychological preferences are reflected in contemporary cultural artifacts. The consumption and production of specific types of fiction, movies, musical pieces, and portraits correlate with openness to experience, prosociality, and romantic love (Table 1). The relative importance of love stories in novels and movies, plays, web novels, and fanfictions tells us how much individuals value romantic love and their investment in long-term relationships. Imaginary worlds, and more generally genres such as fantasy and science fiction, track psychological traits related to exploration and information-seeking. Trustworthiness displayed in portraits provides information about the importance of cooperation in the community and can work as a proxy for the level of generalized social trust. Overall, cultural artifacts can thus be construed as imprints of individual psychological traits.

Cultural artifacts as cognitive fossils of past psychologies

When studying psychological variations in historical populations, it is impossible to use experiments or questionnaires. Nevertheless, cultural artifacts – books, paintings, pieces of music –

Glossary

Cognitive fossils: cognitive imprints that survived the disappearance of their producers and that can be used to study the expression of specific psychological traits in past societies.

Cognitive imprints: cultural artifacts that have been shaped by specific psychological traits and that can be used to study the expression of specific psychological traits in a given society.

Cognitive signature: the specific effect of a universal cognitive mechanism on the content of a cultural artifact. Examples are the baby schema in painting for parental care motivation, and the literary tropes of two lovers (e.g., love at first sight, tragic separation) for romantic love.

Individual preferences: expressed liking or inclinations for particular objects, experiences, activities, or situations over others. Expressed preferences are behavioral manifestations of psychological traits. Individual preferences can span a wide range of domains, including esthetic tastes, hobbies, leisure activities, political affiliations, and lifestyle choices. They shape the form and nature of the cultural artifacts that people consume.

Examples of individual preferences include those for abstract art, romantic movies, sad music, or tragedies.

Psychological traits: the variable expression of universal cognitive mechanisms in individual psychology. Psychological traits are enduring characteristics that define the behavior, emotions, and thought patterns of an individual across different situations and contexts. These include variable traits such as openness to experience, prosociality, parental care motivation, interest in romantic love, dominance orientation, and many others. Crucially, we can meaningfully compare the expression of psychological traits across cultures because they are constrained by universal cognitive mechanisms that evolved to solve recurrent adaptive challenges. For example, although cultures can differ in the degree of parental care motivation, people universally find that faces with bigger eyes are cuter.

Table 1. Individual preferences for diverse cultural artifacts reflect variability in psychological traits

Psychological trait	Reflection in cultural artifacts	Refs
Interest in romantic love	Individual interest in romantic love correlates with their consumption of romantic fiction	[35]
Openness to experience	Openness to experience correlates with the consumption of speculative fiction (fantasy and science fiction) in literature and movies, and with the diversity of artistic genres they consume	[9,11–13]
Parental care motivation	Parental investment is associated with their interest in baby faces in photographs	[29,40–42]
Prosociality	Prosociality is associated with increased attention to presenting oneself as trustworthy in selfies, with higher preference for sad music and for works of fiction depicting social relationships	[17–19,21]
Dominance orientation	Seeking dominance is associated with increased attention to presenting oneself as physically dominant in portraits, increasing muscularity in one's body, and choosing physically massive personal items (massive dogs, massive cars). People who buy massive personal items are perceived as being more dominant	[33,34,127,128]
Social prejudices	Stereotypes about specific social groups (minorities, immigrants, females, etc.) are associated with the consumption of non-fiction (newspapers, books) that convey these stereotypes	[1,2,129]

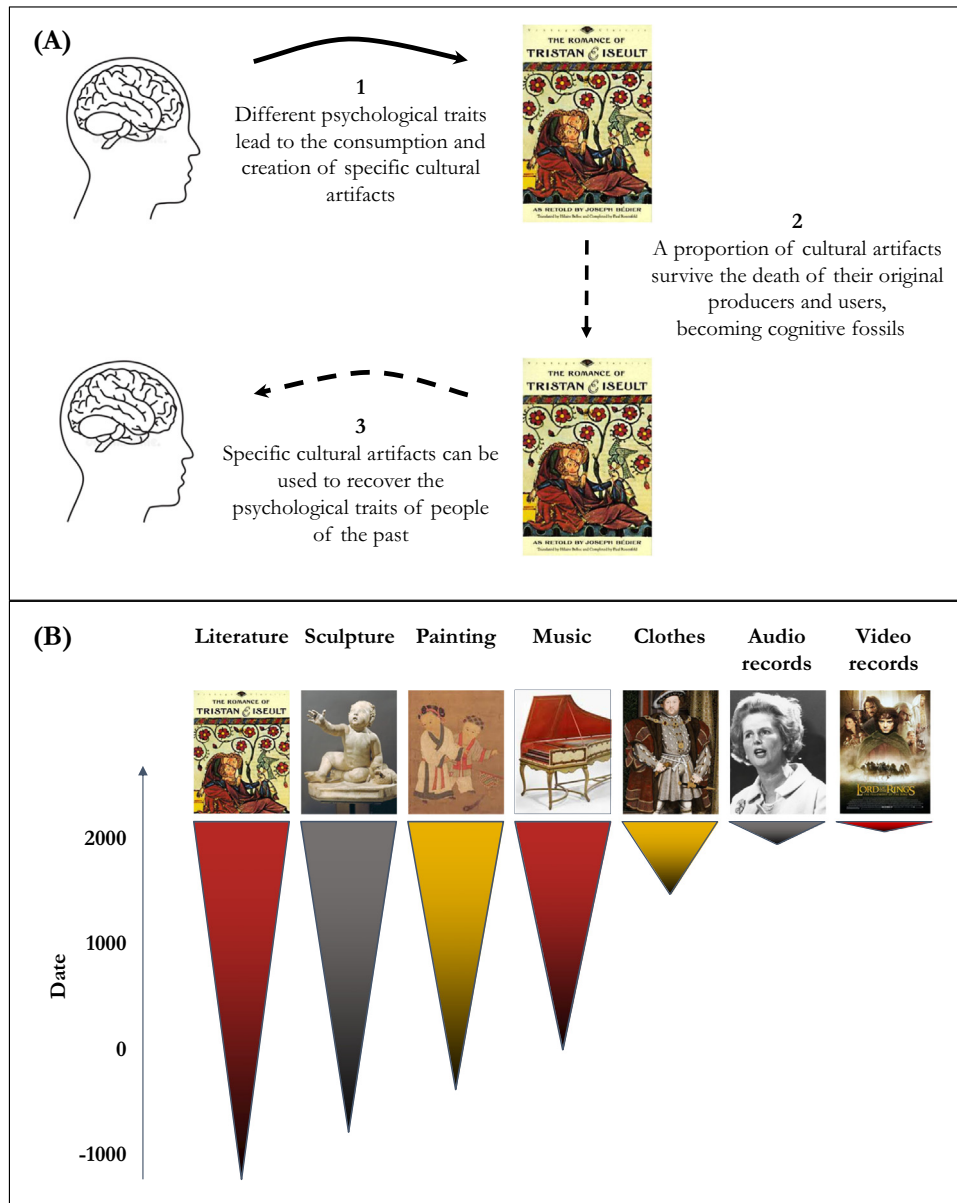
offer rich information about the people who created and consumed them, and about the society in which they lived. Cultural artifacts from the past can be construed as **cognitive fossils**: they represent the **cognitive imprints** of psychological traits belonging to people who no longer exist, and can therefore be leveraged to track more or less distant psychological changes throughout history [38–43] (Figure 1, Key figure).

Returning to our three illustrative examples (romantic love, openness to experience, and prosociality), a recent study demonstrates that romantic content has fluctuated throughout history, using a database of literary fiction covering 19 geographical areas and spanning 3800 years from the Middle Bronze Age to the Early Modern period [41]. Increased romantic content is particularly noticeable in Eurasia over the past millennium, and earlier in Ancient Greece, Rome, and Classical India [41]. Importantly, this is coherent with qualitative scholarship in literary history. With a much smaller temporal depth, the dynamics of openness to experience can be approximated by using the popularity of imaginary worlds and genres such as fantasy and science fiction. Using large databases of movies ($N = 85\,855$) and novels ($N = 96\,711$), a recent study demonstrated that the proportion of fiction involving an imaginary world increased regularly over the past two centuries in both literature and cinema [44]. Interestingly, this result cannot be due to the development of technological effects (better sound, better setting) because the same trend is visible in novels, where technology does not play any role. Turning to prosociality, historians have long hypothesized a psychological shift towards more cooperation during the modern and contemporary periods [45]. Recent studies in psychological history confirm these earlier qualitative works. For instance, the frequency of words related to cooperation increased relative to those related to coercion over the early and late modern periods both in French and English theater. In portraiture, cues of perceived trustworthiness (e.g., smiling faces) increased over time both for lay people and for monarchs, suggesting that being perceived as trustworthy became increasingly valued over the modern period [37,46]. Interestingly, this trend continued during the 20th century (e.g., in official portraits of French members of parliament).

A closer look at the famous portrait by Holbein the Young of Henry VIII, King of England, can help to activate our intuitions about how the elite of the day wanted to be perceived, and what this

Key figure

What is a cognitive fossil, and how far into past human psychology can we go



Trends In Cognitive Sciences

Figure 1. (A) The production of cultural artifacts and how they can be used as cognitive fossils. (B) The historical depth associated with particular types of cultural productions and examples of traits that can be measured. (i) Interest in Romantic love (*Tristan and Isolde*), (ii) parental care motivation in sculptures (a child from the Hellenistic period) and paintings (children from the Song period), (iii) prosociality (preference for empathetic music – 17th century harpsichord), (iv) preference for dominance in portraits (Henry VIII) and voices (Margaret Thatcher), and (v) openness to experience (*Lord of the Rings*)
(Figure legend continued at the bottom of the next page.)

might reveal about the expectations and values of Tudor England (Figure 1B, clothes). Holbein's portrayal depicts Henry VIII in a commanding stance, exuding regal authority and confidence, with imposing garments and luxurious fabrics, signifying his status as a powerful ruler. The long *basques* (the parts of a waistcoat that extend below the waist) and *chiquetades* (a type of jacket, also known as doublet) aim to create an impression of high upper-body strength by increasing the length of the upper body with the *basques* and the size of the arms with the *chiquetades*. This complex ornament, the high skills, and the amount of labor it required suggest how important it was for 16th century male nobility to appear this way. In 2023, by contrast, it would be inconceivable for Charles III (the current king of the UK) to pose in a manner that emphasizes physical dominance or luxury. Instead, Charles III is generally portrayed as smiling and non-dominant. The portraits of Charles III and Henry VIII thus indirectly tell us something about the degree of dominance and authoritarianism that their subjects considered to be acceptable. More broadly, the fact that men used costumes to increase their perceived upper-body size, which is a reliable cue of physical formidability [47], can be used as a fossil of the importance of dominance in history.

This idea is not new, and historians of mentalities have long relied on cultural materials as proxies to assess the dynamics of individual attitudes in domains such as childcare [48], romantic love [49–51], and self-discipline [45,52] (Box 1). As famous historian Lucien Febvre argued: "psychology is at the very core of any historian's work" [53]. However, recent advances in the characterization of psychological traits, together with methodological strides in computational sciences, have the potential to boost the field of historical psychology [38,39,54,55]. For example, text mining facilitates the quantification of emotions and personality traits [56,57], face-detection algorithms enable the automated extraction of emotional expressions [58–60], and automatic extraction of melodic information from music scores and audio records allows quantification of the emotional content of songs [61,62]. These novel methods, together with the increasing availability of digitized cultural datasets, have improved our ability to characterize and quantify several psychological dimensions across a variety of documents and historical periods. This provides exciting new opportunities as well as challenges for the developing field of historical psychology.

Challenges when measuring the psychology of the past

Biases in data collection

Using historical materials to infer variations in psychological traits poses several challenges. The first challenge is that the transmission of cultural artifacts is incomplete, and available historical data represent a mere fraction of the total production. Both social biases and survivorship biases must therefore be taken into account [63]. Social biases are linked to the fact that cultural artifacts were consumed only by a small elite and may serve different functions over time. For example, specific types of portraits, such as those exchanged to negotiate marriages between members of royal families, had a very precise social function in a very limited time period. Survivorship biases arise because many cultural artifacts have been lost, destroyed, or forgotten [63]. Researchers should therefore be aware of gaps in the fossil record when drawing inferences from historical data. Depending on their research question, researchers must also decide whether to adopt a selective versus comprehensive strategy. In a selective strategy, researchers focus on cultural artifacts produced in a similar context that are inferred to fulfill a similar function for a similar audience. In a comprehensive strategy, researchers aim for exhaustivity and analyze all the cultural artifacts in known databases. The combination of various sources (such as those

of the Rings). The transmission of cultural artifacts is incomplete, and the available historical data represent a mere fraction of the total production. The shape of the triangle represents the decrease in quality (darker colors) and quantity (narrower shapes) of historical data as we move backwards in time.

Box 1. How does historical psychology relate to the history of mentalities?

Historical psychology is nothing new. Historians have long studied psychological changes in history, especially in art, literature, politics, and popular culture, from the 19th century onwards [130]. However, it was not until the 1930s that historians began to consider that there were hidden psychological variables beyond observable behaviors whose evolution could explain cultural, social, and political changes, such as new artistic movements, changes in family practices, and political revolutions. This has led to the emergence of a subdiscipline within historical studies: the 'history of mentalities' (from the French *histoire des mentalités*) [130]. This approach sought to describe the evolution of these hidden variables, such as preferences for children [48], romantic love [49,51], self-discipline [45,52], novelty and innovation [131], and empathy and tolerance [132]. The history of mentalities developed particularly strongly in France in the 1950s and 1980s, notably by the *École des Annales*, a leading school in history that favored interdisciplinarity, quantitative approaches, and the long term [130].

In the 1960s, however, historians of mentalities faced a significant challenge when studying the evolution of individual preferences. How can love, parental affection, or trust be adequately captured in the distant past? At that time, historians of mentalities had no access to the modern psychological characterization of romantic love, parental affection, or emotion recognition (the first experimental studies on love and parental affection were only beginning). Romantic love is a case in point. In *Love and the Western World*, one of the most famous works in the history of mentalities, Denis de Rougemont famously claimed that a special type of love, 'romantic love', was invented or discovered in 12th-century medieval Europe [49]. How can one prove there was no such love in earlier periods? Different periods might use very different words to talk about love. Studying changes in romantic love requires a clear description of the underlying psychological concept and a way to characterize it across time and space. It is only since the 1990s that anthropology and psychology have shown that romantic love is a universal emotion observed across human cultures, and that has specific behavioral, hormonal, and neuropsychological signatures [71,72].

Eventually, without rigorous behavioral and cognitive characterizations, the categories produced by historians of mentalities appeared fragile, arbitrary, and contingent [133,134]. Studying mentalities across cultures and periods seemed to be difficult without their precise characterization (e.g., what are the universal features associated with love?). Similarly, the explanatory power of mentalities appeared to be limited in the absence of a clear understanding of their functions (e.g., why is love important, why is it more important in some contexts?) [135]. In response to these criticisms, historians progressively abandoned the history of mentalities and turned to cultural history [130] – which focuses on observable cultural trends rather than on hidden psychological traits. However, recent developments in cognitive science allow more accurate characterization of the relationship between psychological and cultural processes, which has the potential to reshape historical psychology, both theoretically and empirically.

listed in Figure 1B) is particularly important to mitigate social and survival biases. For example, when analyzing the early modern period in Europe, data from portraits might reflect elite preferences more than theater plays which were consumed by both the elite and the middle classes. Similarly, in the 20th century, some social groups might be more likely to consume novels than films, and vice versa. The triangulation afforded by combining various media is likely to provide a more complete picture of psychological dynamics across society. Importantly, although the values of social groups may differ on average, the crucial object of analysis is the diachronic variation that may be similar across social groups (and cultural media).

Internal and external validity of the proxies

A second challenge for historical psychology is the need to rely on valid proxies of psychological traits. These proxies must be sensibly derived from theoretical frameworks. In addition, findings from experimental psychology must undergo comprehensive internal and external validation before hypothesis testing [40,42,64]. As is the case in psychometric studies, the first step is to check the internal validity of the measure. One way to do this is to create multiple indices of the same psychological trait and test cross-index consistency [42]. For example, when studying prosociality in historical texts, indices of cooperation (A1), sympathy (A2), and trustworthiness (A3) should load on the same factor. Indices linked to dominance, such as authoritarianism (B1), anger (B2), and strength (B3), should load on an orthogonal factor. Another way to assess the internal validity of a given index is to check whether it leads to sensible distinctions between well-documented features of genres. For example, tragedies are known to contain more

oppression and coercion than comedies. Thus, a good index of prosociality should be higher in comedies than in tragedies.

External validity can be assessed by checking whether preference for a given cultural artifact correlates with a psychological trait. In this paper we have deliberately focused on measures for which robust associations have been observed (Table 1). It is only because we know that higher parental care motivation correlates with increased reward sensitivity to juvenility cues [65,66] that we can use juvenility cues in historical material as an indirect measure of parental care motivation (Boxes 2 and 3). Similarly, it is only because we know that contemporary individuals who score the highest in openness to experience are also those who most enjoy fiction containing imaginary worlds [8,9] that we can infer an increase in openness to experience from the increase in the frequency of fiction with imaginary worlds over the course of 19th century Europe [36,67]. This is a crucial step because the relationship between cultural preferences and psychological traits is not necessarily intuitive. For instance, individual interest in horror fiction is not particularly predictive of their threat reactivity, but it is predictive of sensation-seeking [10,68]. Conversely, the presence of words related to sex in books may not systematically reflect individual interest in sex but their attention to controlling the sexual life of others [69]. The assumption that specific bags of words are good proxies of specific psychological traits must therefore be backed by external evidence. For example, the standard tools for the analysis of contemporary texts – the linguistic inquiry and word count – validate bags of words by cross-referencing linguistic analysis of the participant texts to their results on psychometric tests [70].

Finally, generalizability from contemporary to past populations is a significant challenge. One key solution is to focus on psychological traits that are universally present in human populations and that function in the same way. For instance, anthropology and psychology have shown that romantic love is a universal emotion observed across human cultures, and has specific behavioral, hormonal, and neuropsychological signatures [71,72]. In behavioral ecology it is conceived as a commitment device that motivates pair bonding in humans. Pair bonding evolved to facilitate the idiosyncratic life history of hominins by helping to provide the massive investment required to raise children. Consistent with this functional characterization, cross-cultural research has shown that romantic love universally triggers identical behaviors designed to regulate and monitor pair bonding: partner idealization, emotional attachment, long-term commitment, and reordering life priorities [73,74]. Importantly, the **cognitive signature** is also visible in fictional narratives worldwide. Narrative elements associated with pair bonding, such as idealization of the partner (e.g., love at first sight), emotional attachment (e.g., tragic separations), long-term commitment (e.g., vows of eternal fidelity), and reordering of life priorities (e.g., suicide for love), are found throughout the world literary record, from *Leucippe and Clitophon* in Ancient Greek to *Tristan and Iseult* in Old French, from *Layla and Majnun* in Arabic to *The Story of the Western Wing* in Chinese, and from *Nala and Damayanti* in Sanskrit to *The Love Suicides at Sonezaki* in Japanese [41]. Similarly, prosociality is a defining universal feature of the human species, and a large body of work has shown that people across the globe use similar cues, for example to evaluate cooperative intentions and form first impressions of trustworthiness [23–25]. Juvenility cues are also universally appraised, such that big eyes, smaller noses, and larger foreheads consistently lead to impressions of juvenility (Box 2).

Cognitive fossils thus help generate inferences about psychological changes in the distant past. The validity of these inferences can be further assessed by studying whether the hypothesized psychological shift has a predictable impact in other contexts [3,75]. For instance, if cognitive fossils of prosociality increase, the consequences of increased prosociality should be observed in broader contexts. Indeed, cognitive fossils of prosociality in theater plays in early modern Western

Box 2. Changes in juvenility cues illuminate the history of childhood

In what is probably the most cited work in the history of mentality, *Centuries of Childhood*, Philippe Ariès documented the evolution of attitudes towards children during the medieval and modern periods, and demonstrated that people had increasingly positive and emotional relationships with children. His work then faced substantial criticism regarding the validity of the evidence [136]. For instance, depictions of children were less common in the medieval period and, when present, children were often portrayed as being less innocent than in later periods. However, how reliably can artworks inform the nature of parental affection? It is only with the advance of experimental psychology that the description of the 'baby schema' (round face, high forehead, big eyes, small nose and mouth) became sufficiently clear that cues of juvenility can be used reliably to infer parental affection from the arts (Figure 1) [65]. A range of studies have demonstrated that positive reactions to the baby schema correlate with being a parent (currently investing in parental care), and with circulating oxytocin (positively) and testosterone (negatively) [137–139].

Interestingly, people who report a greater desire to have children and a greater motivation to take care of children (i.e., a greater level of parental attitudes) tend to display longer gaze durations toward baby faces and a higher motivation to view the faces of children [29,66]. These data suggest that the evolution of baby portraits could afford a proxy for the evolution of parental attitudes over time. Because parental care increases individual interest in looking at cute baby portraits, an increase in parental care should lead people to buy or celebrate cuter baby portraits. At the level of cultural production, an increase in the number of cute baby portraits might therefore be indicative of a change in the parental investment of a portion of the population (those who purchase portraits or influence their content) (see Box 3).

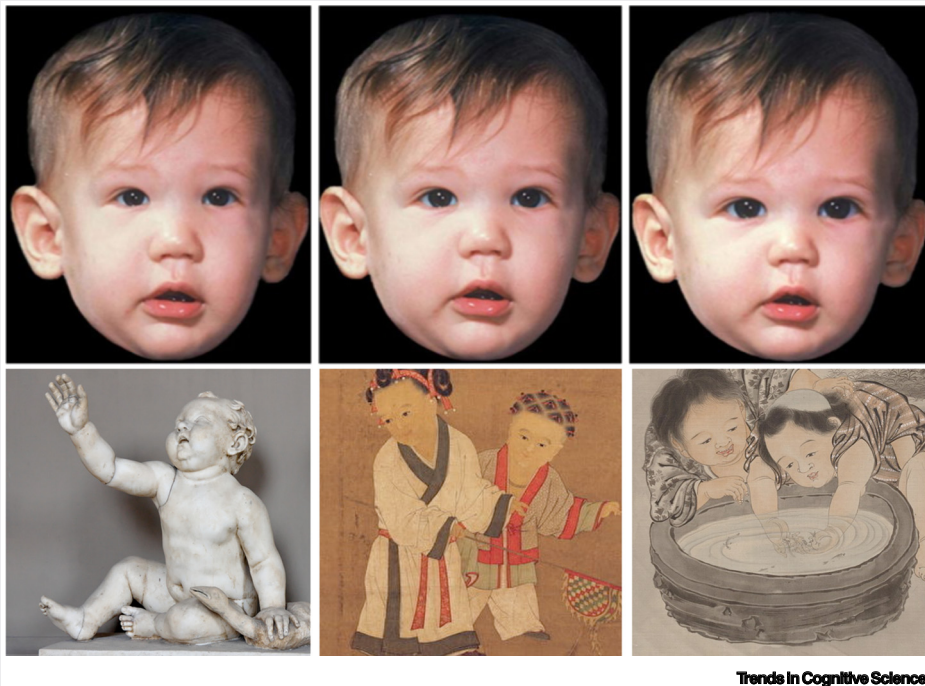


Figure 1. Juvenility in baby faces and in historical artwork. (i) Examples of low (narrow face, low forehead, small eyes, big nose, and mouth), unmanipulated, and high (round face, high forehead, big eyes, small nose, and mouth) baby schema faces (top panel) (adapted from Glocker *et al.* [65]), and (ii) children from Hellenistic Greece, Ming China, and Edo Japan (bottom panel).

Europe suggest that cooperation increased over that period [76]. If the cognitive fossil concept is valid, then concomitant societal changes linked to cooperation should be found. In line with this idea, the decline of violence is visible in the drop in homicides [77], the progressive ban on torture and the death penalty [78], the concomitant rise of social trust (visible in the rise of social clubs [79]), the increase in religious tolerance [78], the decline of social control [80], and the gradual increase in the popularity of democracy [81].

Box 3. Using portraits to capture the *Zeitgeist* of a society

It is often thought that portraits reflect the psychology of the sitter. This is true. However, they also reflect the traits of a much larger group of people. To see how, consider the famous portrait of Master Crewe (Figure 1) painted by Joshua Reynolds in 1776. At first glance it appears to reflect the psychology of his parents – John and Frances Crewe. Historians have shown that John and Frances Crewe chose the painter Joshua Reynolds for his ability to paint children in a vivid, age-appropriate manner [136]. With this portrait they did not simply want to show their children as worthy heirs to a lineage (as Van Dyck had done a century earlier with the children of Charles I). Instead, this portrait shows their son's idiosyncrasies, interests, and age-appropriate joys, an esthetics consistent with the new positive vision of childhood as promoted by Rousseau and the Romantics.

However, the portrait of Master Crewe also tells us much about the psychology of British high society at the time. As historian Kate Retford says: "Reynolds ... had to operate in a market, securing and then maintaining popularity that could underpin his increasingly high prices". Thus "If 'putting one's best foot forward' in earlier dynastic portraiture [i.e., in Van Dyck's time, mid-17th century] had meant a dominant emphasis on wealth and future high status, then, in this era [i.e., late 18th century] it meant engaging with the particularities of the condition of infancy, presented in such a way as to make it clear that the viewer of the picture should find those particularities appealing" [136].

With his round and rosy cheeks, the plumpness characteristic of children of that age, and his happiness in playing Henri VIII, this portrait rapidly became iconic. It was presented at the Royal Academy exhibition of 1776, which received thousands of visitors, and visitors purchased the mezzotint made after the portrait. The portrait was also the subject of many critical comments, and Reynolds was praised for his ability to paint 'sweet', 'natural', and 'playful'. In other words, if a painter as famous as Reynolds had accepted to do such a portrait for the Crewe family, it is not only because he had received a considerable amount of money. The historical scholarship shows that he also anticipated that such a portrait would please a much larger audience and increase his fame [136]. Portraits, like novels and paintings, say much about the psychology of the people at the time and place they were created.



Trends in Cognitive Sciences

Figure 1. Portrait of a Boy in the character of Henry VIII by Joshua Reynolds (1776).

Causal inferences

The third challenge is that explaining cultural and social changes raises the important issue of causality. Psychology is traditionally an experimental science in which causality is tested by comparing experimental conditions in the laboratory. Things are much more complex in history. Experiments are impossible to conduct, and economic, political, cultural, and psychological phenomena often change together. Consider the relationship between economic development and romantic love during the European Middle Ages. Historians have long suggested that the rise of romantic love in the Middle Ages could be the product of rising living standards, a hypothesis that fits well with psychological and anthropological literature. However, the relationship could be the other way around. It could be that higher levels of romantic love increase economic

development (e.g., through higher social trust). Another possibility is that some hidden ecological variable affects both economic development and romantic love.

Disentangling causes from consequences is notoriously difficult without tools specifically designed to go beyond correlations. Econometrics can be leveraged here to identify properly causal by effects using a variety of statistical methods such as instrumental variables, regression discontinuity, propensity score matching, and natural experiments [82,83]. To test whether increased prosperity has a causal effect on individual interest in romantic love, it is necessary to identify a change in economic development that can be attributed to a specific event that cannot be causally linked to the evolution of romantic love. The introduction of the heavy plow in medieval Europe provides such an event: it increased yields disproportionately, but only in regions with a high concentration of clay soils, a geological feature that is naturally independent of romantic love [84]. Analyses showed that the level of romantic elements in literary fictions did not differ between regions with low and high concentration of clay soils before the introduction of the heavy plow, but regions with high concentration of clay soils presented a significantly higher level of romantic fictions after the introduction of the heavy plow. In summary, using the introduction of the heavy plow as an instrumental variable, it was possible to demonstrate that economic development had a causal effect on the increased interest of people in romantic love in fiction during the medieval and modern periods [41].

Another difficulty concerns the potential interactions between psychological traits and cultural artifacts. Cultural artifacts do not only reflect psychological traits but may actively shape psychological traits. Specifically, a change in the prevalence of cognitive fossils (e.g., an increase in murder and crime novels) could not only emerge from a change in psychological traits (i.e., an increase in sensation-seeking) but could also potentially influence future behaviors (i.e., making violent crimes more salient, or socially more acceptable). Although a cognitive fossil would not primarily act as a photograph that captures and records the past, it could also spawn changes in future behavior because it acts as a normative device itself.

This hypothesis is all the more appealing because many works seem to precede and even cause psychological changes: *Uncle Tom's Cabin* and the growing sympathy for slaves, *The Sorrows of Young Werther* and the rise of subjectivity, or *On the Road* and the rise of anti-conformism. However, it is not easy to establish a causal link between cultural product and psychological traits, and a large body of literature in psychology and the social sciences has shown that individual traits are not easily shaped by proselytizing, propaganda, or advertising [85–88]. Thus, it is likely that literary successes were enormously successful not because they influenced psychological traits, but because psychological traits were already changing, thus making the first cultural products that matched these new traits appealing to the public. In line with this idea, most studies reporting an effect of cultural products on psychological traits are correlational, report small effect sizes, and have limited temporal stability (the effect disappears after a few weeks) and poor replicability [89,90]. A few studies have used natural experiments (e.g., differential access to the television network as a result of exogenous technical factors [91]). However, even in these cases the evidence is mixed [92].

The underappreciated role of psychology in history

Historians and social scientists mainly focus on the roles of economics, geography, technology, conflicts, and institutions when explaining historical changes. Psychology, by contrast, is rarely considered to be a causal factor. This is probably because cultural phenomena are visible whereas psychological phenomena are hidden. From this perspective, cognitive fossils provide a powerful way to make psychological factors visible. However, one might ask – what is the point of explaining historical changes in psychology if the source of those changes is itself

unknown? In a sense, explaining historical change in terms of psychological change merely moves the explanatory target one step further.

The origins of changes in individual preferences have long been poorly understood. Things are changing, however, and we would like to conclude with a specific example of how ecological changes can lead to psychological changes, which in turn lead to cultural and social changes. This particular example is the impact of economic development on individual psychology. In economic history, a range of works have demonstrated that the energy budget of humans has increased a hundredfold within a few thousand years [93,94]. The domestication of plants and animals, agricultural advances (irrigation, plows, metal tools), industrial advances (water mills, steam engines, electricity), and medical advances (antibiotics, vaccines) have significantly increased the ability of humans to extract resources from their environment and to meet their vital needs not only for food but also for safety, shelter, health, companionship, education, and insurance against accidents [95–97].

In behavioral ecology [98,99] and behavioral economics [100], new advances have demonstrated that material conditions predict the preferences of individuals. In particular, when living conditions are better, their preferences tend to become more future-oriented, with a higher level of time-discounting, pair-bonding, parental investment, exploration, and social trust toward non-kin, converging with Maslow's idea of a 'hierarchy of needs' [101,102]. Thus, as technology advances and economic development increases, psychological science predicts a significant value shift from more present-oriented to more future-oriented preferences. In line with this idea, 50 years of large-scale values and standardized personality surveys have revealed that psychological traits are not fixed and change in response to environmental shifts [103–106]. Such psychological changes might be responsible for significant political, social, and cultural dynamics throughout history. The unprecedented prosperity and security of the postwar era is a case in point. It is associated with a shift toward more social trust and less materialistic preferences, which in turn might have favored sexual and social changes, the environmentalist movement, and the spread of democracy [103,107].

Recent papers have demonstrated the fruitfulness of this framework to account for historical changes, such as the rise of moralizing religions [108,109], the increase of technological innovation in England before the Industrial Revolution [54], the increase in love in world literature during periods of affluence [41,64], the rise of cooperation in early modern Europe [37,76], and the success of speculative fiction in contemporary high-income societies [9,44]. Further research should aim to replicate and extend these results using a range of cognitive fossils from various cultures and historical periods.

Concluding remarks

Historians have long studied psychological change throughout history (Box 1). Until recently, however, the psychological sciences lacked the tools and frameworks to quantify psychological traits in the past and how these fluctuated over time. Three major advances are changing this situation. First, a large body of work in psychology demonstrates that individual preferences and personality traits are reflected in contemporary cultural productions. Second, preferences have specific cognitive signatures in cultural productions, such as the baby schema (e.g., round face, high forehead, big eyes, small nose and mouth) in portraits or pair-bonding elements (e.g., love at first sight, tragic separations) in romances. Third, these cognitive signatures share similar characteristics, which makes it possible to trace them across time and space, and quantify their evolution. Cognitive signatures within cultural productions can therefore function as cognitive fossils.

Outstanding questions

Are there detectable behavioral syndromes in history? In behavioral ecology, psychiatry, and personality psychology, syndromes are a suite of correlated behavioral traits. Psychologists have demonstrated the existence of different syndromes of preferences that are respectively associated with harsh and favorable environments. Can these syndromes be observed in history? Are particular psychological syndromes associated with periods of affluence?

Are there psychological convergences in history? Insofar as a large number of psychological mechanisms (parental care, romantic love) operate in a similar way in all human populations, the same ecological causes should produce the same psychological effects. This hypothesis could explain several converging trends observed by historians in Europe, China, Japan, and India, such as the growing valorization of parental affection, romantic love, and self-control.

Can we observe the effect of rising (or falling) inequality on human psychology throughout history? Psychologists have long suspected that the degree of inequality should affect a range of traits, from time-discounting to parental care and cooperation. This predicts that we should observe specific psychological changes when inequality is especially high.

Could pathogens play a role in explaining specific changes throughout history? It is well known that levels of pathogens specifically impact on human psychology and can explain psychological variability across a population. This predicts that we should find some psychological changes that are associated with the most dramatic outbreaks in history.

Could scientists use architecture and personal items to recover fluctuations in individual psychology? In this article we have considered a range of materials, from fiction to sculptures and clothes. However, additional materials from architecture to cuisine to pets might be used to recover individual psychologies,

This approach makes it possible to draw on recent advances in psychology and behavioral science to generate new hypotheses (see [Outstanding questions](#)). One of these hypotheses is that converging psychological changes should be observed in very different cultures. Indeed, insofar as a large number of psychological mechanisms (e.g., parental care, romantic love) operate in a similar way in all human populations, the same ecological causes should produce the same psychological effects. For example, it has been shown that an improvement in living conditions is associated with an increase in the importance of romantic love in ancient Greece, medieval Europe, and the Chinese world [41]. This hypothesis could explain a number of converging trends observed by historians in Europe, China, Japan, and India, such as the growing valorization of parental affection [110–112] and self-control [113–115].

In the same way, psychologists have demonstrated the existence of syndromes – a suite of correlated behavioral traits [116] – that are associated with respectively harsh and favorable environments [99]. The presence of these syndromes in modern populations suggests that we should find similar associations in history [117,118]. For instance, periods of higher economic development and favorable living conditions (e.g., Hellenistic Greece, Early Roman Empire, Renaissance Italy, Ming Dynasty) should be characterized not only by higher level of romantic love (as shown in [41]) but also by higher levels of parental care, intellectual exploration, and prosociality because all these traits tend to cluster together in contemporary populations living in affluent environments.

It should be noted that economic development is only one dimension of the environment, among others, that can affect human psychology. Other ecological parameters should be explored [119]. For instance, psychologists have long suspected that the degree of inequality should affect a range of traits, from temporal discounting to parental care and cooperation [120]. This predicts that we should observe the effect of rising or falling inequality on human psychology throughout history. In the same way, pathogens and epidemics have played a crucial role in human history, from the Black Death to the corona virus disease 2019 crisis [121,122]. It is also well known that levels of pathogens specifically impact on human psychology and can explain psychological variability across a population [119]. This predicts that we should find some psychological changes that are associated with the most dramatic outbreaks in history. Conversely, the decreasing level of pathogen infection in the human population (visible in the secular decline in body temperature [123]) should also have important consequences for human psychology.

Finally, psychology suggests that all types of material can be used by historical psychologists. In this article we have considered a range of materials, from fiction to sculptures and clothes. Additional materials might be used to recover the prevailing psychology (Figure 1). Architecture is an obvious candidate. Innovation in architecture, as in the other visual arts, is probably associated with openness to experience [11,12,124]. Personal items such as cars or pets are less obvious candidates, but may reveal much about their owners. People use their cars, pets, or even their mugs to signal qualities that interest their audience [125,126]. In principle, then, all types of personal items could be used to recover fluctuations in individual psychology.

Historical psychology is still in its infancy. Using new insights from experimental work and the examination of an increasing diversity of artifacts, from literature to architecture to cuisine, psychologists and historians should be able to study a growing part of the psychological life of people in the past, and thus understand the role that psychology has played in the course of human history.

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Declaration of interests

No interests are declared.

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