Determining the Extent of Taste-Based and Statistical Discrimination: Evidence from a Field Experiment in India

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March 2023

Abstract

We conduct a controlled field experiment in India and exploit the violation of preference axioms to identify preference rankings that are inconsistent with taste-based discrimination. By eliciting patients' preference rankings of physicians of different castes and experiences, we estimate that for 73% of patients, it is difficult to tell if they taste-based or statistically discriminated physicians. With the aid of additional instruments to measure social affinity, the estimated upper bound of taste-based discrimination decreases to 30%, suggesting that most patients statistically discriminate. Belief differences about the healthcare quality of physicians by caste and cohort also support statistical discrimination being the main source of discrimination.

JEL codes: I14, J15, O15

Keywords: Field experiment, taste-based discrimination, statistical discrimination, affirmative action, healthcare.

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1. Introduction

The economics literature posits two major sources of discrimination: taste-based and statistical. The former is due to the fact that agents dislike some categories of the population while the latter occurs in an environment of imperfect information where agents form beliefs based on limited signals of quality. To empirically identify whether the behavior of an individual is more consistent with one of these two sources is challenging because differential treatments across groups are often consistent with the predictions of both theories. The main contribution of this paper is in providing evidence that distinguishes between statistical versus taste-based discrimination using a direct revealed preference approach.

We conduct a controlled field experiment across 40 localities in Uttar Pradesh, India, to examine whether taste-based discrimination or statistical discrimination is the main driver of patients' discriminatory behaviors against physicians of different castes. Indeed, in India, caste is a salient dividing line and can factor into patients' healthcare decisions (see Section 3.1 below). Uttar Pradesh is a suitable setting to study this question because it is one of the Indian states with the largest concentration of lower-caste population, who also receive caste-based reservations for medical college seats. Through a simple theoretical framework that describes the experimental setting, we first show that taste-based discriminators, whether they have homophily (in-group) or heterophily (out-group) caste preference, can exhibit preference rankings that completely overlap with a subset of statistical discriminators' preference rankings. Because of this overlap, we can bound the extent of taste-based discrimination by identifying violation of axioms of preferences.

We use a correspondence method to elicit 3,128 patients' rankings of four doctors of two different caste groups and two different years of experience. A patient can have one out of 24 feasible preference rankings of doctors. Our theoretical framework shows that if we do not impose any parametric assumptions about taste while maintaining that preference relations satisfy five fundamental axioms of preferences, at most only eight out of these 24 rankings are possible under taste-based discrimination whereas all 24 of them are possible under statistical discrimination. Focusing on the most preferred doctors as the measure of choices, we find that mean choices by caste of patients are consistent with both theories of discrimination. Thus, it can be difficult to empirically distinguish whether *individuals' choices* are primarily driven by taste-based or belief-based discrimination on the typical data collected in most field experiments. Using individual-level preference rankings and adjusting for potential statistical errors due to the greater feasible

number of preference rankings that can violate preference axioms, we find that only 27% of patients have rankings that are unambiguously consistent with statistical discrimination. The results highlight that in most cases (73%), preference rankings of taste-based discriminators and statistical discriminators are indistinguishable.

As most patients' preference rankings are consistent with both taste-based discrimination and statistical discrimination, we use an auxiliary method to tighten the bound of taste-based discrimination by examining whether *revealed* caste preferences in the *field experiment contradict revealed* caste preferences based on measures of *social affinity*. We rely on survey questions regarding the patients' general attitudes towards different caste groups to measure social affinity. To implement this method, we focus on a *strict* contradiction between the revealed caste preferences in the field experiment and the revealed caste preferences in the survey. For example, if a patient's preference ranking of doctors revealed in the field experiment is consistent with homophily caste preference while the patient's general caste attitude in the survey is positive towards the out-group, then we reclassify the preference ranking in the field experiment from being consistent with both taste-based and statistical discrimination to being consistent with statistical discrimination only. As survey measures are known to *under detect* discriminatory attitudes due to social desirability concerns, our method that focuses on strict contradiction provides a conservative bound on the extent of taste-based discrimination. We show that the percentage of taste-based discriminators decreases from 73% to 30% using this approach. In a robustness check, we use incentivized instruments as an alternative method to measure social affinity and also find that the percentage of taste-based discriminators decreases similarly. Thus, the evidence suggests that the patients in the experiment are *mostly statistical discriminators*.

Since statistical discrimination is a belief-based explanation, we provide corroborative evidence that mean choices revealed in the field experiment can also be rationalized by belief differences in perceived quality of healthcare by caste and age cohort of doctors potentially induced by the temporal changes in how medical school seats are allocated across caste groups. Additional incentivized measures of beliefs obtained from a separate sample of survey respondents also support these differences in perceived quality of healthcare by caste and age cohort of doctors. Thus, *belief differences* are also consistent with statistical discrimination.

There is a large literature focusing on detecting discrimination and examining the sources of discrimination using laboratory experiments, field experiments, natural experiments, and non-

experimental approaches. In particular, correspondence methods have been the primary approach used to investigate discrimination in a variety of settings, including employment (Bertrand & Mullainathan, 2004; Banerjee et al., 2009; Guiletti et al., 2019), housing (Ewens et al., 2014), product markets (Gneezy et al., 2012; Doleac and Stein, 2013; Zussman, 2013; Siddique et al., 2023), financial markets (Bayer et al., 2018), education (Hanna & Linden, 2012), and along different dimensions, including race, ethnicity, caste, gender, age, disability, sexual orientation, obesity, and religion.[1] However, as noted by Charles and Guryan (2011) and Neumark (2018), it remains a challenge to empirically differentiate behaviors consistent with taste-based discrimination and statistical discrimination.[2]

This paper helps advance the research on discrimination. Past studies that reject taste-based discrimination as the main driver of differential treatments across groups typically make specific assumptions about preferences, such as functional form and group bias assumptions. They then focus on how the aggregate patterns of *choices* vary with experimentally manipulated information in order to make inferences about whether the *average* individual's discriminatory behavior is more consistent with taste-based discrimination or statistical discrimination (e.g., List 2004, Ewens et al. 2014, Bohren et al. 2019). We show that if we only maintain that preferences must satisfy five fundamental axioms of preferences as all past studies that reject taste discrimination do, while not imposing additional assumptions, then it is difficult to rule out the role of taste-based discrimination in driving the aggregate patterns of choices. More generally, our contribution is to show customer discrimination in linking a correspondence study to a real transaction by separating belief and preference-based motives for discrimination while relaxing several of the strong assumptions usually required.

Our focus on preference rankings circumvent a major shortcoming of past studies on discrimination in which an *individual* discriminator's preference rankings over the *choice set* was unobserved. The technique of eliciting individuals' preference rankings was previously

[1] See Altonji and Blank (1999), Guryan and Charles (2013), Lang and Lehmann (2012), Neumark (2018), and Lang and Kahn-Lang Spitzer (2020) for general overviews, Anderson et al. (2006) and Lane (2016), for tests of discrimination in the laboratory, Baert (2018), for correspondence experiments, and Riach and Rich (2002), Rich (2014), and Bertrand and Duflo (2017), for field experiments.

[2] See Altonji and Pierret (2001) and Arcidiacono et al. (2010) for testing in a non-structural way statistical discrimination in the context of ability in the labor maket. There is also an entire literature on identifying prejudiced based discrimination by looking at performance. Most notably, Anwar and Fang (2006) on police stops that also exploits ranks and Arnold et al. (2018) on bail decisions. However, these papers do not separately identify statistical discrimination, prejudice-based discrimination or both.

implemented in the laboratory setting to test theories about correlated beliefs (Cason et al., 2020) and self-regarding and other-regarding preferences (Levati et al., 2014). We apply this technique to a field setting to study the violation of preference axioms and examine the sources of discrimination in the *final stage of real transactions*. We demonstrate that it is possible to bound the extent of taste-based discrimination by focusing on the violation of key axioms of preferences on the basis of individuals' preference rankings over their choice sets. We also demonstrate that with the aid of additional instruments, this bound can be further tightened.

Our axiomatic approach departs from the recent literature that focuses on testing whether discriminatory behaviors are on *average* more consistent with biased beliefs or unbiased beliefs (e.g., Bohren et al. 2019). By not imposing assumptions on functional form of utility and group preference (e.g., all subjects have distaste against the same group), we show it is much harder to separate preference-based explanation from belief-based explanation. Importantly, we are able to reject preference-based explanation as the main source of caste discrimination by patients against doctors, even though we do not test whether beliefs are biased or not.

2. The benchmark model

We outline the two major economic theories of discrimination in the context of our field experiment and present the situations in which the predictions of statistical discrimination completely overlap with the predictions of taste-based discrimination and the situations in which they do not. In order to match our field experiment, we assume only two types of castes for both the doctors and the patients: the low and the high caste, and two different levels (years) of experience for the doctors: low and high. We denote the caste of a doctor by $c = c_H, c_L$, where c_H corresponds to the high caste and c_L corresponds to the low caste, and the caste of a patient by $c^p = c_H^p, c_L^p$, where the superscript p refers to the patient. We denote the experience of a doctor by $e = e_H, e_L$, with $e_H > e_L$.

2.1. Taste-based discrimination

According to Becker's (1957) theory of taste-based discrimination, prejudiced employers (or workers or consumers) dislike employing (or working with, or purchasing from) people from a certain group (e.g., race, gender, caste, etc.).

Here, we model taste-based as a consumer choice problem. The patient (consumer) chooses a doctor consumption bundle, x, which contains both the social closeness or proximity (Φ) to the doctor's social group relative to the patient's social identity and the perceived quality of healthcare (q) provided by the doctor, among the patient's consumption set X of all possible doctors. Social proximity between the patient and a doctor is fully characterized by strength to which the patient relates or identifies with the doctor's caste group. The idea that social proximity measures taste for caste is consistent with Becker's (1957) notion of taste where the cost of interacting with the socially distant group is higher as well as Akerlof's (1997) idea that social distance determines attitudes toward discrimination. We denote $\Phi(c^p, c)$, the social proximity of a patient from caste c^p to a doctor from caste c. Furthermore, the perceived quality of healthcare provided by a doctor is fully characterized by the years of experience e the doctor has been practicing medicine. On average, we expect the perceived quality to be increasing in years of experience, but there can be individual patients who perceive a doctor with fewer years of experience as one with better quality. [3] We thus allow for the possibility that $q'(e) > 0$ for some patients, but $q'(e) < 0$ for other patients. A consumption bundle $\mathrm{x} \in X$ is thus represented by a vector $\mathrm{x} \in \mathbb{R}^2_+$.

We assume that patients' preferences for doctors with various levels of social proximity and perceived healthcare quality satisfy five fundamental axioms of consumer choice: completeness, transitivity, continuity, strict monotonicity, and strict convexity. It follows that a patient's preference relation between two doctors with different levels of social proximity and perceived healthcare quality can be represented by a real-valued utility function: $\mathrm{U}: \mathbb{R}^2_+ \to \mathbb{R}, \forall \mathrm{x}^0, \mathrm{x}^1 \in \mathbb{R}^2_+$, such that $\mathrm{U}(\mathrm{x}^0) \geq U(\mathrm{x}^1) \Leftrightarrow \mathrm{x}^0 \succsim \mathrm{x}^1$. We denote this utility function for a patient c^p by $U(\Phi(c^p, c), q)$ and assume that it is strictly increasing in both arguments.

2.1.1. Homophily versus heterophily taste-based discrimination

[3] What matters to patients is likely not the experience of a doctor per se, but the quality of healthcare, such as the accuracy of diagnosis, the efficacy of the prescribed medicine, etc., provided by the doctor. We assume that the quality of healthcare can be fully described by the doctor's experience as it is the dimension that we manipulate in the experiment. In reality, patients may use experience as a noisy signal of quality $\mathbb{E}(q|e)$ to predict the quality of healthcare to be provided by the doctor. We can accommodate this possibility in the model by having the patient to first use the experience of the doctor to predict the quality of healthcare that the doctor will provide (with some errors) before choosing doctors with different levels of predicted quality and caste backgrounds. In order to put aside the possibility of statistical discrimination, we must however assume patients do not utilize the information related to the caste of a doctor when predicting the quality of healthcare that the doctor will provide.

We consider two possible manifestations of caste preference. The first is patients with a preference bias for own caste or homophily (McPherson et al., 2001; Currarini et al., 2009), so that the patients identify more with people from the same caste group and there is a cost of interacting with a doctor from a different caste. This is a standard assumption that the racial discrimination literature typically makes (at least for the average individual). Thus, for a low-caste patient with homophily preference, the social proximity to a low-caste doctor is higher than to that of a high-caste doctor, $\Phi(c_L^p, c_L) > \Phi(c_L^p, c_H)$. Likewise, for a high-caste patient with homophily preference, the social proximity to a low-caste doctor is lower than to that of a high-caste doctor, $\Phi(c_H^p, c_L) < \Phi(c_H^p, c_H)$.

The second type of manifestation is patients with out-group preference bias or heterophily. For this type of patients, they identify more with people from a different caste group and there is a cost of interacting with a doctor from the same caste. We do not expect the majority of individuals to be this type, but it is possible that there are some of them and our theoretical framework allows for such a possibility. For a low-caste patient with heterophily preference, we have $\Phi(c_L^p, c_L) < \Phi(c_L^p, c_H)$. Likewise, for a high-caste patient with heterophily preference, we have $\Phi(c_H^p, c_L) > \Phi(c_H^p, c_H)$.

2.1.2. Rankings from the perspective of a low-caste patient

On the basis of the axioms and assumptions specified above for taste-based discriminators, we now list the possible preference rankings of doctors for a low-caste patient c_L^p who has homophily preference, given their choice set of doctors with two levels of experience e_L and e_H and two caste backgrounds c_L and c_H. There are in total 24 possible rankings of the four different doctors, and we list those that are consistent with taste-based discrimination.

For a homophily low-caste patient who views more years of experience as an indication of better healthcare quality, the best possibility is a doctor $c_L e_H$, i.e., a doctor from a low-caste group c_L and with a high experience level e_H, because the social proximity and quality of this doctor are both the highest. For this patient, the worst possibility is a doctor $c_H e_L$, as the social proximity and quality of the doctor are both the lowest. For a homophily low-caste patient who perceives more years of experience as better quality, there are two possible rankings of doctors that are compatible with taste-based discrimination:

$$c_L e_H \succ c_L e_L \succ c_H e_H \succ c_H e_L$$

$$c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$$

Figures 1A and 1B illustrate these two possible rankings for a homophily low-caste patient given an arbitrary utility function $U\left(\Phi\left(c_L^p, c\right), q\right)$ that satisfies the axioms and assumptions of consumer choice specified above. Note that, in the first ranking (Figure 1A), the patient exhibits stronger preference for social proximity than for quality, while in the second ranking (Figure 1B), the patient exhibits stronger preference for quality than for social proximity. We show these results using an additively separable utility function that generates all rankings consistent with taste-based discrimination in Online Appendix A.

[Figure 1 here]

For a homophily low-caste patient who views fewer years of experience as an indication of better healthcare quality, the best possibility is a doctor $c_L e_L$ and the worst possibility is a doctor $c_H e_H$. For such a homophily low-caste patient, there are two possible rankings of doctors that are compatible with taste-based discrimination:

$$c_L e_L \succ c_L e_H \succ c_H e_L \succ c_H e_H$$
$$c_L e_L \succ c_H e_L \succ c_L e_H \succ c_H e_H$$

Figures 1C and 1D illustrate these two possible rankings for a homophily low-caste patient given an arbitrary utility function $U\left(\Phi\left(c_L^p, c\right), q\right)$ that satisfies the axioms and assumptions of consumer choice specified above.

For a heterophily low-caste patient who views more years of experience as an indication of better healthcare quality, the best possibility is a doctor $c_H e_H$, as both the social proximity and quality of this doctor are the highest. The worst possibility for this patient is a doctor $c_L e_L$ as both the social proximity and quality of this doctor are the lowest. For a heterophily low-caste patient, there are two possible rankings of doctors that are compatible with taste-based discrimination:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$

For a heterophily low-caste patient who views fewer years of experience as an indication of better healthcare quality, there are two possible rankings of doctors that are compatible with taste-based discrimination:

$$c_H e_L \succ c_H e_H \succ c_L e_L \succ c_L e_H$$
$$c_H e_L \succ c_L e_L \succ c_H e_H \succ c_L e_H$$

Figure 2 illustrates all four possible rankings for a heterophily low-caste patient given an arbitrary utility function $U\left(\Phi\left(c_L^p, c\right), q\right)$ that satisfies the axioms and assumptions of consumer choice specified above.

[Figure 2 here]

In sum, there are 8 out of 24 possible rankings for a low-caste patient who taste-based discriminates doctors by caste.

2.1.3. Rankings from the perspective of a high-caste patient

We now provide the possible preference rankings of doctors for a high-caste patient whose preferences satisfy the axioms and assumptions specified above. We list the possible rankings of doctors for different types of high-caste patients in the following order: (1) a homophily high-caste patient who views more years of experience as an indication of healthcare quality; (2) a homophily high-caste patient who views fewer years of experience as an indication of healthcare quality; (3) a heterophily high-caste patient who views more years of experience as an indication of healthcare quality; and (4) a heterophily high-caste patient who views fewer years of experience as an indication of healthcare quality.

For a homophily high-caste patient who views more years of experience as an indication of healthcare quality, the two possible rankings are:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$

Note that the above two rankings are identical to those for a heterophily low-caste patient who views more years of experience as an indication of healthcare quality since both patients view

a high-caste doctor being socially closer than a low-caste doctor and more years of experience as an indication of better healthcare quality.

For a homophily high-caste patient who views fewer years of experience as an indication of healthcare quality, the two possible rankings are:

$$c_H e_L \succ c_H e_H \succ c_L e_L \succ c_L e_H$$
$$c_H e_L \succ c_L e_L \succ c_H e_H \succ c_L e_H$$

Again, note that the above two rankings are identical to those for a heterophily low-caste patient who views fewer years of experience as an indication of healthcare quality.

For a heterophily high-caste patient who views more years of experience as an indication of healthcare quality, the two possible rankings are:

$$c_L e_H \succ c_L e_L \succ c_H e_H \succ c_H e_L$$
$$c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$$

The above two rankings are identical to those for a homophily low-caste patient who views more years of experience as an indication of healthcare quality.

For a heterophily high-caste patient who views fewer years of experience as an indication of healthcare quality, the two possible rankings are:

$$c_L e_L \succ c_L e_H \succ c_H e_L \succ c_H e_H$$
$$c_L e_L \succ c_H e_L \succ c_L e_H \succ c_H e_H$$

The above two rankings are identical to those for a homophily low-caste patient who views fewer years of experience as an indication of healthcare quality.

In sum, there are 8 out of 24 possible rankings for a high-caste patient who taste-based discriminates doctors by caste. These 8 possible rankings are identical to those for a low-caste patient who taste-based discriminates doctors by caste. Therefore, there are 16 out of 24 possible rankings that are inconsistent with taste-based discrimination.

2.2. Statistical discrimination

Phelps (1972) and Arrow (1973) pioneered statistical discrimination theory. The theory posits that, in the absence of direct information about quality, a decision maker would use group averages

(beliefs) to make inferences. For instance, labor market discrimination may exist because employers do not know with certainty workers' productivity and, therefore, may base their employment decisions on the workers' visible features, such as group identity or race, as long as these features are correlated with the unobserved productivity. This type of discrimination can result in self-fulfilling behavior from the disadvantaged groups. For example, Verdier and Zenou (2004) show that, if all agents, including blacks themselves, believe with no reason that blacks are more criminal than whites, blacks can become more criminal than whites because, based on wrong beliefs, employers pay them less, which forces them to reside far away from job centers, which leads blacks to rationally commit more crime than whites.[4]

As in the case of taste-based discrimination, we assume that a statistically discriminating patient's preference relations satisfy five fundamental axioms consumer choice: completeness, transitivity, continuity, strict monotonicity, and strict convexity. However, for this statistically discriminatory patient, the caste of a doctor does not influence the social proximity of the doctor and that all doctors irrespective of caste have the same social proximity. Thus, it is only the quality of healthcare that influences their preferences for doctors. Because the actual quality of healthcare, q, to be delivered by a doctor is unobserved to the patient before the transaction takes place, she uses the information about the doctor's caste, c, and experience, e, to predict this quality, $\mathbb{E}(q|e,c)$. It is important to note that what matters to this patient is not the experience of a doctor per se but the quality of healthcare or treatment provided by the doctor. Their consumption bundle, x, contains only the expected quality of healthcare, $\mathbb{E}(q|e,c)$. The patient's preference relation between two doctors is *now* represented by a real-valued utility function: $\mathrm{U}: \mathbb{R}_+ \to \mathbb{R}, \forall \mathrm{x}^0, \mathrm{x}^1 \in \mathbb{R}_+$, such that $\mathrm{U}(\mathrm{x}^0) \geq U(\mathrm{x}^1) \Leftrightarrow \mathrm{x}^0 \succsim \mathrm{x}^1$.

We follow Phelps (1972) and Aigner and Cain (1977) to model statistical discrimination for our case. The experience e of a doctor from caste group c now provides a signal of the doctor's quality q with an error (noise) ε so that:

$$e = q + \varepsilon \tag{1}$$

where $\varepsilon \sim N\left(0, \sigma_{\varepsilon,c}^2\right)$ and $q \sim N\left(\beta_c, \sigma_{q,c}^2\right)$. It is assumed that $cov(q, \varepsilon) = 0$. Thus, $\mathbb{E}(e_c) = \beta_c$ and $Var(e_c) = \sigma_{q,c}^2 + \sigma_{\varepsilon,c}^2$. Each patient infers the expected value of the doctor quality q from the noisy signal e (experience) using the available information, including the caste of the doctor c. In

[4] For a substantive survey on the theory of statistical discrimination, see Fang and Moro (2011).

order to choose (rank) a doctor, each patient forms $\mathbb{E}(q|e,c)$. Since q and e are jointly normally distributed, for each caste of doctor $c = c_L, c_H$, we have:[5]

$$\hat{q}_c \equiv \mathbb{E}(q|e,c) = (1-\gamma_c)\beta_c + \gamma_c e_c \tag{2}$$

where $0 < \gamma_c < 1$ is given by:

$$\gamma_c = \frac{\sigma^2_{q,c}}{\sigma^2_{q,c}+\sigma^2_{\varepsilon,c}} = \frac{Cov(q_c,e_c)}{Var(e_c)} \tag{3}$$

where $Cov(q_c, e_c) > 0$ as experience is a positive signal of quality according to equation (1). In other words, for a given caste of doctor, c, a doctor with higher experience is perceived to be providing a higher quality healthcare. On the other hand, if experience is a negative signal of quality, then $Cov(q_c, e_c) < 0$.

Equation (2) says that $\hat{q}_c \equiv \mathbb{E}(q|e,c)$, the conditional distribution of q given e and c, follows a normal distribution with mean equal to a weighted average of the signal e_c and the unconditional group mean β_c. If the signal e_c is very noisy, i.e., the variance of ε, $\sigma^2_{\varepsilon,c}$, is large, the expected conditional value of doctor's quality is close to β_c, the population average of caste group c, regardless of the signal's value. In other words, when experience is not informative of quality, the patient uses the average quality of healthcare provided by the doctor's caste group to make inferences about a particular doctor's quality. On the other hand, if the signal is very precise, i.e., $\sigma^2_{\varepsilon,c}$ close to zero, then the signal e_c provides an accurate estimate of the doctor's quality. γ_c is often interpreted as the "reliability" of the signal since the higher is γ_c, the less noisy and thus more precise is the signal e_c.

2.2.1. Belief differences across caste groups

The choice of a doctor from a patient of caste c^p will depend on $\mathbb{E}(e_c) = \beta_c$, the signal e_c, and γ_c, the "reliability" of the signal. Different cases may arise based on what the patients' beliefs are.

We are agnostic about how beliefs about doctors from different castes may arise for an *individual* patient in the first place. One can imagine that everyone starts with a common prior about the quality of doctor from various caste groups, but the idiosyncratic experiences with different types of doctors over a patient's lifetime lead to the patient having different posterior beliefs about different types of doctors. In other words, their beliefs are shaped by the draws of doctors (from different caste groups and with different years of experience) they have encountered.

[5] Observe that under statistical discrimination, there is no bias on average, i.e., $\mathbb{E}(\hat{q}_c|e,c) = \beta_c$.

These draws are unlikely to be independently and identically distributed, and the posterior beliefs that they lead to are unlikely to map to the posterior beliefs of the average patient.[6]

Consider an assumption typically made in the labor market discrimination literature, where the signal of labor productivity is assumed to be noisier for minority workers to explain why minority individuals with strong test performance may be discriminated on average (e.g., Aigner & Cain, 1977). In the case of an individual patient that discriminates doctors based on caste, the equivalence would be to assume that the patient have the beliefs that $\beta_{c_H} = \beta_{c_L}$, $\sigma^2_{q,c_H} = \sigma^2_{q,c_L}$, $Cov(q_c, e_c) > 0$, and $\sigma^2_{\varepsilon,c_L} > \sigma^2_{\varepsilon,c_H}$. These beliefs imply that $0 < \gamma_{c_L} < \gamma_{c_H} < 1$, so that the signal about a doctor's experience is less informative the quality of healthcare for the lower caste c_L doctor than the higher caste c_H doctor. In this standard case, three possible rankings of doctors may arise:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_L e_L \succ c_H e_L$$

In the above three possible preference rankings of the four doctors, the first two of them are identical to the preference rankings that a taste-based discriminator (either a homophily high-caste or a heterophily low-caste patient) who views greater experience as an indicator of better healthcare quality may have. Only the last of the three rankings is unique for a statistical discriminator. Panels A to B in Figure 3 illustrate these three possible rankings. We show the relationship between $\hat{q}_c$ and e_c for simplicity given that $\mathrm{U}: \mathbb{R}_+ \to \mathbb{R}, \forall \mathrm{x}^0, \mathrm{x}^1 \in \mathbb{R}_+$ such that $\mathrm{U}(\mathrm{x}^0) \geq U(\mathrm{x}^1) \Leftrightarrow \mathrm{x}^0 \gtrsim \mathrm{x}^1$ for a caste-based statistical discriminator.

[Figure 3 here]

[6] Ewens et al. (2014) show that for racial discrimination in the US rental apartment market, when the draws are correlated within neighborhoods in which landlords are leasing apartments, the differences in variances across groups may arise since the variance includes all the pairwise correlations of observations. Bohren et al. (2019) examine whether belief differences across groups get updated as new information arrives in the context of gender discrimination in online evaluations of user-generated mathematics discussions. They find that without prior evaluations, women face significant discrimination, but the direction of discrimination reverses following a sequence of positive evaluations. Their findings imply that the beliefs are biased.

It is highly unlikely for all patients to share the beliefs that $\beta_{c_H} = \beta_{c_L}$, $\sigma^2_{q,c_H} = \sigma^2_{q,c_L}$, $Cov(q_c, e_c) > 0$, and $\sigma^2_{\varepsilon,c_L} > \sigma^2_{\varepsilon,c_H}$, even though it might be the case that the *average* patient has these beliefs. More generally, the idiosyncratic experiences of individual patients may give rise to all kinds of beliefs, including $\beta_{c_H} > \beta_{c_L}$, $\beta_{c_H} < \beta_{c_L}$, $\sigma^2_{q,c_H} > \sigma^2_{q,c_L}$, $\sigma^2_{q,c_H} < \sigma^2_{q,c_L}$, $Cov(q_c, e_c) < 0$, $\sigma^2_{\varepsilon,c_L} < \sigma^2_{\varepsilon,c_H}$, and $\sigma^2_{\varepsilon,c_L} > \sigma^2_{\varepsilon,c_H}$. Indeed, it is even possible for a patient to simultaneously have the belief that $Cov(q_{c_H}, e_{c_H}) > 0$ and the belief that $Cov(q_{c_L}, e_{c_L}) < 0$, for example. Without data on the history of encounters that each patient has had, it is impossible to estimate these beliefs at the *individual* patient level. Nonetheless, we can *infer* preference rankings that are consistent with the beliefs of statistical discriminators and identify those preference rankings that are distinguishable from the preference rankings of taste-based discriminators.

In total, all 24 feasible rankings are consistent with statistical discrimination, but only the following eight completely overlap with the preference rankings of taste-based discriminators. These eight rankings are:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$
$$c_L e_H \succ c_L e_L \succ c_H e_H \succ c_H e_L$$
$$c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$$
$$c_H e_L \succ c_H e_H \succ c_L e_L \succ c_L e_H$$
$$c_H e_L \succ c_L e_L \succ c_H e_H \succ c_L e_H$$
$$c_L e_L \succ c_L e_H \succ c_H e_L \succ c_H e_H$$
$$c_L e_L \succ c_H e_L \succ c_L e_H \succ c_H e_H$$

3. Context and experimental design

In this section, we provide some background on the caste system in India and then explain the way we implemented the field experiment.

3.1. Caste system in India

The caste groups in India are broadly categorized into the upper (high) castes and the lower (low) castes. The upper castes historically had social and economic rights. The lower castes were typically listed in three categories – (1) Scheduled Castes (SCs) or Dalits; (2) Scheduled Tribes

(STs); and (3) Other Backward Classes (OBCs). For centuries, caste dictated almost every aspect of Hindu religious and social life. In recent decades, the influence of caste has somewhat declined, especially in cities where different castes live side-by-side and interact economically and socially. Despite the changes, caste identities remain strong, and surnames provide identification of castes.

After the independence of India, discriminating a person based on caste was legally forbidden. In 1950, the Indian government launched Affirmative Action (AA),[7] which is known as reservation policy in India, to promote equal opportunities for SCs and STs in areas of government jobs, government-funded education, and politics (Deshpande, 2012). Following the Mandal Commission's recommendations, quotas for government jobs were extended to OBCs in the early 1990s. In 1992, the Supreme Court of India put a cap on reservation and ruled that reservations should not exceed 50%. In 2006, educational quotas for OBCs were established through the 93rd educational amendment. Government-funded colleges and universities allot seats according to caste-based quotas, which assign 7.5% to STs, 15% to SCs, and 27% to OBCs (Deshpande, 2012). However, there is evidence indicating that individuals from low-caste groups continue to face discrimination, stigmatization, exclusion and rejection (Madheswaran and Attewell, 2007; Thorat and Attewell, 2007; Banerjee et al., 2009; Siddique, 2011; Islam et al., 2021).

3.2. The field experiment

We conducted a field experiment to test for the presence and source of caste discrimination in the demand for healthcare in the Kanpur Nagar district of Uttar Pradesh (UP), India. UP has the most population and also the largest concentration of lower caste people among all Indian states. Caste-based issues and policies have historically dominated the state's politics.

The field experiment took place in 40 localities across the Kanpur Nagar district between August and October 2017. Online Appendix B lists these localities. We selected these locations because their demographic and social characteristics are representative of the overall demographic and social characteristics of the UP state. A total of 3,128 adults participated in the field experiment. Table 1 shows that the average demographic and social economic characteristics of

[7] For general overviews on the pros and cons of AA policies, see Holzer and Neumark (2000, 2006) and Arcidiacono and Lovenheim (2016). The literature examining the unintended consequences of AA policies under statistical discrimination dated back to the seminal work of Coate and Loury (1993).

the participants are broadly similar to the demographic and social economic characteristics of individuals in UP state.

[Table 1 here]

We implemented the field experiment in four stages. In the first stage, participants registered their interests and expressed preferences for different types of doctors presented to them. In the second stage, participants answered a short survey questionnaire. In the third stage, participants were assigned to doctors and appointments. In the fourth stage, participants received the health services.

In the first stage, we randomly approached households in each locality to advertise for an upcoming, free-of-charge health check service offered by a mobile clinic. Due to safety and ethical concerns, individuals with potential urgent and life-threatening diseases or injuries were advised to seek immediate medical attention at the local hospital, instead of waiting for the upcoming health check. At the point of registration, we requested participants to express their preferences over four potential doctors listed on a sign-up sheet. In India, mobile medical units are a common practice in places where medical facilities are inadequate, or in areas populated by low-income households. Thus, the main advantage of our field experiment is that it occurred in a "natural" environment since people in these areas have used such services. It is also common for patients to register their interest for an upcoming service and express their preference. We therefore believe that the participants did not know that they were taking part in a caste discrimination study and they acted the way they normally would.

The sign-up sheet on which participants expressed their preferences showed a two-by-two matrix containing information for four different doctors: (i) a doctor with a high-caste surname and a high number of years of experience ($c_H e_H$); (ii) a doctor with a low-caste surname and a high number of years of experience ($c_L e_H$); (iii) a doctor with a high-caste surname and a low number of years of experience ($c_H e_L$); and (iv) a doctor with a low-caste surname and a low number of years of experience ($c_L e_L$).[8] The high-caste surnames that appear on the sign-up sheet belong to the general-category (GC) caste. The low-caste surnames that appear on the sign-up sheet belong

[8] The sign-up sheet also indicated that, in case the participant was not assigned to any of the listed doctors, an alternative doctor would be provided.

to one of the three low-caste groups (i.e., either SC, ST, or OBC). Similarly, the high number of years of experience is either 12 years or eight years but never both.[9] The low number of years of experience is always four years. We randomized the order in which each type of doctor appeared in the matrix. We did not disclose the first name of the doctor but only the initial. Participants were randomly assigned to either a female-doctor group or a male-doctor group and they were informed about the gender of the doctors. This design is to ensure that there are only two dimensions (caste group and experience level) that the four doctors differ.

Participants were instructed to rank the four doctors from their most desired (rank 1) to their least desired (rank 4), without the possibility of an equal rank. They were also explained that they had a higher chance of getting the more preferred doctor than the less preferred doctor. Thus, the elicited rankings are incentivized. There are several reasons why we did not allow participants to rank doctors equally. First, it is *impossible* to elicit true indifference. The fact that a participant chooses one doctor over another is completely consistent with the theoretical notion of indifference between two doctors, because when a patient is indifferent between two doctors the patient chooses one at random. Second, by forcing participants to give strict ranking, we prevent the situations in which participants with weak preferences give equal ranking out of social desirability concern. Third, as long as we empirically detect ranking differences by doctor type, any measurement errors due to indifferences are differenced out on average.[10]

In stage two, the participants filled out a short demographic and social economic survey. The survey collects information about their age, gender, caste identity, caste identity, educational attainment, religious affiliation, etc. The short survey also includes questions about their attitudes toward individuals of different castes. By surveying them after the elicitation exercise, we minimized any potential priming effect. The correspondence study effectively concluded by the end of stage two.

[9] The high-caste surnames used are: Bajpai, Dixit, Mishra, and Pandey. The low-caste surnames used are: Katiyar, Pal, Rajput, Yadav, Kanaujiya, Kureel, Sonkar, and Valmiki.

[10] Some patients may be indifferent between some or all of the four doctors. In this case, they may randomize the rankings. Because there are fewer preference rankings that can be consistent with taste-based discrimination than statistical discrimination, any randomization or errors are more likely to turn their preference ranking from consistent with both theories into one that is consistent with statistical discrimination only. We address this problem by applying differential weights so that preference rankings that are consistent with taste-based discrimination get twice the weight that preference rankings that are uniquely statistical do. Details are discussed in Section 4.2.

In stage three, we informed the participants about the doctor they were assigned to and the location and time of their upcoming health-check appointment. In stage four, the mobile clinic arrived in the locality to deliver service. The service was delivered within one week of registration.

4. Results

4.1. Evidence of caste discrimination

We examine whether on average there is any evidence of caste discrimination first by pooling the responses of all patients and ignore the preference rankings of doctors at the individual patient level. We focus on the share of first rank that each caste-experience doctor-type receives in the full sample, before splitting the sample by the caste of patients. By focusing on first preferences, we illustrate why it can be difficult for choice data to help identify the primary source of discrimination.

[Figure 4 here]

Panel A of Figure 4 shows that low-caste, high-experience ($c_L e_H$) doctors are ranked first the most (46%); high-caste, high-experience ($c_H e_H$) doctors are ranked first the second most (43%); high-caste, low-experience ($c_H e_L$) doctors are ranked first the third most (7%); and low-caste, low-experience ($c_L e_L$) doctors are ranked first the least (4%) among the four doctors. If each patient was instructed to select only one doctor and they always selected their most preferred, the inferred average ranking of doctors is $c_L e_H \succ c_H e_H \succ c_H e_L \succ c_L e_L$, which is consistent with statistical discrimination and inconsistent with taste-based discrimination. The beliefs that are consistent with this preference ranking under statistical discrimination are either $\sigma^2_{\varepsilon,c_H} > \sigma^2_{\varepsilon,c_L}$, $\beta_{c_H} < \beta_{c_L}$, or both. These belief differences are not standard in the discrimination literature, which usually shows that the minority groups are discriminated; however, our results can be rationalized in the UP context because *low-caste individuals are the majority group*. Specifically, if signals of doctors are positively correlated in the sample that each patient observed based on their past experience and the majority of patients (i.e., low-caste patients) tend to encounter low-caste doctors, then $\sigma^2_{\varepsilon,c_H} > \sigma^2_{\varepsilon,c_L}$ (see e.g., Ewens et al. 2014).

If there were no caste discrimination, for the same level of experience, there should not be any difference between high-caste and low-caste doctors. The difference in the share of first-

ranked doctor is statistically significant between high-caste and low-caste doctors at each level of experience ($p < 0.01$). The significant differences also mean that by not offering patients the possibility to rank doctors equally is not a major concern, as we would not have detected the statistical differences had patients randomized doctors due to indifference. Without information about the discriminators, most field experiments would conclude that statistical discrimination is the main driver of differential treatments (choices) by caste of doctors based on the evidence in panel A of Figure 4.

As we also collect information about the group identities of discriminators, the natural next step is to split the sample by the caste of patients. Panel B of Figure 4 shows that for *low-caste patients*, the inferred average ranking of doctors is $c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$, which is consistent with both theories. Panel B of Figure 4 shows that for *high-caste patients*, the inferred average ranking of doctors is $c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$, which is also consistent with both theories. If patients taste-based discriminate on average, then the inferred rankings based on the patterns shown in panel B suggest that patients in both groups have homophily caste preferences. If patients statistically discriminate on average, then the inferred rankings based on the patterns shown in panel A suggest that low-caste patients hold the beliefs $\sigma^2_{\varepsilon,c_H} > \sigma^2_{\varepsilon,c_L}$, $\beta_{c_H} < \beta_{c_L}$, or both on average, while high-caste patients hold the beliefs $\sigma^2_{\varepsilon,c_H} < \sigma^2_{\varepsilon,c_L}$, $\beta_{c_H} > \beta_{c_L}$, or both on average.

4.2. Bounding taste-based discrimination using individual preference rankings

As the aggregate-level choice data by caste of patients are consistent with both taste-based discrimination and statistical discrimination, we now turn to the preference rankings of doctors at the individual patient level to provide an upper bound of taste-based discrimination by examining the share of rankings that are consistent with both theories of discrimination. If this upper bound is less than 50% of rankings, then we can conclude that statistical discrimination is likely the main source of caste discrimination.

There are fewer preference rankings that can be consistent with taste-based discrimination than statistical discrimination. Specifically, one third of all possible rankings (8/24) are consistent with both theories, while two thirds of all possible rankings (16/24) are uniquely statistical. If some taste-based discriminatory patients make small errors in expressing their preference ranking of doctors, the errors are more likely to turn their preference rankings from those that are consistent

with both theories into those that are consistent with statistical discrimination only. Similarly, if non-discriminatory patients who are indifferent between a few or all of the doctors randomize their preference orders, their preference rankings are more likely to be consistent with those that are uniquely statistical. As the number of preference rankings that are consistent with taste-based discrimination are half of those that are consistent with statistical discrimination only, we apply differential weights so that preference rankings that are consistent with taste-based discrimination get twice the weight that preference rankings that are uniquely statistical do.

Table 2 reports the share of patients who report each of the 24 possible rankings of doctors and quantifies these differences by the type of discrimination and by caste of patients. We report both the unweighted and weighted shares. Looking at the unweighted shares among low-caste patients, 33.4% of them have preference rankings of doctors consistent with homophily taste-based discrimination and statistical discrimination, 23.2% of them have preference rankings of doctors consistent with both heterophily taste-based discrimination and statistical discrimination, and a little over 43.4% of them have preference rankings of doctors consistent with only statistical discrimination. Looking at unweighted shares among high-caste patients, 44% of them have preference rankings of doctors consistent with homophily taste-based discrimination and statistical discrimination, 15.4% of them have preference rankings of doctors consistent with both heterophily taste-based discrimination and statistical discrimination, and a little over 40.6% of them have preference rankings of doctors consistent with only statistical discrimination. Overall, both high-caste and low-caste patients are more likely to have preference rankings consistent with both homophily taste-based discrimination and statistical discrimination (36.3%) as opposed to preference rankings consistent with both heterophily taste-based discrimination and statistical discrimination (21.1%). More importantly, 42.7% of patients have preference rankings that are consistent with statistical discrimination only. Thus, the upper bound of taste-based discrimination can be as high as 57.4%. When we look at the weighted shares, where lower weights are placed on preference rankings that are consistent with statistical discrimination only, the share of patients with preference rankings consistent with taste-based and statistical discrimination becomes even higher (72.9%). Given the large extent of overlap between the two potential sources of discrimination, by focusing on violation of the five preference axioms without imposing additional assumptions, such as homophily preference, we cannot conclude that statistical discrimination is the main driver of discrimination.

[Table 2 here]

4.3. Tightening the bound of taste-based discrimination

Given that we cannot clearly identify the primary source of discrimination by looking at the rankings of doctors at the aggregate level and at the individual patient level, we now demonstrate an auxiliary method to tighten the upper bound of taste-discrimination.

The general attitudes of a person towards different caste groups provide measures of their social affinities towards different caste groups and can be used to infer their caste preferences in general. If their inferred caste preferences in general are different to the inferred caste preferences in the field experiment, then it cast doubt on the inference of taste-based discrimination in the field experiment. In this case, we reclassify the preference rankings of doctors that are consistent with both theories as consistent with statistical discrimination only.

In stage two of the field experiment, we asked participants how strongly they agreed or disagreed with a set of statements about different caste groups in order to gauge their attitudes towards individuals from different caste backgrounds. Four of these attitude questions are useful for us to infer their relative affinity towards high-caste and low-caste persons. These four questions are as follows: (i) "It really upsets me if anyone says anything negative about people from Backward Caste"; (ii) "I have very positive attitudes towards people from Backward Caste"; (iii) "It really upsets me if anyone says anything negative about people from General Caste"; (iv) "I have very positive attitudes towards people from General Caste". We code each response on a 5-point Likert scale, with a higher scale indicates stronger agreement. To measure a person's positive attitudes towards low-caste individuals, we compute the total points for the first two questions and denote this score as $S_{c_L}^p$. Similarly, to measure a person's positive attitudes towards high-caste individuals, we compute the total points for the last two questions and denote this score as $S_{c_H}^p$.

If a participant has relatively positive or neutral attitudes towards their own caste in the survey, then the participant exhibits homophily caste preference in general. Negative attitudes would imply heterophily caste preference in general. Since survey respondents may exhibit equal treatment due to social desirability concerns, we only reclassify preference rankings in the field

experiment of survey attitudes that *strictly* contradict the inferred caste preference in the field experiment. If a patient's ranking of doctors in the field experiment is one of the four consistent with both statistical discrimination and homophily taste-based discrimination, but the patient exhibits heterophily preference in their survey response, we treat their preference ranking of doctors as uniquely statistical discrimination, instead of consistent with both homophily taste-based discrimination and statistical discrimination. For example, if a high-caste patient has the preference ranking of doctors as $c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$, but the patient reveals $S^p_{c_H} < S^p_{c_L}$ in the survey, then the patient is deemed not a taste-based. On the other hand, if another high-caste patient also has the preference ranking of doctors as $c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$ but reveals $S^p_{c_H} = S^p_{c_L}$ in the survey, then the patient's preference ranking of doctors is still classified as consistent with both homophily taste-based discrimination and statistical discrimination. Similarly, if a patient's ranking of doctors in the field experiment is one of the four consistent with both statistical discrimination and heterophily taste-based discrimination, but the patient exhibits homophily preference in their survey response, we treat their preference ranking of doctors as uniquely statistical discrimination, instead of consistent with both heterophily taste-based discrimination and statistical discrimination. As the preference rankings provided by patients who exhibit equal treatment in the survey due to social desirability concerns are not reclassified as consistent with statistical discrimination only, our method that focuses on strict contradiction provides a conservative bound on the extent of taste-based discrimination.

The majority of patients' caste preferences inferred from the rankings of doctors in the field experiment actually contradict their caste preferences inferred from the survey. Approximately 43.6% of low-caste patients and 46.5% of high-caste patients who have preference rankings of doctors that are consistent with homophily taste-based discrimination exhibit heterophily preference in the survey. Approximately 86.4% of low-caste patients and 79.1% of high-caste patients who have preference rankings of doctors that are consistent with heterophily taste-based discrimination exhibit homophily preference in the survey. After reclassifying preference rankings consistent with both theories as uniquely statistical discrimination based on this auxiliary method, Table 3 shows that we are able to tighten the upper bound of taste-discrimination to 23.3% based on the unweighted estimates and to 29.6% based on the weighted estimates. Thus, the evidence is consistent with the majority of patients statistically discriminate doctors based on their castes.

[Table 3 here]

5. Belief differences and testable implications

Using individual level data, we have shown that statistical discrimination is likely the major source of caste discrimination in the demand for healthcare in India. As statistical discrimination is a belief-based explanation, we now examine whether the variation in preference rankings can also be substantiated with the variation in the potential sources of belief differences.

5.1. Caste-based reservations in higher education

Caste-based reservations have been implemented in government-funded higher educational institutions for decades. In 1992, the Supreme Court of India put a cap on reservation and ruled that reservations should not exceed 50%. In 2006, educational quotas for OBCs were established through the 93rd educational amendment. Government-funded colleges and universities allot seats according to caste-based quotas, which assign 7.5% to STs, 15% to SCs, and 27% to OBCs (Deshpande, 2012).

Candidates from SCs, STs, and OBCs have to take entrance examinations for higher educational institutions, but they compete only among themselves to fill the reserved seats for their caste groups. Depending on the extent of competition within each caste group, admission requirements adjust to fill the reserved seats. These adjustments can lead to a gradation of admission scores, with high-caste students facing the highest qualifying scores, and lower caste students facing lower qualifying scores (Bertrand et al., 2010; Bagde et al., 2016; Deshpande, 2012; Frisancho & Krishna, 2016).

Although caste-based quotas have been in place for years, the share of low-caste students enrolled in various medical science programs has adjusted gradually. The All India Survey of Higher Education data shows that the share of low-caste students enrolled in various medical science programs in Indian higher education institutions steadily rose from a little under 40% in 2012 to near the 50% cap in 2018, even though the policy has been in place since 2006 (Figure 5).

[Figure 5 here]

Given that reserved seats are filled using different qualifying scores by caste (Bertrand et al., 2010; Bagde et al., 2016; Deshpande, 2012; Frisancho & Krishna, 2016), Figure 5 implies that younger cohorts of low-caste students face lower admission requirements than older cohorts of low-caste students, while younger cohorts of high-caste students face higher admission requirements than older cohorts of high-caste students. It is possible that patients form beliefs about the quality of healthcare provided by doctors of different cohorts and castes that are consistent with these trends in admission requirements. First, patients may believe that the quality of doctors and their qualifying scores for medical school admissions are positively correlated. Second, as the qualifying scores are set differentially across caste groups and age (experience) cohorts, differential beliefs about the quality of doctors by caste and cohort may arise.

5.2. Caste-based reservations and beliefs

We conducted a separate phone survey on 253 individuals in UP to infer the (equilibrium) beliefs that individuals have about: (1) the relationship between the quality of doctor and qualifying test scores for medical school admissions; (2) the differences in the difficulty in medical school admissions across caste groups; and (3) the differences in the relative difficulty in medical school admissions by caste between younger and older cohorts of doctors. The belief elicitation was implemented in the form of a coordination game (Cooper et al., 1990). We asked the respondents to choose an answer that they believe most respondents would choose in each of the survey questions. They were paid an amount (5 Rupees) if their guess was correct.[11] This way of eliciting beliefs using respondents who did not participate in the field experiment can help minimize social desirability concerns and ex-post justifications of decisions.

[Table 4]

Table 4 reports these beliefs. First, 87% of respondents, irrespective of their castes, believe that high quality doctors were also students with high qualifying test scores (item 1, columns 1 to 3). Second, about 75% of respondents believe that it is generally harder for high-caste students to be admitted into medical schools than low-caste students (items 2-5, column 3). Such belief is much stronger among high-caste respondents (92%, items 2-5, column 2) than low-caste

[11] Online Appendix D provides more details about the survey and respondents.

respondents (67%, items 2-5, column 1). Third, more than three quarters of respondents believe that it has become harder for high-caste individuals to be admitted into medical schools relative to lower caste individuals in recent years than 10-20 plus years ago. Such belief is also much stronger among high-caste respondents (92%, item 6, column 2) than low-caste respondents (68%, item 6, column 1).

In sum, the phone survey on a sample of respondents who did not participate in the field experiment indicates that the majority of respondents, whether they are from a low-caste or high-caste background, hold the beliefs that: (1) doctors with higher qualifying test scores in medical school admissions are better-quality doctors; (2) it is generally more difficult for high-caste students to gain medical school admissions; and (3) the admission requirements are relatively lower for younger cohorts of low-caste medical students than older cohorts of low-caste medical students, but relatively higher for younger cohorts of high-caste medical students than older cohorts of high-caste medical students.

5.3. Testable implications and experimental results

The differential trends in admission requirements across caste groups and age (experience) cohorts and the belief that doctors with higher qualifying test scores in medical school admissions are better-quality doctors imply: (1) lower mean and higher variance of healthcare quality for older cohorts of high-caste doctors than for younger cohorts of high-caste doctors; and (2) higher mean and lower variance of healthcare quality for older cohorts of low-caste doctors than for younger cohorts of low-caste doctors.

By differentiating $\hat{q}_c$, which is defined in equation (2) in Section 2.2., we obtain:

$$\frac{\partial \hat{q}_c}{\partial \beta_c} = 1 - \gamma_c, \tag{4}$$

$$\frac{\partial \hat{q}_c}{\partial \sigma^2_{q,c}} = (e_c - \beta_c)\left[\frac{-\sigma^2_{q,c}}{(\sigma^2_{q,c}+\sigma^2_{\varepsilon,c})^3}\right]. \tag{5}$$

Expression (4) is non-negative given that $0 < \gamma_c < 1$. The sign of expression (5) is ambiguous, but for a sufficiently large e_c, it is likely to be negative.

With the beliefs of lower β_{c_H} and larger σ^2_{q,c_H} for older cohorts of high-caste doctors relative to younger cohorts of high-caste doctors, at a high level of experience, the expected quality

of healthcare is likely to decrease as experience increases. In contrast, with the beliefs of higher β_{c_L} and smaller σ^2_{q,c_L} for older cohorts of low-caste doctors relative to younger cohorts of low-caste doctors, the expected quality of healthcare is likely to increase as experience increases.

There are basically two forces that influence the return to experience. The first is the "pure experience" factor where experience on its own provides positive signal of quality for all doctors, regardless of their caste, on average (as most patients prefer a doctor with more years of experience). The second is the cohort (age) factor that is positively correlated with experience and linked to how the application of AA policy is perceived to have evolved over time. In this second case, experience lowers the perceived quality of high-caste doctors, but increases the perceived quality of low-caste doctors. Thus, experience has two effects. On the one hand, it helps doctors, regardless caste. On the other hand, there is a counteracting effect of experience (age) on quality for high-caste doctors, but a reinforcing effect of experience (age) on quality of low-caste doctors. In net, these effects increase the return to experience for low-caste doctors but decrease the return to experience for high-caste doctors. Thus, the return to experience is likely to be larger for low-caste doctors than for high-caste doctors.

In the field experiment, we randomly assigned half of the participants to choose among doctors with four years or eight years of experience, while the other half to choose among doctors with four years or 12 years of experience. By comparing the share of first-ranked doctors with eight years of experience and doctors with 12 years of experience within the same caste group of doctors, we examine whether the differences in beliefs inferred from the field experiment are consistent with the implications of caste-based reservations in higher education.

Figure 6 shows that the return to experience in the experiment is *negative* for *high-caste doctors* between 8 years and 12 years of experience, but *positive* for *low-caste doctors* between 8 years and 12 years of experience for both low-caste and high-caste patients. The negative return to experience is statistically significant for high-caste doctors based on the first preferences of all patients (P<0.01). Thus, the return to experience is not only lower for high-caste doctors at high levels of experience, but it actually becomes negative. Interestingly, this significant negative return is primarily driven by the preferences of low-caste patients. Furthermore, younger cohorts of low-caste doctors are more discriminated against when their college admission scores were lower, while older cohorts of low-caste doctors are favored when their college admission scores were

higher. These results suggest that the way AA policy in higher education has been implemented in India can potentially explain the belief differences inferred from the field experiment.

[Figure 6 here]

6. Robustness

We perform a number of robustness checks to examine whether the results are sensitive to a number of assumptions made. The results are reported and discussed in Online Appendix D. Here, we briefly summarize the key points. First, we examine whether our results are sensitive to allowing taste-based discriminatory patients to have preferences for the gender of a doctor, which is an additional unobserved good or characteristic of a doctor that is correlated with experience but not theoretically modelled under taste-based discrimination (see Online Appendix D.1). We find that the estimated upper bound of taste-based discrimination is similar by gender of doctor. Second, as we reclassify caste preferences to tighten the bound of taste-based discrimination using survey responses that are not incentivized, we also check if our results are robust to using an incentivized measure of taste obtained from lab-in-the-field experiments. We adopt Ferschtman and Gneezy's (2001) and List's (2004) notion of group taste revealed in dictator games to measure patients' preferences for different caste groups and reclassify their caste preferences (see Online Appendix D.2). The upper bound of taste-based discrimination is tightened to 31% to 39% based on the incentivized measures, which also suggest that the majority of patients statistically discriminate.

7. Conclusion

This paper highlights the empirical challenge in separating the predictions of taste-based discrimination from the predictions of statistical discrimination using a simple theoretical framework that models discrimination of patients against doctors based on their castes and years of experience. The framework informs our approach that exploits violation of five fundamental axioms of preferences to bound the extent of taste-based discrimination. Specifically, by eliciting individual patients' preference rankings of doctors in a field experiment conducted in Uttar Pradesh, India, we first show that when we focus on the most-preferred doctor to examine

discriminatory choices made by patients, the aggregate level data are consistent with both (homophily) taste-based discrimination and statistical discrimination. We then demonstrate that even if we examine individual patients' preference rankings of doctors, in 73% of patients, we cannot distinguish whether they taste-based discriminate or statistically discriminate. The results highlight that if we only allow preferences to satisfy some fundamental axioms of preferences without imposing additional assumptions on preferences, it is difficult to rule out the role of taste in driving discriminatory behaviors.

We also demonstrate that the upper bound of taste-based discriminators can be tightened with the aid of additional instruments to measure the social proximities between an individual and different caste groups. The upper bound of taste-based discrimination is narrowed down from 73% to 30% using survey measures and to 39% using incentivized lab-in-the-field experimental measures. Thus, by bounding taste-based discrimination using individual level data, we reject taste-based discrimination as the primary source of caste discrimination in the demand for healthcare in India. Although we find that statistical discrimination explains the overall patterns in which patients discriminate doctors based on their castes, it is important to note that our results do not rule out the presence of taste-based discrimination because the upper bound of taste-based discrimination remains sizable.

Because statistical discrimination is a belief-based explanation, we further examine whether the variation in preference rankings can also be substantiated with the variation in the potential sources of belief differences. First, using incentivized measures of beliefs obtained from a separate sample of respondents, we find supportive evidence that the beliefs about the quality of doctors by caste and age cohort are consistent with the temporal changes in caste-based reservations. Second, we find that the negative return to experience for high-caste doctors with high levels of experience in the experiment can also be explained by how caste-based reservations might have shaped the beliefs about the quality of doctors by caste and age cohort.

Although we find that belief differences about the quality of doctors by caste in India can be rationalized by how caste-based reservations in higher educational institutions have been implemented, our data do not allow us to test whether these beliefs are biased or not nor allow us to test whether the use of Affirmative Action (AA) policy reinforces the negative stereotype about the quality of low-caste doctors. There can be an alternative explanation for why the average return to experience at high levels of experience is significantly higher for low-caste doctors than high-

caste doctors. It could be that patients have biased beliefs that low-caste doctors have a lower quality or training on average. At lower years of experience, the prior dominates (since surviving four or eight years in the industry is less diagnostic of quality) and the patient chooses the high-caste doctor. Observing that a low-caste doctor persisted for 12 years in the industry despite facing discrimination would then imply they are especially high quality.

More generally, our methodology that exploits the violation of preference axioms to reject taste-based discrimination can be applied in many other settings to understand the primary source of discrimination along different dimensions, such as race, ethnicity, gender, religion, age, etc. Given the recent major events around the world, such as the Black Lives Matter movement and Covid-19 related racism, identifying the primary source of discrimination can be a first step towards implementing appropriate policy responses to address the underlying problems.

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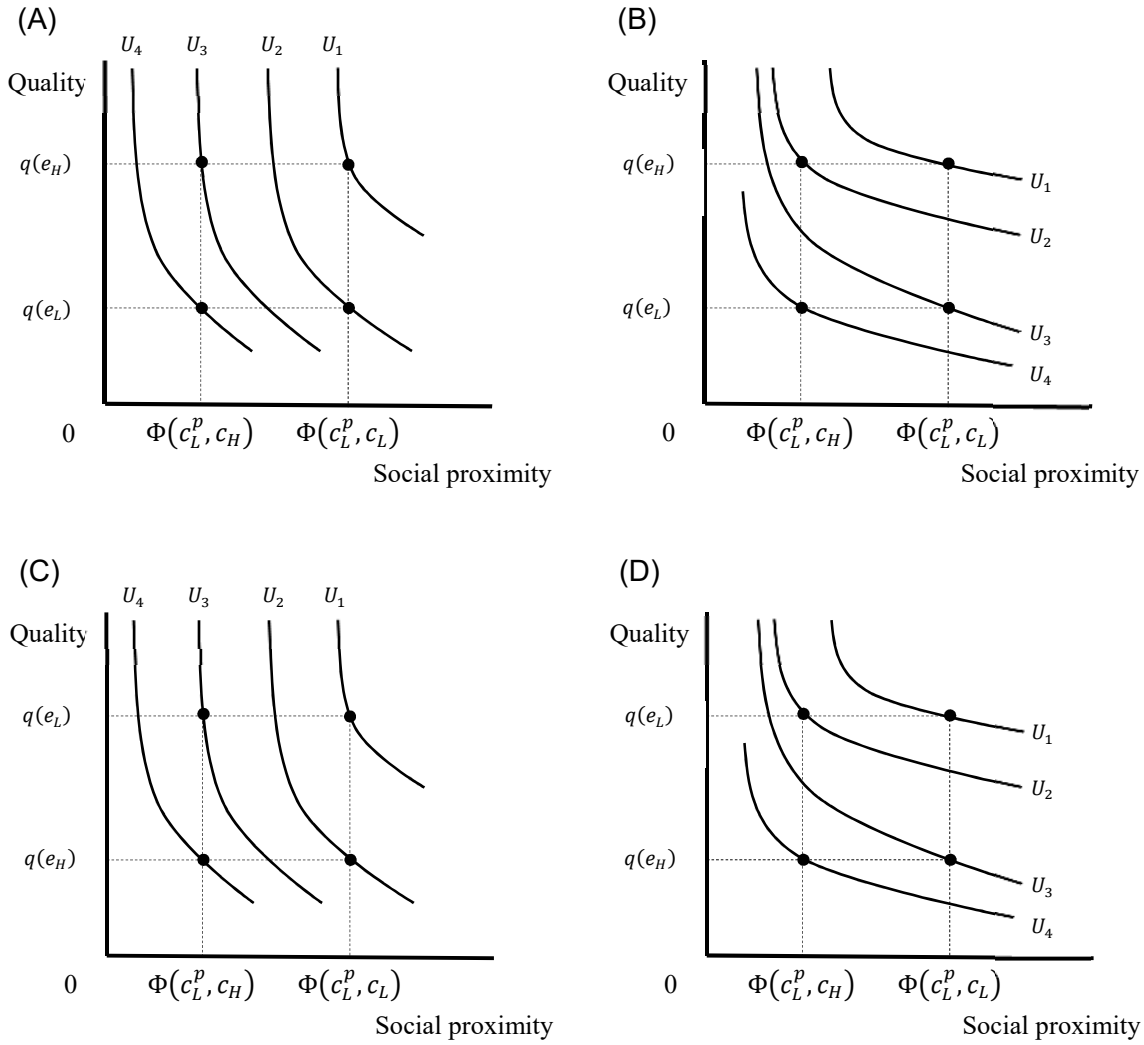
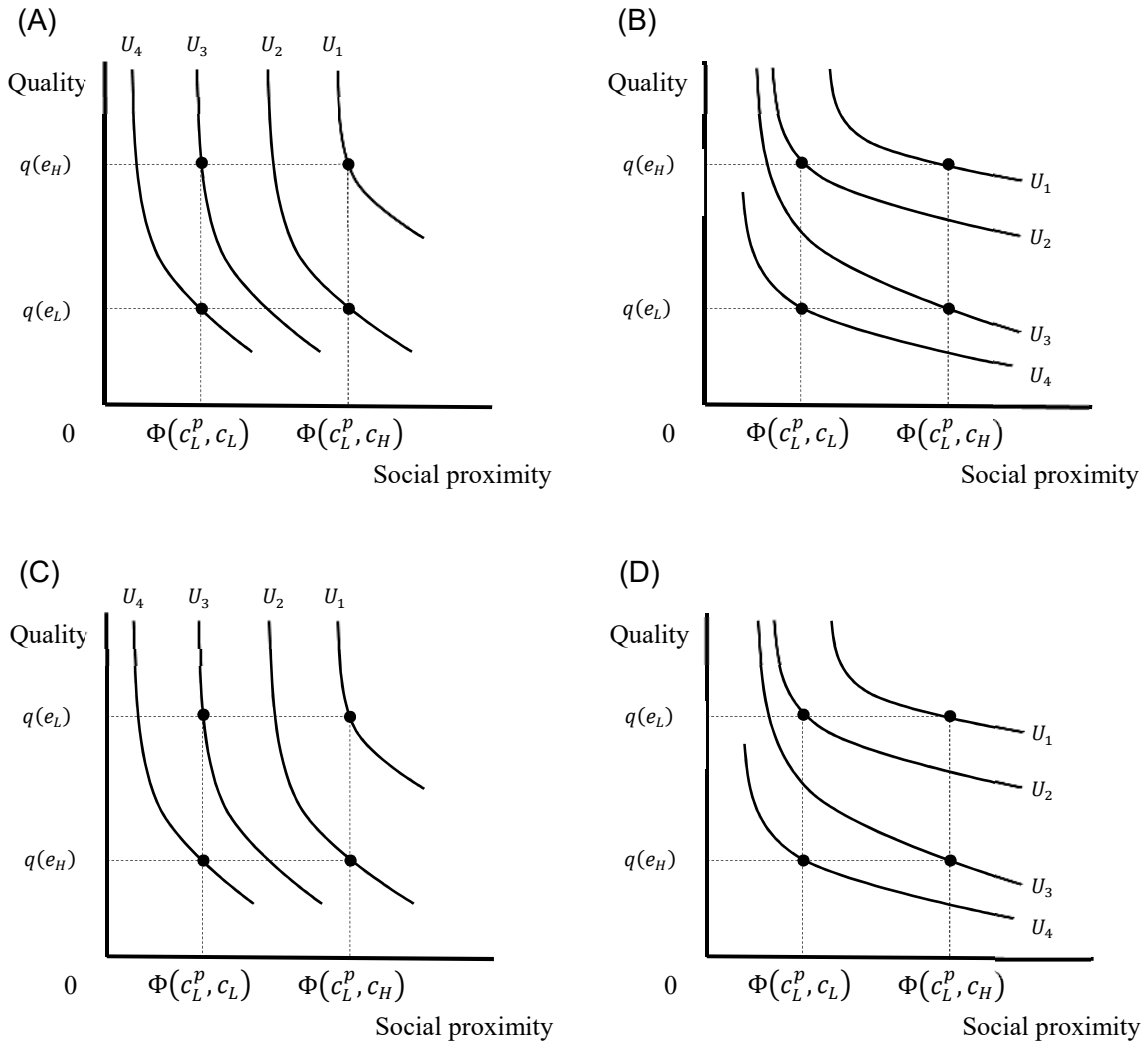
FIGURES

Figure 1: Low-caste homophily patients' preferences for and rakings of doctors with different levels of social proximity and quality of healthcare



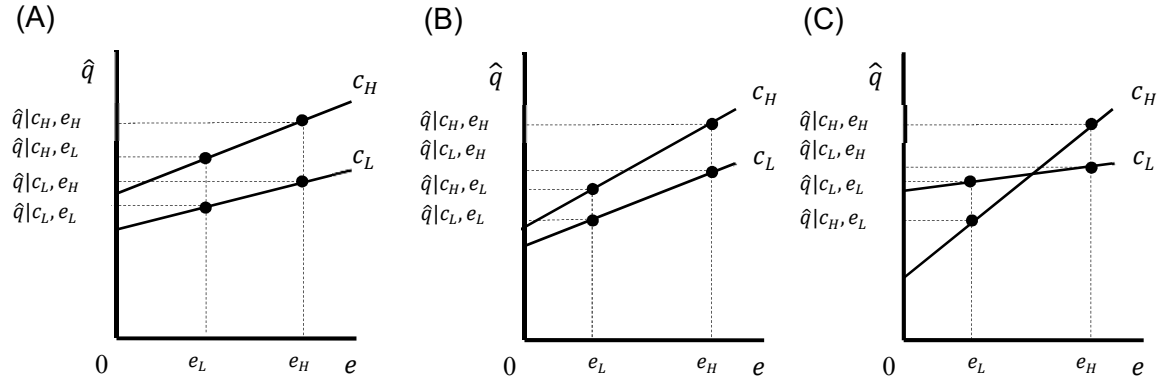
Notes: In panels A and B, the low-caste homophily patient prefers more years of experience to fewer years of experience. In panels C and D, the low-caste homophily patient prefers fewer years of experience to more years of experience. All four panels are identical for high-caste heterophily patients.

Figure 2: Low-caste heterophily patients' preferences for and rakings of doctors with different levels of social proximity and quality of healthcare



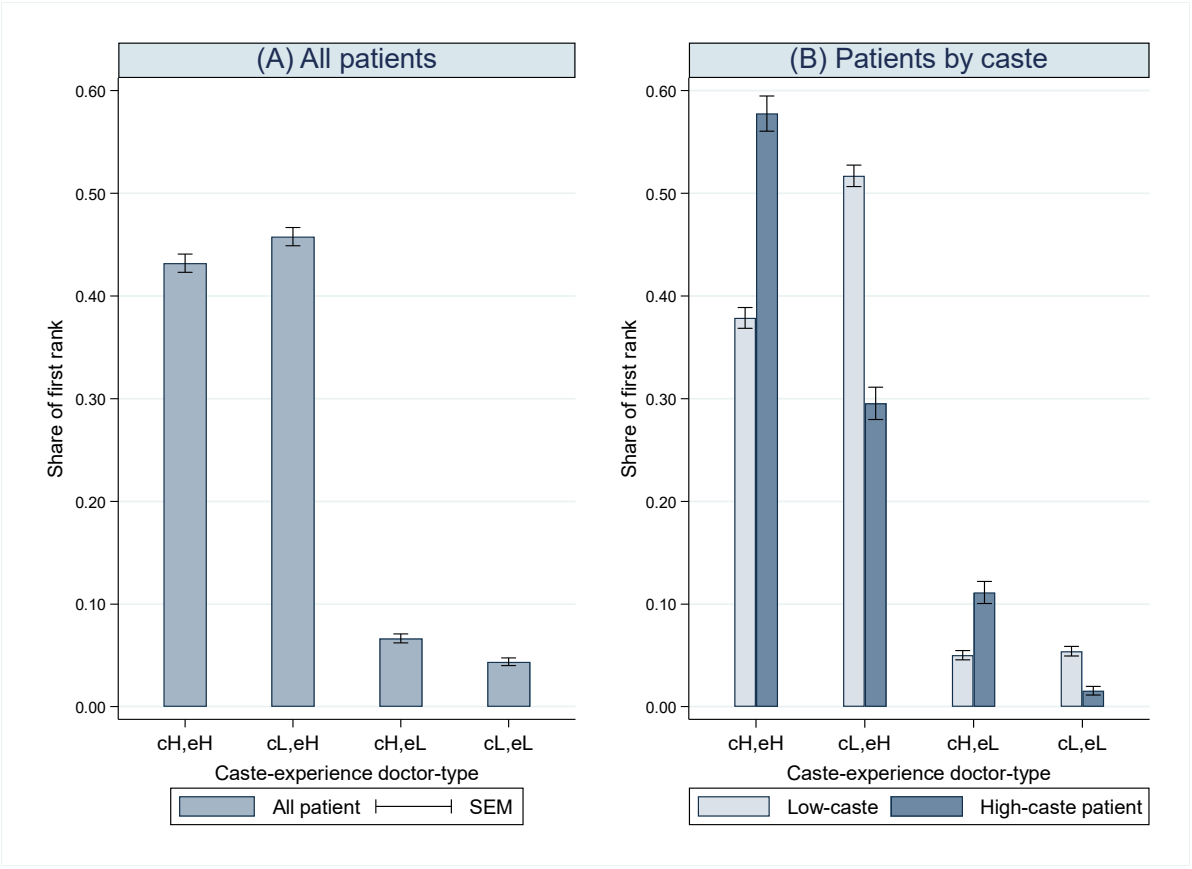
Notes: In panels A and B, the low-caste heterophily patient prefers more years of experience to fewer years of experience. In panels C and D, the low-caste heterophily patient prefers fewer years of experience to more years of experience. All four panels are identical for high-caste homophily patients.

Figure 3: The relationship between expected quality of healthcare and years of experience when patients statistically discriminate



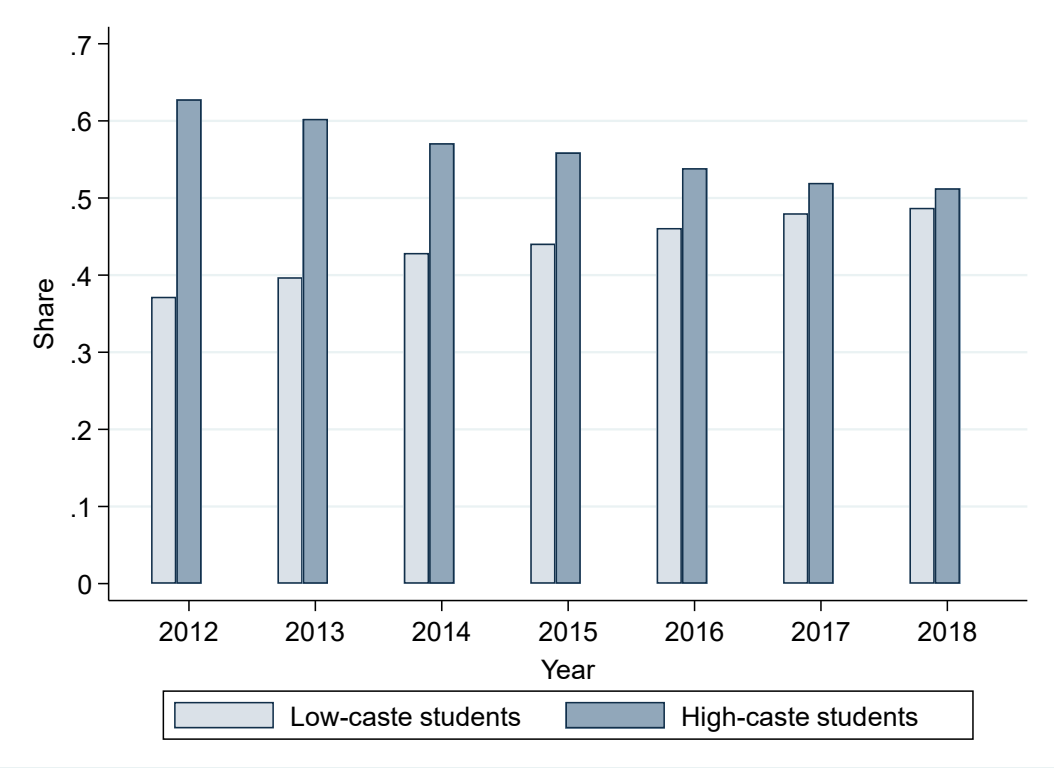
Notes: In all cases, the beliefs are assumed to be $\beta_{c_H} = \beta_{c_L}$, $\sigma^2_{q,c_H} = \sigma^2_{q,c_L}$, $Cov(q_c, e_c) > 0$, and $\sigma^2_{\varepsilon,c_L} > \sigma^2_{\varepsilon,c_H}$.

Figure 4: Share of first rank by doctor type and caste of patient



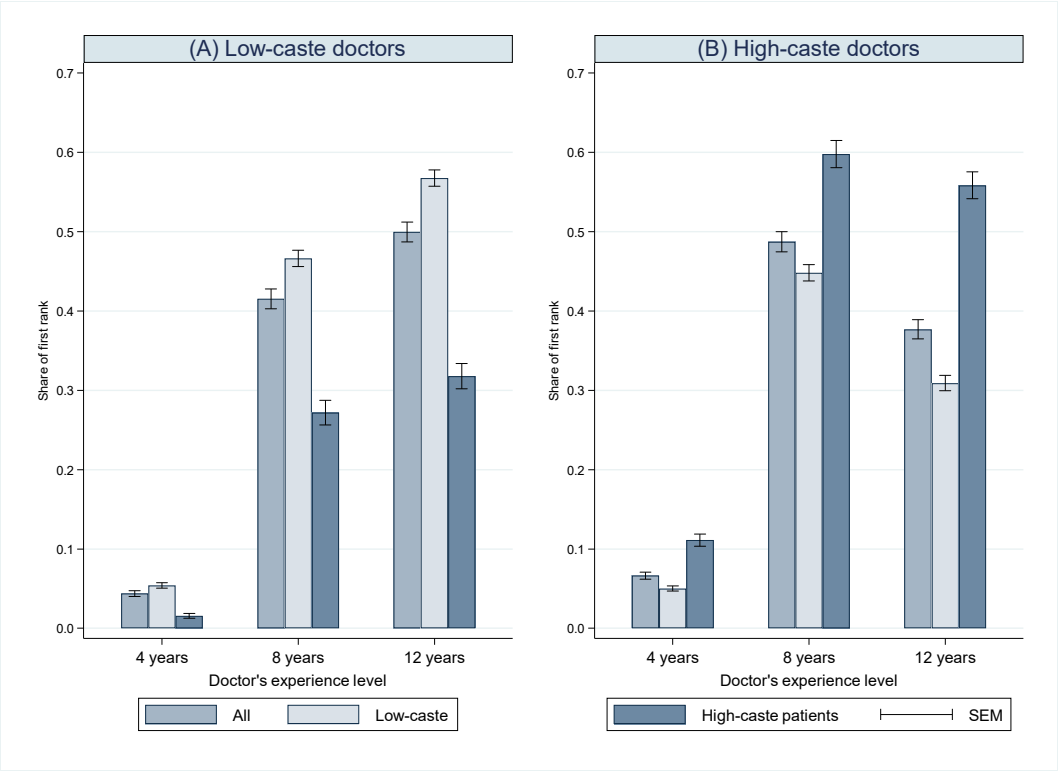
Notes: First rank is a dummy variable that takes the value of one if the doctor is chosen as the most preferred. cH,eH = high-caste high-experience doctor; cL,eH = low-caste high-experience doctor; cH,cL = high-caste low-experience doctor; and cL,eL = low-caste low-experience doctor. The standard error bar denotes the standard error of the mean.

Figure 5: Share of students enrolled in medical science programs by caste and year



Notes: Authors' calculation based on data drawn from the All India Survey of Higher Education (AISHE). The data include tertiary students enrolled in all medical science programs (e.g., MBBS, pharmacy and pharmacology, nursing, etc.).

Figure 6: Return to experience of doctor by doctor type and caste of patient



Notes: First rank is a dummy variable that takes the value of one if the doctor is chosen as the most preferred. SEM denotes the standard error of mean.

TABLES

Table 1: Descriptive statistics

	Uttar Pradesh	Experimental Sample	
	Mean	Mean	Std. Dev.
Male	0.51	0.51	0.50
Age	38.0	37.8	14.3
High caste	0.27	0.27	0.44
Hindu	0.80	0.80	0.40
College educated	0.08	0.11	0.32
Below poverty line	0.29	0.34	0.47
Urban resident	0.34	0.34	0.48

Notes: The field experiment sample include 3,128 participants. All statistics for Uttar Pradesh were sourced from NSS 68th Round, 2011-2012, except the below poverty line figure which came from World Bank (2016).

Table 2: Distribution of preference rankings consistent with different theories by caste of patient

	--------- Unweighted ---------			--------- Weighted ---------		
	Low-caste patient	High-caste patient	All patient	Low-caste patient	High-caste patient	All patient
A. Taste-based or statistical discrimination						
r_1: $c_He_H \succ c_He_L \succ c_Le_H \succ c_Le_L$	2.53	22.97	7.99	3.23	28.81	10.16
r_2: $c_He_H \succ c_Le_H \succ c_He_L \succ c_Le_L$	18.72	16.63	18.16	23.91	20.86	23.08
r_3: $c_Le_H \succ c_Le_L \succ c_He_H \succ c_He_L$	7.16	0.84	5.47	9.14	1.05	6.95
r_4: $c_Le_H \succ c_He_H \succ c_Le_L \succ c_He_L$	23.47	14.11	20.97	29.98	17.70	26.66
r_5: $c_He_L \succ c_He_H \succ c_Le_L \succ c_Le_H$	1.31	3.59	1.92	1.67	4.50	2.44
r_6: $c_He_L \succ c_Le_L \succ c_He_H \succ c_Le_H$	0.61	0.84	0.67	0.78	1.05	0.85
r_7: $c_Le_L \succ c_Le_H \succ c_He_L \succ c_He_H$	1.61	0.00	1.18	2.06	0.00	1.50
r_8: $c_Le_L \succ c_He_L \succ c_Le_H \succ c_He_H$	0.48	0.12	0.99	1.50	0.60	1.26
Homophily taste-based or statistical	33.42	44.02	36.25	42.69	55.21	46.08
	(0.99)	(1.72)	(0.86)	(0.83)	(1.36)	(0.71)
Heterophily taste-based or statistical	23.17	15.43	21.10	29.59	19.35	26.82
	(0.88)	(1.25)	(0.73)	(0.76)	(1.08)	(0.63)
B. Statistical discrimination						
r_9: $c_He_H \succ c_Le_H \succ c_Le_L \succ c_He_L$	12.22	8.37	11.19	7.80	5.25	7.11
r_{10}: $c_Le_H \succ c_He_H \succ c_He_L \succ c_Le_L$	17.06	13.40	16.08	10.89	8.40	10.22
r_{11}: $c_He_L \succ c_Le_L \succ c_Le_H \succ c_He_H$	0.61	0.24	0.51	0.39	0.15	0.33
r_{12}: $c_Le_L \succ c_He_L \succ c_He_H \succ c_Le_H$	0.79	0.72	0.77	0.50	0.45	0.49
r_{13}: $c_He_H \succ c_Le_L \succ c_Le_H \succ c_He_L$	0.35	0.24	0.32	0.22	0.15	0.20
r_{14}: $c_He_H \succ c_Le_L \succ c_He_L \succ c_Le_H$	1.18	0.72	1.05	0.75	0.45	0.67
r_{15}: $c_He_H \succ c_He_L \succ c_Le_L \succ c_Le_H$	2.88	8.85	4.48	1.84	5.55	2.84
r_{16}: $c_Le_L \succ c_Le_H \succ c_He_H \succ c_He_L$	1.09	0.00	0.80	0.70	0.00	0.51
r_{17}: $c_Le_L \succ c_He_H \succ c_He_L \succ c_Le_H$	0.39	0.12	0.32	0.25	0.08	0.20
r_{18}: $c_Le_L \succ c_He_H \succ c_Le_H \succ c_He_L$	0.35	0.24	0.32	0.22	0.15	0.20
r_{19}: $c_He_L \succ c_Le_H \succ c_Le_L \succ c_He_H$	0.22	0.36	0.26	0.14	0.23	0.16
r_{20}: $c_He_L \succ c_Le_H \succ c_He_H \succ c_Le_L$	0.57	0.72	0.61	0.36	0.45	0.39
r_{21}: $c_He_L \succ c_He_H \succ c_Le_H \succ c_Le_L$	1.70	5.38	2.69	1.09	3.38	1.71
r_{22}: $c_Le_H \succ c_Le_L \succ c_He_L \succ c_He_H$	3.18	0.24	2.40	2.03	0.15	1.52
r_{23}: $c_Le_H \succ c_He_L \succ c_He_H \succ c_Le_L$	0.35	0.60	0.42	0.22	0.38	0.26
r_{24}: $c_Le_H \succ c_He_L \succ c_Le_L \succ c_He_H$	0.48	0.36	0.45	0.31	0.23	0.28
Uniquely statistical discrimination	43.41	40.55	42.65	27.72	25.43	27.10
	(1.04)	(1.70)	(0.88)	(0.75)	(1.19)	(0.63)

Notes: Taste-based discrimination is indistinguishable from statistical discrimination. High experience may signal better or worse quality of healthcare service when classifying with which theory a particular ranking is consistent. Preference rankings consistent with both theories are weighted twice as much as those uniquely statistical when weights are applied. Standard errors are reported in parentheses.

Table 3: Distribution of preference rankings consistent with different theories by caste of patient after reclassification of taste-based discrimination

	--------- Unweighted ---------			--------- Weighted ---------		
	Low-caste Patients	High-caste Patients	All Patients	Low-caste Patients	High-caste Patients	All Patients
Homophily taste-based or statistical	18.84	23.56	20.11	24.07	29.56	25.56
	(0.82)	(1.47)	(0.72)	(0.71)	(1.25)	(0.62)
Heterophily taste-based or statistical	3.14	3.23	3.16	4.01	4.05	4.02
	(0.36)	(0.61)	(0.31)	(0.33)	(0.54)	(0.28)
Uniquely statistical discrimination	78.01	73.21	76.73	71.91	66.39	70.42
	(0.87)	(1.53)	(0.76)	(0.75)	(1.29)	(0.65)

Notes: Taste-based discrimination is indistinguishable from statistical discrimination. High experience may signal better or worse quality of healthcare service when classifying with which theory a particular ranking is consistent. Preference rankings consistent with both theories are weighted twice as much as those uniquely statistical when weights are applied. Standard errors are reported in parentheses.

Table 4: Beliefs of respondents

	(1) Low-caste [N = 177]	(2) High-caste [N = 76]	(3) All [N = 253]
The most frequently chosen answer:			
Quality of doctors increases with test performance	0.864	0.882	0.870
	(0.026)	(0.037)	(0.021)
For doctors with 16 years of experience, admission was harder for upper-caste ones (about 21 years ago)	0.672	0.921	0.747
	(0.035)	(0.031)	(0.027)
For doctors with 12 years of experience, admission was harder for upper-caste ones (about 17 years ago)	0.672	0.921	0.747
	(0.035)	(0.031)	(0.027)
For doctors with 8 years of experience, admission was harder for upper-caste ones (about 13 years ago)	0.672	0.921	0.747
	(0.035)	(0.031)	(0.027)
For doctors with 4 years of experience, admission was harder for upper-caste ones (about 9 years ago)	0.672	0.921	0.747
	(0.035)	(0.031)	(0.027)
It has become harder for upper-caste individuals to be admitted into medical schools relative to lower-caste individuals in recent years than 10-20 plus years ago	0.684	0.921	0.755
	(0.035)	(0.031)	(0.027)

Notes: Each cell reports the share of survey respondents' guess regarding the answer most frequently chosen by other survey respondents. Respondents were paid 5 Rupees for making the correct guess for each question in the phone survey. Standard errors are reported in parentheses. The survey respondents did not participate in the field experiment, but reside in UP and have similar characteristics to the participants in the field experiment. Online Appendix D details the survey and the characteristics of respondents.

Online Appendix

A. Rankings of doctors under taste-based discrimination

A.1. Homophily taste-based discrimination

We present a simple additively separable utility function for patients of caste $c = c_L, c_H$ to illustrate the eight possible rankings under taste-based discrimination when quality of healthcare is permitted to be positively or negatively correlated with experience. We note that these rankings are true for any utility function that satisfies the five axioms of preferences specified in Section 2.1.

The utility function for a low-caste patient c_L^p choosing a doctor of caste $c = c_L, c_H$ is given by:

$$U\left(\Phi\left(c_L^p, c\right), q\right) = q(e) - 1_{\theta_H} \tag{A.1}$$

where $1_{\theta_H} = \theta_H > 0$ if the doctor is from a high caste background and zero otherwise. The indicator 1_{θ_H} indicates whether there is any social distance between the doctor's caste group and the patient's caste group.

If $q'(e) > 0$ (i.e., doctors with more years of experience provide better quality health service), the possible rankings for a low-caste patient compatible with (A.1) are:

$$c_L e_H \succ c_L e_L \succ c_H e_H \succ c_H e_L$$
$$c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$$

In the first ranking, we need to give the condition for which $c_L e_L \succ c_H e_H$ (the other inequalities are always true by definition since $e_H > e_L$). The condition is:

$$\theta_H > q(e_H) - q(e_L) \tag{A.2}$$

In the second ranking, we need to give condition for which $c_H e_H \succ c_L e_L$ (the other inequalities are always true by definition since $e_H > e_L$). The condition is:

$$\theta_H < q(e_H) - q(e_L) \tag{A.3}$$

If $q'(e) < 0$ (i.e., doctors with fewer years of experience provide better quality health service), the possible rankings for a low-caste patient compatible with (A.1) are:

$$c_L e_L \succ c_L e_H \succ c_H e_L \succ c_H e_H$$
$$c_L e_L \succ c_H e_L \succ c_L e_H \succ c_H e_H$$

In the first ranking, we need to give the condition for which $c_L e_H \succ c_H e_L$ (the other inequalities are always true by definition since $e_L < e_H$). The condition is:

$$\theta_H > q(e_L) - q(e_H) \tag{A.4}$$

In the second ranking, we need to give condition for which $c_H e_H \succ c_L e_L$ (the other inequalities are always true by definition since $e_L < e_H$). The condition is:

$$\theta_H < q(e_L) - q(e_H) \tag{A.5}$$

The utility function for a high-caste patient c_H^p choosing a doctor of caste $c = c_L, c_H$ is given by:

$$U\big(\Phi\big(c_H^p, c\big), q\big) = q(e) - 1_{\theta_L} \tag{A.6}$$

where $1_{\theta_L} = \theta_L > 0$ if the doctor is from a high caste background and zero otherwise.

If $q'(e) > 0$ (i.e., doctors with more years of experience provide better quality health service), the possible rankings for a high-caste patient compatible with (A.6) are:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$

In the first ranking, we need to give the condition for which $c_H e_L \succ c_L e_H$ (the other inequalities are always true by definition since $e_H > e_L$). The condition is:

$$\theta_L > q(e_H) - q(e_L) \tag{A.7}$$

In the second ranking, we need to give condition for which $c_L e_H \succ c_H e_L$ (the other inequalities are always true by definition since $e_H > e_L$). The condition is:

$$\theta_L < q(e_H) - q(e_L) \tag{A.8}$$

If $q'(e) < 0$ (i.e., doctors with fewer years of experience provide better quality health service), the possible rankings for a high-caste patient compatible with (A.6) are:

$$c_H e_L \succ c_H e_H \succ c_L e_L \succ c_L e_H$$
$$c_H e_L \succ c_L e_L \succ c_H e_H \succ c_L e_H$$

In the first ranking, we need to give the condition for which $c_H e_H \succ c_L e_L$ (the other inequalities are always true by definition since $e_L < e_H$). The condition is:

$$\theta_L > q(e_L) - q(e_H) \tag{A.9}$$

In the second ranking, we need to give condition for which $c_L e_L \succ c_H e_H$ (the other inequalities are always true by definition since $e_L < e_H$). The condition is:

$$\theta_L < q(e_L) - q(e_H) \tag{A.10}$$

To summarize, with taste-based discrimination, there are eight possible rankings in total. The four possible rankings for a low-caste homophily patient that are compatible with (A.1) are:

$$c_L e_H \succ c_L e_L \succ c_H e_H \succ c_H e_L$$
$$c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$$
$$c_L e_L \succ c_L e_H \succ c_H e_L \succ c_H e_H$$
$$c_L e_L \succ c_H e_L \succ c_L e_H \succ c_H e_H$$

The four possible rankings for a high-caste homophily patient that are compatible with (A.6) are:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$
$$c_H e_L \succ c_H e_H \succ c_L e_L \succ c_L e_H$$
$$c_H e_L \succ c_L e_L \succ c_H e_H \succ c_L e_H$$

A.2. Heterophily taste-based discrimination

The utility function for a low-caste patient c_L^p choosing a doctor of caste $c = c_L, c_H$ is given by:

$$U\big(\Phi\big(c_L^p, c\big), q\big) = q(e) - 1_{\theta_L} \tag{A.11}$$

where $1_{\theta_L} = \theta_L > 0$ if the doctor is from a low caste background and zero otherwise.

If $q'(e) > 0$, the possible rankings for a low-caste patient compatible with (A.11) are:

$$c_H e_H \succ c_H e_L \succ c_L e_H \succ c_L e_L$$
$$c_H e_H \succ c_L e_H \succ c_H e_L \succ c_L e_L$$

If $q'(e) < 0$, the possible rankings for a low-caste patient compatible with (A.11) are:

$$c_H e_L \succ c_H e_H \succ c_L e_L \succ c_L e_H$$
$$c_H e_L \succ c_L e_L \succ c_H e_H \succ c_L e_H$$

The utility function for a high-caste patient c_H^p choosing a doctor of caste $c = c_L, c_H$ is given by:

$$U\left(\Phi\left(c_H^p, c\right), q\right) = q(e) - 1_{\theta_H} \tag{A.12}$$

where $1_{\theta_H} = \theta_H > 0$ if the doctor is from a high caste background and zero otherwise.

If $q'(e) > 0$, the possible rankings for a high-caste patient compatible with (A.12) are:

$$c_L e_H \succ c_L e_L \succ c_H e_H \succ c_H e_L$$
$$c_L e_H \succ c_H e_H \succ c_L e_L \succ c_H e_L$$

If $q'(e) < 0$, the possible rankings for a high-caste patient compatible with (A.12) are:

$$c_L e_L \succ c_L e_H \succ c_H e_L \succ c_H e_H$$
$$c_L e_L \succ c_H e_L \succ c_L e_H \succ c_H e_H$$

B. Locations of field experiment

The areas covered in our study include Ratanpur, Lodhar, Kursauli, Maksudabad, Tikra, Singhpur, Hora, Paigupur, Pachor, Mandhana, Kukradev, Tikkanpurwa, Bairy, Mharajpur, Loharkheda, Pargahi, Guraha, Sandeela, Shadipur, Naurangabad, Baikunthpur, Sakshupurwa, Iswaringanj, Hradaypur, Parapratappur, Chandula, Pokharpurwa, Naramau, Karsaitpur, Madarpur, Indra Nagar, Kalyanpur Khud, Devi Shai Nagar, Sahab Nagar, Jai Prakash Nagar, Loharanbhatta, Fazalganj, Barasirohi, Mirjapur, and Maswanpur.

C. Phone survey

In June 2021, we conducted a phone survey on a different sample of individuals to infer the (equilibrium) beliefs that they have about: (1) the relationship between test score used for medical school admissions and the healthcare quality of a doctor; (2) differences in the difficulty being admitted into medical school across caste groups; (3) differences in the relative difficulty in being admitted into medical school by caste between younger and older generations of doctors.

The phone survey includes 253 respondents who are residents in Kanpur, Uttar Pradesh. Their characteristics are similar to those participated in the field experiment (Table D1).

Table D1: Characteristics of respondents

	Uttar Pradesh Mean	Experiment Mean	Survey Mean
Male	0.51	0.51	0.51
Age	38.0	37.8	38.4
High caste	0.27	0.27	0.30
Hindu	0.80	0.80	0.76
College educated	0.08	0.11	0.11
Below poverty line	0.29	0.34	0.34
Urban resident	0.34	0.34	0.31

Notes: The field experiment sample include 3,128 participants. All statistics for Uttar Pradesh were sourced from NSS 68th Round, 2011-2012, except the below poverty line figure which came from World Bank (2016). The phone survey sample includes 253 participants.

The belief elicitation was implemented in the form of a coordination game (Cooper et al., 1990). We presented respondents six questions. We asked the respondents to choose an answer that they believe most other respondents would choose in each of six questions. They were paid an amount (5 Rupees) if each guess was correct.

Based on their responses, we report in Table 5 the share of respondents who believe that:

1. The quality of healthcare given by a high-test-performance doctor is likely to be greater than the quality of healthcare given by the low-test-performance doctor.
2. It is harder for upper caste students to be admitted into medical school than lower caste students.
3. It has become harder for upper caste individuals to be admitted into medical schools relative to lower caste individuals in recent years than 10-20 plus years ago

The six survey questions are as follows.

1. Consider two doctors. The only difference between the two is their test scores when they were students applying for admissions into medical schools:
    - The first one has high test performance before medical school
    - The second one has low test performance before medical school

In the following question, choose the answer that you believe most other participants would choose in terms of the healthcare quality of the two doctors. Note that the higher the test performance of a student is, the easier it is for the student to be admitted into a medical school.

You will earn a bonus of 5 Rupees if your guess about what most other survey participants choose below is correct.

The quality of healthcare given by the high-test-performance doctor is likely to be:
- higher than the quality of healthcare given by the low-test-performance doctor.
- lower than the quality of healthcare given by the low-test-performance doctor.
- equal to the quality of healthcare given by the low-test-performance doctor.

2. Consider two doctors both have 16 years of experience

The only difference between the two doctors is caste.
- The first one is from an upper caste background (general category)
- The second one is from a lower caste background (OBC/SC/ST)

In the following question, choose the answer that you believe most other participants would choose in terms of the difficulty in getting admitted into a medical when the doctors were high school students. Note that the higher the admission cutoff score is, the harder it is for a student to be admitted into a medical.

You will earn a bonus of 5 Rupees if your guess about what most other survey participants choose below is correct.

When the two doctors were still high school students and were applying to study medicine (almost 21 years ago), it was:
- harder for the upper caste student to be admitted than the lower caste student.
- easier for the upper caste student to be admitted than the lower caste student.
- equally difficult to be admitted for both the upper caste student and the lower caste student.

3. Consider two doctors both have 12 years of experience

The only difference between the two doctors is caste.
- The first one is from an upper caste background (general category)
- The second one is from a lower caste background (OBC/SC/ST)

In the following question, choose the answer that you believe most other participants would choose in terms of the difficulty in getting admitted into a medical when the doctors were high school students. Note that the higher the admission cutoff score is, the harder it is for a student to be admitted into a medical.

You will earn a bonus of 5 Rupees if your guess about what most other survey participants choose below is correct.

When the two doctors were still high school students and were applying to study medicine (almost 17 years ago), it was:
- o harder for the upper caste student to be admitted than the lower caste student.
- o easier for the upper caste student to be admitted than the lower caste student.
- o equally difficult to be admitted for both the upper caste student and the lower caste student.

4. Consider two doctors both have 8 years of experience

The only difference between the two doctors is caste.
- The first one is from an upper caste background (general category)
- The second one is from a lower caste background (OBC/SC/ST)

In the following question, choose the answer that you <u>believe most other participants</u> would choose in terms of the difficulty in getting admitted into a medical when the doctors were high school students. Note that the higher the admission cutoff score is, the harder it is for a student to be admitted into a medical.

You will earn a bonus of 5 Rupees if your guess about what most other survey participants choose below is correct.

When the two doctors were still high school students and were applying to study medicine (almost 13 years ago), it was:
- o harder for the upper caste student to be admitted than the lower caste student.
- o easier for the upper caste student to be admitted than the lower caste student.
- o equally difficult to be admitted for both the upper caste student and the lower caste student.

5. Consider two doctors both have 4 years of experience

The only difference between the two doctors is caste.
- The first one is from an upper caste background (general category)
- The second one is from a lower caste background (OBC/SC/ST)

In the following question, choose the answer that you <u>believe most other participants</u> would choose in terms of the difficulty in getting admitted into a medical when the doctors were high school students. Note that the higher the admission cutoff score is, the harder it is for a student to be admitted into a medical.

You will earn a bonus of 5 Rupees if your guess about what most other survey participants choose below is correct.

When the two doctors were still high school students and were applying to study medicine (almost 9 years ago), it was:

- harder for the upper caste student to be admitted than the lower caste student.
- easier for the upper caste student to be admitted than the lower caste student.
- equally difficult to be admitted for both the upper caste student and the lower caste student.

6. In the following question, choose the answer that you believe most other participants would choose.

   You will earn a bonus of 5 Rupees if your guess about what most other survey participants choose below is correct

   - it has become harder for upper caste individuals to be admitted into medical schools relative to lower caste individuals in recent years than 10-20 plus years ago.
   - it has become easier for upper caste individuals to be admitted into medical schools relative to lower caste individuals in recent years than 10-20 plus years ago.
   - it is equally difficult for upper caste individuals to be admitted into medical schools relative to lower caste individuals in recent years compared to 10-20 plus years ago.

D. Robustness

D.1. Preferences for attributes other than caste and experience

In the taste-based discrimination model, we assume that a patient has only preferences for the social proximity of a doctor in terms of caste and the quality of healthcare, but nothing else. In reality, patients are likely to have preferences for other attributes of a doctor. A good example is the gender of a doctor. Now imagine that, in our experiment, patients are shown only two of the three attributes in their consumption bundle, x. Given that they also have preferences for the gender of a doctor, it is plausible to think that they may use the doctor's experience to infer the doctor's gender because female doctors are increasingly more represented in the medical profession in India (Bhadra, 2011). This possibility is similar to the Heckman's (1998) critique about using experiments to detect taste-based discrimination. Note that, to put aside the possibility of caste-based statistical discrimination, we still assume that these patients do not use the doctor's caste to help make inferences about gender. In this case, differences in the predicted gender of a doctor across patients will influence how they rank the four doctors. The possible rankings under taste-based discrimination for the case when patients try to infer the unobserved attribute from an observed attribute in $x \in \mathbb{R}^3_+$ may thus include more than the eight possible rankings we have highlighted for the case when $x \in \mathbb{R}^2_+$.

Table D1: Robustness of results to genders of doctors

	--- Unweighted ---		--- Weighted ---	
	Male Doctors	Female Doctors	Male Doctors	Female Doctors
Homophily taste-based or statistical discrimination	19.85	20.37	25.15	25.97
	(1.01)	(1.02)	(0.87)	(0.89)
Heterophily taste-based or statistical discrimination	3.19	3.14	4.04	4.00
	(0.44)	(0.44)	(0.40)	(0.40)
Uniquely statistical discrimination	76.96	76.49	70.80	70.03
	(1.06)	(1.07)	(0.91)	(0.93)

Notes: Taste-based discrimination is indistinguishable from statistical discrimination. High experience may signal better or worse quality of healthcare service when classifying with which theory a particular ranking is consistent. Preference rankings consistent with both theories are weighted twice as much as those uniquely statistical when weights are applied. Standard errors are reported in parentheses.

If the share of (uniquely) statistical discriminators does not vary considerably when additional correlated attributes are taken into consideration, then our method of bounding taste-based discrimination is unlikely to yield biased estimates due to taste-based discriminators using observable attributes of a doctor to infer other unobservable attributes of the doctor for which they have preferences.

We thus examine if the findings differ between the case when all the four doctors are females and the case when all the four doctors are males. The results are reported in Table D1. The share of discriminators who have preference rankings consistent with only statistical discrimination is similar regardless of whether they are presented with female or male doctors.

Therefore, our results are robust to the possibility that taste-based discriminators use a doctor's experience to make inferences about other unobserved attributes of the doctor.

D.2. Lab-in-the-field experiment

As the survey responses are not incentivized, it is possible that homophily individuals may still report relative positive attitudes towards the outgroup out of social desirability concerns. In late October 2017, we invited a random subset of the initial field-experimental participants in 30 randomly selected localities to participate in an incentivized lab-in-the-field experiment.

The lab-in-the-field experiment includes four dictator money-giving games. The four games correspond to four different groups of partners: high-caste, low-caste, above the poverty line (APL), and below the poverty line (BPL). Arguably, using this incentivized method to infer caste preference is less likely to suffer from social desirability bias. Similar to the survey method, we reclassify patients' preference rankings of doctors by checking whether their inferred social affinity to a caste group based on the amounts given in the lab-in-the-field experiment are consistent with their inferred social affinity to a caste group in the field experiment. Using the relative amounts allocated to different groups in dictator games to infer social proximities to and preferences for these groups are in line with the Fehr and Schmidt's (1999) notion of other-regarding preferences that are shaped by social proximity.

In total, 482 subjects participated in the lab-in-the-field experiment. In each dictator game, each participant, who had an endowment of 100 Rupees, decided how much to keep from this endowment (a number between 0 and 100 (inclusive) Rupees), given that what was not kept went to a randomly drawn "partner" from one of the four social groups of participants. If the participant is a low-caste person, we reminded the participant that the low-caste partner was from the same low-caste group. The anonymous partner was randomly drawn from our field experiment and the allocation was later given to them.

Steps were taken to minimize experimenter demand effect and social desirability bias. At the beginning of each game, an envelope with the group identity of an anonymous partner written on the envelope was drawn from a set of four envelopes. The participant was then given the group identity of the anonymous partner and the envelope with 100 Rupees (10 x Rs10 notes). The experimenter then instructed the participants to go to quiet corner to allocate whatever amount they wished for themselves and put the remaining amount in the envelope they wanted to give to the anonymous partner. They were also informed that, once they finished the task, they would drop the envelope in a bag full of similar-looking envelopes that the experimenter placed in a different corner. In the inside of each envelope, each participant's unique ID is written, so the amount can be linked to their responses in the field experiment. By letting them allocate the money in a quiet corner and drop each of the envelopes in a bag full of similar-looking envelopes away from the scrutiny of the experimenter, we minimize experimenter demand effect and social desirability bias.

Table D2 shows that the characteristics of these 482 participants in the lab-in-the-field experiment are similar to the 3,128 participants in the initial field experiment. The main findings in Table 2 are replicated when we restrict the sample to these 482 participants (Table D3). Thus, these 482 participants behave, on average, similar to the 3,128 participants in the field experiment.

To tighten the bound of taste-based discrimination using this incentivized method, we classify whether a participant's caste preference in the field experiment is consistent with the participant's caste preference in the lab-in-the-field experiment in two ways. First, in line with Ferschtman and Gneezy's (2001) and List's (2004) approach, we infer whether a person's social affinity to and caste preference for one group are greater another based on the differential amounts given to the two groups. Similar to the survey method, if a participant gives at least as much to another person of the same caste relative to another person of a different caste, we classify the participant as having homophily caste preference. If a participant gives less to another person of the same caste relative to another person of a different caste, we classify the participant as having heterophily caste preference.

Table D2: Descriptive statistics

	Field experiment (n = 3,128)		Lab-in-the-field experiment (n = 482)	
	Mean	Std. Dev.	Mean	Std. Dev.
Male	0.51	0.50	0.53	0.50
Age	37.8	14.3	38.5	15.0
High caste	0.27	0.44	0.26	0.44
Hindu	0.80	0.40	0.76	0.43
College educated	0.11	0.32	0.09	0.28
Below poverty line	0.34	0.47	0.34	0.47
Urban resident	0.34	0.48	0.33	0.47

Table D3: Distribution of preference rankings consistent with different theories by caste of patient

	--------- Unweighted ---------			--------- Weighted ---------		
	Low-caste Patients	High-caste Patients	All Patients	Low-caste Patients	High-caste Patients	All Patients
Homophily taste-based or statistical	34.92	47.58	38.17	43.78	58.71	47.67
	(2.52)	(4.50)	(2.22)	(2.08)	(3.48)	(1.80)
Heterophily taste-based or statistical	24.58	14.52	21.99	30.82	17.91	27.46
	(2.28)	(3.18)	(1.89)	(1.93)	(2.71)	(1.61)
Uniquely statistical discrimination	40.50	37.90	39.83	25.39	23.38	24.87
	(2.60)	(4.37)	(2.23)	(1.82)	(2.99)	(1.56)

Notes: The sample size is 482. Taste-based discrimination is indistinguishable from statistical discrimination. High experience may signal better or worse quality of healthcare service when classifying with which theory a particular ranking is consistent. Preference rankings consistent with both theories are weighted twice as much as those uniquely statistical when weights are applied. Standard errors are reported in parentheses.

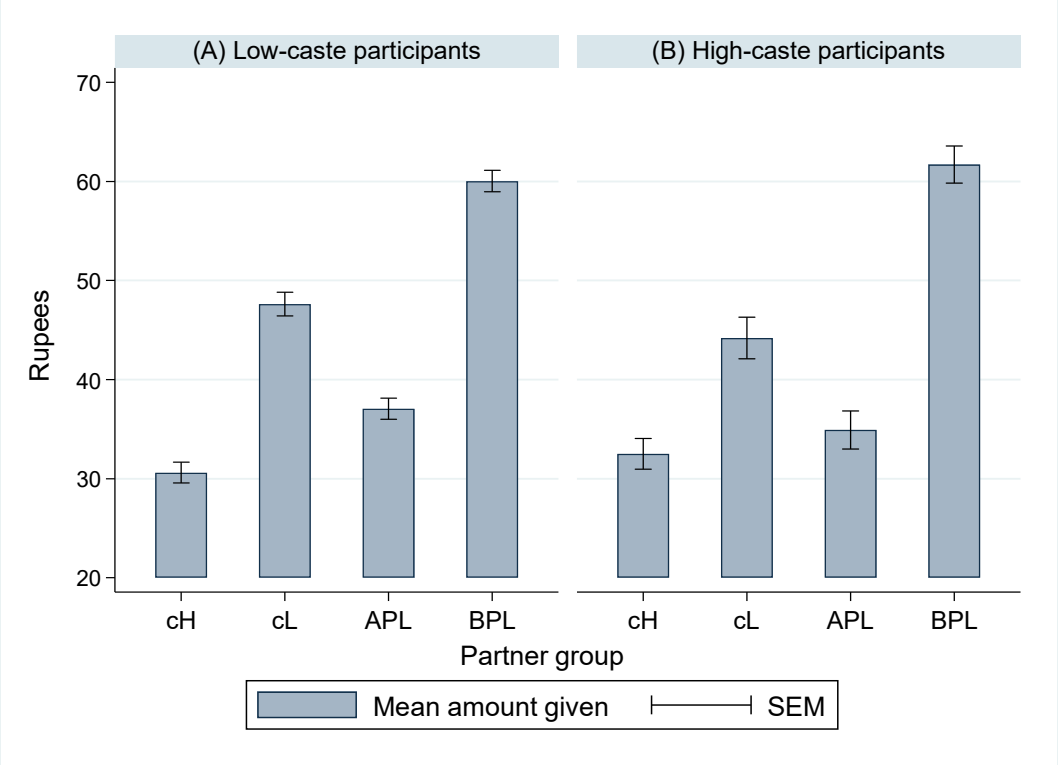
In our lab-in-the-field experiment, both the high-caste and low-caste participants tend to give more to individuals from a low-caste background and to individuals living below the poverty line (Figure D1). Since low-caste individuals are more likely to live below the poverty line, it is

plausible that the tendency for all individuals to give more to low-caste individuals reflects preferences to help people in need of financial assistance. To account for this tendency, we also refine Ferschtman and Gneezy's (2001) and List's (2004) original method to estimate the following equation by caste of patient and area to obtain the residuals $\hat{\epsilon}_i^p$:

$$G_{c_H,i}^p - G_{c_L,i}^p = \alpha_0 + \alpha_1 G_{APL,i}^p + \alpha_2 G_{BPL,i}^p + \beta' Z_i^p + \epsilon_i^p$$

where $G_{c_H,i}^p$ and $G_{c_L,i}^p$ are the amounts given to the high-caste partner and the low-caste partner by participant i, $G_{APL,i}^p$ and $G_{BPL,i}^p$ are the amounts given to the APL partner and the BPL partner by participant i, and Z_i^p is a set of characteristics of participant i, which include gender, religion, poverty status, and education.

Figure D1: Mean amount given to different groups by caste of patient



We infer a person's caste preference in the lab-in-the-field experiment using the residuals $\hat{\epsilon}_i^p$. If the residual is below zero, i.e., $\hat{\epsilon}_i^p < 0$, then the participant exhibits a preference for low caste. This is because the negative residual informs us that this participant gives relatively more to a low-caste person than a high-caste person even after considering the participant's tendency to give more to the poor (who are more likely to be low-caste). The excess giving is consistent with this participant preferring low caste. If the residual is greater than zero, i.e., $\hat{\epsilon}_i^p > 0$, then the participant exhibits a preference for high caste.

Table D4 shows that we are able to tighten the upper bound of taste-discrimination to 30.8% after reclassifying caste preferences based on Ferschtman and Gneezy's (2001) and List's (2004) original method and to 38.9% after reclassifying caste preferences based on the refined method. Thus, the majority of patients statistically discriminate doctors based on their castes and the estimates reported in Table 3 are robust to using incentivized measures of social affinity to reclassify caste preferences.

Table D4: Distribution of preference rankings consistent with different theories by caste of patient after reclassification of taste-based discrimination

	--------- Unweighted ---------			--------- Weighted ---------		
	Low-caste Patients	High-caste Patients	All Patients	Low-caste Patients	High-caste Patients	All Patients
A. Original method						
Homophily taste-based or statistical	22.35	13.71	20.12	28.02	16.92	25.13
	(2.20)	(3.10)	(1.83)	(1.88)	(2.66)	(1.56)
Heterophily taste-based or statistical	1.96	12.10	4.56	2.45	14.93	5.70
	(0.73)	(2.94)	(0.95)	(0.65)	(2.52)	(0.83)
Uniquely statistical discrimination	75.70	74.19	75.31	69.53	68.16	69.17
	(2.27)	(3.95)	(1.97)	(1.93)	(3.29)	(1.66)
B. Refined method						
Homophily taste-based or statistical	16.48	30.65	20.12	20.67	37.81	25.13
	(1.96)	(4.16)	(1.83)	(1.70)	(3.43)	(1.56)
Heterophily taste-based or statistical	11.73	8.87	11.00	14.71	10.95	13.73
	(1.70)	(2.56)	(1.43)	(1.48)	(2.21)	(1.24)
Uniquely statistical discrimination	71.79	60.48	68.88	64.62	51.24	61.14
	(2.38)	(4.41)	(2.11)	(2.00)	(3.53)	(1.76)

Notes: The sample size is 482. When the caste preference inferred in the dictator games contradicts the caste preference inferred from the preference ranking of doctors in the field experiment, preference ranking consistent with taste-based discrimination is reclassified as consistent with statistical discrimination. Preference rankings consistent with both theories are weighted twice as much as those uniquely statistical when weights are applied. Standard errors are reported in parentheses.