Moral attitudes towards effort and efficiency:

A comparison between American and Chinese history

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Abstract

In some cultures, simply exerting effort is deemed virtuous, even when the effort lacks efficiency (i.e., inefficient effort). Our study examines how this moral attitude towards effort (relative to efficiency) evolves in history across two distinct sociopolitical and linguistic contexts, the People's Republic of China and the United States, using natural language processing techniques. Specifically, two formal, political corpora were used – the People's Daily for China (1950 – 2021) and the congressional speeches for the U.S. (1873 - 2010). As a linguistic indicator of the concepts of effort and efficiency, we developed a dictionary for each concept based on pre-trained word embedding models in both languages. Moral attitudes towards effort and efficiency in the corpora were calculated, on a year-by-year basis, as the cosine similarity between the dictionaries of these concepts and an existing dictionary of morality. We first benchmarked the fluctuation of moral attitude towards inefficient effort against critical historical events in the two countries. Additional time series analysis revealed the association and potential causality between the evolution of moral attitude towards inefficient effort and critical socio-cultural variables such as collectivism and cultural looseness. Our research sheds light on the historical and socio-cultural roots of moralization of effort and has implications for historical psychology research on moral attitudes.

Keywords: Inefficient effort, Natural Language Processing, historical psychology, moralization, word embedding

Introduction

Imagine a scenario: A newspaper company recently purchases an Artificial Intelligence (AI) system that can generate articles that are indistinguishable from those written by human journalists. The sale of the newspaper is unaffected after the company relies entirely on the AI system. As such, the two journalists hired by the company have enjoyed indefinite paid time off (PTO). However, one of them still privately writes two articles per day as before, while the other sits on the couch and watches TV all day long. Whom would you instinctively deem as more morally praiseworthy? Recent work on moralization of inefficient effort has suggested that across multiple cultures, people tend to morally praise the individuals who exert efforts even when the efforts produce no discernable outcomes (Amos et al., 2019; Bigman & Tamir, 2016; Celniker et al., 2023; Ess & Burke, 2022; Fwu et al., 2014). In laboratory settings, individuals tend to infer positive moral attributes from a mere cue of effort (Amos et al., 2019; Celniker et al., 2023). Utilizing vignettes across various domains—including paid employment and partner choice—in different cultures, this line of research demonstrates that individuals who exert greater effort, even in tasks that appear meaningless and completely replaceable by less effortful alternatives, are perceived as more moral and deserving of higher monetary reward. Such cues about effort can influence behavioral outcomes. For example, the demonstration of effort exerted by fundraisers has been shown to increase participants' willingness to donate to the charity; participants were more likely to pay higher salaries to employees who exhibited more effort, even when the actual outcome or end product remains the same (Celniker et al., 2023).

The tendency of morally praising effort independent of outcomes is not only observed in laboratory settings, but also seems to be a common theme in the workplace of many developed economics, where many high paying and prestigious jobs are deemed useless and meaningless (or "bullshit jobs") even by employees in those positions themselves (Celniker et al., 2023; Graeber, 2018). A sociology work suggests that wealthy people in the U.S. tend to use their "hard work" to morally justify their advantageous socioeconomic status, while intentionally or unintentionally downplaying or ignoring the structural privilege they have enjoyed (Sherman, 2017).

Interestingly, the consequences of moralization of inefficient effort may differ at the societal level compared with the individual level. While the dissociation between effort and efficiency can lead to negative individual consequences, such as diminished learning outcomes

(Kirk-Johnson et al., 2019) and a lack of sense of meaningfulness (Graeber, 2018), it can serve a strategic role at the societal level. By valuing effort irrespective of results, societies might encourage continuous striving and persistence, fostering resilience in the face of challenges and setbacks. Such work ethics can pave the way for long-term innovation (Kundro, 2022) and stimulate economic growth (Becker & Woessmann, 2009), even if immediate results are not always evident. In short, the moralization of inefficient effort, in its ambivalent nature and its relationship to societal environment, is more than merely justifying one's effortful actions but rather is linked to the evolution of moral systems and their intricate interplay with broader contexts.

Delving deeper into the moralization of inefficient effort, we could find its roots in a society's history and culture. Historically, many cultures have celebrated virtues such as diligence, perseverance, and hard work, often rooted in religious and/or philosophical teachings (Fitouchi et al., 2022). For instance, the Protestant Work Ethic (PWE) emphasizes labor and discipline as symbols of personal virtue (Weber, 1905). Empirical studies have shown that societies with a strong emphasis on PWE tend to place a higher value on individual effort and achievement, even in secular contexts (Furnham, 1984; Uhlmann & Sanchez-Burks, 2014). Similarly, Confucian values from East Asia stress the importance of industriousness and constant self-improvement as moral obligations (Hwang, 2012). For example, in a society under the influence of Confucian values (e.g., China, Korea), the education system is designed to reward effort-driven practice such as intensive memorization for exams, in which students might internalize the belief about effort as a source of motivation, a belief often instilled by parents and educators (S.-W. Chen, 2023). These cultural norms may have shaped societies to prioritize the exertion of effort itself over its outcome, perceiving genuine hard work as intrinsically valuable, regardless of its direct utility or efficiency.

Furthermore, the differences also manifest in the perception and pursuit of efficiency. In the Confucian value system, equality is prioritized over individual efficiency (Poznanski, 2017). In contrast, the PWE not only promotes hard work but also sees efficiency and individual achievement as the means to achieve personal salvation (Weber, 1905). For example, compared to American families, Japanese families tended to promote task involvement through interpersonal cooperation rather than competition, often eschewing evaluations based on individual performance (Holloway, 1988).

In both cultures, the moral underpinnings of effort and efficiency are not just abstract values. They influence educational practices, societal judgments, and even economic policies. However, traditional survey and experimental methods have limited capacity in revealing the historical roots and evolution of these moral attitudes at the societal level (Atari & Henrich, 2022; Muthukrishna et al., 2021).

Here, we aim to trace the moral values of effort and efficiency within two distinct sociopolitical and linguistic contexts - the United States and People's Republic of China. We explore how these values evolved over time and how they interacted with key historical and economic events. Our approach integrates advanced natural language processing techniques and data from historical and contemporary sources, providing a robust and nuanced analysis of these complex moral constructs.

The historical and cultural perspectives

Rarely any moral attitude remains static throughout history (Muthukrishna et al., 2021). Delineating the evolution of moral attitudes and the societal factors leading to and resulting from their changes can advance our understanding of cross-cultural and cross-time variations in human cognition. Investigating these variations and their historical origins can provide insight into the fundamental aspects of human society, such as its values, ethics, and customs.

In the study of the evolution of moral attitudes, text corpora serve as an invaluable gateway into history, as it documents the collective minds of the human societies in the past (Muthukrishna et al., 2021).. With the recent trend of applying computational linguistic models to historical text corpora, psychologists are able to reveal theoretically intriguing and hitherto neglected historical evolutions of various cultural and social constructs. For example, previous studies have identified a rise in individualistic values and the loosening of cultural norms within the U.S. society over a span of 200 years (Greenfield, 2013; Jackson et al., 2019). Adopting a similar approach, Choi and colleagues track the changes in the use of threatening language in American English books, and show that these changes correspond with actual threats in the U.S. history (Choi et al., 2022). Other studies have documented the surge of language use that is associated with cognitive distortion, such as overgeneralizing and mislabeling, in American English, Spanish, and German books since the 1980s, and shown that this pattern is not driven by linguistic shifts (Bollen et al., 2021).

This line of work typically relies on the frequency of a set of words (i.e., a dictionary) that represents the psychological construct in question in large language corpora (e.g., Google Book) across the years (Michel et al., 2011). A second approach for studying historical psychology employs co-occurrence analysis. By rating language proximal to specific terms based on psychological constructs, such as positivity and stereotypes, researchers can gain insights into the increasing negativity of attitudes toward old age group across time and ambivalent age stereotypes across cultures (Mason et al., 2015; Ng & Chow, 2021). The most recent approach leverages advanced natural language processing techniques, such as word and sentence embeddings, to measure semantic similarity between psychological constructs of interests, and to examine the historical evolution of such semantic similarities. This approach departs from the distributional hypothesis from linguistics, which posits that the semantic contexts around words captures their meaning in terms of cultural associations (Sahlgren, 2008) and has been shown to align well with human implicit bias data (Caliskan et al., 2017). Existing research has demonstrated its application in quantifying the cultural associations such as capturing historical dynamics of social group representation (Charlesworth et al., 2022), identifying polarized framing of immigrants between political parties' speeches (Card et al., 2022), tracking the decline of gender and ethnic stereotypes in American historical corpora (Garg et al., 2018; Jones et al., 2020) as well as consistency of gender stereotypes across child and adult corpora (Charlesworth et al., 2022).

Like the various psychological constructs reviewed above, cross-cultural diversity in moral attitudes in today's world is likely a consequence of distinct historical evolution trajectories in different geographic, linguistic, and social contexts (Henrich, 2020). Existing NLP-based historical psychological research has largely been focused on the so-called Western, Educated, Industrial, Rich, and Democratic (WEIRD) societies, and has primarily relied on English texts. While there are exceptions that use non-English sources such as German and French (Baumard et al., 2022; Bollen et al., 2021; Martins & Baumard, 2020), the Eurocentric focus in previous research has constrained the exploration of broader cultural and historical diversity. Here, we examine and compare the historical evolution of moral attitudes toward effort and efficiency in recent Chinese and U.S. American history, two societies significantly differ in their political and economic institutions, popular cultures, ideologies, and languages. This allows

us to identify similar and distinct societal and cultural drivers behind the different evolution trajectories.

Specifically, we set out to address three novel research questions and goals: (1) developing a computational linguistic tool targeting moral attitudes toward effort and efficiency expressed in Chinese and English texts; (2) characterizing the historical evolution trajectories of moral attitudes toward efforts and efficiency in modern Chinese and U.S. American histories; and (3) understanding the social and cultural antecedents and consequences of the moral attitudes toward efforts and efficiency in both cultures.

Method

Dictionary Development

How do we represent the concept of effort and efficiency in text data? First, we need to develop a dictionary representing the concept. To represent positive and negative moral values, we used the words from the Moral Foundations Dictionary 2.0 (Frimer et al., 2019) which is based on the Moral Foundations Theory (Graham et al., 2013). Some examples of these words, which are rooted in moral foundations (care, fairness, loyalty, authority, and sanctity), include "compassion," "equality," "loyalty," "respect," and "purity." The Chinese Moral Foundations Dictionary was adapted and translated from the English version and demonstrated its ability to effectively capture moral values in Chinese texts in our previous work (Y. Chen et al., 2023; Garten et al., 2018). We acknowledge that various versions of the Moral Foundations Dictionary exist, both in English and Chinese (e.g., the Extended Moral Foundations Dictionary, Hopp et al., 2021; the Chinese Moral Foundations Dictionary 2.0, Cheng & Zhang, 2023). Our choice of the dictionaries was based on the consideration of compatibility and ease of comparison between the English and Chinese analysis. We demonstrated the validity of the moral dictionaries in a validation analysis, where we benchmarked the fluctuations of the moral attitudes toward the U.S.S.R. in the Chinese and American corpora (see *Dictionary Validation* in the **Results** section).

Representing effort and efficiency through language is more challenging compared to gender or moral foundations due to the lack of established dictionaries. To develop the dictionaries, we employed a combination of pre-trained language models and human ratings,

following the procedures of previous studies (Choi et al., 2022; Jackson et al., 2019; Lin et al., 2022). The process consisted of four main steps:

First, we identified English and Chinese seed words related to effort and efficiency from WordNet (Miller, 1995), a comprehensive lexical database, and thesaurus.

Second, we computed the mean vector coordinates for seed words using pre-trained models, including Google News (Mikolov et al., 2013), Wikipedia (Bojanowski et al., 2017), and Twitter (Pennington et al., 2014) for English, and Renmin, Wikipedia and Weibo for Chinese (Li et al., 2018), to represent seed words in high-dimensional semantic spaces and identify similar terms. The selection of these pre-trained models was based on their coverage across diverse platforms, spanning traditional mass media, encyclopedic references, and social media.

Third, we extracted the 50 words most proximal to the mean coordinates in each pre-trained model. These words were considered closely related to the concepts.

Finally, two native speakers of English and two native speakers of Chinese were trained to evaluate the extracted words for relevance. They selected those with average ratings exceeding 8 out of 10 to ensure the content validity of the intended concepts. The final dictionaries comprised of 10 words each for effort and efficiency in English, while the Chinese versions incorporated 13 for effort and 10 for efficiency. Some examples of the effort dictionary are “effort”, "toil", and "perseverance. The efficiency dictionary comprises words like “efficiency,” "productivity," "effective," "economical," and "profitable"; Some examples of the Chinese effort dictionary are “努力”， “力求”，and “尽力”， and some examples of the Chinese efficiency dictionary are“效益”，“效率”，and “效用”.

By following this systematic approach, we created reliable dictionaries of effort and efficiency in English and Chinese, enabling capturing the embeddings of effort and efficiency in text (see Appendix for full lists).

Data Collection and Model Training

To examine the societal attitudes toward effort and efficiency, we compiled two datasets from the U.S. congressional speeches from 1873 to 2021 and People’s Daily Newspaper of China from 1950 to 2021. the U.S. congressional speeches encompass a wide range of discussions and debates on various policy issues, reflecting the diverse views of American lawmakers. On the other hand, People's Daily of China, as the official mouthpiece of the Chinese

Communist Party, presents a crucial perspective on the Chinese government's stance on effort and efficiency in the context of their political and socio-economic environment. By analyzing these two sources, we aim to uncover patterns and trends in political attitudes toward effort and efficiency.

The corpora are split by year and trained into word2vec model using python *gensim* package. Word2Vec models in natural language processing converts a word into a word vector, i.e., a word embedding in a high-dimensional semantic space.

Measuring moral values in text corpora

To assess the moral values of effort and efficiency in the above corpora, we adopt the word embeddings bias method, a natural language processing technique widely used in previous studies that quantify changes in stereotypical bias throughout the U.S. history (Charlesworth et al., 2022; Garg et al., 2018). First, our analysis required dictionaries representing the concepts of interest, including effort, efficiency, and moral values, detailed in *Dictionary Development* section above.

Second, to measure bias in word embeddings, we computed the strength of association (or similarity) between the dictionary of a concept (e.g., effort) and the dictionary of the evaluative words (e.g., moral virtues). Specifically, we calculated the average cosine similarity between each concept (effort or efficiency) and the evaluative words, as shown in the formula below:

$$\mathrm{sim}_{(effort \cdot virtue)} = \frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} \cos(\mathbf{v}_{effort_i}, \mathbf{v}_{virtue_j})$$

Here, $\mathrm{sim}_{(effort \cdot virtue)}$ represents the average cosine similarity between the effort concept and positive moral values (virtue), while *M* and N denotes the total number of words in the two dictionaries. We used the same approach to calculate the negative moral values (vice) of effort and efficiency. Moral attitude towards effort (or efficiency) is defined as the difference between the positive and negative moral values of effort (or efficiency). Hereafter, we use Effort and Efficiency to denote the moral attitudes towards effort and efficiency, respectively. Moral attitude toward inefficient effort is defined as the difference between the positive moral value of effort and the positive moral value of efficiency. Hereafter, we use Inefficient Effort to denote the moral attitudes towards inefficient effort.

Other variables

Individualism/Collectivism. To investigate the evolution of cultural values along with the moral values of inefficient effort, we incorporated individualism and collectivism measures. We derived these measures from the Google *Ngram* word frequency data, which provides insight into the prevalence of individualistic and collectivistic terms in published texts over time. For clarity, in the following context, "Individualism" and "Collectivism" refer to the model variables, while "individualistic values" and "collectivistic values" denote the broader conceptual values. The English and Chinese dictionaries are taken from existing studies in historical psychology (Greenfield, 2013; Zeng & Greenfield, 2015).

Tightness/Looseness. Cultural tightness and looseness refer to the extent to which a culture adheres to social norms and tolerates deviant behavior (Gelfand et al., 2006). Tight cultures have strict norms and little tolerance for deviations, whereas loose cultures are more permissive and flexible. Recent advances in research have facilitated the measurement of these constructs in textual content, examining the prevalence and context of norm-related words in various English corpora (Jackson et al., 2019). For clarity, in the following context, "Tightness" and "Looseness" refer to the model variables, while "cultural tightness" and "cultural looseness" denote the broader conceptual values. We translated the Chinese dictionary from the English version.

GDP per capita. To control for economic factors that may influence the attitudes toward effort and efficiency, we utilized GDP per capita data. This information was obtained from the Maddison Project, a comprehensive dataset that provides historical GDP per capita estimates for various countries (Bolt & van Zanden, 2020). By including GDP per capita in our analysis, we aimed to account for potential economic influences on the examined concepts.

Statistical analysis

First, we present a descriptive analysis of the long-term trends in the moral values of effort and efficiency based on the U.S. congressional speeches and China's People's Daily Newspaper.

Null models as baseline. To establish reference points for linguistic fluctuations over time and demonstrate the moral significance of the concepts, we ran 10,000 simulations. In these

simulations, we substituted effort- and efficiency-related words with randomly selected words and extracted their semantic similarities with moral evaluative words (virtue and vice dictionaries, respectively). It yielded a distribution of the association between 10,000 random sets of words (same size as the effort and efficiency dictionaries, respectively) and the moral evaluative words for each year, forming a 95% confidence interval for these random associations. We then compared these with the moral associations with the concepts we are interested in (Bollen et al., 2021; Jones et al., 2020).

Bayesian Change Point Detection. To assess the convergent validity of the moral measures, we employed Bayesian Change Point Detection, a statistical technique designed to identify shifts in data patterns by estimating the probability of change points at each timepoint. This approach allows us to pinpoint the precise time points at which moral value shifts occur and examine their correspondence with key historical turning points in each country. Utilizing this method, we can establish a connection between our findings and the broader historical context. The *bcp* package in R was used for change point analysis (Erdman & Emerson, 2008).

Time Series. To estimate the long-term trends of moral values associated with effort and efficiency in the U.S. congressional speeches and China's People's Daily Newspaper, we applied the Autoregressive Integrated Moving Average (ARIMA) modeling, utilizing the *auto.arima* function from the forecast package in R (Hyndman & Khandakar, 2008), to the yearly association data. ARIMA is a time-series model that allows us to account for both the temporal dependencies and random fluctuations within the data, while controlling for GDP per capita.

Causality Test. To further analyze the directionality between moral values and cultural changes, we employed Granger causality test to determine whether moral values of effort and efficiency precede cultural values, or vice versa. To ensure stationarity of the data, we extracted the time series data from ARIMA models. To determine the optimal lag length for the Granger tests, we compared models with lags ranging up to 10 years and selected the one with lowest Akaike Information Criterion (AIC). The Granger causality test was performed using the *grangertest* function from the *lmtest* package in R (Zeileis & Hothorn, 2002).

Data and code associated with this research can be accessed at https://github.com/amberxuqianchen/effort-osf

Results

Dictionary validation

To validate the moral measures in the U.S. congressional speeches and People's Daily of China, we employed the embedding bias method to examine the moral values of the Union of Soviet Socialist Republics (U.S.S.R.) in the two corpora. It is expected that the evolution of moral attitudes toward the U.S.S.R. fluctuates in response to known events in diplomatic history.

As illustrated in Figure 1A, the moral attitudes towards the U.S.S.R. in the U.S. congressional speeches showed fluctuations during the 1920s and 1930s, with a prominent peak coinciding with the establishment of the U.S.-U.S.S.R. diplomatic ties in 1933, and remained relatively high during the World War II, during which U.S. and the U.S.S.R. were close allies against the Nazi Germany. However, the moral attitudes towards the U.S.S.R. quickly declined after the end of the war, when the tension between the Socialism bloc and the West accelerated and the Cold War was in the corner. Of note, Winston Churchill's Iron Curtain Speech was delivered in 1946 and the Gouzenko Affair (high-profile U.S.S.R. spy at the Soviet Embassy in Ottawa) went viral in the media between 1945 and 1946. Moving forward, the moral attitudes towards the U.S.S.R. remained negative in the congressional speech corpus, despite a brief uptick coinciding with Khrushchev's 1959 the U.S. visit. In contrast, the moral attitudes towards the U.S.S.R. in the People's Daily of China notably fluctuated in response to historical events, as shown in Figure 1B. For instance, there have been marked declines since the 1960s, during which the moral attitudes dropped from positive to negative. This downturn reached its nadir in 1971 following the Sino-Soviet border conflict in 1969. However, there was a resurgence in moral attitude towards the U.S.S.R. in 1980s along with the resumption of diplomatic relations, culminating in a peak when Soviet Communist leader Mikhail Gorbachev paid a state visit to China in 1989 for the Sino-Soviet Summit.

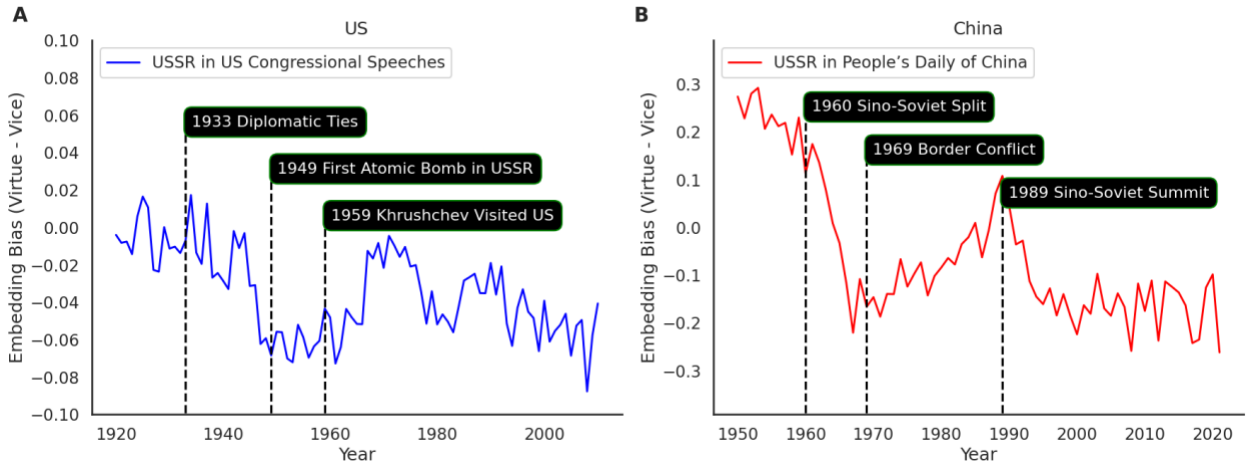


Figure 1. Historical trend of moral attitude toward the Union of Soviet Socialist Republics (U.S.S.R.) in the U.S. congressional speeches and People's Daily of China

Historical trends of moral attitudes toward inefficient effort

We first showed the descriptive trajectories of the evolution of moral attitudes toward efforts, efficiency, and inefficient effort over the last 7 decades of Chinese history and nearly 14 decades of U.S. history, in their respective text corpus. All the years cited below in this section have been determined as significant change points by Bayesian Change Point Detection, with the first three highest probabilities in the series (Erdman & Emerson, 2008). This method is employed to detect substantial shifts in a data sequence, offering a probabilistic framework to identify the number and location of these changes by calculating the posterior probability of a change at each time point.

As displayed in **Figure 2A**, in the U.S. Congressional speeches, the moral attitude towards effort is predominantly positive. An upward surge occurred in 1957 when it increased beyond the predictions of the null model, a year of significant change identified by Bayesian Change Point Detection. During a period of mostly uprising in the moral attitude towards effort from 1964 to 2010, there is a marked decline in 1998, coincides with the Asian Financial Crisis. The trajectory of efficiency mirrors this historical pattern, with less significant increasing trend starting from 1964. Between 1964 to 2010, 1996 stands out as a year that exhibits an abrupt dip in its moral values. Together, before 1960s, effort and efficiency appeared relatively indistinguishable from each other and overlapped with the predictions of the null models. Post-1960s, a discernible moralization of these terms emerges, with effort consistently receiving more positive evaluations than efficiency.

The trajectory of moral attitude toward inefficient effort (**Fig. 2B**) is mainly positive but marked by significant fluctuations. Before the 1940s, the trajectory largely overlaps with the null model predictions. Since the 1940s, the trajectory has been consistently above the null model predictions.

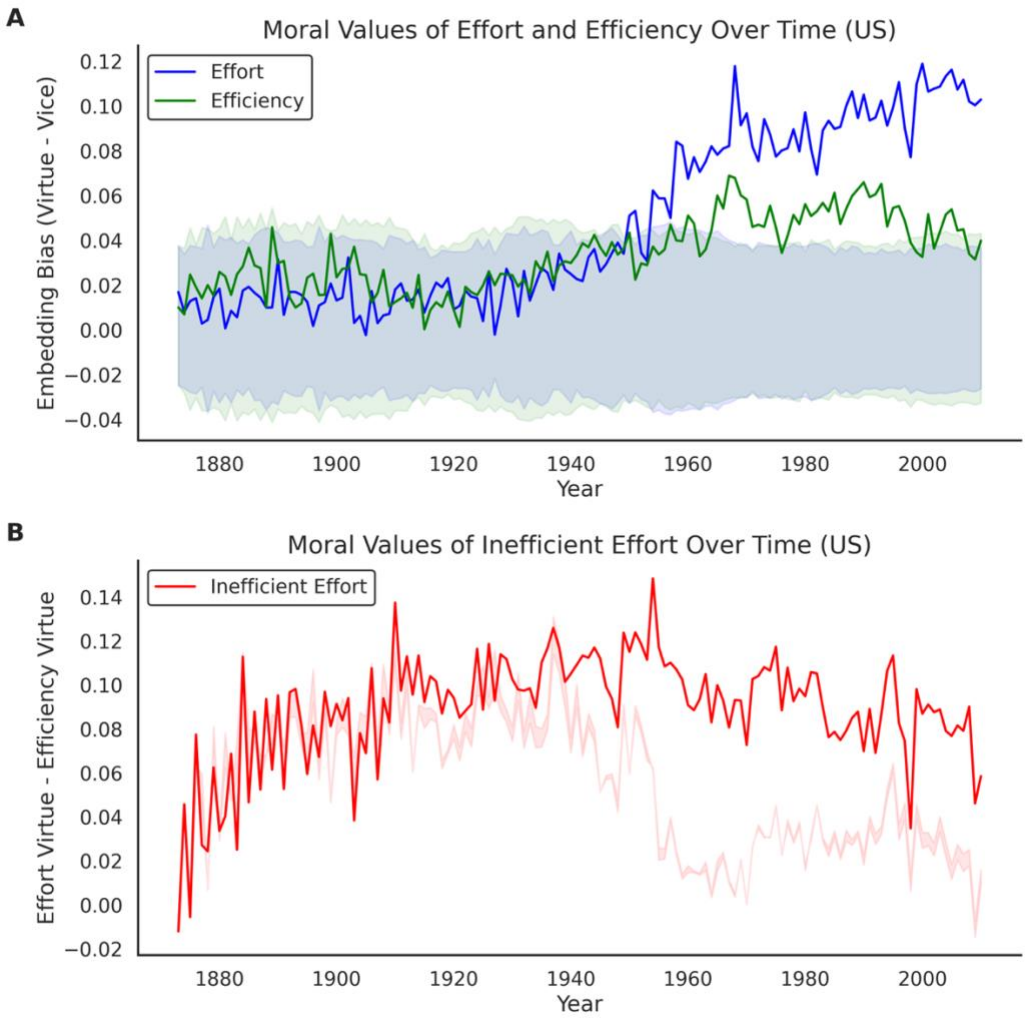
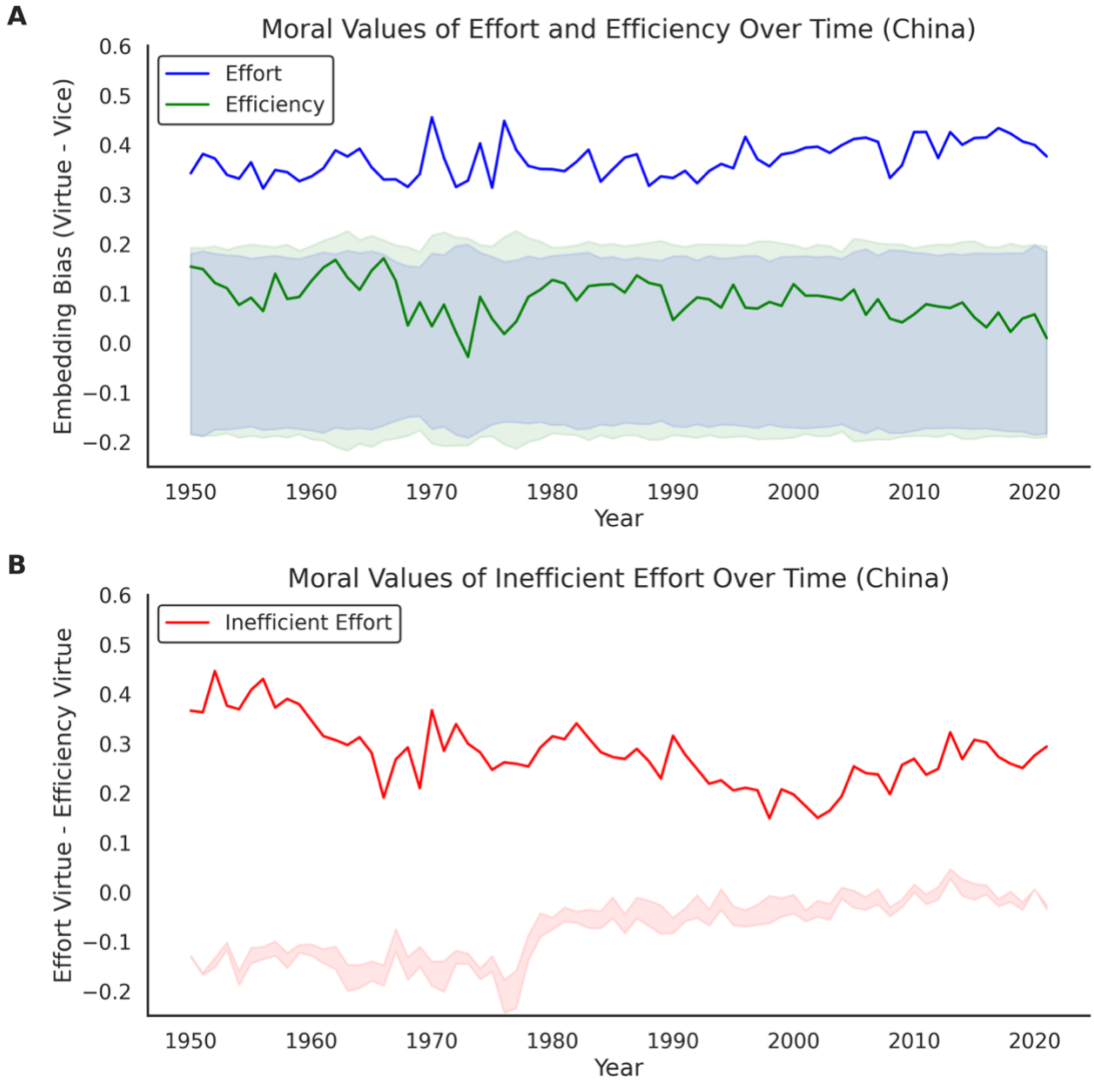


Figure 2. Historical trends of moral attitudes towards effort, efficiency, and inefficient effort in the U.S. congressional speeches (1873 – 2010). (A) Moral attitudes towards effort and efficiency. (B) Moral attitudes towards inefficient effort. The shaded regions denote the 95% confidence interval derived from a null model, comprising 10,000 sets of random words matched in length to the English effort/efficiency dictionaries (see the *Null Model as Baseline* section in *Methods*).

As shown in **Figure 3A**, in People's Daily of China, effort consistently demonstrates a stronger association with virtue words compared to vice words. Notably, the trajectory of moral attitude toward effort is consistently above the levels predicted by the null model. Conversely,

while efficiency maintains its positive valuation across most data points, it consistently falls within the 95% confidence intervals of the null model except for the duration from 1990s to 2000s, implying that the observed positive moral values is only distinguishable from mere random occurrences during this specific timeframe. This indicates that efficiency the moralization of efficiency may not be as distinct or robust as that of effort in this context. Importantly, in contrast to the U.S. congressional speeches where both effort and efficiency underwent significant shifts in moral valuation across years, moral values of effort and efficiency in People's Daily of China displayed more stability, as evidenced by the absence of any year where the Bayesian Change Point (BCP) detection probability exceeded 50%. This highlights a distinctive pattern between the two cultural contexts.

Regarding inefficient effort shown in **Figure 3B**, its association with positive moral values has been consistently positive over the seven decades that we have data for. The trend for inefficient effort remained relatively stable until 1959, the year marked as a significant change point identified by Bayesian Change Point Detection analysis. Between 1959 to 1978, we observed some fluctuations but gradually a downward trend emerged after 1978, paralleling China's period of profound economic reform and transition to a more market-oriented economy, which emphasizes the relative importance of efficiency. The period from 1992 witnessed an even steeper decline, during which China's economic reform and opening moved to a "fast track". Notably, in 1992 the then paramount leader of Chinese Communist Party, Deng Xiaoping, delivered a series of speeches that emphasized the importance of economic reform in the survival and thriving of the country and its people.



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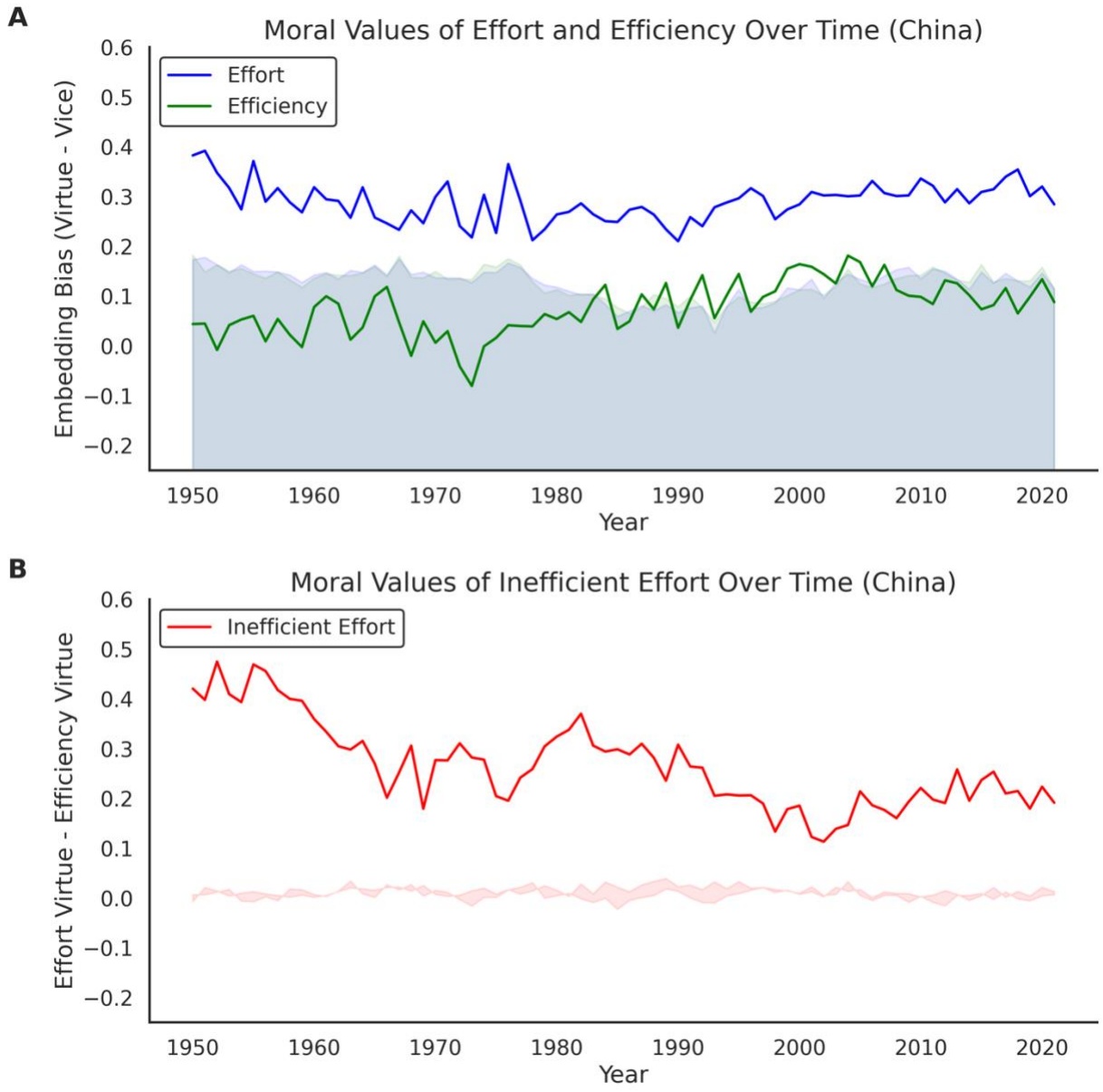

Figure 3. Historical trends of moral attitudes towards effort, efficiency, and inefficient effort in People's Daily of China (1950 – 2021). (A) Moral attitudes towards effort and efficiency. (B) Moral attitudes towards inefficient effort. The shaded regions denote the 95% confidence interval derived from a null model, comprising 10,000 sets of random words matched in length to the Chinese effort/efficiency dictionaries (see the *Null Model as Baseline* section in *Methods*).

ARIMA Models: the U.S. congressional speeches

Next, we used a time series analysis (ARIMA model) to examine the association between the fluctuations of the moral attitudes toward effort, efficiency, and inefficient effort on the one hand, and a number of cultural values (i.e., Individualism, Collectivism, Looseness, Tightness)

on the other hand. As shown in **Table 1**, during the period of U.S. history we examined here (1873 – 2010), positive moral attitude toward effort is positively correlated with Looseness (b = 0.03, 95% CI [0.01, 0.05], p = < 0.001), even after controlling for GDP per capita (b = 0.03, 95% CI [0.01, 0.04], p = < 0.001). This suggests that in the society with a higher tolerance of deviance (i.e., higher culture looseness), we can expect a significant increase in the positive moral attitude towards effort.

For the moral attitude toward efficiency, collectivism is a significant predictor (b = -0.01, 95% CI [-0.02, -0.01], p = < 0.001). However, the significant relationship disappeared after controlling for GDP per capita (b = -0.01, 95% CI [-0.03, 0.00], p = 0.099). This implies that as collectivist values decrease in the U.S. society, the moral attitudes toward efficiency in the U.S. congressional speeches increase, but this relationship appears to be dependent on the economic conditions. In contrast, Individualism is not in itself a significant predictor of the moral attitude toward efficiency (b = -0.01, 95% CI [-0.03, 0.01], p = 0.195). Interestingly however, when adjusted for GDP per capita, Individualism became a significantly negative predictor (b = -0.01, 95% CI [-0.03, -0.00], p = 0.027). This suggests when the economic performance is held constant, the more prevalent the individualist values are in the U.S. society, the more negative the moral attitude toward efficiency is, as observed in the congressional speeches.

For the moral attitude toward inefficient effort, after controlling for GDP per capita, Looseness became a negative predictor (b = -0.06, 95% CI [-0.07, -0.05], p = < 0.001). This suggests that in the relatively culturally looser periods in the U.S. history, inefficient effort in the U.S. congressional speeches becomes more morally negative statistically, possibly indicating a greater condemnation of wastefulness and inefficiency in their public discourse.

In the context of People's Daily of China (1950 – 2021), the basic effort models (not controlling for GDP per capita) show that collectivism was a significantly positive predictor of effort after controlling for GDP per capita (b = 0.04, 95% CI [0.02, 0.06], p = < 0.001) (**Table 2**). The significant influences of collectivistic values on the moral attitudes towards effort reflect the intrinsic cultural appreciation for hard work and diligence that is deeply ingrained in Chinese culture (Heine, 2001; Leong et al., 2014).

In the basic efficiency models, Looseness emerged as a positive predictor of Efficiency before (b = 0.03, 95% CI [0.02, 0.05], p = < 0.001) or after controlling for GDP per capita (b = 0.05, 95% CI [0.00, 0.10], p = 0.040). This association can be interpreted in light of the societal transformation, where flexible norms and behaviors (indicative of looseness) might lead to a favorable valuation of efficiency during China's shift toward a market economy.

Most notably, in the inefficient effort models, Collectivism was a significantly positive predictor only before controlling for GDP per capita (b = 0.06, 95% CI [0.02, 0.10], p = 0.005) . Interestingly, Looseness emerged as a negative predictor of Inefficient Effort only after adjusting for GDP per capita (b = -0.15, 95% CI [-0.22, -0.08], p = < 0.001). The negative impact of Looseness on moralization of inefficient effort observed in the People's Daily of China echoes findings from the U.S. congressional speeches, suggesting a broader, cross-cultural trend. This pattern could imply that societies with more flexible norms and behaviors might, universally, be less valuing of inefficiencies, likely viewing them as counterproductive in rapidly changing environments.

Table 1. ARIMA Results based on the U.S. congressional speeches

Effort Model						GDP-Adjusted Effort Model				
Predictor	(p, d, q)	Coef	SE	t	p	(p, d, q)	Coef	SE	T	p
Individualism	(0, 1, 1)	0.01	0.01	1.46	0.15	(0, 1, 1)	0.01	0.01	0.71	0.48
Collectivism	(0, 1, 1)	-0.01	0.01	-1.20	0.23	(0, 1, 1)	-0.00	0.01	-0.09	0.93
Looseness	(0, 1, 1)	0.03	0.01	3.39	0.00	(1, 0, 1)	0.03	0.01	3.30	0.00
Tightness	(0, 1, 1)	-0.00	0.01	-0.67	0.50	(0, 1, 1)	-0.00	0.01	-0.44	0.66
Efficiency Model						GDP-Adjusted Efficiency Model				
Predictor	(p, d, q)	Coef	SE	t	p	(p, d, q)	Coef	SE	T	p
Individualism	(0, 1, 1)	-0.01	0.01	-1.30	0.20	(1, 0, 1)	-0.01	0.01	-2.21	0.03
Collectivism	(1, 0, 1)	-0.01	0.00	-5.13	0.00	(1, 0, 1)	-0.01	0.01	-1.65	0.10
Looseness	(0, 1, 1)	0.00	0.01	0.07	0.94	(1, 0, 1)	-0.00	0.01	-0.36	0.72
Tightness	(0, 1, 1)	-0.01	0.00	-1.06	0.29	(1, 0, 1)	-0.00	0.00	-0.91	0.36
Inefficient Effort Model						GDP-Adjusted Inefficient Effort Model				
Predictor	(p, d, q)	Coef	SE	t	p	(p, d, q)	Coef	SE	T	p
Individualism	(3, 1, 1)	-0.00	0.01	-0.19	0.85	(3, 1, 1)	-0.01	0.01	-0.82	0.41
Collectivism	(3, 1, 1)	-0.01	0.01	-0.92	0.36	(3, 1, 1)	-0.00	0.02	-0.06	0.95

Looseness	(1, 1, 1)	-0.02	0.02	-0.97	0.33	(0, 0, 0)	-0.06	0.01	-10.97	0.00
Tightness	(3, 1, 1)	0.01	0.01	1.39	0.17	(3, 1, 1)	0.01	0.01	1.64	0.10

Notes: The ARIMA models on the left have one of the cultural variables as their predictor. The models on the right additionally included the log-transformed GDP per capita as a control variable. The ARIMA model parameters are specified by its nonseasonal components (p, d, q). "Coef": coefficient; SE: standard error. Same for Table 2.

Table 2. ARIMA Results based on People's Daily of China

Effort Model						GDP-Adjusted Effort Model				
Predictor	(p, d, q)	Coef	SE	t	p	(p, d, q)	Coef	SE	T	p
Individualism	(0, 1, 1)	0.01	0.02	0.71	0.48	(0, 1, 1)	0.03	0.03	1.02	0.31
Collectivism	(0, 1, 1)	0.03	0.01	1.94	0.05	(4, 1, 1)	0.04	0.01	3.71	0.00
Looseness	(0, 1, 1)	-0.01	0.03	-0.23	0.82	(0, 1, 1)	-0.02	0.04	-0.47	0.64
Tightness	(0, 1, 1)	0.01	0.01	0.46	0.64	(0, 1, 1)	0.01	0.01	0.58	0.56
Efficiency Model						GDP-Adjusted Efficiency Model				
Predictor	(p, d, q)	Coef	SE	t	p	(p, d, q)	Coef	SE	T	p
Individualism	(0, 1, 3)	-0.02	0.04	-0.43	0.66	(0, 0, 1)	-0.04	0.02	-1.75	0.08
Collectivism	(0, 1, 3)	-0.04	0.03	-1.32	0.19	(1, 0, 3)	-0.03	0.02	-1.40	0.16
Looseness	(1, 0, 0)	0.03	0.01	4.64	0.00	(1, 0, 0)	0.05	0.03	2.06	0.04
Tightness	(0, 1, 3)	-0.01	0.02	-0.51	0.61	(0, 0, 1)	0.02	0.01	1.87	0.06
Inefficient Effort Model						GDP-Adjusted Inefficient Effort Model				
Predictor	(p, d, q)	Coef	SE	t	p	(p, d, q)	Coef	SE	T	p
Individualism	(0, 1, 1)	-0.03	0.04	-0.66	0.51	(1, 0, 1)	-0.06	0.06	-1.08	0.28
Collectivism	(1, 0, 1)	0.06	0.02	2.84	0.00	(1, 0, 1)	0.05	0.03	1.68	0.09
Looseness	(0, 1, 1)	-0.09	0.05	-1.68	0.09	(1, 0, 1)	-0.15	0.04	-4.33	0.00
Tightness	(0, 1, 1)	-0.02	0.02	-0.89	0.37	(1, 0, 1)	-0.03	0.02	-1.47	0.14

Granger Tests

Did cultural values lead to changes in the moral valuation of effort and efficiency, or did these moral values trigger shifts in cultural norms? To examine the existence and directionality of these relationships, we applied Granger analysis to the time series of cultural variables and moral attitudes.

Our findings revealed that within the U.S. congressional speeches, Individualism significantly influenced Effort ($F(9, 220) = 3.05$, $p = 0.002$) and Efficiency ($F(9, 220) = 2.56$, $p = 0.008$), without significant reverse causality from Effort ($F(9, 220) = 1.28$, $p = 0.251$) or Efficiency ($F(9, 220) = 0.61$, $p = 0.785$) back to Individualism. Similarly, Collectivism significantly influenced Effort ($F(10, 214) = 2.89$, $p = 0.002$) and Efficiency ($F(10, 214) = 3.12$, $p = < 0.001$), without notable reverse causality from Effort ($F(10, 214) = 0.86$, $p = 0.571$) or Efficiency ($F(10, 214) = 1.00$, $p = 0.442$) to Collectivism.

In contrast, Inefficient Effort was a significant precursor of shifts in cultural values including Individualism ($F(9, 220) = 1.93$, $p = 0.049$) and Collectivism ($F(10, 214) = 3.30$, $p = < 0.001$). Meanwhile, cultural norms such as Tightness and Looseness did not show a causal influence on Inefficient Effort. In contrast, Inefficient Effort significantly predicted changes in Tightness ($F(10, 214) = 2.45$, $p = 0.009$).

When examining the data from People's Daily of China, the interplay between cultural variables and moral attitudes toward effort and efficiency showed different patterns. Specifically, individualism had a significant causal influence on Effort ($F(9, 82) = 2.07$, $p = 0.042$) with no significant reverse causality ($F(9, 82) = 1.19$, $p = 0.314$). Similarly, changes in collectivism drove shifts in Effort ($F(9, 82) = 2.97$, $p = 0.004$) with no reverse relationship ($F(9, 82) = 0.82$, $p = 0.599$). Regarding the cultural dimensions of Looseness and Tightness, neither showed a significant causal relationship with Effort except for a significant impact where the change of moral values of effort preceded the change of Tightness ($F(9, 82) = 2.01$, $p = 0.048$). This could suggest that increased valuations of effort might have some influence on adherence to norms and regulations. Regarding the relationship with Efficiency, none of the cultural demonstrated significant causality. However, intriguingly, Efficiency was found to significantly precede Individualism ($F(9, 82) = 2.33$, $p = 0.021$).

In analyzing Inefficient Effort, a robust causal relationship was identified where Collectivism showed a causal relationship with Inefficient Effort ($F(9, 82) = 2.94$, $p = 0.004$) and vice versa ($F(9, 82) = 2.37$, $p = 0.020$). This bidirectional causality indicates a dynamic interplay between collective values and the moralization of inefficient efforts in the Chinese narrative.

Additionally, Looseness preceded the changes of Inefficient Effort ($F(2, 124) = 3.73$, $p = 0.027$) with no significant reverse causality ($F(2, 124) = 1.76$, $p = 0.176$).

Table 3. Granger Causality Results based on the U.S. congressional speeches

IV	DV	Lag	F value	p value	Reverse F	Reverse p
Individualism	Effort	9	**F(9, 220) = 3.05**	**0.00**	F(9, 220) = 1.28	0.25
Collectivism	Effort	10	**F(10, 214) = 2.89**	**0.00**	F(10, 214) = 0.86	0.57
Looseness	Effort	4	F(4, 250) = 1.59	0.18	F(4, 250) = 1.8	0.13
Tightness	Effort	10	F(10, 214) = 1.57	0.12	F(10, 214) = 1.26	0.25
Individualism	Efficiency	9	**F(9, 220) = 2.56**	**0.01**	F(9, 220) = 0.61	0.78
Collectivism	Efficiency	10	**F(10, 214) = 3.12**	**0.00**	F(10, 214) = 1	0.44
Looseness	Efficiency	3	F(3, 256) = 2.49	0.06	F(3, 256) = 2.64	>0.05
Tightness	Efficiency	9	F(9, 220) = 1.78	0.07	F(9, 220) = 1.11	0.36
Individualism	Inefficient Effort	9	F(9, 220) = 0.97	0.47	**F(9, 220) = 1.93**	**0.05**
Collectivism	Inefficient Effort	10	F(10, 214) = 0.70	0.72	**F(10, 214) = 3.3**	**0.00**
Looseness	Inefficient Effort	10	F(10, 214) = 1.48	0.15	F(10, 214) = 1.61	0.11
Tightness	Inefficient Effort	10	F(10, 214) = 0.93	0.51	**F(10, 214) = 2.45**	**0.01**

Notes: The columns labeled “Reverse F” and “Reverse p” represent the F-statistic and p-value from the reverse Granger test, where the dependent variable (DV) is swapped with the predictor. As an illustration, the first row demonstrates that at a lag of 9, Individualism is a Granger cause of changes in Effort ($p = 0.002$). Conversely, Effort is not a Granger cause for changes in Individualism ($p = 0.251$). Same for Table 4.

Table 4. Granger Causality Results based on People’s Daily of China

IV	DV	Lag	F value	p value	Reverse F	Reverse p
Individualism	Effort	9	F(9, 82) = 2.07	0.04	F(9, 82) = 1.19	0.31
Collectivism	Effort	9	F(9, 82) = 2.97	0.00	F(9, 82) = 0.82	0.60
Looseness	Effort	9	F(9, 82) = 1.07	0.40	F(9, 82) = 1.08	0.38
Tightness	Effort	9	F(9, 82) = 1.09	0.38	F(9, 82) = 2.01	0.05

Individualism	Efficiency	9	F(9, 82) = 0.46	0.89	F(9, 82) = 2.33	0.02
Collectivism	Efficiency	9	F(9, 82) = 1.13	0.35	F(9, 82) = 0.52	0.86
Looseness	Efficiency	10	F(10, 76) = 0.74	0.68	F(10, 76) = 0.4	0.94
Tightness	Efficiency	9	F(9, 82) = 1.26	0.27	F(9, 82) = 0.98	0.46
Individualism	Inefficient Effort	9	F(9, 82) = 1.05	0.41	F(9, 82) = 0.82	0.60
Collectivism	Inefficient Effort	9	F(9, 82) = 2.94	0.00	F(9, 82) = 2.37	0.02
Looseness	Inefficient Effort	2	F(2, 124) = 3.73	0.03	F(2, 124) = 1.76	0.18
Tightness	Inefficient Effort	10	F(10, 76) = 1.23	0.29	F(10, 76) = 1.92	0.06

Discussion

In this study, we combined computational linguistic approach (Charlesworth et al., 2022; Choi et al., 2022; Garg et al., 2018; Jones et al., 2020) and historical text corpora in China and the U.S. to examine the historical trend of the moral attitudes towards effort and efficiency (Celniker et al., 2023). The two societies exemplify two distinctive cultures: the Protestant Work Ethic (PWE) predominant in the U.S. (Furnham, 1984; Uhlmann & Sanchez-Burks, 2014), and Confucian values that characterize China (Hwang, 2012, 2015). By examining the historical trend of these moral attitudes in the U.S. and China, we offer insights into the evolving cultural narratives of hard work and productivity. The U.S., deeply influenced by the PWE, has historically valued hard work as moral virtue during the rise of capitalism. Yet, our study discerns a more intricate narrative. Up until the 1960s, the moral attitudes toward effort and efficiency are indistinguishable, at least in the congressional speech corpus, often overlapping with null models. However, the 1960s era witnessed marked increases in the positive moral values of effort and efficiency, with effort surpassing efficiency in moral values. Intriguingly,

during this period, the moral attitude toward inefficient effort starts to increase. This development might be traced back to the broader societal transformations of post-war America. As the nation reveled in the promise of the 'American Dream'—which valorized hard work as the pathway to upper mobility. Within this context, pure effort, even if not always immediately efficient or productive, gained increasingly positive moral values.

As for China, our findings depict a narrative that is different from that of the American one. The moral value of effort remains consistently positive and above the confidence interval of the null model throughout our period of observation. In contrast, the moral value of efficiency is mostly within the confidence interval of the null model, indicating that the concept of efficiency is not consistently and meaningfully associated with morality during this period of history. The lack of moral value associated with efficiency may be related to China's long-standing adherence to Confucian values, which emphasizes collective obligations irrespective of their outcomes. This philosophy is captured by sayings such as "Heroes are not judged solely by success or failure". Indeed, Confucius himself is known as someone who "knows the impracticable nature of the times and yet will be doing in them" (*Analects*). A significant decline of positive moral attitude toward inefficient effort began at the turn of 1960s, when China's leadership became aware of the detrimental effects of unrealistic ideological zeal and rolled back some of the inefficient policies mandated during the Great Leap Forward. Another decline occurred in the early 1990s and coincided with the implementation of market reform policies. The zeitgeist of this period is best illustrated by the motto of the City of Shenzhen, one of the pioneering regions of China's economic reform, "Time is money, efficiency is life". This trajectory, perhaps, mirrors China's transition to a rapidly modernizing and industrializing country.

Our results from the exploratory time series analysis (ARIMA and Granger causality), reveal distinct patterns of associations and precedence between cultural variables (i.e., individualistic/collectivistic values, cultural tightness/looseness) and the moral attitudes towards effort and efficiency (i.e., effort, efficiency, and inefficiency effort) in the U.S. and China. Specifically, in the U.S., cultural looseness positively is correlated with Effort and negatively with Inefficient Effort. On the other hand, collectivistic values are negatively correlated with Efficiency without GDP per capita beign controlled and precedes Efficiency. This suggests that in the U.S. society, where cultural looseness prevails, there may be a greater emphasis on

productive effort. Meanwhile, the presence of collectivistic values could potentially drive the devaluation of efficiency.

On the other hand, in China, collectivism upholds the moral importance of effort, even when its outcomes appear insignificant. This is evident from the positive and bidirectional relationship between collectivism and the moralization of inefficient effort. However, cultural looseness negatively associated with and preceded positive moral value of inefficient effort, independent of the society's economic performance. This might reflect Confucian values that emphasize individuals' obligations to the group and social ideal, valuing effort as a means to fulfilling these obligations, regardless of its outcomes, is challenged by the shifting dynamics brought about by cultural looseness.

These findings not only underscore the intricate relationships between cultural dimensions and moral values but also highlight the divergent paths through which these associations manifest in different socio-cultural contexts. However, we acknowledge that our time series analyses are largely exploratory and descriptive. Future research is needed to more closely address the mechanisms underlying the relationship between societal and cultural variables and moral attitudes towards effort and efficiency.

There are several limitations in the present research. First, our text corpora are exclusively drawn from the U.S. congressional speeches and Chinese newspapers. Both the corpora are formal, politically oriented narratives and texts. While these texts offer rich insights into their respective societies and times, future investigations should also diversify the source materials to include non-political content such as literature, local newspapers, magazines, and other popular media outlets, to capture a more comprehensive and representative understanding of work ethics.

Another limitation is the restricted timeframe of our study. Although this period witnessed momentous societal shifts in both the U.S. and China, a deeper historical dive would no doubt unravel even richer evolutionary patterns. In the West, epochs such as the Renaissance, Age of Exploration, Reformation—which heralded the rise of the PWE—and the Industrial Revolution, and Age of Enlightenment likely have enormous influences on the moral values of effort and efficiency. Likewise, China's transition from millennia of imperial rules to republic regime at the turn of 20th century, the New Culture Movement, World War II, and the Chinese Civil War, may have profoundly shaped the moral landscapes of effort and efficiency. Future

research is needed to examine the evolution of moral attitudes towards effort and efficiency during these historical times.

Lastly, our moral evaluative words were based on the Moral Foundations Dictionary (MFD). This dictionary, while grounded in the Moral Foundations Theory (MFT) (Graham et al., 2013), only represents one of various computational linguistic measures of morality, such as the moral judgment dictionary from The Development and Psychometric Properties (Boyd et al., 2022; Brady et al., 2020) or other versions of Moral Foundations Dictionary (Hopp et al., 2020). For example, the Extended Moral Foundations Dictionary (eMFD) was based on a more comprehensive, crowd-sourced annotation procedure instead of expert-driven content analysis (Hopp et al., 2020; Hopp & Weber, 2021; Weber et al., 2018). Our choice of the Chinese version of MFT, developed and validated specifically for Chinese texts (Y. Chen et al., 2023), was to ensure compatibility with its English counterpart. The present study does not aim to advocate one theoretical framework or tool over another but utilizes the MFD for its established efficacy in analyzing both English and Chinese texts. It is also worth noting that the field of computational linguistics has been burgeoning, with novel tools being developed for moral content analysis in textual data (Hoover et al., 2018; Vaisey & Miles, 2014). Future studies that integrate and compare these advanced tools will be able to bring about a richer, more nuanced exploration of morality from textual data.

In sum, we investigated the evolving patterns of moral attitudes toward effort, efficiency, and inefficient effort in the recent history of China and the U.S., by combining a novel computational linguistic tool and historical text corpora. We found that the fluctuations of moral attitudes towards inefficient effort roughly corresponded with critical historical events or periods in both societies that mark significant social changes in world view and ideology. Further investigation through time series analysis suggests associations and possible influence of social and cultural factors, such as collectivism/individualism and cultural looseness, on the evolution of moral attitudes toward inefficient effort. Our study not only provides insights into the historical and sociocultural origins of the moralization of inefficient effort but also has implications for historical psychological investigations into the evolution of morality.

Data Availability Statement

Data and analysis codes needed to reproduce the results reported in this paper can be accessed at https://github.com/amberxuqianchen/effort-osf

References

Amos, C., Zhang, L., & Read, D. (2019). Hardworking as a Heuristic for Moral Character: Why We Attribute Moral Values to Those Who Work Hard and Its Implications. *Journal of Business Ethics*, *158*(4), 1047–1062. https://doi.org/10.1007/s10551-017-3725-x

Atari, M., & Henrich, J. (2022). *Historical Psychology*. PsyArXiv. https://doi.org/10.31234/osf.io/m8b9g

Baumard, N., Huillery, E., Hyafil, A., & Safra, L. (2022). The cultural evolution of love in literary history. *Nature Human Behaviour*, *6*(4), Article 4. https://doi.org/10.1038/s41562-022-01292-z

Becker, S. O., & Woessmann, L. (2009). Was Weber Wrong? A Human Capital Theory of Protestant Economic History*. *The Quarterly Journal of Economics*, *124*(2), 531–596. https://doi.org/10.1162/qjec.2009.124.2.531

Bigman, Y. E., & Tamir, M. (2016). The road to heaven is paved with effort: Perceived effort amplifies moral judgment. *Journal of Experimental Psychology: General*, *145*(12), 1654–1669. https://doi.org/10.1037/xge0000230

Bojanowski, P., Grave, E., Joulin, A., & Mikolov, T. (2017). Enriching word vectors with subword information. *Transactions of the Association for Computational Linguistics*, *5*, 135–146.

Bollen, J., ten Thij, M., Breithaupt, F., Barron, A. T. J., Rutter, L. A., Lorenzo-Luaces, L., & Scheffer, M. (2021). Historical language records reveal a surge of cognitive distortions in recent decades. *Proceedings of the National Academy of Sciences*, *118*(30), e2102061118. https://doi.org/10.1073/pnas.2102061118

Bolt, J., & van Zanden, J. L. (2020). *Maddison style estimates of the evolution of the world economy. A new 2020 update*.

Boyd, R., Ashokkumar, A., Seraj, S., & Pennebaker, J. (2022). *The Development and Psychometric Properties of LIWC-22*. https://doi.org/10.13140/RG.2.2.23890.43205

Brady, W. J., Crockett, M. J., & Van Bavel, J. J. (2020). The MAD Model of Moral Contagion: The Role of Motivation, Attention, and Design in the Spread of Moralized Content Online. *Perspectives on Psychological Science*, *15*(4), 978–1010. https://doi.org/10.1177/1745691620917336

Caliskan, A., Bryson, J. J., & Narayanan, A. (2017). Semantics derived automatically from language corpora contain human-like biases. *Science (New York, N.Y.)*, *356*(6334), 183–186. https://doi.org/10.1126/science.aal4230

Card, D., Chang, S., Becker, C., Mendelsohn, J., Voigt, R., Boustan, L., Abramitzky, R., & Jurafsky, D. (2022). Computational analysis of 140 years of US political speeches reveals more positive but increasingly polarized framing of immigration. *Proceedings of the National Academy of Sciences*, *119*(31), e2120510119. https://doi.org/10.1073/pnas.2120510119

Celniker, J. B., Gregory, A., Koo, H. J., Piff, P. K., Ditto, P. H., & Shariff, A. F. (2023). The moralization of effort. *Journal of Experimental Psychology. General*, *152*(1), 60–79. https://doi.org/10.1037/xge0001259

Charlesworth, T. E. S., Caliskan, A., & Banaji, M. R. (2022). Historical representations of social groups across 200 years of word embeddings from Google Books. *Proceedings of the National Academy of Sciences*, *119*(28), e2121798119. https://doi.org/10.1073/pnas.2121798119

Chen, S.-W. (2023). Learning motivations and effort beliefs in Confucian cultural context: A dual-mode theoretical framework of achievement goal. *Frontiers in Psychology*, *14*. https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1058456

Chen, Y., Chen, A. X., Yu, H., & Sun, S. (2023). Unraveling moral and emotional discourses on social media: A study of three cases. *Information, Communication & Society*, 1–18. https://doi.org/10.1080/1369118X.2023.2246551

Choi, V. K., Shrestha, S., Pan, X., & Gelfand, M. J. (2022). When danger strikes: A linguistic tool for tracking America's collective response to threats. *Proceedings of the National Academy of Sciences*, *119*(4), e2113891119. https://doi.org/10.1073/pnas.2113891119

Erdman, C., & Emerson, J. W. (2008). bcp: An R Package for Performing a Bayesian Analysis of Change Point Problems. *Journal of Statistical Software*, *23*, 1–13. https://doi.org/10.18637/jss.v023.i03

Ess, M., & Burke, S. E. (2022). Class attitudes and the American work ethic: Praise for the hardworking poor and derogation of the lazy rich. *Journal of Experimental Social Psychology*, *100*, 104301. https://doi.org/10.1016/j.jesp.2022.104301

Fitouchi, L., André, J.-B., & Baumard, N. (2022). Moral disciplining: The cognitive and evolutionary foundations of puritanical morality. *Behavioral and Brain Sciences*, 1–71. https://doi.org/10.1017/S0140525X22002047

Frimer, J. A., Boghrati, R., Haidt, J., Graham, J., & Dehgani, M. (2019). *Moral foundations dictionary for linguistic analyses 2.0*. https://doi.org/10.17605/OSF.IO/EZN37

Furnham, A. (1984). The protestant work ethic: A review of the psychological literature. *European Journal of Social Psychology*, *14*(1), 87–104. https://doi.org/10.1002/ejsp.2420140108

Fwu, B., Wei, C.-F., Chen, S.-W., & Wang, H. (2014). Effort counts: The moral significance of effort in the patterns of credit assignment on math learning in the Confucian cultural context. *International Journal of Educational Development*, *39*, 157–162. https://doi.org/10.1016/j.ijedudev.2014.07.010

Garg, N., Schiebinger, L., Jurafsky, D., & Zou, J. (2018). Word embeddings quantify 100 years of gender and ethnic stereotypes. *Proceedings of the National Academy of Sciences*, *115*(16), E3635–E3644. https://doi.org/10.1073/pnas.1720347115

Garten, J., Hoover, J., Johnson, K. M., Boghrati, R., Iskiwitch, C., & Dehghani, M. (2018). Dictionaries and distributions: Combining expert knowledge and large scale textual data content analysis: Distributed dictionary representation. *Behavior Research Methods*, *50*(1), 344–361. https://doi.org/10.3758/s13428-017-0875-9

Gelfand, M. J., Nishii, L. H., & Raver, J. L. (2006). On the nature and importance of cultural tightness-looseness. *Journal of Applied Psychology*, *91*(6), 1225. https://doi.org/10.1037/0021-9010.91.6.1225

Graeber, D. (2018). *Bullshit jobs: A theory*. Simon and Schuster.

Graham, J., Haidt, J., Koleva, S., Motyl, M., Iyer, R., Wojcik, S. P., & Ditto, P. H. (2013). Moral Foundations Theory. In *Advances in Experimental Social Psychology* (Vol. 47, pp. 55–130). Elsevier. https://doi.org/10.1016/B978-0-12-407236-7.00002-4

Greenfield, P. M. (2013). The Changing Psychology of Culture From 1800 Through 2000. *Psychological Science*, *24*(9), 1722–1731. https://doi.org/10.1177/0956797613479387

Heine, S. J. (2001). Self as cultural product: An examination of East Asian and North American selves. *Journal of Personality*, *69*(6), 881–906. https://doi.org/10.1111/1467-6494.696168

Henrich, J. (2020). *The WEIRDest people in the world: How the West became psychologically peculiar and particularly prosperous*. Penguin UK.

Holloway, S. D. (1988). Concepts of Ability and Effort in Japan and the United States. *Review of Educational Research*, *58*(3), 327–345. https://doi.org/10.3102/00346543058003327

Hoover, J., Dehghani, M., Johnson, K., Iliev, R., & Graham, J. (2018). Into the wild: Big data analytics in moral psychology. In *Atlas of moral psychology* (pp. 525–536). The Guilford Press.

Hopp, F. R., Fisher, J. T., Cornell, D., Huskey, R., & Weber, R. (2020). *The Extended Moral Foundations Dictionary (eMFD): Development and Applications of a Crowd-Sourced Approach to Extracting Moral Intuitions from Text*. 23.

Hwang, K.-K. (2012). *Foundations of Chinese Psychology* (Vol. 1). Springer New York. https://doi.org/10.1007/978-1-4614-1439-1

Hwang, K.-K. (2015). Morality 'East'and 'West': Cultural concerns. *International Encyclopedia of the Social & Behavioral Sciences*, *15*, 806–810. https://doi.org/10.1016/B978-0-08-097086-8.64005-9

Hyndman, R. J., & Khandakar, Y. (2008). Automatic Time Series Forecasting: The forecast Package for R. *Journal of Statistical Software*, *27*, 1–22. https://doi.org/10.18637/jss.v027.i03

Jackson, J. C., Gelfand, M., De, S., & Fox, A. (2019). The loosening of American culture over 200 years is associated with a creativity–order trade-off. *Nature Human Behaviour*, *3*(3), Article 3. https://doi.org/10.1038/s41562-018-0516-z

Jones, J., Amin, M., Kim, J., & Skiena, S. (2020). Stereotypical Gender Associations in Language Have Decreased Over Time. *Sociological Science*, *7*, 1–35. https://doi.org/10.15195/v7.a1

Kirk-Johnson, A., Galla, B. M., & Fraundorf, S. H. (2019). Perceiving effort as poor learning: The misinterpreted-effort hypothesis of how experienced effort and perceived learning relate to study strategy choice. *Cognitive Psychology*, *115*, 101237. https://doi.org/10.1016/j.cogpsych.2019.101237

Kundro, T. G. (2022). The Benefits and Burdens of Work Moralization on Creativity. *Academy of Management Journal*, amj.2021.0273. https://doi.org/10.5465/amj.2021.0273

Leong, F. T. L., Huang, J. L., & Mak, S. (2014). Protestant Work Ethic, Confucian Values, and Work-Related Attitudes in Singapore. *Journal of Career Assessment*, *22*(2), 304–316. https://doi.org/10.1177/1069072713493985

Lin, Y., Caluori, N., Öztürk, E. B., & Gelfand, M. J. (2022). From virility to virtue: The psychology of apology in honor cultures. *Proceedings of the National Academy of Sciences*, *119*(41), e2210324119. https://doi.org/10.1073/pnas.2210324119

Martins, M. de J. D., & Baumard, N. (2020). The rise of prosociality in fiction preceded democratic revolutions in Early Modern Europe. *Proceedings of the National Academy of Sciences*, *117*(46), 28684–28691. https://doi.org/10.1073/pnas.2009571117

Mason, S. E., Kuntz, C. V., & McGill, C. M. (2015). Oldsters and Ngrams: Age Stereotypes across Time. *Psychological Reports*, *116*(1), 324–329. https://doi.org/10.2466/17.10.PR0.116k17w6

Michel, J.-B., Shen, Y. K., Aiden, A. P., Veres, A., Gray, M. K., Pickett, J. P., Hoiberg, D., Clancy, D., Norvig, P., & Orwant, J. (2011). Quantitative analysis of culture using

millions of digitized books. *Science*, *331*(6014), 176–182. https://doi.org/10.1126/science.1199644

Mikolov, T., Sutskever, I., Chen, K., Corrado, G., & Dean, J. (2013). Distributed Representations of Words and Phrases and their Compositionality. *arXiv:1310.4546 [Cs, Stat]*. http://arxiv.org/abs/1310.4546

Miller, G. A. (1995). WordNet: A lexical database for English. *Communications of the ACM*, *38*(11), 39–41. https://doi.org/10.1145/219717.219748

Muthukrishna, M., Henrich, J., & Slingerland, E. (2021). Psychology as a Historical Science. *Annual Review of Psychology*, *72*(1), 717–749. https://doi.org/10.1146/annurev-psych-082820-111436

Ng, R., & Chow, T. Y. J. (2021). Aging Narratives Over 210 Years (1810–2019). *The Journals of Gerontology: Series B*, *76*(9), 1799–1807. https://doi.org/10.1093/geronb/gbaa222

Pennington, J., Socher, R., & Manning, C. D. (2014). GloVe: Global vectors for word representation. *Empirical Methods in Natural Language Processing (EMNLP)*, 1532–1543. http://www.aclweb.org/anthology/D14-1162

Poznanski, K. (2017). Confucian economics: How is Chinese thinking different? *China Economic Journal*, *10*(3), 362–384. https://doi.org/10.1080/17538963.2017.1370170

Sahlgren, M. (2008). The distributional hypothesis. *Italian Journal of Disability Studies*, *20*, 33–53.

Sherman, R. (2017). *Uneasy street: The anxieties of affluence*. Princeton University Press.

Uhlmann, E. L., & Sanchez-Burks, J. (2014). The implicit legacy of American Protestantism. *Journal of Cross-Cultural Psychology*, *45*(6), 992–1006. https://doi.org/10.1177/0022022114527344

Vaisey, S., & Miles, A. (2014). Tools from moral psychology for measuring personal moral culture. *Theory and Society*, *43*(3/4), 311–332. https://doi.org/10.1007/s11186-014-9221-8

Weber, M. (1905). *The protestant ethic and the spirit of capitalism*. Unwin Hyman.

Zeileis, A., & Hothorn, T. (2002). Diagnostic checking in regression relationships. *R News*, *2*(3), 7–10.

Zeng, R., & Greenfield, P. M. (2015). Cultural evolution over the last 40 years in China: Using the Google Ngram Viewer to study implications of social and political change for cultural values. *International Journal of Psychology*, *50*(1), 47–55. https://doi.org/10.1002/ijop.12125

Appendix

Yibei's trend

Wordlists

Chinese Effort/Efficiency Wordlist

effort	努力	力求	尽力	殚思竭虑	刻苦	奋斗	倾注全力	力争	始终不懈	孜孜不息	败而不馁	坚守不渝	躬行实践
efficiency	效益	效率	效用	效能	效果	最优化	产出率	节本降耗	利用率	增值性			

English Effort/Efficiency Wordlist

effort	effort	toil	hardwork	travail	labor	endeavor	perseverance	persistence	tenacity	dedication
efficiency	efficient	successful	productive	expedient	effective	efficacious	economical	cost-effective	profitable	beneficial

Examples of English Moral Foundations Dictionary (Frimer et al., 2019)

Authority vice	disrespect	disobey	disobedience	anarchy	chaos	subversion	subvert	lawlessness	subverting	disrespecting
Authority virtue	respect	obey	authority	obeyed	deference	reverence	respecting	obeying	tradition	adhere
Care vice	harm	suffer	hurt	harmed	hurting	hurts	cruel	endanger	harming	harms
Care virtue	compassion	empathy	kindness	caring	generosity	benevolence	altruism	compassionate	nurture	gentleness
Fairness vice	cheat	unfair	cheating	unfairness	injustice	fraud	dishonest	unjust	cheated	fraudulent
Fairness virtue	equality	fairness	justice	rights	equitable	civil rights	fairplay	impartiality	equal	fairminded
Loyalty vice	traitor	disloyal	treason	traitors	betray	betraying	betrayer	betrayers	unpatriotic	betrayed
Loyalty virtue	team player	player	patriot	loyal	loyalty	patriots	follower	fidelity	allegiance	ally
Sanctity vice	impurity	degradation	depravity	desecrate	desecration	repulsiveness	degrading	decay	filth	depravities
Sanctity virtue	sanctity	sacred	sacredness	purity	wholesome	pureness	wholesomeness	holiness	dignity	godly

Examples of Chinese Foundations Dictionary (Y. Chen et al., 2023)

Authority vice	无序	反叛	违抗	犯上	颠覆	反抗	反复无常	无所顾忌	任,性	不法	非法	不服	煽动
Authority virtue	领导岗位	权威	服从	尊崇	合法	责任	尊敬	敬重	敬意	崇敬	敬仰	敬佩	秩序

Care vice	戕害	欺负	伤害	折磨	践踏	忍受	遭受	暴力	暴虐	残暴	杀戮	危害	损害
Care virtue	保全	友善	友爱	善,良	助人为乐	关心	关怀	爱护	爱护	关爱	照顾	庇护	保护
Fairness vice	驱逐	排外	作假	不公	歧视	不平	偏颇	盲从	偏见	偏执	偏心	偏爱	排斥
Fairness virtue	正直	公平	公正	公平正义	合理	公平合理	客观	正义	权利	一致	平等	互惠	互利
Loyalty vice	敌伪	汉奸	背叛	变节	不忠	敌对	唾弃	邪恶势力	势力	叛变	特务	叛徒	叛乱
Loyalty virtue	团体	忠心	忠诚	忠心耿耿	矢志不渝	热爱祖国	同胞	爱国	团结	团结互助	团结合作	祖国	社群
Sanctity vice	糟粕	玷污	传染	罪恶	肮脏	恶心	纳粹	法西斯	堕落	泯灭	松懈	庸俗	粗鄙
Sanctity virtue	崇高品质	崇高	纯净	神圣	清白	纯洁	圣洁	光荣	庄严	风范	光辉	荣耀	崇高精神