When Information Conflicts With Obligations: the Role of Motivated Cognition

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June 1, 2021 [§]

Abstract

This paper reports a field experiment that tests the effect of motivated cognition on information acquisition. When the high-stakes College Entrance Exam is held in the month of Ramadan, Chinese Muslim students not only underestimate the cost of fasting when uninformed, but further, misread clear empirical evidence of the cost, which we obtain by analyzing administrative data on past students' exam performance. Inspired by the theory of motivated cognition, we tackle this learning failure by randomly offering a subset of the students reading materials in which well-respected Muslim clerics explain that it is permissible to postpone the fast until after the exam. Students who receive the material are substantially less likely to misread our empirical analysis and more willing to postpone the fast.

Keywords: Motivated Cognition, Ramadan Fasting, College Entrance Exam
JEL Codes: D91, I21, Z12

1   Introduction

Do people react differently to the same objective information if it conflicts with, rather than conforms to, their fundamental values? In the presence of such conflicts, numerous observational studies document learning failures that lead to belief polarization, suggesting a correlation between fundamental values and information acquisition.[1] A causal interpretation of such correlations comes from the theory of motivated cognition: to gain psychological utility, individuals actively distort their beliefs to conform with their fundamental values (Bénabou, 2015; Bénabou and Tirole, 2011). However, a spurious correlation between fundamental values and information acquisition might arise under standard Bayesian updating, where information spillovers exist among individuals who share similar values. To isolate the causal effect of fundamental values on information acquisition, one needs to randomly assign fundamental values without altering information sets, a task seemingly impossible in common settings.

In this paper we attempt to answer whether religious norms, a core aspect of fundamental values, can causally shape information acquisition as predicted by the theory of motivated cognition.[2] We focus on a unique setting where the month of Ramadan overlapped with the extremely high-stakes, once-a-year Chinese College Entrance Exam (CEE) between 2016 and 2018. In concordance with previous literature (Oosterbeek and van der Klaauw, 2013), we document that Ramadan fasting has substantial negative impacts on the exam performance of Muslim students, using administrative data. Consequently, Muslim students who were about to take the CEE during Ramadan in 2018 were facing a conflict between the fundamental value that Ramadan fasting is morally desirable and the empirical evidence that the secular cost of such practice can be significant.

Leveraging this empirical setting, we conducted a field experiment in 2018, which investigates how Muslim CEE takers' fundamental values attached to Ramadan fasting might affect their processing of information on how Ramadan fasting affects exam performance. Specifically, we present students with a previously unreleased graph, Figure 1a, which shows (based on administrative data) that the CEE performance gap between Muslim and non-Muslim students remained stable between 2011 and 2015, but suddenly enlarged substantially in 2016, when the CEE started to fall in the month of Ramadan. We then ask these students, in an incentivized manner, to read from this graph the magnitude of the 2016 CEE perfor-

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[1]For example, despite overwhelming scientific evidence, public opinion is polarized on topics such as GMO foods (Priest, 2000), evolution (Plutzer and Berkman, 2008), and global warming (Hart and Nisbet, 2012).

[2]The theoretical literature on motivated cognition in economics (Bénabou, 2015; Bénabou and Tirole, 2011) is also closely related to an older psychology literature on motivated reasoning, as summarized by Kunda (1990).

mance gap between Muslim and non-Muslim students. It is worth noting that these students are being asked to answer a purely objective question. In the absence of motivated cognition, whether they "trust" or "like" this graphical information should not affect *what information is being presented in this graph*.

Our core experimental innovation is that, prior to showing students this graphical information, we randomly offer a subset of the students reading materials in which well-respected Muslim clerics use Quranic reasoning to explain that it is permissible for students to be exempted from fasting until after the exam. While this "pro-exemption" reading material could substantially reduce the psychological costs of postponing the fast, from the perspective of classical Bayesian theory, such a change in fundamental values should not affect how these students read the objective graphical information on the cost of fasting.[3] In contrast, the theory of motivated cognition predicts that, in the presence of stringent religious norms, Muslim students attach high fundamental values to practicing Ramadan fasting, and thus might engage in "reality denial" (Bénabou and Tirole, 2016): they could try to rationalize their own fasting practice by intentionally misreading clear signals about the high cost of Ramadan fasting on exam performance. In this case, the "pro-exemption" reading material, by reducing the fundamental value that students attach to Ramadan fasting, could potentially help them more accurately interpret how Ramadan fasting affects exam performance when reading Figure 1a.

We find that, without receiving our graphical information based on administrative data, Muslim students tend to severely under-appreciate the potential cost of Ramadan fasting on CEE performance. When clearly presented with such information, Muslim students who have not read the "pro-exemption" article (control group) show strong patterns of motivated cognition: when reading Figure 1a, they systematically underestimate the 2016 CEE score gap between Muslim and non-Muslim students, despite the fact that this information is purely objective and clearly presented in front of their eyes. In contrast, when asked to estimate the same gap from the same graph, Muslim students who have read the "pro-exemption" article (treatment group) are 40% more accurate, consistent with predictions of the theory of motivated cognition.[4] Using a "list experiment" approach, we also provide suggestive evidence that alleviating motivated cognition makes students better informed about the costs of Ramadan, and thus more willing to delay the fast until after the CEE.

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[3]In two control arms, we also show that the reading material alone does not change students' beliefs about the cost of fasting. This confirms our premise that the reading material does not change the information set and is thus irrelevant in Bayesian updating. We explain this in greater detail in Section 4.

[4]It is worth noting that, after the survey, all students are provided access to the "pro-exemption" article. This means that, beyond the survey, which took place a month before the CEE, our intervention should not create any subsequent difference in CEE performance between the treatment and control groups. This is later confirmed by the eventual CEE score in 2018, which shows no significant correlation with our intervention.

We conduct a series of additional analyses to better understand the underlying mechanisms. First, when students are asked to guess the magnitude of the 2016 CEE performance gap between Muslim and non-Muslim students without seeing our graphical information, reading the "pro-exemption" article alone does not change their prior on the cost of Ramadan fasting. Second, we show that the bias in information cognition is most salient among students who strictly practiced Ramadan fasting in the past, and they are also the ones who respond strongly to our provision of "pro-exemption" reading materials. This suggests that the baseline findings are indeed driven by students' fundamental values attached to Ramadan fasting. Third, in a placebo test, we find that receiving the "pro-exemption reading material" does not affect information acquisition on issues unrelated to Ramadan fasting.

Our paper speaks to two strands of literature. First, it provides a direct test for motivated cognition in a field setting with high-stakes information. Our paper complements existing laboratory studies that have established the existence of motivated cognition.[5] Specifically, we find that motivated cognition can take place at the very beginning of the decision-making process, before information storage (Chew et al., 2019; Zimmermann, 2020) and the potentially complex process of (non-)Bayesian updating (Eil and Rao, 2011; Mobius et al., 2011).[6] Such "reality denial" is yet to be widely documented, despite being a distinct prediction generated by the theory of motivated cognition (Bénabou, 2015; Bénabou and Tirole, 2011, 2016).

Our paper also sheds light on the costs and benefits of religious participation. In addition to confirming the costs of Ramadan fasting (Almond and Mazumder, 2011; Oosterbeek and van der Klaauw, 2013; Schofield, 2014; Almond et al., 2015; Majid, 2015), we also show that such significant costs are severely under-appreciated by practicing Muslims (due to motivated cognition), which is consistent with conjectures in the literature (Kuran, 2018).[7] More broadly, such under-appreciation of the costs of religious activities, when combined with a "rational choice" framework of religious behaviors,[8] could help explain the prevalence of religious participation.

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[5]For example, see Eil and Rao (2011); Mobius et al. (2011); Di Tella et al. (2015); Ambuehl (2017); Exley and Kessler (2018); Chew et al. (2019); Zimmermann (2020).

[6]This complements existing studies that investigate the role of motivation in beliefs or decision making (Dana et al., 2007; Di Tella et al., 2015; Exley, 2016; Exley and Kessler, 2018).

[7]On the benefit side of the equation, Augenblick et al. (2016) find that religious followers sincerely attach high pecuniary values to their religious beliefs, and Campante and Yanagizawa-Drott (2015) find that Ramadan fasting increases happiness. Our paper complements these papers by investigating the cost side of the equation.

[8]For example, Azzi and Ehrenberg (1975); Iannaccone (1992, 1998); Montgomery (1996); Stark and Finke (2000); Berman (2000).

2   Background

In this paper, for both the analysis of administrative data and the survey experiment, we focus on the Ningxia Hui Autonomous Region (henceforce Ningxia), which is a provincial unit in the northwest of China, with a population of 6.3 million and a GDP pc of $7103.

Among the 6.3 million residents in Ningxia, 38% are Hui, a Muslim minority ethnic group in China, and the rest are mainly Han, the majority ethnic group in China, who are non-Muslim. Due to the large presence of Hui people, Islam is the dominant religion in Ningxia. There are currently more than 3300 major mosques and more than 4000 certified Imams in Ningxia. In comparison, there are fewer than 200 religious sites for all the other religions combined, including churches, Buddhist temples, Taoist temples, etc.

In this section, we introduce the background of our empirical setting: the College Entrance Exam in China, Muslim Ramadan fasting, and how the overlap between Ramadan and the exam affected the performance of Muslim students.

2.1   Muslim Ramadan Fasting

Ramadan is the 9th month in the Islamic Calendar, and is observed by Muslims around the world as the holy month of fasting (Sawm) to commemorate the first revelation of the Quran to Muhammad. Fasting during Ramadan is regarded as one of the "five pillars of Islam." It requires abstinence from food and liquids (including water) from dawn to sunset, and is obligatory for practicing Muslims.

The Quran specifies certain subjects for whom exemptions from the fast can be granted, which include children, the ill, the elderly, travelers, and breastfeeding women. However, many other conflicts between secular activities and religious practices are not explicitly discussed in the Quran, and, under these conditions, practicing Muslims typically rely on a local expert in Islamic jurisprudence (Faqih) to decide whether they may be exempted from fasting.[9]

Due to the difference between the Islamic (lunar) calendar and the commonly used Gregorian calendar, Ramadan shifts 11 days forward every year and has a 33-year cycle. The detailed fasting schedule changes every year and is different across regions based on each location's latitude, which is publicized locally by the Imams before the start of the month of Ramadan.

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[9]For instance, the Egyptian national soccer team qualified for the FIFA World Cup in 2018, but the game was scheduled to start right after the end of the month of Ramadan. Seeing this potential conflict, the Grand Mufti of Egypt, Shawki Allam, granted the Egyptian national squad permission to postpone their Ramadan fasting obligations. On the contrary, the Tunisian national team faced the same problem, but did not get such an exemption, and the players kept fasting while preparing for the World Cup.

2.2 Ramadan and Exams

Between 2016 and 2018, the month of Ramadan fell in May and June, which are popular times for final exams and high school and college entrance exams around the world. As a result, millions of Muslim students worldwide faced a dilemma between practicing the Ramadan fasting and excelling in academic exams. For example, as described in an information paper by the Association of School and College Leaders, 2016 was the first time Ramadan had clashed with major exams and tests in the UK since the 1980s, and this overlap would continue until 2019/20.[10]. Existing evidence suggests that taking exams during Ramadan has significant negative impacts on the performance of Muslim students (Oosterbeek and van der Klaauw, 2013; Schofield, 2014).

The problem was particularly severe for Chinese Muslim students: between 2016 and 2018, the extremely high-stakes College Entrance Exam in China, which is fixed on June 7th and 8th for all students, fell in the month of Ramadan. When deciding how they observe Ramadan, students need to take into consideration: (1) the great importance of the CEE for their future, (2) the negative impact of fasting on CEE performance, and (3) any flexibility to postpone the fast until after the CEE. While there is little doubt that most CEE-takers are well aware of the importance of this exam, neither (2) nor (3) is fully clear in the Chinese context: no empirical evidence exists regarding the cost of Ramadan on CEE performance, and little information regarding "whether the fast could be delayed until after the exam" could be found on the Chinese internet or other media outlets.[11]

2.3 The Costs of Taking the CEE During Ramadan

To identify the causal impact of taking the CEE during Ramadan on students' academic performance, we obtained administrative data on the exam performance of every urban student in Ningxia who took the CEE between 2011 and 2016. This information is maintained by the Ningxia Educational Examination Institute, and is the predominant criterion of college admission. This administrative dataset contains the exam score of every urban CEE-taker in Ningxia during the six-year period, as well as their basic background information, such as ethnicity, gender, age, etc.

Exploiting the fact that the CEE began falling in the month of Ramadan in 2016, and the fact that Ramadan is expected to mostly affect the performance of Muslim students, we

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[10] "Ramadan: Exams and Tests, 2018", visited on Aug 5, 2018

[11] Two pieces of relevant information could be found through online search engines: an article written by an Imam arguing that students should keep fasting during the CEE, and a translated piece based on the statement of the Egyptian Grand Mufti, suggesting students could delay their fast under certain circumstances.

illustrate the impact of taking the exam during Ramadan by measuring how the Hui-Han gap in exam scores changed in 2016, relative to the pre-existing gaps between 2011 and 2015. As shown in Figure 1a, the Hui-Han gap in exam scores was stable between 2011 and 2015: on average Hui students score 15 points lower than their Han counterparts.[12] However, the Hui-Han gap almost doubled in 2016, suggesting that taking the exam during Ramadan had salient negative impacts on the relative performance of Muslim students.

We formalize these graphical patterns in Figure 1b and Table B1, in which we estimate Difference-in-Differences specifications controlling for a rich set of fixed effects. Our results suggest that the empirical patterns documented in Figure 1a are highly robust, both qualitatively and quantitatively.

In this context, a score loss of roughly 15 points is a huge burden for the Muslim students, and would very likely lead to admission by a lower-ranked college, or at least a less desirable major within the same college.[13] It is also worth noting that our DiD model estimates an "Intention to Treat (ITT)" effect, rather than a "Treatment on the Treated (TOT)" effect, given the fact that not all Hui students are practicing Muslims, and some of them might not fast during the exam. Therefore, the real impact of fasting during the exam would be even larger.[14]

3 Experiment and Hypotheses

In this section, we explain the design and implementation of our field experiment, and lay out the main testable hypotheses that will guide the subsequent empirical investigations.

3.1 Experiment

We partnered with a large urban Muslim high school in Ningxia to conduct a survey experiment. The high school is the second largest in its prefecture city, with 24 classes in its senior cohort (students who were about to take the CEE in June 2018). The majority of students are Hui Muslim, and the average CEE score in the school is comparable to the provincial average. More than 80% of the students board at school on the weekdays, making

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[12]The enlarged gap in 2014 was driven by the fact that more Hui students chose the humanities track rather than the STEM track, and the humanities track exam was relatively difficult in 2014. This fluctuation disappears once we control for a Track-by-Year Fixed Effect in the regression analysis.

[13]To put the magnitude in context, in Ningxia, winning in the highly prestigious National Mathematics Olympiad Competition would be rewarded with only 5 bonus CEE points.

[14]As shown in Table B2, in our experimental sample, around 54% of high school students never broke a fast. If the sample is representative of Ningxia, this would suggest that the TOT effects could be nearly twice as large as the ITT estimates.

a student's religious compliance generally observable to other students.

Our survey experiment took place on May 4th, 2018 (about one month before the CEE in 2018), during a 40-minute afternoon class on Friday, simultaneously for the entire senior cohort. The 533 Hui students who were present constitute our population for this study. Our survey questions were answered carefully by the majority of students, as reflected by the fact that most of them correctly answered our multiple choice questions based on a 1000-word reading material.

As summarized in Table 1, our survey experiment has a 2-by-2 design. Randomly, half of the students read an article arguing for exemptions to delay the fast for the CEE (*Exemption*); the other half read a placebo article on art and philosophy (*No Exemption*). In the meantime, we cross-randomized the graphical information received by students: half of the students were incentivized to read a graph about the Hui-Han CEE score gap (*Information*), while the other half were incentivized to read a graph about the Sino-Janpanese income gap (*No Information*). The 533 Muslim students participating in the study were randomized into one of these four arms, which they were unaware of during the survey experiment. A flow chart summarizing the survey experiment, translated versions of all survey questions, and translated versions of the treatment and control reading materials can be found in Appendix C.

In our treatment reading material, we summarized statements from well-respected Chinese Muslim leaders as an article of about 1000 words, which clearly explained that it would be permissible to delay the fast until after the CEE. Specifically, we interviewed an established Muslim scholar, the Imam of an historic mosque, who explicitly said that "*Muslim students should delay their fast until after the CEE is finished.*" We also interviewed a famous religious leader, who is the vice president of the provincial Islamic Association, and were told that "*we should interpret the Quran in the modern context and allow the CEE participants to delay their fast.*" The two Imams also explained the Quranic reasoning behind their arguments in greater detail. We also collected similar exemptions given in Egypt and France to further demonstrate the case. For the control reading material, we edited an article from a famous Chinese writer, which is about different perspectives in appreciating art, and has roughly the same length as the religious reading. For both treatment and control readings, to ensure that students understood the materials correctly, we asked three multiple choice reading comprehension questions after the main texts, and students got monetary rewards if they answered these questions correctly.

Our main outcome of interest is whether a student could accurately acquire the information regarding the cost of taking the CEE during Ramadan. To measure such cognitive accuracy, we randomly presented half the students in each group (treatment and control)

with Figure 1a, which documents how the Hui-Han gap in CEE score was stable between 2011 and 2015, but enlarged abruptly in 2016. The scale of Figure 1a was intentionally labeled in a coarse way, where we only showed the max (0) and min (-40) values, but omitted all the intermediate scales, so that the students had to read carefully to accurately report the enlarged Hui-Han gap in 2016.

We explicitly told the students that "*between 2011 and 2015, the CEE did not overlap with Ramadan, and the Hui-Han CEE gap was relatively stable (-14.7 in 2011, and -16.6 in 2015); however, in 2016, the CEE fell in the month of Ramadan, and the Hui-Han CEE gap enlarged in this year. Please read and report the Hui-Han gap in 2016 from the graph.*" In order to incentivize careful reading of the gap, we offered cash rewards to students whose estimates were in the top 50% in terms of accuracy. The main hypothesis is that if students think they need to fast during the CEE, they would be motivated to underestimate the cost of fasting, and therefore would tend to have downward biases when reading the gap from the graph. On the contrary, when aware of the pro-exemption arguments from Muslim leaders, some students would think that they do not have to fast during the CEE, and would thus be able to absorb the same graphical information with less influence from psychological motivations, and therefore get more precise estimates.

Both our anecdotal knowledge and the recent literature suggest that Muslim students might not be fully aware of the negative impacts of fasting (Kuran, 2018). To verify whether this is the case in our context, for the other half of the students in each group, we did not show them the "Hui-Han CEE gap" graph (Figure 1a). Instead, we just told them "*between 2011 and 2015, the CEE did not fall in the month of Ramadan, and the average Hui-Han CEE gap was -16.4; however, in 2016, the CEE fell in the month of Ramadan,*" and then we asked the students to guess the 2016 Hui-Han CEE gap, in an incentivized way. By doing so, we could elicit students' priors regarding the Hui-Han CEE gap, in the absence of any intervention.

For the students who did not read the "Hui-Han CEE gap" graph, we also conducted a placebo test, where we asked them to read a graph on the Sino-Japanese income gap, as illustrated in Figure 1c. Since exemptions to delay the fast should not affect motivations to distort beliefs about the Sino-Japanese income gap, we expect no difference in reading the gap in this graph between the treatment and control groups ("Exemption" vs. "No Exemption").

For students in all four arms, in addition to the randomized contents (pro-exemption vs. placebo reading; Hui-Han vs. Sino-Japanese graph), we also asked them a common set of questions on basic individual characteristics, including age, gender, parental education, access to computer/internet, academic track, whether boarding at school, whether the student

prays daily, whether the student ever broke a fast during high school, etc.

At the end of the questionnaire, we also conducted a "List Experiment" for every student, where we provided five statements about the CEE, four of which were subjective and unrelated to religion, including "*(1) learning alone is more effective than learning in groups, (2) we should care about what we have actually learned more than the CEE score itself, (3) playing sports is good for exam preparation, (4) the CEE mainly tests on familiarity with the material rather than actual intelligence;*" and one statement was about Ramadan fasting, "*(5) delaying the fast until after the CEE is acceptable.*" We asked each student *how many* of the five statements they agree with, without having to specify which statements in particular. By comparing the number of statements agreed with in each experimental arm, we could estimate the impacts of our experimental interventions on fasting attitudes.

Given the 2-by-2 design, we prepared four different types of questionnaires: *No Exemption*No Information, Exemption*No Information, No Exemption*Information, Exemption*Information.* All questionnaires have an identical cover letter explaining that the survey data is confidential and will be used for purely academic purposes. We pre-randomized the order of the questionnaires before distributing them in each classroom; as a result, the 533 Muslim students were randomly assigned one of the four types of questionnaires. Given that the cover letters were identical and the students were not able to communicate with each other during the survey, the students did not realize that they were assigned differentiated questionnaires until the end of the survey experiment.

In Appendix Table B2, we conduct balance tests across the four different arms for all the baseline characteristics. The four arms are well balanced with each other, suggesting that the randomization was well-executed.

3.2 Testable Hypotheses

To rationalize the experimental design and guide the empirical analysis, we propose a simple conceptual framework based on the theory of motivated cognition. In this model, a subject jointly chooses two parameters: (1) his belief about the average cost of Ramadan on CEE performance; and (2) whether or not to postpone the fast during the CEE. By doing so, he maximizes his own utility, which consists of three components: (a) anticipatory utility of exam results; (b) benefits from sticking to the religious practice; and (c) the cognitive cost of manipulating his own beliefs.

In this section, we lay out the main testable hypotheses derived from the model, and briefly explain the underlying intuition. The details of the model, including its setup, mathematical proofs, and full propositions, are elaborated in Appendix A.

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Hypothesis 1 *When reading the 2016 Hui-Han CEE score gap from Figure 1a, in the absence of the pro-exemption reading material, Muslim students would underestimate the true gap.*

Students who stick to fasting due to stringent religious norms are motivated to underestimate the cost of fasting.

Hypothesis 2 *When presented with the 2016 Hui-Han CEE score gap from Figure 1a, students who received the pro-exemption reading material would read the graphical information more accurately.*

This is the main test of our paper. Receiving the exemption relaxes the religious constraint, which should alleviate the motivation to underestimate the cost of Ramadan on exam performance, and lead to more accurate readings of Figure 1a.

Hypothesis 3 *When Muslim students receive the graphical information (on the cost of Ramadan on CEE performance) and the pro-exemption reading material at the same time, they will be more willing to delay the fast.*

Receiving the pro-exemption reading material directly enables students to delay the fast, while also helping them better appreciate the graphical information on the cost of fasting. Both effects would result in increased willingness to delay the fast.

4 Results

In this section, we analyze the experimental data to test the the theory of motivated cognition, and discuss whether alternative explanations could rationalize our findings.

4.1 Hypotheses 1 and 2: Fundamental Values and Motivated Cognition

Hypothesis 1 predicts that Muslim students would distort their own beliefs when learning about the cost of taking the exam during Ramadan, which leads to an underestimation of the true cost. And according to Hypothesis 2, such cognitive bias can be alleviated by relaxing the stringency of the religious norm (*Exemption*).

To test these two hypotheses, we examine the accuracy of graph-reading by Muslim students in "*No Exemption*Information*" and in "*Exemption*Information*." Specifically, for

all the Muslim students who were asked to read the Hui-Han CEE gap (Figure 1a), we estimate:

$$Gap_i = \alpha \cdot Exemption_i + X_i' \cdot \beta + \gamma + \epsilon_i \qquad (1)$$

where Gap_i is student i's estimate of the Hui-Han CEE gap in 2016 based on reading Figure 1a. $Exemption_i$ is a dummy variable, which equals 1 if student i received the pro-exemption reading material, and 0 otherwise. X_i is a vector of individual characteristics, γ is a constant, and ϵ_i is the error term.

Since the constant term γ reflects students' estimation of the gap in the absence of any exemption, if Muslim students distort the objective graphical evidence presented to them (Hypothesis 1), γ should be significantly smaller than the true gap (-29.4). Since α reflects the extent to which the pro-exemption reading material could reduce the students' bias in graph-reading, α should be negative and significant, as predicted by Hypothesis 2.

As shown in Table 2, for those who did not receive the "pro-exemption" reading material, the average estimated gap is -24.4, which understates the true gap by about 5 points (statistically significant). When randomly assigned the "pro-exemption" reading material, the students' reading of the 2016 CEE gap enlarged by 2 to 2.2 points, eliminating roughly 40% of the baseline cognitive bias. From Column 1 to Column 3, the coefficient of interest remains highly robust as we control for class fixed effects and a rich set of individual controls. These empirical patterns confirm the main hypothesis of this paper: the stringency of religious practices leads to motivated cognition regarding the cost of religious behaviors (Hypothesis 1), and the relaxation of religious norms could help alleviate such cognitive bias (Hypothesis 2).

The theory of motivated cognition also implies that our intervention will have heterogeneous treatment effects: students who strictly followed Ramadan fasting in the past would attach higher fundamental values to this religious norm, which means they have stronger incentives to manipulate their beliefs to underestimate the cost of Ramadan, but they should also be more responsive to the provision of pro-exemption reading materials.

In the survey, we asked each student "whether you strictly practiced Ramadan fasting (never broke a fast) throughout high school." Roughly 54% of the students answered "Yes" to this question, and the ratio is balanced across the four arms due to random assignment. In Columns 4 to 6 of Table 2, we interact "whether a student strictly followed Ramadan fasting in the past" with "whether the student received the pro-exemption reading material." Consistent with our hypothesis, the baseline findings of the initial cognitive bias among Muslim students, and the subsequent de-biasing effect of providing pro-exemption reading

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materials, are both significantly stronger among the more religious students.[15]

4.2 Hypothesis 3: Fasting Decisions

As predicted by Hypothesis 3, when both graphical information on the cost of fasting on CEE performance and pro-exemption reading materials are provided to students simultaneously, the students would become more willing to delay the fast: the exemption not only mechanically reduces the students' mental cost of postponing the fast, but also helps the students better appreciate the cost of fasting on CEE performance, which further increases their perceived return to delaying the fast.

As explained in Section 3, directly eliciting students' willingness to postpone the fast might be deemed "sensitive" and lead to mis-reporting. To circumvent this issue, we follow the literature to conduct a "list experiment," in which we present students with five statements related to the CEE, one of which says *"delaying the fast until after the CEE is acceptable"* and the other four are unrelated to students' religious beliefs. Students only need to report *how many* of the statements they agree with, and do not need to indicate specifically *which* statements they agree with, which alleviates the social image concerns related to directly admitting to one's willingness to postpone the fast.

In this list experiment, if, on average, students in a certain experimental arm agree with more statements than students in other arms do, we can infer that the corresponding intervention causally increased students' willingness to postpone the fast for the CEE. As shown in Table 3, relative to the control group (*No Exemption*No Information*), just showing students the Hui-Han CEE gap alone (*No Exemption*Information*) barely changes students' willingness to delay the fast, while just providing students with the pro-exemption reading (*Exemption*No Information*) makes them more willing to delay the fast. Importantly, the combination of both exemption and information (*Exemption*Information*) persuades the most students to postpone the fast for the CEE, which is consistent with our hypothesis that *Exemption* complements *Information* by alleviating motivated cognition.

Ideally, it would be interesting to also investigate the subsequent impacts of our interventions on the actual fasting behaviors and CEE performance of these students. However, to ensure that our interventions could potentially benefit more students, upon finishing the survey, we provided all students access to the "pro-exemption reading material" and the "Hui-Han CEE gap graph." As a result, beyond the survey experiment, we no longer have

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[15]We also define an alternative outcome variable $Deviation_i$, which directly measures how far each student's reading deviates from the true value (-29.4), thus taking into account that some students might over-estimate the gap. All the main findings remain with this alternative outcome variable, as shown in Appendix Table B3.

any experimental variation to identify the eventual impacts on fasting behaviors and exam outcomes.

4.3 Mechanisms for Cognitive Bias

We now investigate the underlying mechanisms behind our baseline findings.

4.3.1 Direct Impacts of Exemption

A potential concern is that, in addition to alleviating the students' religious constraints, the pro-exemption reading material itself might carry some information on the cost of Ramadan: for example, students might infer from the Imam's statements that fasting could hurt exam performance, which makes the information presented in the Hui-Han CEE figure more credible. In principle, this interpretation should not confound our main findings, because our main test focuses entirely on the students' reading of the objective information presented in Figure 1a, and whether or not they find such information credible should be of no relevance.

Nevertheless, we explicitly investigate whether the pro-exemption reading material itself directly affects students' priors on how Ramadan affects CEE performance. Specifically, for students who do not receive graphical information on the Hui-Han CEE gap (arms *"No Exemption*No Information"* and *"Exemption*No Information"*), we first informed them about the benchmark Hui-Han CEE gap between 2011 and 2015, and then asked them, in an incentivized manner, to make their most accurate guess on the 2016 Hui-Han CEE gap when the exam happened during Ramadan.[16]

By comparing the elicited guesses on the enlarged 2016 Hui-Han gap between *"No Exemption*No Information"* and *"Exemption*No Information,"* we can test whether the exemption itself affects the students' priors about the cost of Ramadan on exam performance. As shown in Table B4, in the absence of the pro-exemption reading material, students guess that the 2016 Hui-Han CEE gap was -17.9, which is statistically indistinguishable from the average gap between 2011 and 2015 (-16.4). This is consistent with conjectures in the literature that many practicing Muslims are not fully aware of the cost of their religious activities (Kuran, 2018). Importantly, when students receive the pro-exemption reading material, their elicited guess of the 2016 Hui-Han CEE gap barely changes at all, confirming that providing the exemption alone does not change the students' priors on the 2016 Hui-Han gap.

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[16]We tell the students *"Between 2011 and 2015, the CEE was held outside of the month of Ramadan, and the average score gap between Hui and Han students was -16.4 points. In 2016, the CEE was held in the month of Ramadan. Please give us your most accurate guess: what was the average Hui-Han CEE score gap in 2016?"*

4.3.2 Placebo Test

As motivated cognition is generated by the fundamental values attached to Ramadan fasting, receiving an exemption to delay the fast should not affect the cognitive accuracy regarding topics unrelated to either the CEE or Ramadan fasting.

To further rule out alternative mechanisms, we conduct a placebo test, where some students read the religious article (exemption) and were required to estimate the Sino-Japanese income gap from Figure 1c (*Exemption*No Information*), and others read the placebo article (about art) and were required to estimate the Sino-Japanese income gap from the same graph (*No Exemption*No Information*).

As can be seen in Table B5, students in general tend to underestimate the Sino-Japanese income gap.[17] But, importantly, reading about the religious exemption has no statistically meaningful impact on the accuracy of reading the Sino-Japanese income gap, suggesting that our findings are indeed driven by religion-induced motivated cognition, rather than alternative mechanisms.

5   Conclusion

In this paper, we find that, when information conflicts with one's fundamental values, an individual may exhibit strong patterns of motivated cognition by significantly distorting the "undesirable" information in his learning process, even if the information is purely objective and of very high stakes. These findings suggest that, in order to effectively disseminate important information on polarized issues (e.g., climate change, vaccination, etc.), it is crucial to first identify and intervene against the underlying fundamental values that might prevent individuals' accurate digestion of the high-stakes information.

[17]The true gap is -30771, while the students in the control group on average read -28434.

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Figure 1: Graphical Information
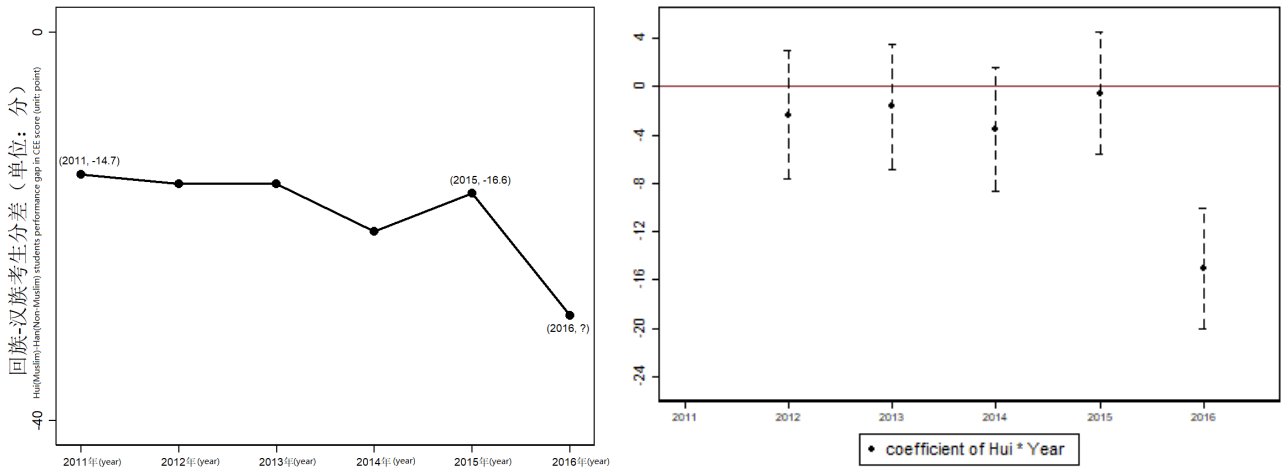
(a) Hui-Han CEE Gap (2011-2016)

(b) DiD Estimates: Hui-Han CEE Gap
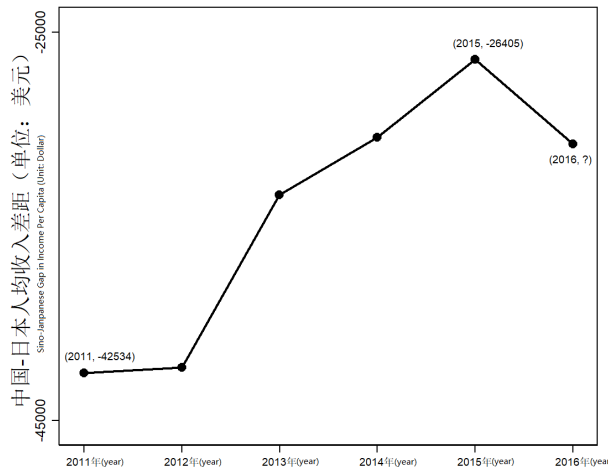
(c) Sino-Japanese Income Gap (2011-2016)

Note: Panel 1a displays the Hui-Han CEE score gap between 2011 and 2016. Panel 1b displays the DiD coefficients of the Hui-Han CEE gap (controlling for Track-by-Year FE), with 95% confidence intervals. Panel 1c displays the Sino-Japanese income gap between 2011 and 2016. Panels 1a and 1c are the graphs presented to students in our survey experiment, with English translations of the Chines labels.

Table 1: 2*2 Experimental Design

Information / Religion	Read the gap in CEE score between Muslim and Non-Muslim students	Read the Sino-Japanese Gap in GDP pc
Exemption to delay fast for the CEE	Exemp*Info	Exemp*No Info
No Exemption	No Exemp*Info	No Exemp*No Info

Note: This table summarizes the 2*2 design of our survey experiment. Randomly, half of the Muslim students get pro-exemption reading materials explaining that it would be permissible to postpone the fast until after the CEE (*"Exemption"*), while the other half of students read a placebo reading material unrelated to religion (*"No Exemption"*). Then we cross-randomize between these two groups, such that half of them are required to read a graph on "Hui-Han CEE gap between 2011 and 2016" (*"Info"*) while the other half of them required to read a placebo graph on "Sino-Japanese income gap between 2011 and 2016" (*"No Info"*).

Table 2: Motivated Cognition in Reading Graphical Information

	(1)	(2)	(3)	(4)
	Perceived Hui-Han CEE Score Gap in 2016			
Exemption	-1.9032***	-2.1985***	-0.5822	-0.8654
	(0.7387)	(0.7451)	(1.0672)	(1.0935)
Fast			2.5805**	2.9742***
			(1.0425)	(1.0753)
Exemption*Fast			-2.6181*	-2.5483*
			(1.4617)	(1.5348)
Constant	-24.3954***		-25.6952***	
	(0.5289)		(0.7399)	
Mean of Control	-24.395	-24.395	-24.395	-24.395
Class FE	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes
Number of Observations	277	274	277	274
R squared	0.024	0.233	0.045	0.242

Note: Columns 1 and 2 present the effects of receiving exemption to delay fast on the accuracy of reading the 2016 enlarged Hui-Han gap in CEE performance. As shown, the average gap read by students is -25.4, 4 points smaller than the true value of -29.4; receiving an exemption would make the guess 2 points closer to the true value. Columns 3 and 4 present heterogeneous treatment effects of exemption based on fasting history. As shown, students who strictly followed the Ramadan fasting during high school had larger downward bias to start with, and responded to the religious intervention by eliminating such cognitive bias. On the contrary, students who did not strictly follow Ramadan fasting were not responsive to the exemption. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3: Fasting Attitudes Revealed in List Experiment

	(1)	(2)	(3)
	Agreed Statements in List Experiment		
Exemp*No Info	0.1769*	0.1924*	0.2168*
	(0.1065)	(0.1085)	(0.1107)
No Exemp*Info	0.0383	0.0540	0.0485
	(0.1051)	(0.1074)	(0.1089)
Exemp*Info	0.2936***	0.2988***	0.3216***
	(0.1038)	(0.1063)	(0.1075)
Constant	1.3543***		
	(0.0754)		
Mean of Control	1.354	1.354	1.354
Class FE	No	Yes	Yes
Control Variables	No	No	Yes
Number of Observations	532	531	528
R squared	0.019	0.053	0.088

Note: This table presents the effects of the graphical information, the pro-exemption reading material, and their interaction on the number of statements one agreed with in the list experiment. The results suggest that receiving the exemption alone makes one more willing to delay fast, receiving the information does not have any significant impact, and receiving both the religious and information interventions have the most powerful persuasion effects. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Appendix

A Setup of the Model

There are two periods, period 0 and period 1. Student i derives payoff v_i from fasting in each normal Ramadan period. Denote her vulnerability to hunger and thirsty by $\rho_i \in \{0, 1\}$, which she cannot observe directly in period 1. However, she has a prior about this vulnerability which can be fully characterized by $\hat{\rho} \equiv P\{\rho_i = 1\}$.[18] Denote her fasting behavior in periods 0 and 1 by f_0 and f_1 respectively.

Period 0 describes students' fasting behavior during a normal Ramadan period, when Ramadan does not overlap with the CEE. In this period, fasting only affects students' performance in CEE via negatively affecting the effectiveness of learning during Ramadan but not their health status during the exam. The quantity of this effect is expressed as κh, where h is the full effect had she fasted during the CEE and $\kappa < 1$ captures the relatively minor impact on CEE due to inefficient learning during previous Ramadan months. $\omega_i > 0$ represents the importance students i attach to the final outcome of the college entrance exam. For simplicity, we assume that students know their ρ_i due to repeated fasting experience in middle school. They choose f_0 to maximize:

$$f_0 v_i + (1 - f_0)(\kappa \omega_i h \rho_i + \epsilon_{i0}) \tag{2}$$

where ϵ_{i0} is a random disturbance governed by distribution $F_0(\epsilon_{i0})$. Put it in another way, students will either fast ($f_0 = 1$), in which case they derive utility v_i by committing to religious practice, or not to fast ($f_0 = 0$), in which case they enjoy enhanced learning effectiveness. Note that we arrange the utility in this form to highlight the tradeoff between fasting ($f_0 = 1$) and not fasting ($f_0 = 0$).

In period 1, students have answered the survey we distributed, and were expecting the

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[18]Here we binarize the impact of fasting to be either "negative" or "nonexistent," this is without much loss of generality because no more than 3% of the students in any treatments have beliefs that Ramadan will help boost their performance in the CEE.

CEE in a month. They decide to fast or not in the exam, get anticipatory utility about her performance in the exam and derive utility from fasting behavior, denoted by f_1. In this period, they can no longer remember ρ_i but instead, they form a posterior about ρ_i based on prior $\hat{\rho}$ and previous fasting behavior f_0 as a Bayesian. This is due to either forgetfulness or that they lack knowledge about the impact of fasting on test performance (remember in period 0 that they only experienced fasting when no formal exams like CEE happened). In this period students jointly choose $(\hat{\rho}, f_1)$ to maximize:

$$f_1 \cdot (v_i r - \omega_i E[\rho_i|\hat{\rho}, f_0]h - C(\rho_0 - \hat{\rho})) + (1 - f_1)(-C(\rho_0 - \hat{\rho}) + \epsilon_{i1}) \tag{3}$$

where ϵ_{i1} is governed by distribution $F_1(\epsilon_{i1})$. Denote the joint distribution of (ϵ_{i1}, v_i) and the marginal distribution of v_i by $F(\epsilon_{i1}, v_i)$ and $G(v_i)$ respectively. Note that v_i has to be non-negative, which is the only restriction for distribution $F(\epsilon_{i1}, v_i)$ and $G(v_i)$. r is the special return for this special Ramadan period (i.e. fasting during CEE). For simplicity, $r \equiv r_C = 1$ if students regard this fasting period the same and the rest; $r \equiv r_T$ with $0 < r_T < 1$ if students are persuaded by religious leaders, and believe that fasting may not be necessary during the particular exam days. Therefore $v_i r$ captures the payoff from fasting during CEE. $-E[\rho_i|\hat{\rho}, f_0]h$ is the expected cost of fasting during CEE, and $-C(\rho_0 - \hat{\rho})$ is the cognitive cost of manipulating her prior away from her original prior ρ_0 had motivated beliefs been not at play. We assume that $C(.)$ is twice continuously differentiable, minimized at 0. We also assume ρ_0 and $\hat{\rho}$ to be a real number between 0 and 1. Note that we arrange the utility in this form to highlight the utility derived from both fasting ($f_1 = 1$) and not fasting ($f_1 = 0$) respectively.

The major difference between our model and the previous studies is the focus on the manipulable prior $\hat{\rho}$, which merits further discussions. Aside from the mechanical explanation above, another interpretation of ρ_0 is that this prior is subconscious, and the subject's cognition process manipulates her prior away from the subconscious one to maximize her anticipated utility. The modeling of $\hat{\rho}$ is similar in spirit to Augenblick et al. (2016), where

students manipulate their beliefs about the probability of dooms day above their original beliefs had a religious concern not been present. Importantly, this subconscious belief need not be accurate. While Augenblick et al. are agnostic about the formation and implications of differential ρ_0 in their paper as this is not their focus, we directly test the additional implication of a wrong ρ_0 and confirms the validity of our model.

Our model is also different from previous studies on motivated beliefs in that the anticipatory utility merely comes from students' expectation about their own performance in the exam. Arguably, as an once-in-lifetime high-stakes exam, for which students have been preparing for years, the effect of anticipatory utility should be particularly strong. We do not specifically model the utility of religious beliefs, such as utility carried by h itself, which may reflect people's belief on how omnipotent their religion is. The primary reason of this omission is that the incorporation of this utility does not qualitatively change our results, and our empirical results do not support this possibility either.

This model has a number of predictions about students' response in beliefs and fasting attitudes. We categorize them into three groups to highlight the relationship between these propositions and the results presented in the next section. Specifically, Proposition 1 predicts response in beliefs under unawareness of fasting impact; Proposition 2, 3, 4 predicts response in beliefs under awareness of fasting impact; Proposition 5 discusses the relationship between the beliefs and the perceived importance of the College Entrance Exam; Proposition 6 and 7 presents our model's prediction on fasting attitudes.

Proposition 1 When $\rho_0 = 0$, $\hat{\rho} = 0$ irrespective of the value of f_0, f_1, r and v_i.

This proposition discusses how students might react when their subconscious beliefs are wrong. Since anecdotal evidence suggests that students may not be aware of the negative impact of fasting at all, our proposition focus on the prediction in this case. The framework predicts that the students do not have to incur any cost to create illusion, but just happily take the view that fasting does not do even cause the slightest harm. As a result they sincerely do not believe that on average, fasting is significantly detrimental to their cognitive

function regardless of whether religious leader try to persuade them to fast or not during CEE. This prediction of this proposition, in our context, is elaborated by Hypothesis 1 in the main text.

Proposition 2 In case of $\rho_0 > 0$ and for almost any given (ϵ_{i1}, f_0), $\hat{\rho} < \rho_0$ if $f_1 = 1$ for any positive r and v_i.

As one of the most basic results of this model, this proposition says that for people who choose to fast, they have the incentive to distort their prior as long as they become partially aware of the fact that fasting is harmful to their exam performance, irrespective of its magnitude. In our experiment, we use "belief about the average impact of taking the CEE during Ramadan" as a proxy for the parameter ρ_0. This prediction of this proposition, in our context, is elaborated by Hypothesis 2 in the main text.

For simplicity, we additionally assume that κ is small in the discussion of last proposition. This assumption says that the impact of Ramadan fasting during pre-exam period (say fasting one year or two years ahead of the CEE) is minor to fasting on CEE exam. We argue that this is a reasonable assumption for the following two reasons: first, the length of Ramadan fasting is merely one month for every year in Islamic calendar, which is relatively short compared to years of exam preparation; second, even if students' learning activity are affected during fasting, they can still make up for it by studying harder before/after the fasting month.

This proposition concerns the heterogeneity of the treatment effects with respective to past fasting behavior f_0. While the prediction of model in general may not be entirely clear given different κ, f_0, $C(.)$ and the joint distribution of v_i and ρ_i, with assumption on κ, we can derive the following results.

Proposition 4 When κ is sufficiently small, the distribution of v_i given $f_0 = 1$ stochastically dominates that given $f_0 = 0$. Hence given the same ρ_0, $E[\hat{\rho}|f_0 = 1] < E[\hat{\rho}|f_0 = 0]$

The proposition discuss the case where fasting in the past can barely affect the CEE outcome. In this case, students can only extract information about v_i from f_0. For those

who did not fast in the past, then have lower v_i, hence less incentive to manipulate their beliefs. We view this assumption as plausible because as we have discussed in institutional details, past fasting rarely affects the exam outcome because students have three years to prepare for the exam, hence they can have plenty time and opportunities to make up had they, by any chance, fallen behind during the fasting period. Moreover, the results are fairly robust even when κ is large [19]

The last two propositions concerns treatment effects on fasting attitudes.

Proposition 6 In case of $\rho_0 > 0$, for almost any given $(\epsilon_{i1}, f_0, v_i, r)$, as long as $h > 0$, $f_1 = 0$ if and only if $\hat{\rho} = \rho_0$

This proposition provides us with a tight link between the elicited beliefs $\hat{\rho}$ and fasting behavior f_1 during CEE: when students are aware of the harm of Ramadan fasting (i.e. their subconscious belief ρ_0 is positive), those who hold the right beliefs will not fast and vice versa. While the implication that we can precisely identify those who do not fast must express the right belief is not robust to alteration such as incorporating people's utility from the omnipotence of their religion (i.e. utility as a function of h), it is indeed robust that given a correct ρ_0, as beliefs become more accurate, students are less likely to fast during the CEE across different treatment groups. This proposition provides a way to proxy fasting behavior: if we want to focus on the group of people who fast (say, examine the impact of perceived stake on biases conditional on fasting), we can restrict our attention to subsample where people don't read the graph accurately.

While people will not adjust their beliefs given the initial unawareness of the harm of fasting, the persuasion from religious leaders do decrease r, which decreases the gap of utility between fasting and not fasting in period 1. If there are any independent disturbance of fasting preferences as illustrated by ϵ_{i1} in the model, the rate of fasting will also be decreased by authorization from religious leaders.

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[19]When κ is large, f_0 is affected by both ρ_i and v_i. We need to consider the joint distribution of these two variables. However, even in this case, with moderate assumptions on cognitive cost, we will be able to get the result that the optimal probabilistic beliefs for those who choose f_1 to be 1 is smaller for students who fast in the past.

The next proposition discusses the effectiveness of information treatments in terms of changing fasting attitudes. We can easily deduce from Equation 3 that religious leader persuasion alone is sufficient to shift the fasting decisions of some people. In addition to that direct channel, there is also an additional role of information dissemination on changing fasting attitudes:

Proposition 7 For any given ϵ_{i1}, Denote the minimum level of v_i needed to choose fast for treatments "*No Exemp*No Info*," "*Exemp*No Info*," "*No Exemp*Info*," "*Exemp*Info*" by $\bar{v}_1$, $\bar{v}_2$, $\bar{v}_3$, $\bar{v}_4$, respectively. If, say, any non-negative v_i is enough for fast in treatment "*No Exemp*No Info*," then $\bar{v}_1 = 0$. We have: (i) $\bar{v}_1 < \bar{v}_2$, $\bar{v}_1 < \bar{v}_3$;(ii) $\bar{v}_4 - \bar{v}_2 > \bar{v}_3 - \bar{v}_1$.

This proposition use a specific set measures, $\bar{v}_1$, $\bar{v}_2$, $\bar{v}_3$, $\bar{v}_4$, to measure people's preference to choose fasting in the end. The higher the threshold is, to the less extent people would prefer fasting. (i) says that the threshold for merely providing information $\bar{v}_3$ and threshold for merely providing religious exemption $\bar{v}_2$ both move up relative to control threshold $\bar{v}_1$, indicating that both treatment works in the same direction, whereas the relative effectiveness of them is an empirical question. (ii) says that the information treatment and religious exemption may serve as compliments: when religious exemption is granted, the effectiveness of providing information in terms of the movement of the threshold, $\bar{v}_4 - \bar{v}_2$, is larger than $\bar{v}_3 - \bar{v}_1$, in which case no exemption is granted. Of course, the results still hold when we regard these threshold as a function of ϵ_{i1}, and integrate over it to compare the expected level of thresholds. This prediction of this proposition, in our context, is elaborated by Hypothesis 8 in the main text.

B   Appendix Tables

Table B1: Impacts of Ramadan on CEE Score

	(1)	(2)	(3)	(4)
	Score	Score	Score	Score
Hui*Year_2012	-0.9527	-2.3302		
	(2.7122)	(2.7103)		
Hui*Year_2013	-1.0004	-1.6581		
	(2.6467)	(2.6448)		
Hui*Year_2014	-2.7471	-3.5299		
	(2.6090)	(2.6067)		
Hui*Year_2015	-1.9583	-3.1176		
	(2.5705)	(2.5686)		
Hui*Year_2016	-14.5265***	-15.0378***		
	(2.5613)	(2.5596)		
Hui	-14.6394***	-13.3878***	-15.5981***	-15.5981***
	(1.9194)	(1.9183)	(0.8138)	(0.8138)
Hui*Ramadan			-12.8275***	-12.8275***
			(1.8799)	(1.8799)
Mean of Dep Variable	383.218	383.218	383.218	383.218
Year FE	Yes	No	Yes	No
STEM-Year FE	No	Yes	No	Yes
Number of Observations	124369	124369	124369	124369
R squared	0.022	0.025	0.025	0.025

Note: This table presents the effects of taking the CEE during Ramadan on the relative performance of Muslim students. In columns 1 and 2, we interact Muslim dummy with year dummies, and see an abrupt increase the Hui-Han gap in 2016, the year that Ramadan overlaps with the CEE. In columns 3 and 4, we collapse the pre-treatment years into a larger control group, and get quantitatively similar results. In columns 1 and 3, we control for Year FE; in columns 2 and 4, we control for STEM-by-Year FE. Standard errors in parentheses are clustered at the high school level. * significant at 10%, ** significant at 5%, *** significant at 1%.

<div align="center">**Table B2:** Balance Test</div>

Variables	All Mean	All Std.Dev	No Exp*No Info Mean	Exp*No Info Mean	No Exp*Info Mean	Exp*Info Mean	Anova Test F-stat	Anova Test p-value
Geneder: male	0.405	0.491	0.445	0.398	0.393	0.387	0.38	0.765
Parents with college education	0.045	0.208	0.016	0.047	0.044	0.070	1.57	0.195
Access to computer at home	0.390	0.488	0.390	0.375	0.400	0.394	0.06	0.980
Access to Internet at home	0.814	0.389	0.859	0.758	0.837	0.803	1.67	0.172
Boarding at school	0.831	0.375	0.852	0.82	0.859	0.796	0.84	0.475
Risk loving	2.461	2.125	2.480	2.438	2.652	2.282	0.71	0.548
Perceived value of college	3.692	1.186	3.543	3.680	3.919	3.620	2.51	0.058*
STEM track	0.610	0.488	0.609	0.625	0.630	0.577	0.32	0.810
Honors class	0.334	0.472	0.320	0.336	0.385	0.296	0.88	0.454
Pray everyday	0.589	0.492	0.641	0.555	0.607	0.556	0.95	0.418
Never broke a fast	0.535	0.499	0.602	0.469	0.504	0.563	1.85	0.137
Mock exam score	365.856	62.899	371.006	368.126	366.081	358.953	0.91	0.435
Observations	533		128	128	135	142		

Note: These two panels present the balance tests across the four different arms in the 2*2 experimental design. As can be seen, most variables are well-balanced, indicating that the randomization was well-implemented. "Risk loving" and "Perceived value of college" are measured using a five-point Likert scale. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B3: Motivated Cognition in Graph Reading: Alternative Outcome Variable

	(1)	(2)	(3)	(4)	(5)	(6)
	Deviation	Deviation	Deviation	Deviation	Deviation	Deviation
Exemption	-1.6436***	-1.6625***	-1.8617***	-0.2870	-0.5661	-0.5823
	(0.6295)	(0.6346)	(0.6396)	(0.9092)	(0.9238)	(0.9372)
Fast				2.1833**	2.3905***	2.4848***
				(0.8881)	(0.9052)	(0.9216)
Exemption*Fast				-2.6392**	-2.2253*	-2.4455*
				(1.2453)	(1.2788)	(1.3154)
Constant	5.8576***			4.7579***		
	(0.4507)			(0.6303)		
Mean of Control	5.858	5.858	5.858	5.858	5.858	5.858
Class FE	No	Yes	Yes	No	Yes	Yes
Control Variables	No	No	Yes	No	No	Yes
Number of Observations	277	276	274	277	276	274
R squared	0.024	0.144	0.227	0.046	0.167	0.238

Note: This table presents the effects of receiving exemption to delay fast on the accuracy of reading the 2016 enlarged Hui-Han gap in CEE performance, as well as heterogeneous treatment effects of exemption based on fasting history. We use the "absolute deviation from true value" as outcome variable instead of the gap read by students. As shown, it produces similar results. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B4: The Effect of Exemption on Prior

	(1)	(2)	(3)	(4)	(5)	(6)
	Gap	Gap	Gap	Deviation	Deviation	Deviation
Exemption	-0.0699	-0.2167	-0.1481	-0.1610	-0.3070	-0.4357
	(0.9995)	(1.0141)	(1.0586)	(0.7726)	(0.7718)	(0.8188)
Constant	-17.9325***			12.3602***		
	(0.7082)			(0.5474)		
Mean of Control	-17.933	-17.933	-17.933	12.360	12.360	12.360
Class FE	No	Yes	Yes	No	Yes	Yes
Control Variables	No	No	Yes	No	No	Yes
Number of Observations	247	247	246	247	247	246
R squared	0.000	0.116	0.218	0.000	0.143	0.217

Note: This table presents the effects of religious intervention alone on updating prior. As shown in the table, the mean of the elicited 2016 Hui-Han gap is -17.97, close to the -16.4 gap between 2011 and 2015, much smaller than the true value of -29.4, indicating that Muslim students have acute downward bias in their priors. Receiving the exemption does not update this prior in any substantial way. As shown in columns 4-6, using the "absolute deviation from true value" as outcome variable produces similar results. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B5: Effect of Exemption on Placebo Graph Reading (GDP Per Capita)

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP gap	GDP gap	GDP gap	Deviation	Deviation	Deviation
Exemption	-712.084	-876.285	-1126.323	799.783	1011.386	628.583
	(1088.079)	(1146.520)	(1202.963)	(1371.746)	(1375.892)	(1464.607)
Constant	-28433.923***			6140.187***		
	(760.942)			(959.323)		
Mean of Control	-28433.923	-28433.923	-28433.923	6140.187	6140.187	6140.187
Class FE	No	Yes	Yes	No	Yes	Yes
Control Variables	No	No	Yes	No	No	Yes
Number of Observations	229	229	228	229	229	228
R squared	0.002	0.061	0.161	0.001	0.149	0.216

Note: This table presents the placebo effect of receiving an exemption on the accuracy of reading the 2016 Sino-Japanese income gap. As can be seen, the religious intervention has no meaningful impacts on reading the income gap. As shown in columns 4-6, using the "absolute deviation from true value" as outcome variable produces similar results. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.
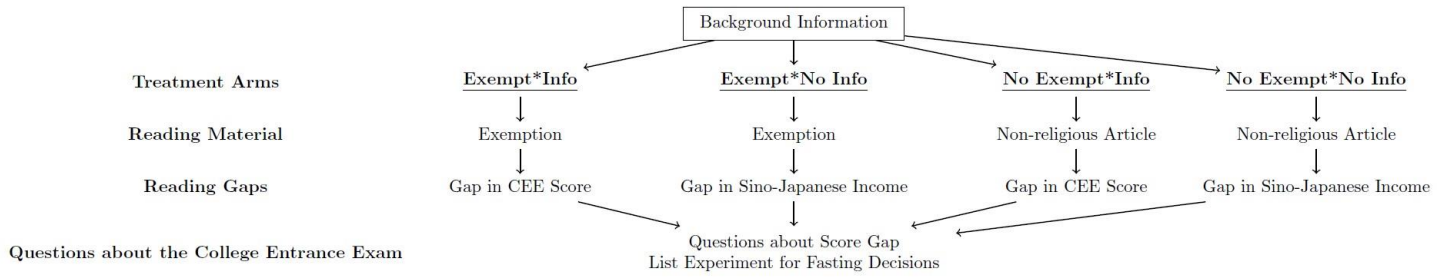
C Translated Survey Questions and Reading Materials

Section A: Background Information

Section B: Reading Material (treatment and control reading materials randomly assigned to students)

Section C: Reading Gaps (treatment and control graphs randomly assigned to students)

Section D: Questions about the College Entrance Exam

	Background Information			
Treatment Arms	Exempt*Info	Exempt*No Info	No Exempt*Info	No Exempt*No Info
Reading Material	Exemption	Exemption	Non-religious Article	Non-religious Article
Reading Gaps	Gap in CEE Score	Gap in Sino-Japanese Income	Gap in CEE Score	Gap in Sino-Japanese Income
Questions about the College Entrance Exam		Questions about Score Gap List Experiment for Fasting Decisions		

Section A: Background Information

Name and Student ID

1. **Your gender**:   A. Male   B. Female

2. **Your ethnic group**:   A. Han   B. Hui   C. Other

3. **The highest education level among your parents**:
    A. Primary school or below   B. Middle school
    C. Occupational high school
    D. Regular high school
    E. Community college
    F. Regular college
    G. Graduate degrees

4. **Do you have access to computer and internet at home?**
    A. Access to neither
    B. Access to computer but not internet
    C. Access to internet but not computer
    D. Access to both

5. **Do you board at school?**
    A. Yes   B. No

6. **Which of the following hobbies do you have?**
    A. Video games on PC
    B. Video games on smart phone
    C. Foreign sports matches
    D. Japanese and Korean TV shows
    E. American and British TV shows
    F. Foreign popular music
    G. None of the above

7. What is your risk attitude in making high-stakes life decisions?

Please evaluate on a scale of 1 to 5：1=very cautious，2=relatively cautious，3=neutral，4=relatively adventurous，5=very adventurous）

8. Do you think higher education can lead to a better life?

Please evaluate on a scale of 1 to 5：1=completely disagree，2=generally disagree，3=neutral，4= generally agree，5= completely agree）

9. Do you pray everyday？

    A. Yes   B. No   C. Not applicable because I am not Muslim

10. Did you ever break a fast during Ramadan in the past three years?

    A. Yes   B. No   C. Not applicable because I am not Muslim

Section B: Reading Material

(treatment and control reading materials randomly assigned to students)

Please read the following article and answer three reading comprehension questions. (For each correct answer, you will receive 2 RMB in rewards.)

(Treatment reading material)

Between 2016 and 2018, the Muslim holy month of Ramadan coincided with the college entrance examination. Therefore, for many Muslim students, ``whether they can break the fast and make it up later after the college entrance exam'' has become an important issue that cannot be ignored.

In order to understand whether ``Ramadan fasting can be postponed during the college entrance examination,'' we consulted Guo Haihui, a well-known scholar who graduated from the Royal Religious University of Malaysia and the current Imam of the century-old temple ``Xiangfang Mosque.'' He said:

``The acts of worship of Islam has three goals: to express faith to Allah, exercise good words and deeds and sublimate souls. The Prophet (PBUH) said: `Allah does not look at your appearance and your goods. He looks only at your heart and your deeds.' The good intention for any deed is the key to get good results. The college entrance examination has become a major concern for the whole society, let alone for the students. It is no exaggeration to describe it as the turning point for the students. Because the examination is both mentally and physically exhausting and no easier than any other work, both parents and students need to make great efforts to prepare for it. Therefore, it is necessary to appropriately reduce their burden. To temporarily postpone the fasting during the college entrance examination will neither anger Allah, nor will it weaken your beliefs.''

We also consulted the famous scholar Liu Xueqiang, who is also the vice president of the Provincial Islamic Association and the Imam of the famous Xigong Mosque. His suggestion was consistent with that of Guo Haihui:

``The purpose of Islamic law is to create convenience for people, not to create difficulties. The implementation of Islamic law can be flexible in the actual process and it should not be interpreted rigidly. Allah never asks people to do things beyond their ability. Therefore, if the candidate thinks that fasting will affect his or her test scores, it is acceptable to break the fast, and make up afterwards. It poses no problem in the Islamic law.''

This situation is not unique to China: as the college entrance examination is held in June in many countries, the jurists in these countries also give corresponding doctrinal orders for the examination and fasting. Through summarizing, we find that many authoritative religious scholars and institutions abroad share similar views on this issue with imams in China. For example, when being asked if

``students can break the fast during the college entrance examination,'' Grand Mufti <u>Shawki</u> <u>Allam</u> of the Egyptian Shariah Committee replied:

``If fasting affects the students' ability to revise and study for the exam, resulting in symptoms like reduced concentration, unresponsiveness, dizziness, etc., and the exam time stipulated by the education system cannot be adjusted to the end of Ramadan, students should break the fast and make it up after the exam, so that their previous efforts will not be wasted.''

Experts of the French Muslim Religious Committee also conducted in-depth researches on this issue and finally issued a notice: ``It is recommended that candidates break the fast, especially those who need to take the exam in the afternoon. However, they need to make it up after Ramadan.''

11. According to Mr. Guo Haihui, one is allowed to delay the fast for the CEE, because Allah cares the most about:
- A. Your appearance and your goods
- B. Your heart and your deeds
- C. Both A and B are correct
- D. Both A and B are incorrect

12. What is the opinion of Mr. Liu Xueqiang on Ramadan fasting:
- A. The implementation of Islamic law can be flexible, and students should be allowed to delay their fast for the CEE
- B. Ramadan fasting is an outdated tradition that does not fit modern societies
- C. Both A and B are correct
- D. Both A and B are incorrect

13. According to Mr. Shawki Allam, what are the conditions that warrant an exemption to delay the fast for an exam:
- A. Ramadan fasting would hurt exam performance
- B. The exam cannot be rescheduled
- C. Both A and B are needed to delay the fast
- D. Neither A nor B is needed to delay the fast

Please read the following article and answer three reading comprehension questions. (For each correct answer, you will receive 2 RMB in rewards.)

(Control reading material) :

There is a US diplomat who spent ten years in Moscow in the 1920s and 1930s. He wrote in his memoir that he has watched the ``Swan Lake'' performance for 300 times. Even for a classic ballet as famous as the ``Swan Lake,'' 300 times is too much. But for a diplomat, some social engagements are inevitable, and he had no choice but to watch this play again and again until it was a bit overwhelming.

I guess, for the first few dozen times to watch the "Swan Lake" performance, what the American heard was the beautiful music of Tchaikovsky and what he saw was the beautiful performance of the artists of the former Soviet Union. He appreciated it wholeheartedly and applauded ardently from time to time. After having watched it for 100 times, the impression became different. At that time, he could only hear some instruments ringing and see some people running on the stage and he became slow-witted as well. Then, after 200 times, the impression changed again. The music was on and the curtain was up, but there was only the white void in front of him - he was caught in the nightmare of this play. At this point, his eyes were blank, his face was smirking, like a hibernating crocodile whose loose muscles could not support the chin, or a landing boat rushing to the beach, and his mouth was opening, with big drops rolling down from the corner of his mouth and falling on his knees. It was so intoxicating that not until the curtain was down and someone switched off the light did he realize that it was over. He quickly slapped himself awake and went home. Later, when he got the order to leave the Soviet Union, he said with relief: well, finally, no more "Swan Lake."

As you know, the scene above is just my guess - to be honest, no one will ever include this in one's memoirs - but I think anyone repeatedly appreciating a piece of work will encounter these three phases. In the first phase, you hear the music and see the dance - in short, you are enjoying art. In the second phase, you hear some sounds and see some objects moving, and you are aware of a familiar physical process. In the third phase, you have gained a philosophical perspective and finally realized that the ballet, just like everything else in the world, is a form of material existence. From art to science and then to philosophy, it is a process of returning to the original nature.

Normally, people's appreciation always stays in the first phase, but some people can reach the second phase. For example, in the movie "Farewell My Concubine," the tyrant played by Ge You blamed an actor: The Conqueror played by other people took six steps, why did you take four steps? In the lab, a physicist would also ask an object in confusion: how can your acceleration be two Gs while others is a G when falling in a vacuum? In the laboratory, a physical process must be reproducible, or otherwise it will not be scientific.

Therefore, no object falls with two Gs' acceleration. The classic works of art should also be reproducible. Take "Swan Lake" for example, the content of this ballet cannot be changed in order to let future generations appreciate the best things created by the predecessors. It can only be played over and over again.

Classic works are good and worth watching, but not too many times. Otherwise, the art cannot be appreciated - just like tea drinking in the "Dream of Red Mansions": one cup is for tasting, two cups are for the thirst, and three cups are drinking like a fish. Of course, whether it is tea-tasting or drinking like a fish, it is just a way of material existence. In this respect, there is no difference between them...

11. According to the author, what are the three phases in the repeated appreciation of art?

    A. Science-Philosophy-Art

    B. Philosophy-Art-Science

    C. Art-Science-Philosophy

    D. Art-Philosophy-Science

12. What is the author's opinion regarding the "reproducibility" of art：

    A. Physics should be reproducible, art should not be reproducible

    B. Physics should not be reproducible, art should be reproducible

    C. Both should be reproducible

    D. Neither should be reproducible

13. What is the author's opinion regarding the appreciation of art：

    A. One should appreciate the same work repeatedly

    B. One should not appreciate the same work repeatedly

    C. Both statements above are wrong

    D. No clear opinion expressed by the author

Section C: Reading Gaps
(treatment and control graphs randomly assigned to students)

Hui-Han gap figure:

Based on the administrative information provided by the Ningxia Provincial Bureau of Examination, we plot the gap in the College Entrance Exam (CEE) score between Hui (Muslim) and Han (non-Muslim) students in Ningxia from 2011 to 2016. The trend of this Hui-Han gap is shown in the figure below.
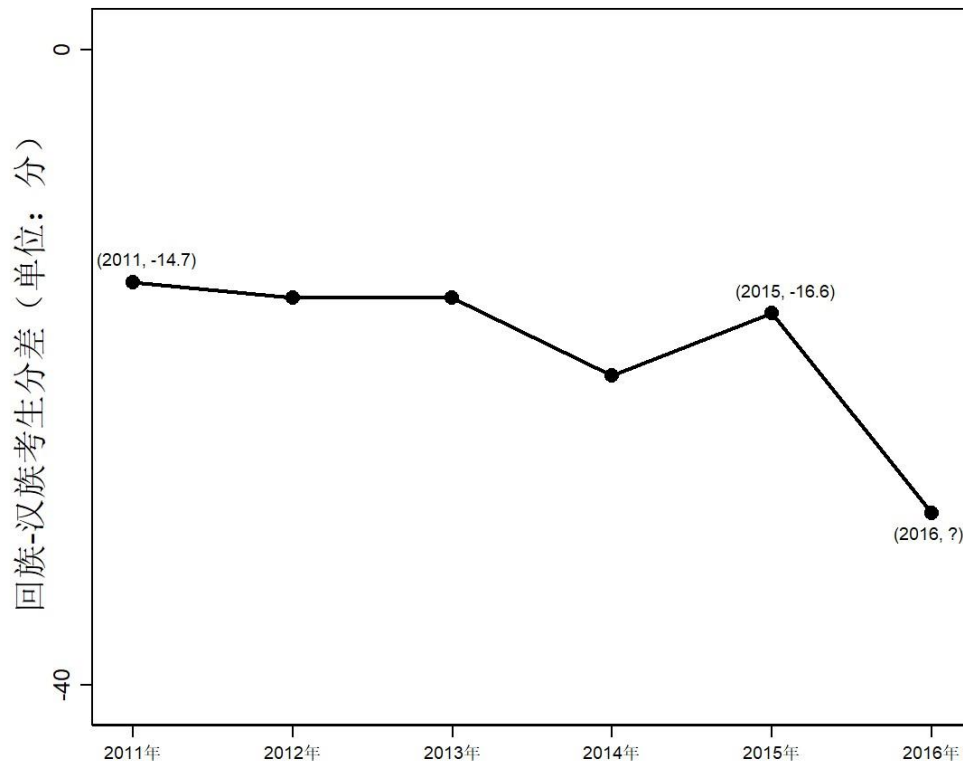
(Note: The y-axis label is "College Entrance Exam score gap between Muslim (Hui) and non-Muslim (Han) students (unit: point)")

In 2011, the average CEE score of Hui students was 366.9, the average score of Han students was 381.6, so the average Hui-Han gap was -14.7 points. In 2015, this gap was -16.6 points.

14. In 2016, the CEE happens during Ramadan. Please read from this figure: what was the CEE score gap between Muslim and non-Muslim students in 2016? (Based on the accuracy of your answer, you will receive a cash reward up to 3 RMB.)

Answer: _____ points

Sino-Japanese gap figure:

Based on data published by the World Bank, we plot the gap in average annual income between China and Japan from 2011 to 2016. The trend of this Sino-Japanese gap is shown in the figure below.
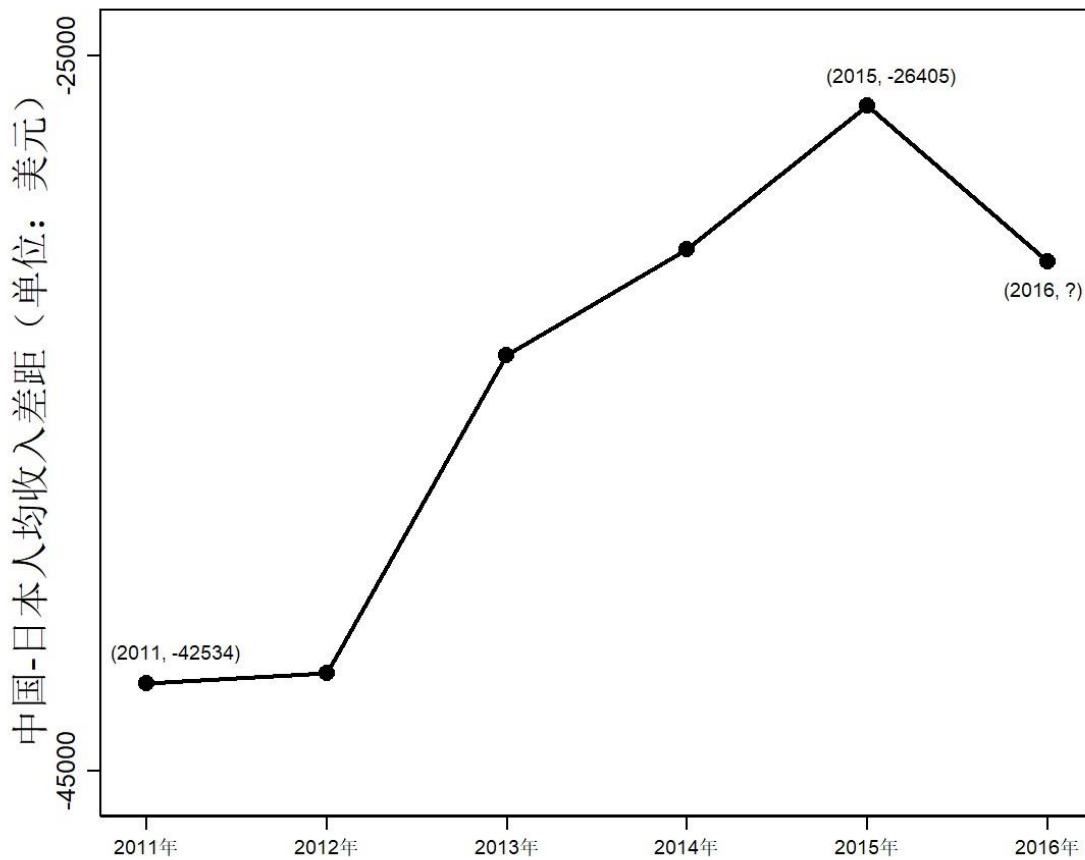
(Note: The y-axis label is "Per-capita income gap between China and Japan (unit: U.S. dollar)")

In 2011, the average annual income was 5634 USD in China, while 48168 USD in Japan, so the average Sino-Japanese gap was -42534 USD. In 2015, this gap was -26405 USD.

14. Please read from this figure: what was the annual income gap between China and Japan in 2016? (Based on the accuracy of your answer, you will receive a cash reward up to 3 RMB.)

Answer: _____ USD

Section D: Questions on the CEE

15. Your total score in the "second mock exam": _____

16. Among the five statements listed below, how many do you agree with?

In this question, you do not need to specify which exact statements you agree with, you just need to tell us the number of statements that you agree with (0-5).

(1) Learning alone is more effective than learning in groups.
(2) We should care about what we have actually learned more than the CEE score itself.
(3) Delaying Ramadan fast until after the CEE is acceptable.
(4) Playing sports is good for exam preparation.
(5) The CEE mainly tests on one's familiarity with the material rather than actual intelligence.