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First Impression Biases in the Performing Arts: Taste-Based Discrimination and the Value of Blind Auditioning

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Abstract

I develop a game-theoretic framework to study the repercussions of an evaluator's bias against a specific group of applicants. The evaluator decides upfront between holding an informed or a blind audition. In the latter, the evaluator learns neither the applicant's ability nor the gender. I show that, above a threshold bias, the evaluator prefers a blind audition to provide high effort incentives exclusively for high-ability applicants. Consequently, committing to no information can be beneficial for the evaluator. I also show that a highly biased evaluator's preferences align with those of a highly able female. The introduction of performance uncertainty may lead to market failure or may render informed auditions more profitable, rationalising ability-targeting interventions. My results can explain why blind auditions have increased the probability of women being hired via taste-based discrimination and challenge explanations grounded in statistical discrimination.

Keywords: first impression, bias, blind audition, taste-based discrimination, performance uncertainty.

JEL Codes: C70, D81, D86, D91, J16, J71.

1 Introduction

"I've been in auditions without screens, and I can assure you that I was prejudiced. I began to listen with my eyes, and there is no way that your eyes don't affect your judgment. The only true way to listen is with your ears and your heart."

– Julie Landsman in Gladwell, *Blink: The Power of Thinking Without Thinking*

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Auditions are common practice in the performing arts to hire the best candidate. The evaluator, who makes the hiring decision, chooses upfront between two audition forms. If *informed*, the evaluator requires applicants to submit information prior to the audition. This often takes the form of a CV which contains valuable information about ability. One proxy for ability is the school an applicant went to, such as Juilliard, which leads the evaluator's belief about her ability to increase. A CV, however, also contains irrelevant information about gender or race. This may result in *first impression biases* which discount more relevant information obtained at a later stage (Thorngate et al., 2010). If *blind*, the evaluator receives no information and, because the evaluator cannot see the applicant during her performance, the hiring decision is based purely on sound. Given the audition form, the applicant decides whether to participate and how much effort to invest in preparing a performance. Importantly, this sequential decision-making of the potentially biased evaluator and the applicant allows the audition form to affect effort incentives.

In this paper, I analyse the repercussions of the evaluator's bias against a specific group of applicants. I examine whether, and under which conditions, it can be rational for the evaluator to commit to ignore supplementary information about an applicant to avoid misleading first impressions. I ask whether the move to a blind audition can lead to better candidates being hired; in essence, can a blind audition provide better effort incentives exclusively for highly able applicants?

I address the two polarised views on the use of blind auditions to hire the best candidate. Proponents argue that blind auditions have helped evaluators avoid misleading first impressions (Gladwell, 2005). In fact, blind auditions have often been marketed as a fairer form of audition and equal opportunity policy (Karl Schiebler in The Economist, 1996).[1] Opponents fear that, while avoiding bias, the evaluator loses valuable information that can screen applicants by ability (Blasko in Makoff-Clark, 2019). Consequently, top talent may be lost in an increasingly large applicant pool and standards of fairness may even deteriorate (Holland, 1981). My contribution is to show that the two polarised views are not mutually exclusive. I argue that a blind audition comes with a fundamental trade-off: it grants impartiality to the evaluator but may prohibit the screening of applicants by ability. My second contribution lies in providing a theoretical explanation for Goldin and Rouse's (2000) finding that the use of blind auditions in U.S. orchestras has lead to a severalfold increase in the probability that a female will be hired.

I develop a game-theoretic framework in which the evaluator is biased against females and his bias is common knowledge. The evaluator commits to a blind or an informed audition given an exogenously determined wage. He always fills the position with an applicant or a random outside option. His revenue is determined by performance quality and ability whereas the applicant cares only about being hired. In the baseline model, effort maps one-to-one into performance quality. In a generalisation, I allow for moral hazard by considering a setting where low effort can result in low or high performance quality. I focus on a gender bias and frequently use the context of an orchestra

[1] John de Mol, the creator of the singing competition "The Voice", for example, argues that the TV show's blind auditions allow the judges to focus on quality alone and identify genuine singing talent (Universal Music Group, 2011).

to build intuition. However, my framework pertains to a broader range of contexts in which the evaluator requires the applicant to prepare a project for review, and possibly submit additional information susceptible to bias, before deciding upon acceptance. In particular, technology companies like 'GapJumpers' (Cain Miller, 2016) or 'Applied' (Glazebrook, 2019) allow firms to implement blind hiring through software that withholds personal information. Academia may be another application if blind auditioning can help to address the lower success rates of female applicants for funding schemes such as ERC grants (Vernos, 2013).[2]

My main result is that there exists a threshold bias above which the evaluator prefers a blind audition to provide *targeted effort incentives*: high effort incentives for highly able applicants while low-ability applicants do not participate. Consequently, committing to no information can be beneficial for the evaluator. Moreover, above the threshold bias, equal opportunity and targeted effort incentives are complementary objectives: there is no trade-off between implementing blind auditions as a policy to counteract first impression biases and efficiency due to adverse effects on targeted effort provision. If anything, the implementation of equal opportunity is effort-enhancing for high-ability applicants above this threshold. Perhaps surprisingly, the preferences of a highly biased evaluator align with the preferences of high-ability females: a blind audition provides targeted effort incentives and, as a side effect, plays out in favour of high-ability females, as they prefer to conceal their gender. My model sheds light on the forces underlying the empirical findings on the use of blind auditions and shows that the gains from being able to conceal one's gender need not be uniform. For a low bias, the gains from moving to a blind audition accrue to low-ability females. If the bias is high, the gains accrue to high-ability females.

I show in a generalisation that a blind audition cannot provide targeted effort incentives if performance uncertainty exceeds some threshold. Consequently, for a highly biased evaluator, a blind audition is no longer guaranteed to be more profitable than an informed audition. Moreover, there is the sizeable risk of market failure: for certain parameter combinations, neither a blind nor an informed audition is profitable and the evaluator might not want to hold an audition at all. Interventions that ensure the applicant pool to be of sufficiently high ability under performance uncertainty guarantee the profitability of a blind audition when the evaluator is highly biased and avoid market failure.

1.1 Related Literature

My paper relates to several strands of literature. I draw upon the literature on cognitive biases: I argue that the evaluator in an informed audition is likely subject to different types of biases which may be summarised in a reduced-form parameter. One potential driver is intergroup bias: the evaluator may judge members of his own group more favourably (Hewstone et al., 2002; Anwar, 2012;

[2]The act of withholding applicants' names may already have a significant effect. See Bertrand and Mullainathan (2004) for an experiment in which CVs are randomly assigned African-American- or White-sounding names. For an example of name-blind hiring, see the UK Civil Cervice (Manzoni, 2015).

Bagues and Perez-Villadoniga, 2012). In orchestras, gender associations with instruments may drive bias (Abeles, 2009; Stronsick et al., 2018; Sergeant and Himonides, 2019). A third potential driver is due to interaction effects of gender and race: in experimental judging sessions, videotaped males tend to score lowest among black performers; females lowest among whites (Elliott, 1995). Extraneous factors warrant the modelling of bias in performance evaluation. This can be as subtle as the strength of the applicant's handshake at the audition if this opening ritual influences the evaluator's belief about her character strength.[3] Other examples are attractiveness or accent (Purkiss et al., 2006).[4]

I draw upon contract theory by assuming verifiable disclosure (Milgrom, 1981; Grossman, 1981): in an informed audition the applicant cannot misrepresent her gender nor ability on her CV. Conversely, the evaluator cannot commit to cherry-pick relevant information. Effort incentives are, therefore, influenced by the evaluator's bias via his hiring rule. This feature is similar to implicit incentives arising in a dynamic setting (Meyer and Vickers, 1997). The evaluator has a menu of audition forms available to hire the best candidate and, given his commonly known bias, needs to choose the optimal form (Laffont and Tirole, 1986). Moreover, the blind audition is akin to a signalling model à la Spence (1973) as the applicant's effort decision may be informative about the ability dimension of her type while gender cannot be signalled.

My paper builds on literature in the economics of discrimination. One theoretical explanation for the association of blind auditions with an increased probability of hiring females is a model of statistical discrimination (Taylor and Yildirim, 2011): the applicant is endowed with a one-dimensional type that reflects her true ability. There is no room for the evaluator to respond in a biased way to irrelevant information. However, "the possibility of psychological bias on the part of the evaluator and the role of blind [auditions] in mitigating prejudice" (ibid., p.786) is suggested as an important avenue for future research. With this paper, I fill the gap: I argue that a CV is best modelled as a composite of valuable information about ability and irrelevant information. This may trigger misleading first impressions on part of the evaluator and may prevent him from hiring the best candidate. I provide a model of taste-based discrimination (Becker, 1971): for the same level of ability, females and males are equally productive. This assumption stresses that prejudices against female musicians (Seltzer, 1989), social attitudes (Allmendinger and Hackman, 1995) and self-identity (Starr, 1974) are key in explaining the findings of Goldin and Rouse (2000). In Taylor and Yildirim's (2011) commitment benchmark, the evaluator is forced to reject performances that he knows to be of high quality with positive probability in order to provide effort incentives. Such a trade-off at the high end of the quality spectrum does not arise in my informed audition; rather, applicants with low ability may be screened. Moreover, in their blind audition, the evaluator uses a uniform acceptance threshold. My blind audition, in contrast, allows for signalling concerns: a

[3]In particular, "[b]ecause men tend to have greater upper body strength than do women, a male's handshake is likely to be firmer than a female's handshake". As a result, "if the [evaluator] shakes a woman's hand, it is more likely the shake will fail the [evaluator]'s character test", leading him to discount more relevant information obtained from the female's subsequent performance (Thorngate et al., 2010, p.51).

[4]There is evidence for a vision heuristic: evaluators consistently report to value sound as central in performance. However, they select different winners if they have visual information about the applicant (Tsay, 2013).

uniform threshold only arises when applicants pool on high effort, and highlights that the greater realism of my assumptions also allows for new predictions.

Under statistical discrimination (Taylor and Yildirim, 2011), if the applicant pool is of mainly high ability, the evaluator prefers a blind audition because assessing performance quality is less important than providing effort incentives. If the applicant pool is of predominantly low ability, the evaluator prefers an informed audition as selecting high-quality performances is crucial. Taste-based discrimination, in contrast, allows for richer predictions: if there is little bias and the applicant pool is highly able, a blind audition attracts low-ability applicants rather than providing targeted effort incentives. For a high bias, the evaluator prefers a blind audition irrespective of the applicant pool's ability composition. Under statistical discrimination (ibid.), if the signal of performance quality is very precise, the evaluator prefers a blind audition as the incremental information from observing ability is low; if very imprecise, he prefers an informed audition as observing ability has a large incremental informational value. My model, in contrast, makes more nuanced predictions about the effect of performance uncertainty: if there is little bias, informed auditions are preferred irrespective of the degree of performance uncertainty. If the bias is high and performance uncertainty is above a threshold, the ability composition of the applicant pool matters for the evaluator's preferences. For a very low prior about ability, it is paramount to include ability in the hiring policy. While blind auditions provide better effort incentives for the highly able, these types are rather infrequent. For a sufficiently high prior, high effort incentives for the highly able are paramount, making blind auditions preferable.

The remainder of this paper is structured as follows. Section 2 sets out preliminaries common to both auditions. In Section 3 and Section 4, I solve for, and characterise, equilibrium in the informed and blind audition. Section 5 details my main results on the evaluator's and applicant's audition preferences. In Section 6, I introduce asymmetric uncertainty. In Section 7, I briefly highlight the agency cost in the two audition forms. I conclude with avenues for further research in Section 8.

2 Preliminaries

In this section, I set out the timing, preferences of players, simplifying assumptions regarding the performance outcome and solution concepts. Unless stated, all assumptions introduced in this section hold throughout the remainder of this paper.

2.1 Timing

Two risk neutral parties, an applicant (she) and an evaluator (he) play a three-stage game.

In the first stage, the evaluator commits to a blind or an informed audition given an exogenously determined wage w. If the audition is informed, the evaluator learns the applicant's type $\theta := (\eta, g)$, where $\eta \in \{\eta_L, \eta_H\} := \{1, 2\}$ is ability and $g \in \{m, f\} := \{0, 1\}$ is gender. If the audition is blind, the evaluator does not learn the applicant's type. He only knows the type distribution: the applicant is female or male with equal probability and the applicant is of high ability with $\Pr(\eta_H) \coloneqq p \in (0, 1)$. It is common knowledge that ability and gender are independent.

In the second stage, the applicant moves, knowing her type and whether it is a blind or informed audition. She chooses how much costly effort to invest in preparing a performance, where effort $e \in \{e_L, e_H\} \coloneqq \{1, 2\}$ can be low or high and effort costs are $c(e)$. There is an outside option O for the applicant that yields a zero payoff.

In the third stage, the applicant delivers her performance. It can turn out to be of low or high quality; that is, $q \in \{q_L, q_H\} \coloneqq \{1, 2\}$. The evaluator makes the hiring decision based on type θ (i.e. ability and gender) and performance quality q if the audition is informed, and based on performance quality q alone if the audition is blind.[5] In either audition form, the evaluator has a random outside option $\bar{U}$, which he can revert to instead of hiring the applicant.

2.2 Preferences of Players

The evaluator is assumed to be biased against female applicants. This is represented in form of a bias parameter $\beta \in [0, 2]$ which is common knowledge in either audition form. I formalise the evaluator's preferences with a gross utility function consisting of two parts:

$$V(q, \eta, g) = f(q, \eta) - \beta g = q + \eta - \beta g. \tag{1}$$

The first part $f(q, \eta) = q + \eta$ is a production function.[6] The evaluator, therefore, prefers to hire an applicant who is of high ability and delivers a high-quality performance in stage 3. In particular, given the applicant's ability η, which the evaluator may learn in stage 1, and her performance quality q, always observed in stage 3, the evaluator earns revenue $f(q, \eta)$ by hiring the applicant. The assumption that performance quality and ability jointly determine revenue may be justified if $f(q, \eta)$ is regarded more broadly as an applicant's marketable talent, consisting of an endogenous component q and an exogenous component η.[7] The inclusion of ability allows for revenue-generating reputation effects from hiring highly able star soloists[8] that have been shown to attract fans (Hart, 1973, p. 390) and additional single-ticket buyers (Kamakura and Schimmel, 2013). Furthermore, the functional form of $f(q, \eta)$ implies that males and females are perfect substitutes in production: gender does not enter. The second part βg captures the evaluator's bias against female applicants.[9]

[5] An alternative interpretation of the game involves two evaluators: the senior management with a zero bias chooses the audition form in stage 1; the evaluator with a possibly non-zero bias chooses whom to hire in stage 3.

[6] Under a multiplicative form of the production function, $f(q, \eta) = q\eta$, most of the results remain qualitatively unchanged. The proofs are available on request.

[7] See Tsay and Banaji (2011) for the two sources of talent and how they are perceived by expert decision-makers: "naturals" are characterised by early evidence of high innate ability; "strivers" by high motivation and perseverance.

[8] See also the economics literature on the phenomenon of superstars (Adler, 1985; Rosen, 1981).

[9] This form of the utility function is inspired by (Becker, 1971, chapter 3, p.39): an employer has a taste parameter d ("coefficient of discrimination") so that the wage of a member of the minority group N is effectively $w_N + d$.

Assumption 1. $w \coloneqq \mathbb{E}[\bar{U}] = w_g = w_{\bar{U}}$ *for* $g \in \{m, f\}$.

Importantly, the gross utility function (1) does not include wages. This is because w is the same for each applicant and the outside option, and is exogenously determined. Assumption 1 is in line with orchestras' practice to specify a base pay according to which positions are remunerated, making wages independent of the audition form.[10] Furthermore, fixing the wage at the expected value of the outside option captures that trade unions tend to be integrated in the setting of the base pay to performers (Towse, 2010): the base pay reflects the market value of the outside option ex-ante and is the evaluator's maximum willingness-to-pay when negotiating with unions. Given Assumption 1, I can abstract from wages in the evaluator's utility function. Wage costs are sunk and do not affect his hiring decision in stage 3. Later, I will refer to the evaluator's utility net of wage costs as Π.

Assumption 2. $\bar{U} \sim \mathcal{U}[2-\beta, 4]$.

The evaluator always fills the position by either hiring the applicant or a uniformly distributed outside option. Intuitively, as concert schedules are planned far in advance, ticket sales tend to start months before the performances and orchestral parts need to be acquired and allocated prior to rehearsals (Towse, 2010, chap. 8), the evaluator is unlikely to leave a position unfilled. The value of $\bar{U}$ is unknown to the evaluator when making the hiring decision. The bounds on the outside option may be justified if $\bar{U}$ is thought of as the possibility to engage a substitute from an agency. This agency randomly provides the evaluator with the same four types who then choose effort $e \in \{e_L, e_H\}$ nonstrategically. A substitute, therefore, generates gross utility of at least $2 - \beta$ if she is of type $\theta = (\eta_L, f)$ and exerts low effort. A substitute generates at most 4 if he is of type $\theta = (\eta_H, m)$ and exerts high effort. Because the evaluator cannot contract upon the substitute's type and effort choice with the agency, $\bar{U}$ is essentially a gamble that may turn out to be better or worse than the applicant considered in stage 3 of the game. Given this interpretation, a greater bias against female applicants naturally reduces the minimum value of the outside option. In fact, the outside option may turn out to be of no value to a maximally biased evaluator.

The evaluator faces four types of applicants in this game, $\Theta = \{(\eta_L, m), (\eta_H, m), (\eta_L, f), (\eta_H, f)\}$. The applicant, whether of low or high ability, female or male, wants to be hired to receive a wage w net of effort costs. In particular, by choosing $e \in \{e_L, e_H\}$ she maximises her expected utility, taking into account how her effort choice influences the probability of being hired via its effect on performance quality:

$$U(e, \eta, g) = \Pr(\text{hired}|\cdot)w - \frac{e^2}{2\eta}. \tag{2}$$

In an informed audition, the hiring probability depends on performance quality, gender and ability; that is, $\Pr(\text{hired}|q, \eta, g)$. In a blind audition, in contrast, the hiring probability never directly

[10] In the UK, for example, employment agreements are negotiated by the Musicians' Union (n.d.) and applicable to members employed with mayor orchestras. The assumption also eliminates the screening aspect that wage setting would otherwise have in stage 1. In particular, endogenising wages would make a blind audition preferable even for an unbiased evaluator due to significant wage savings. Furthermore, the evaluator would then be best off setting $w = 0$, always hiring the outside option because $\bar{U}$ does not respond to incentives in this model.

depends on gender or ability; that is, Pr(hired$|q$). The applicant's effort costs are given by $c(e) = \frac{e^2}{2\eta}$. Thus, ability determines the marginal cost of exerting high rather than low effort, with high ability corresponding to lower marginal costs. The applicant receives a zero payoff if she is not hired and her outside option gives zero utility.

2.3 Performance Outcome and Solution Concept

In the baseline model, I focus on the interaction of the strength of the evaluator's bias and the information structure of the audition.

Assumption 3. $\Pr(q_i|e_i) = 1$ *for* $i \in \{L, H\}$.

Assumption 3 abstracts from any moral hazard considerations: effort maps one-to-one into performance quality, so can be perfectly inferred by the evaluator. In Section 6, I relax this assumption and allow for moral hazard by considering a setting where low effort can result in low or high performance quality. Given Assumption 3, an informed audition is a game of complete information, and the solution concept is backward induction. A blind audition is a game of incomplete information, and the solution concept is perfect Bayesian equilibrium, refined by the D1-Criterion when necessary.

3 Informed Audition

If the evaluator has committed to an informed audition, stage 2 and 3 are a game of complete information with four proper subgames, one for each applicant type. Appendix A(a) represents this game graphically.

3.1 Hiring Decision of Evaluator

The evaluator compares the utility from hiring the applicant to the value from hiring the outside option. Therefore, he hires the applicant in stage 3 with probability

$$\Pr(\text{hired}|q,\eta,g) := \Pr(\bar{U} \leq V(q,\eta,g)) = \frac{V(q,\eta,g) - (2-\beta)}{4-(2-\beta)} = \frac{q+\eta+\beta(1-g)-2}{2+\beta}. \tag{3}$$

Given Assumption 3 and the hiring rule (3), there are eight possible hiring probabilities in an informed audition:

$$\Pr(h|q_L,\eta_L,f) = 0, \qquad \Pr(h|q_L,\eta_L,m) = \frac{\beta}{2+\beta},$$

$$\Pr(h|q_H,\eta_L,f) = \Pr(h|q_L,\eta_H,f) = \frac{1}{2+\beta}, \qquad \Pr(h|q_H,\eta_L,m) = \Pr(h|q_L,\eta_H,m) = \frac{1+\beta}{2+\beta},$$

$$\Pr(h|q_H,\eta_H,f) = \frac{2}{2+\beta}, \qquad \Pr(h|q_H,\eta_H,m) = 1.$$

Importantly, the evaluator never hires a low-ability-low-effort female in an informed audition: by reverting to the outside option, he can never do worse but may be lucky to engage a substitute of higher ability, higher effort or different gender. On the other hand, the evaluator always hires a high-ability-high-effort male: by reverting to the outside option, the evaluator cannot do any better. The remaining hiring probabilities depend on the strength of the evaluator's bias. Intuitively, for females, the hiring probabilities are decreasing in β. For males, those are increasing in β.

3.2 Effort Decision of Applicant

Given the hiring probabilities, the applicant chooses effort to maximise her expected utility (2).

Lemma 1. *The effort responses of the four applicant types partition the evaluator's bias $\beta \in [0, 2]$ into three regions: (i) For a low bias, $\beta \in \beta^I_L \coloneqq [0, \frac{5-\sqrt{17}}{2})$, only high-ability applicants participate and exert high effort. (ii) For a moderate bias, $\beta \in \beta^I_M \coloneqq [\frac{5-\sqrt{17}}{2}, \frac{6}{5}]$, low-ability males also participate and exert low effort. (iii) For a high bias, $\beta \in \beta^I_H \coloneqq (\frac{6}{5}, 2]$, all applicants except low-ability females participate and exert low effort.*

Proof. Detailed proofs of all results are in Appendix D. □

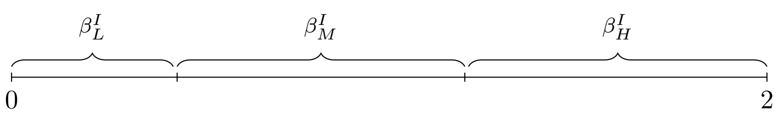


Figure 1: Partition of the evaluator's bias in an informed audition.

The partition of the evaluator's bias into three regions is illustrated in Figure 1. The low and moderate bias cover roughly 21.9 and 38.1 percent of the parameter space, respectively. The high bias is the largest interval, covering 40 percent.

3.3 Expected Utility of Evaluator

The evaluator's prior is that the applicant is equally likely to be a female or male when committing to the audition form. Furthermore, he knows that the applicant is of high ability with probability $p \in (0, 1)$, and that ability is independent of gender. Hence, all four proper subgames are reached with nonzero probability and are, thus, relevant when deriving the evaluator's expected net utility for different values of β.

Proposition 1. *(i) Suppose $\beta \in \beta^I_L$ where β^I_L is defined as in Lemma 1(i). Then,*

$$\mathbb{E}[\Pi_I | \beta \in \beta^I_L] \coloneqq \mathbb{E}[V | \beta \in \beta^I_L] - w = \frac{p}{2}\left[\frac{2}{2+\beta}\left(1 - \frac{\beta}{2}\right) + \left(1 + \frac{\beta}{2}\right)\right] > 0. \tag{4}$$

(ii) Suppose $\beta \in \beta^I_M$ where β^I_M is defined as in Lemma 1(ii). Then,

$$\begin{aligned}\mathbb{E}[\Pi_I|\beta \in \beta^I_M] &\coloneqq \mathbb{E}[V|\beta \in \beta^I_M] - w \\ &= \frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right] + \frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right) + \left(1+\frac{\beta}{2}\right)\right] \gtrless 0.\end{aligned} \tag{5}$$

(iii) Suppose $\beta \in \beta^I_H$ where β^I_H is defined as in Lemma 1(iii). Then,

$$\begin{aligned}\mathbb{E}[\Pi_I|\beta \in \beta^I_H] &\coloneqq \mathbb{E}[V|\beta \in \beta^I_H] - w \\ &= \frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right] + \frac{p}{2}\left[\frac{1}{2+\beta}\left(-\frac{\beta}{2}\right) + \frac{1+\beta}{2+\beta}\left(\frac{\beta}{2}\right)\right] \gtrless 0.\end{aligned} \tag{6}$$

If the evaluator's bias is low, he breaks even in subgame (η_L, f) and (η_L, m), and expects positive net utility in subgame (η_H, f) and (η_H, m). Intuitively, when the evaluator is almost impartial, requiring a CV acts as an effective means to screen applicants by ability and to provide targeted effort incentives: high effort incentives exclusively for high-ability applicants while low-ability applicants do not participate. If the bias is moderate, the evaluator instead expects negative net utility in subgame (η_L, m) as low-ability males exert low effort rather than dropping out. Low-ability males essentially exploit the evaluator's bias: when they know the bias to be moderate, the probability of being hired conditional on exerting low effort and identifying themselves as male is sufficiently high to make the cost of low effort worthwhile. If the evaluator is highly biased, he also expects negative net utility in subgame (η_H, f). Intuitively, when high-ability females know the evaluator's bias to be substantial, the marginal cost from putting in high rather than low effort outweighs the marginal benefit from being hired more often. They are deterred from exerting high effort at such a high bias.[11] Moreover, high-ability males rest on their laurels and have little incentive to exert high effort. Their benefit from exploiting the bias and being able to identify themselves as male makes the increase in cost from exerting high rather than low effort not worthwhile.

Proposition 1 highlights the role of ability. For a low bias, the evaluator's expected net utility (4) is increasing in the prior that the applicant is of high ability. An increasingly able applicant pool makes it more likely that the evaluator faces the profitable subgame (η_H, f) or (η_H, m) relative to the subgames in which he breaks even with the outside option. For a moderate bias, the increase in the evaluator's expected net utility (5) is more pronounced: as subgame (η_L, m) becomes less likely, the evaluator is able to avoid the losses from potentially hiring low-ability males who participate in the audition. For a high bias, the increase in the evaluator's expected net utility (6) is more attenuated: as p increases, the evaluator faces both the unprofitable subgame (η_H, f) and the profitable subgame (η_H, m) more often.

[11] The mechanism is similar to stereotype threats (Günther et al., 2010).

4 Blind Audition

In a blind audition, the evaluator does not learn the applicant's type θ in stage 1. He only observes her performance quality q in stage 3. Thus, there are no proper subgames but two information sets: q_L and q_H. Each information set contains four nodes when the evaluator has to make the hiring decision in stage 3. Because these information sets are non-singletons, stage 2 and 3 in a blind audition are a game of incomplete information. Therefore, I specify beliefs for the evaluator: a probability distribution over the nodes in both q_L and q_H. Intuitively, this probability distribution constitutes the evaluator's revised beliefs how likely it is, upon hearing a low- or high-quality performance, that he is facing a particular applicant type behind the curtain. In what follows, I focus on the case when the bias is either sufficiently low to induce all applicants to exert high effort or sufficiently high to induce only the highly able to exert high effort.[12] I refer to the former case as pooling and the latter case as separating. Appendix A(b) represents this game graphically.

4.1 Pooling Equilibrium

Suppose the evaluator's bias is sufficiently low to induce all applicants to exert high effort. However, when observing a low performance quality off the equilibrium path, the evaluator believes the applicant to be of low ability. Upon observing a low-quality performance, the evaluator can, therefore, infer the applicant's ability from her action and expects gross utility

$$\mathbb{E}[V|q_L] = q_L + 1 - \frac{\beta}{2} = 2 - \frac{\beta}{2}$$

from hiring the applicant.[13] Upon observing a high-quality performance, the evaluator cannot infer the applicant's ability and holds a belief that is equal to his prior. He expects gross utility

$$\mathbb{E}[V|q_H] = q_H + \mathbb{E}[\eta|q_H] - \frac{\beta}{2} = 2 + [(1-p) + 2p] - \frac{\beta}{2} = 3 + p - \frac{\beta}{2}$$

from hiring the applicant. The evaluator compares the expected utility from hiring the applicant to the value from hiring the outside option. Therefore, he hires the applicant at each information set with probability

$$\Pr(\text{hired}|q) \coloneqq \Pr(\bar{U} \leq \mathbb{E}[V|q]) = \frac{\mathbb{E}[V|q] - (2-\beta)}{4 - (2-\beta)} = \frac{q + \mathbb{E}[\eta|q] - \frac{\beta}{2} - (2-\beta)}{2+\beta}. \tag{7}$$

[12] I do not consider applicants pooling on low effort as my focus is on whether, and under which conditions, blind auditions can be superior. To see why this can never obtain in a low-effort pooling equilibrium, compare it to the worst-case scenario in an informed audition; that is, for $\beta \in \beta_H^I$, all applicants except low-ability females exert low effort. This scenario gives the evaluator still a higher payoff because attracting low-ability-low-effort females is never profitable. The evaluator could have broken even with the outside option and, therefore, is worse off.

[13] The evaluator cannot infer gender in a pooling or separating blind audition because, with η fixed, females and males have the same payoff structure. In effect, the evaluator now faces only two applicant types, η_L and η_H.

Given Assumption 3 and the hiring rule (7), there are two possible hiring probabilities for both female and male applicants:

$$\Pr(h|q_L) = \Pr\left(\bar{U} \leq 2 - \frac{\beta}{2}\right) = \frac{\beta}{4+2\beta},$$
$$\Pr(h|q_H) = \Pr\left(\bar{U} \leq 3 + p - \frac{\beta}{2}\right) = \frac{2(1+p)+\beta}{4+2\beta}.$$

Compared to an informed audition, female and male applicants now face the same hiring probabilities as the evaluator cannot bias gender. Similarly, high- and low-ability applicants face the same hiring probabilities as they cannot identify themselves in a pooling blind audition. Furthermore, an increasingly skilled applicant pool raises the evaluator's expected revenue from hiring at q_H. Hence, he finds it optimal to hire more often at this information set.

4.1.1 Effort Decision of Applicant

Given the two hiring probabilities, the applicant chooses effort to maximise her expected utility (2). I now show that the prior determines whether a high-effort pooling equilibrium can be supported, and that p places an upper bound on the evaluator's bias in any such pooling equilibrium. I define $\beta(p) \coloneqq \{\beta : U(e_H, \eta_L) = 0\}$.

Lemma 2. *(i) For $p < \frac{1}{3}$, no high-effort pooling equilibrium exists. (ii) For $p = \frac{1}{3}$, a high-effort pooling equilibrium exists if the evaluator is unbiased. (iii) For $\frac{1}{3} < p < 1$, a high-effort pooling equilibrium exists if $\beta \in \beta_L^B \coloneqq [0, \beta(p)]$, where $\beta'(p) > 0$. As $p \uparrow 1$, the upper bound on the pooling equilibrium $\beta(p)$ approaches the infimum beyond which a separating equilibrium exists (Lemma 3).*

With the observation that it is always optimal for high-ability applicants to exert high effort if it is optimal for low-ability applicants to exert high effort, pooling on high effort is possible if the prior that the applicant is of high ability is sufficiently large and the evaluator's bias is not too high. Furthermore, an increasingly able applicant pool makes it easier for for the fewer low-ability to hide behind the more-and-more high-ability applicants.

4.1.2 Expected Utility of Evaluator

While the evaluator does not learn the applicant's type, the applicant's payoff structure is common knowledge. In particular, for the evaluator's q_H-belief that all applicants exert high effort to be consistent with the applicants' effort decision, he needs to have a sufficiently low bias.

Proposition 2. *Suppose $\beta \in \beta_L^B$ with $\frac{1}{3} \leq p < 1$ where β_L^B is defined as in Lemma 2. Then,*

$$\mathbb{E}[\Pi_B | \beta \in \beta_L^B] \coloneqq \mathbb{E}[V | \beta \in \beta_L^B] - w = p\frac{2(1+p)+\beta}{4+2\beta} > 0. \tag{8}$$

The evaluator's expected net utility (8) is increasing in the prior that the applicant is of high ability because, ceteris paribus, an increasingly skilled applicant pool raises the evaluator's expected revenue from hiring in a pooling blind audition. Intuitively, the revised belief of the evaluator upon observing a high-quality performance takes into account that it is ex-ante more likely to face a high-ability female or a high-ability male behind the curtain.

4.2 Separating Equilibrium

Suppose the evaluator's bias is sufficiently high that only high-ability applicants exert high effort. As before, the evaluator believes the applicant to be of low ability when observing a low performance quality. Therefore, the evaluator has degenerate posterior beliefs at both information sets. Upon observing a low-quality performance, he holds the belief that the applicant is of low ability with probability one, and male or female with equal probability. Upon observing a high-quality performance, he believes the applicant to be of high ability with probability one, and male or female with equal probability. At q_L, the evaluator's expected gross utility $\mathbb{E}[V|q_L] = 2 - \frac{\beta}{2}$ from hiring the applicant is unchanged. At q_H, the evaluator can now infer the applicant's ability from her action and expects gross utility

$$\mathbb{E}[V|q_H] = q_H + 2 - \frac{\beta}{2} = 4 - \frac{\beta}{2}$$

from hiring the applicant. As before, the evaluator compares the expected utility from hiring the applicant to the value from hiring the outside option. Given Assumption 3 and the hiring rule (7), there are two possible hiring probabilities for both female and male applicants:

$$\Pr(h|q_L) = \Pr\left(\bar{U} \leq 2 - \frac{\beta}{2}\right) = \frac{\beta}{4 + 2\beta},$$
$$\Pr(h|q_H) = \Pr\left(\bar{U} \leq 4 - \frac{\beta}{2}\right) = \frac{4 + \beta}{4 + 2\beta}.$$

4.2.1 Effort Decision of Applicant

Given the two hiring probabilities, the applicant chooses effort to maximise her expected utility (2).

Lemma 3. *For $\beta \in \beta_H^B := (\sqrt{17} - 3, 2)$, a separating equilibrium exists in which only high-ability applicants exert high effort and low-ability applicants do not participate.*

Separation is possible if the bias is sufficiently high so that it is too costly for low-ability applicants to participate. Moreover, for $\beta < 2$, the outside option dominates low effort for low-ability applicants. For $\beta \leq 2$, high effort dominates low effort for high-ability applicants.

4.2.2 Expected Utility of Evaluator

For the evaluator's q_H-belief that only high-ability applicants exert high effort to be consistent with the applicants' effort decision, he needs to have a sufficiently high bias. In this case, low-ability applicants do not participate and q_L is not reached. Therefore, the evaluator's belief at this information set is not determined by the applicant's equilibrium play. I provide a robustness check in Appendix C: two refinements based on either deviation payoffs or the D1-Criterion show that the evaluator's belief that the applicant is of low ability when observing a deviation to q_L constitutes a reasonable restriction.

Proposition 3. *Suppose $\beta \in \beta_H^B$ where β_H^B is defined as in Lemma 3. Then,*

$$\mathbb{E}[\Pi_B|\beta \in \beta_H^B] := \mathbb{E}[V|\beta \in \beta_H^B] - w = p\frac{4+\beta}{4+2\beta} > 0. \tag{9}$$

As before, the evaluator's expected net utility (9) is increasing in the prior that the applicant is of high ability. However, the channel through which an increase in the prior leads to an increase in the evaluator's profit is less pronounced. This is because, in a pooling blind audition, an increase in the prior also implied a reduction in the probability that, upon observing a high-quality performance, the evaluator faced a low-ability female or low-ability male behind the curtain.

5 Comparison of Auditions

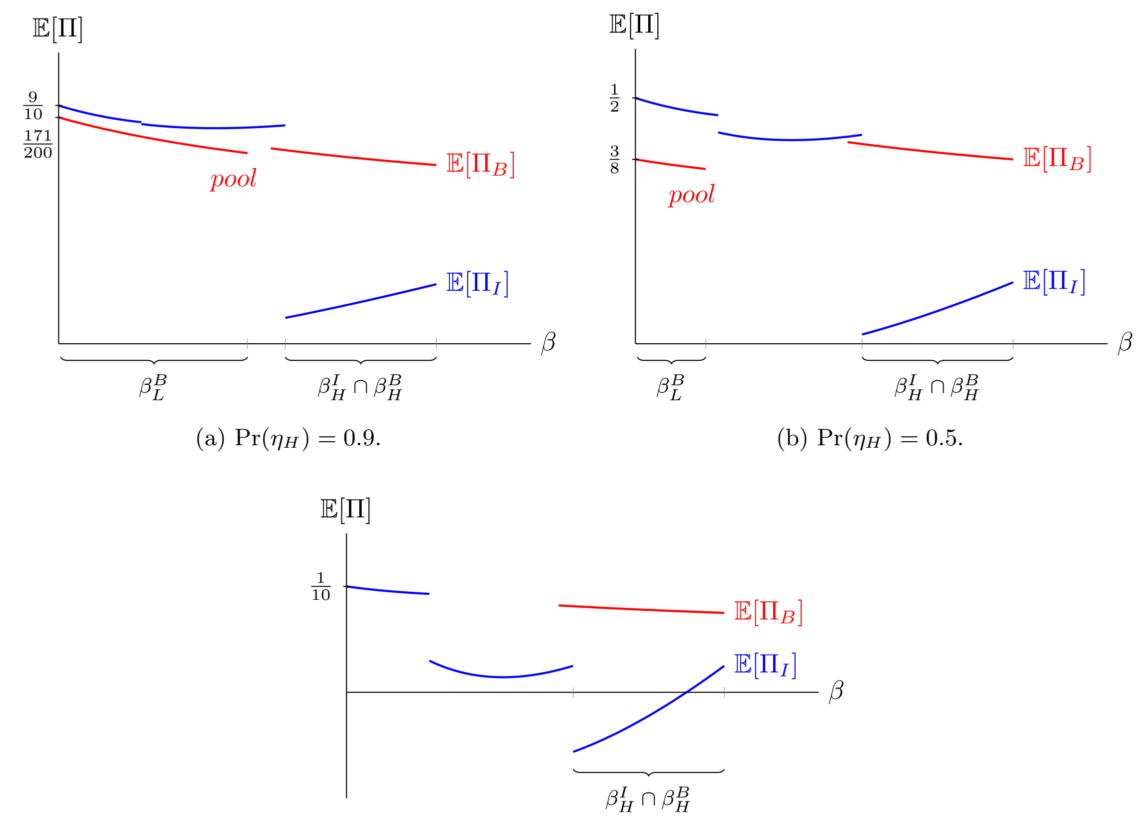
Having discussed the evaluator's net utility in both audition forms, I can conclude under which conditions on the bias and the prior the evaluator prefers a blind or informed audition to maximise his expected net utility.

Theorem 1. *(i) For $\frac{1}{3} \leq p < 1$, if the evaluator's bias against female applicants is low, $\beta \in \beta_L^B$, he prefers an informed audition over a pooling blind audition. (ii) For $0 < p < 1$, if the evaluator's bias against female applicants is high, $\beta \in \beta_H^I \cap \beta_H^B$, he prefers a separating blind audition. (iii) For $0 < p < \frac{2-\beta}{2}$, if the evaluator's bias against female applicants is moderate, $\beta \in \beta_M^I \cap \beta_H^B$, he prefers a separating blind audition. (iv) For $\frac{2-\beta}{2} < p < 1$, if the evaluator's bias against female applicants is moderate, $\beta \in \beta_M^I \cap \beta_H^B$, he prefers an informed audition.*

Theorem 1 details my main result on the evaluator's audition preferences: there exists a threshold bias above which the evaluator is better off having no information about the applicant's type. In this case, a blind audition provides targeted effort incentives. In an informed audition, in contrast, the evaluator's bias would distort effort incentives: all applicants except low-ability females would exert low effort. Consequently, committing to no information can be beneficial for the evaluator. This prediction of my model echoes the insight of Gladwell (2005) regarding first impression biases: "by fixing the first impression at the heart of the audition - by judging purely on the basis of ability - orchestras now hire better musicians, and better musicians mean better music" (p.253).

Conversely, the evaluator is better off having more information if his bias against female applicants is low. An informed audition allows him to attract a pool of exclusively high-ability applicants.

Moving to a blind audition would also induce low-ability applicants to participate and exert high effort if the evaluator's prior is sufficiently high (Figure 2a and Figure 2b). Moreover, a blind audition would prevent the evaluator from discriminating between applicants of different characteristics: when all exert high effort, the evaluator has no means of distinguishing them behind the curtain. Specifically, he can no longer hire a high-ability-high-effort male with probability one. However, reverting to the outside option with positive probability when high-ability males exert high effort can only make the evaluator worse off due to the upper bound on $\bar{U}$. This prediction of my model is in line with Holland (1981) observing that "equal opportunity has unloosed such an avalanche of auditionees that standards of selection and fairness are sometimes actually lowered" and that "[a]s a result, top talent is sometimes lost in the shuffle".



(a) $\Pr(\eta_H) = 0.9$.

(b) $\Pr(\eta_H) = 0.5$.

(c) $\Pr(\eta_H) = 0.1$.

Figure 2: Evaluator's expected net utility in a blind and informed audition.

For a small range of moderate biases, $\beta \in \beta_M^I \cap \beta_H^B$, both a blind and informed audition provide high effort incentives for high-ability applicants. However, the evaluator faces the distortion that an informed audition also attracts low-ability males, who exert only low effort. The prior determines the size of the loss from potentially hiring those types and, thus, whether the evaluator may be better off in a separating blind audition. First, for a range of priors from $\frac{2}{5}$ to $\frac{5-\sqrt{17}}{2}$, the evaluator's preferences over auditions are non-monotonic in his bias (Figure 3). Intuitively, this is because equation (5) is upward-sloping whereas equation (9) is downward-sloping on the interval $\beta^I_M \cap \beta^B_H$. However, if the applicant pool is of predominantly low ability, the evaluator always prefers a blind audition for this range of moderate biases: it is an effective means to provide targeted incentives while reaping the benefits from breaking even with the outside option (Figure 2c). The evaluator avoids substantial losses which he would have incurred in an informed audition from hiring low-ability males relatively frequently. As the applicant pool becomes increasingly able, however, this concern becomes less important. In particular, for a sufficiently high prior, the benefit from being able to hire high-ability females and high-ability males with differing probabilities outweighs the loss from potentially hiring a low-ability-low-effort male in an informed audition.

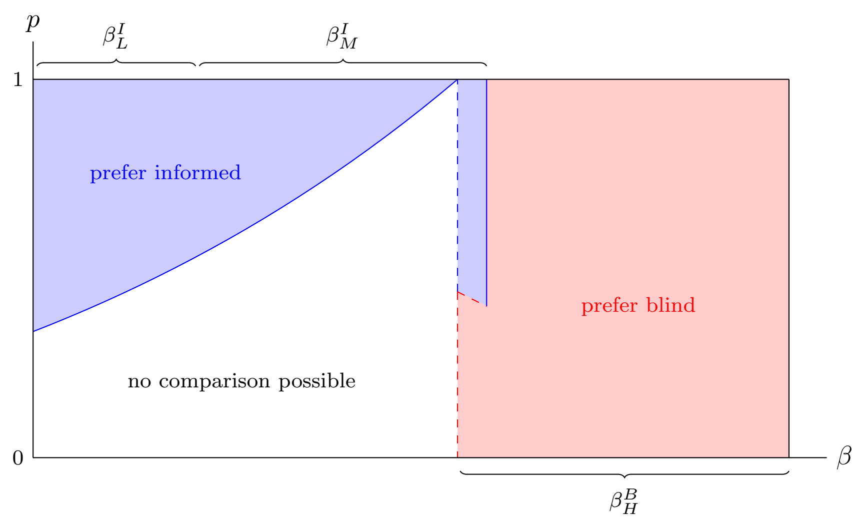


Figure 3: Evaluator's preferences over auditions for different biases and priors.

To gain some intuition behind the evaluator's distribution of preferences, suppose that the bias and the prior on high ability are drawn uniformly from their respective supports. Then, before the three-stage game is played, the evaluator prefers a blind audition approximately sixty-four percent and an informed audition only approximately thirty-six percent of the time (Figure 3). At a macroeconomic level, such simple form of heterogeneity in the bias across evaluators and in the ability composition across applicant pools, may rationalise the observed co-existence of blind and informed auditions in the economy. Furthermore, it may rationalise that the majority of U.S. symphony orchestras use a blind audition as an outcome of optimisation (Goldin and Rouse, 2000).

5.1 Applicant Preferences over Auditions

To complement the discussion of the evaluator's optimal audition form, I consider the applicant's audition preferences. In particular, having solved for optimal effort levels in both audition forms, I can conclude under which conditions on the bias and prior each type prefers a blind or an informed audition to maximise her expected utility.

Theorem 2. *(i) A low-ability female prefers a blind audition if the evaluator's bias against female applicants is low; that is, $\beta \in \beta_L^B$. (ii) She is indifferent if the evaluator's bias against female applicants is high; that is, $\beta \in \beta_H^B$.*

Intuitively, a low-ability female benefits from the move to a blind audition under the condition that the applicant pool is predominantly of high ability and the evaluator's bias is sufficiently low; for example, she benefits for biases weakly below $\beta(0.5) \approx 0.37$ when the prior is one-half (Figure 4a). It allows her to pool with high-ability applicants, concealing her low ability and gender, and, thus, be hired with nonzero probability. In an informed audition, she would never participate because having to reveal both gender and ability would play out against her.

Theorem 3. *(i) A high-ability female prefers an informed audition if the evaluator's bias against female applicants is low. (ii) She prefers a blind audition if the evaluator's bias against female applicants is high; that is, $\beta \in \beta_H^B$.*

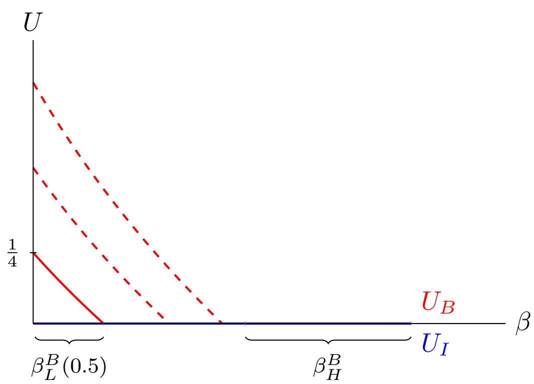
To gain some insight, fix a prior that is sufficiently high such that the range of biases for which a high-ability female prefers an informed audition is determined by the intersection of U_B and U_I (Figure 4b). Then, as the prior that the applicant is of high ability approaches one, the range of biases for which a high-ability female prefers an informed audition is shrinking and approaches zero. Intuitively, for this applicant, it becomes relatively more important to conceal her gender as the evaluator already knows that she is likely to be of high ability. Submitting a CV prior to the audition is of little value to her.

Theorem 4. *(i) A low-ability male prefers a blind audition if the evaluator's bias against female applicants is low. (ii) He prefers an informed audition if the evaluator's bias against female applicants is high; that is, $\beta \in \beta_H^B$.*

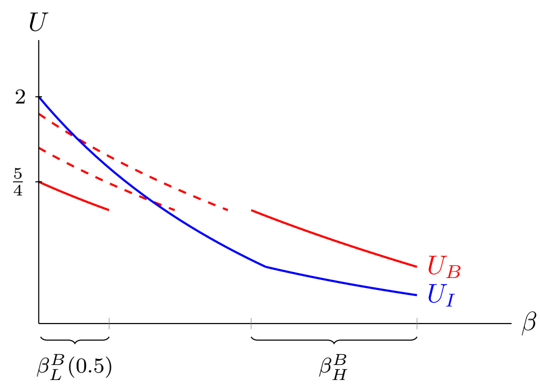
For a very low bias, the intuition behind Theorem 4 is akin to that for low-ability females. A low-ability male benefits from the move to a blind audition under the condition that the applicant pool is predominantly of high ability and the evaluator's bias is sufficiently low (Figure 4c). For this applicant, it is attractive to conceal his low ability in a pooling blind audition. He is, in essence, benefiting from an informational externality because the applicant pool is increasingly able. However, beyond a critical value of the bias, he trades off this advantage and rather identifies himself as low-ability male to reap the benefits of the evaluator's bias against female applicants.

Theorem 5. *(i) A high-ability male prefers an informed audition if the evaluator's bias against female applicants is low; that is, $\beta \in \beta_L^B$. (ii) He also prefers an informed audition if the evaluator's bias against female applicants is high; that is, $\beta \in \beta_H^B$.*

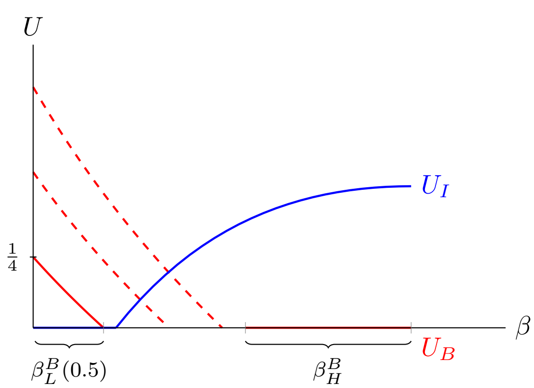
Intuitively, a high-ability male never wants to conceal either his ability or gender, because his type always plays out in his favour. Under the condition that the evaluator's bias is strictly positive, even if the applicant pool was predominantly of high ability, he would benefit from submitting his CV to identify himself as a male. Graphically, this means that, for any strictly positive bias, U_B will always be below U_I, even if the prior approaches one (Figure 4d). This result contrasts with high-ability females whose preferences change to a blind audition as the applicant pool becomes increasingly skilled.



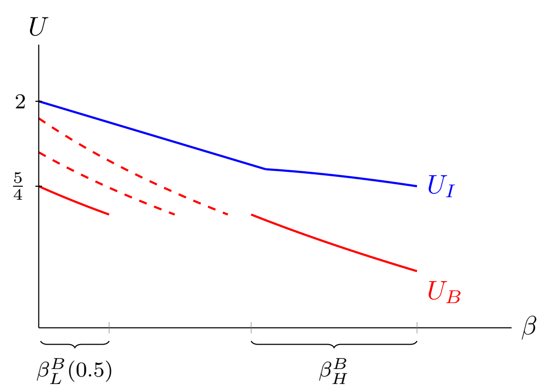
(a) Low-ability female.



(b) High-ability female.



(c) Low-ability male.



(d) High-ability male.

Figure 4: Expected utilities in a blind and informed audition.

5.2 Discussion of Results

Having discussed the preferences of the four applicant types, I conclude that, if the evaluator's bias is low, applicants' audition preferences differ along the ability dimension of their types. The highly able prefer to identify themselves as such in an informed audition whereas the less able prefer to pool with them in a blind audition. In contrast, if the evaluator is highly biased, applicants' audition preferences differ along the gender dimension. Males prefer an informed audition as the bias plays out in their favour. High-ability females, on the other hand, prefer a blind audition: they rather trade off not being able to reveal their high ability for not having to reveal their gender.

Not surprisingly, the evaluator's preferences align with the preferences of high-ability applicants if his bias against females is low. The evaluator wishes to screen applicants by their ability. In this case, requiring a CV results in targeted effort incentives. High-ability applicants favour this policy as they want to distinguish themselves from low-ability applicants. More surprisingly, the evaluator's preferences align with the preferences of high-ability females if his bias is high. In this case, to provide targeted effort incentives, the evaluator does not require a CV and holds the audition behind a curtain. This deters low-ability applicants and, as a side effect, plays out in favour of high-ability females.

The predictions of my model are qualitatively in line with Goldin and Rouse's (2000) findings that "the switch to blind auditions can explain 30 percent of the increase in the proportion female among new hires and possibly 25 percent of the increase in the percentage female in the orchestras from 1970 to 1996" (p.738). Yet, my model sheds light on the underlying forces. First, if there is at most a low bias against female applicants, such that audition preferences differ along the ability dimension, the authors' findings may be driven by the possibility of hiring low-ability females in a blind audition. In fact, the nonzero probability of hiring low-ability females outweighs the reduced probability of hiring high-ability females in a blind audition when the bias is low. To see this, note that the reduced probability is essentially the driver for why high-ability females prefer an informed audition, as their effort level remains unchanged. In other words, for the same effort cost they are less likely to be hired in a blind audition. Second, if the bias is high, such that audition preferences differ along the gender dimension, their findings may be driven by the increased probability of hiring high-ability females in a blind audition, with no change for their low-ability counterparts.

6 Auditions under Performance Uncertainty

Does a highly biased evaluator still prefer relying on a blindfolded performance if there is randomness in the environment? In the performing arts, such randomness is common; for example, due to varying temperature and humidity of the venue (Levinson, 2017). Hence, it is important to understand whether the evaluator's audition preferences are affected by how strongly the applicant's performance quality correlates with her effort.

Assumption 4. $\Pr(q_H|e_H) = 1$ *and* $\Pr(q_L|e_L) = 1 - \varepsilon$.

I relax Assumption 3 to asymmetric performance uncertainty. Performance quality is stochastically determined by the applicant's effort and one additional uncertainty parameter $\varepsilon \in [0, \frac{1}{2})$. As this parameter gets close to zero, the generalised model approaches the baseline model.

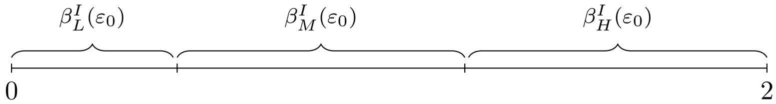
The asymmetry is motivated by the observation that high effort in the performing arts commonly takes the form of deliberate practice (Ericsson et al., 1993; Ericsson, 2006), and learning about performance-controlling factors (McPherson and Schubert, 2004). Performers often describe the process as one of overlearning and overpreparation (Hays and Brown, 2006). Thus, deliberate practice removes the element of randomness in the mapping from high effort to high performance quality. Low effort, in contrast, does not have a deterministic outcome. In this case, "heat, light, noise, as well as any other conditions that might interfere with obtaining a fair assessment of an individual's performance" (Castiglione, 1985, p.34) can play a major role. Assumption 4 may also capture the inherent subjectivity in performance evaluation: the evaluator can identify who engaged in deliberate practice but his standards are too lenient to always identify at the margin those applicants who did not.[14]

6.1 Informed Audition under Performance Uncertainty

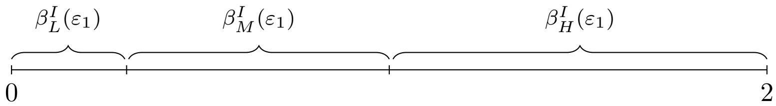
The introduction of performance uncertainty changes the ex-ante hiring probabilities when effort is low: they are a convex combination of low effort mapping into low performance quality as well as the ε chance of attaining high performance quality as a consequence of randomness. Intuitively, such performance uncertainty makes exerting low effort relatively more attractive and alters the applicant's participation and incentive constraints. That, in turn, affects the applicant's optimal effort choice in the second stage as well as the partitioning of the evaluator's bias in Lemma 1. I define $\bar{\beta}_{LM}(\varepsilon) \coloneqq \{\beta : U(e_L, \eta_L, m) = 0, \beta \geq 0\}$ and $\bar{\beta}_{HA}(\varepsilon) \coloneqq \{\beta : U(e_L, \eta_H, \cdot) = U(e_H, \eta_H, \cdot)\}$.

Lemma 1′. *Under Assumption 4, for $\varepsilon < \bar{\varepsilon} \coloneqq \frac{1}{3}$, the applicants' effort responses partition the evaluator's bias $\beta \in [0, 2]$ into three regions: (i) For a low bias, $\beta \in \beta^I_L(\varepsilon) \coloneqq [0, \bar{\beta}_{LM}(\varepsilon))$, only high-ability applicants participate and exert high effort. (ii) For a moderate bias, $\beta \in \beta^I_M(\varepsilon) \coloneqq [\bar{\beta}_{LM}(\varepsilon), \bar{\beta}_{HA}(\varepsilon)]$, low-ability males also participate and exert low effort. (iii) For a high bias, $\beta \in \beta^I_H(\varepsilon) \coloneqq (\bar{\beta}_{HA}(\varepsilon), 2]$, all applicants except low-ability females participate and exert low effort.*

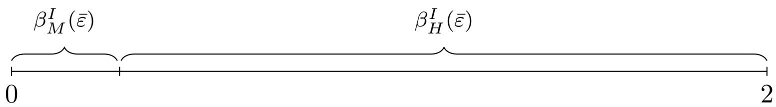
[14] A different interpretation is that the applicant may be lucky, or have mastered the "inner game" (Gallwey, 1974).



(a) $\varepsilon_0 = 0$



(b) $\varepsilon_1 = \frac{1}{10}$



(c) $\bar{\varepsilon} = \frac{1}{3}$

Figure 5: Partition of the evaluator's bias for different degrees of performance uncertainty.

To get some intuition behind Lemma 1′; that is, how the applicants' effort responses under rising performance uncertainty partition the evaluator's bias, fix $\varepsilon_0 = 0$ and $\varepsilon_1 = \frac{1}{10}$. First, Figure 5 illustrates that the interval $\beta_H^I(\varepsilon)$ is expanding to the left as the degree of performance uncertainty increases. Second, an increase in performance uncertainty causes the interval $\beta_L^I(\varepsilon)$ to shrink at a faster rate than the interval $\beta_M^I(\varepsilon)$. As a result, $\bar{\varepsilon}$ marks the threshold beyond which $\beta_L^I(\varepsilon)$ vanishes. These two observations are intuitive: the more uncertain the environment, the lower the bias of the evaluator needs to be to distort effort incentives for the highly able. This is exacerbated by the fact that performance uncertainty attracts low-ability applicants. The threshold $\bar{\varepsilon}$ determines which gender benefits from rising performance uncertainty: as the degree of performance uncertainty approaches the threshold from below, low-ability males benefit and participate for a greater range of biases, with no change for low-ability females. Beyond this threshold, as the degree of performance uncertainty approaches its supremum, low-ability females benefit and participate more often.

In what follows, I assume $\varepsilon < \bar{\varepsilon}$. While this restriction is not without loss of generality, it ensures that low-ability females never participate and that the results are comparable to those derived under Assumption 3.

Proposition 1′. *Suppose Assumption 4 holds and $\varepsilon < \bar{\varepsilon}$. (i) Suppose further that $\beta \in \beta_L^I(\varepsilon)$ where $\beta_L^I(\varepsilon)$ is defined as in Lemma 1′(i). Then, the evaluator's expected net utility (4) is unchanged. (ii) Suppose $\beta \in \beta_M^I(\varepsilon)$ where $\beta_M^I(\varepsilon)$ is defined as in Lemma 1′(ii). Then, $\mathbb{E}[\Pi_I|\beta \in \beta_M^I(\varepsilon)] \gtreqless 0$. (iii) Suppose $\beta \in \beta_H^I(\varepsilon)$ where $\beta_H^I(\varepsilon)$ is defined as in Lemma 1′(iii). Then, $\mathbb{E}[\Pi_I|\beta \in \beta_H^I(\varepsilon)] \gtreqless 0$.*

Proposition 1′ highlights that performance uncertainty alters the evaluator's expected net utility if an informed audition cannot provide targeted effort incentives; that is, if requiring a CV does not pose an effective means to screen applicants by ability.

6.2 Blind Audition under Performance Uncertainty

I now consider the effect of performance uncertainty on the pooling and separating equilibrium analysed in Section 4. A key question for policy is whether the separating equilibrium continues to exist and remains more profitable for the evaluator. This would ensure that my predictions generalise to an uncertain environment and that a strategy of commitment to no information can be beneficial if the evaluator knows that he would otherwise not be impartial.

6.2.1 Pooling Equilibrium

Suppose the evaluator's bias and the degree of performance uncertainty are sufficiently low to induce all applicants to exert high effort. Given the asymmetry in Assumption 4, low performance quality continues to be off the equilibrium path. As in Section 4, I assume that the evaluator believes the applicant to be of low ability when observing a low-quality performance.

I now show that under performance uncertainty p and ε usually determine jointly whether a high-effort pooling equilibrium can be supported and that they place an upper bound on the evaluator's bias in any such pooling equilibrium. I define $\bar{\beta}_{pool}(p,\varepsilon) \coloneqq \min\{\beta(p), \beta(p,\varepsilon)\}$ where $\beta(p,\varepsilon) \coloneqq \{\beta : U(e_H, \eta_L) = U(e_L, \eta_L)\}$.

Lemma 2′. *Under Assumption 4, (i) for $p < \frac{1}{3}$, no high-effort pooling equilibrium exists. (ii) For $p = \frac{1}{3}$, a high-effort pooling equilibrium exists if the evaluator is unbiased and $\varepsilon \leq \frac{1}{4}$. (iii) For $\frac{1}{3} < p < 1$, a high-effort pooling equilibrium exists if $\beta \in \beta_L^B(\varepsilon) \coloneqq [0, \bar{\beta}_{pool}(p,\varepsilon)]$ and $\bar{\beta}_{pool}(p,\varepsilon) > 0$.*

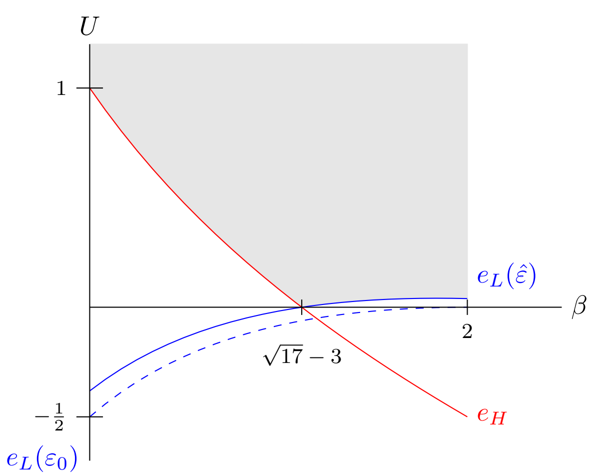
Pooling on high effort is possible if the prior that the applicant is of high ability is sufficiently large and the evaluator's bias as well as the degree of performance uncertainty is not too extreme. In particular, for a fixed prior $p > \frac{1}{3}$, once a critical level of performance uncertainty is reached, the range of biases for which pooling on high effort is an equilibrium is decreasing in performance uncertainty. This is driven by the fact that low effort becomes relatively more attractive. Conversely, for a fixed degree of performance uncertainty $\varepsilon > 0$, once a critical level of bias is reached, the range of biases for which pooling on high effort is an equilibrium outcome is increasing in the prior that the applicant is of high ability. Intuitively, while the ability composition of the applicant pool affects the applicant's utility under either effort choice, the effect of an increasingly able applicant pool is less pronounced when she chooses to exert low effort. This is because the effect of a change in the ability composition of the applicant pool is scaled down by the performance uncertainty that arises from exerting low effort. Therefore, this comparative static is robust to the introduction of performance uncertainty: an increasingly able applicant pool makes it easier for for the fewer low-ability to hide behind the more-and-more high-ability applicants. If a high-effort pooling equilibrium exists under performance uncertainty, the evaluator's expected net utility (8) is unchanged.

6.2.2 Fully Separating Equilibrium

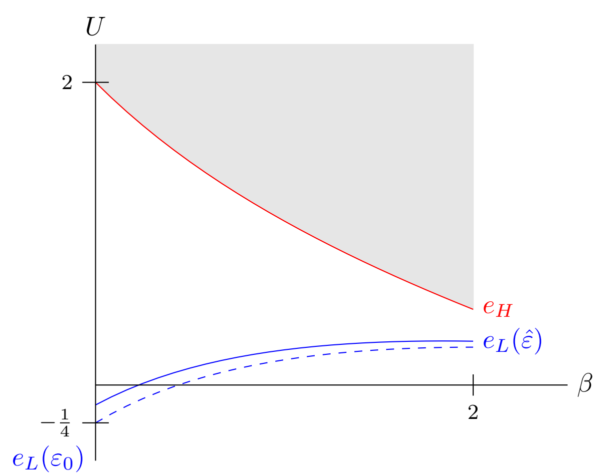
Suppose the evaluator's bias is sufficiently high and the degree of performance uncertainty is sufficiently low to induce high-ability applicants to exert high effort and low-ability applicants to drop out.[15] Under performance uncertainty, this qualification, which I refer to as full separation, is important: it ensures that the evaluator has degenerate posterior beliefs at the information set q_H. In other words, upon observing a high-quality performance, the evaluator is certain to face a highly able applicant who is male or female with equal probability. If, in contrast, low-ability applicants were to exert low effort, the evaluator could not be certain about the applicant's ability at q_H due to the ε probability that low effort results in a high-quality performance. In this case, I would need to use Bayes' rule in deriving the evaluator's expected gross utility conditional upon observing a high-quality performance and this would alter the hiring probability at q_H (see Section 6.2.3)

Lemma 3′. *Under Assumption 4, for $\varepsilon > \hat{\varepsilon}$, a fully separating equilibrium does not exist.*

My non-existence result is illustrated in Figure 6a: performance uncertainty which exceeds a certain degree makes participating and exerting low effort for low-ability applicants worthwhile. More precisely, beyond the threshold $\hat{\varepsilon} := \frac{13-3\sqrt{17}}{16} \approx \frac{1}{25}$ (solid blue line), there is no range of biases that can support a separating equilibrium in which low-ability applicants do not participate. The frailty of the fully separating equilibrium to the introduction of performance uncertainty above this threshold stems from the fact that the payoff from exerting low effort for the less able is just below zero. As a result, the deterrence effect of the evaluator's off-path belief is voided by the chance of attaining a high performance quality as a consequence of randomness if this chance is at least $\hat{\varepsilon}$.



(a) Low-ability applicant.



(b) High-ability applicant.

Figure 6: Effort choices in a fully separating blind audition under performance uncertainty.

[15] As before, the evaluator believes the applicant to be of low ability at q_L.

6.2.3 Partially Separating Equilibrium

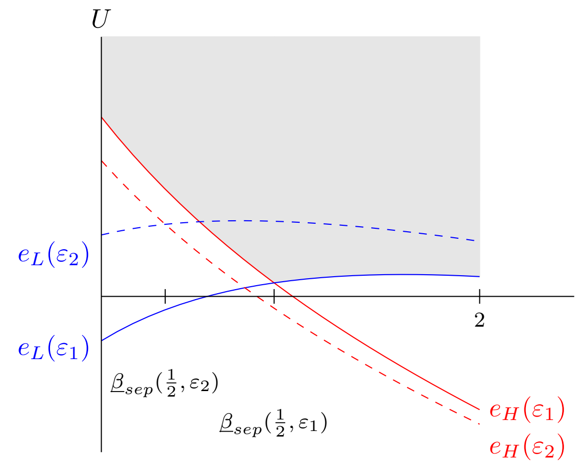
The frailty of the fully separating equilibrium to the introduction of performance uncertainty above a threshold suggests that there exists a less extreme separating equilibrium for a range of bias-prior-uncertainty combinations, in which highly able applicants exert high effort and the less able exert low effort. I refer to this outcome as partial separation. Note that partial separation was not an equilibrium under Assumption 3: I specified the evaluator's beliefs off the equilibrium path to be such that he believes the applicant to be of low ability with probability one and I did not restrict ex-ante whether the less able, in fact, participate or not. However, for $\beta < 2$, the outside option turned out to dominate low effort for the less able and I reverted to two refinements to show robustness.

Suppose the evaluator's bias and performance uncertainty are sufficiently high to induce high-ability applicants to exert high effort and low-ability applicants to exert low effort. By Bayes' rule, if there is randomness in the environment, the evaluator believes the applicant to be of high ability with probability less than unity when observing a high-quality performance. As a result, the hiring probability at q_H is strictly smaller than in the fully separating equilibrium. This is intuitive: under partial separation, the evaluator is more cautious in his hiring policy when observing a high-quality performance due to the chance that the applicant behind the curtain is only of low ability. I define $\underline{\beta}_{sep}(p,\varepsilon) \coloneqq \max\{0, \underline{\beta}_{sep'}(p,\varepsilon), \underline{\beta}_{sep''}(p,\varepsilon)\}$ where $\underline{\beta}_{sep'}(p,\varepsilon) \coloneqq \{\beta : U(e_L,\eta_L) = 0\}$ and $\underline{\beta}_{sep''}(p,\varepsilon) \coloneqq \{\beta : U(e_L,\eta_L) = U(e_H,\eta_L)\}$. Moreover, $\bar{\beta}_{sep}(p,\varepsilon) \coloneqq \min\{2, \bar{\beta}_{sep'}(p,\varepsilon)\}$ where $\bar{\beta}_{sep'}(p,\varepsilon) \coloneqq \{\beta : U(e_L,\eta_H) = U(e_H,\eta_H)\}$.

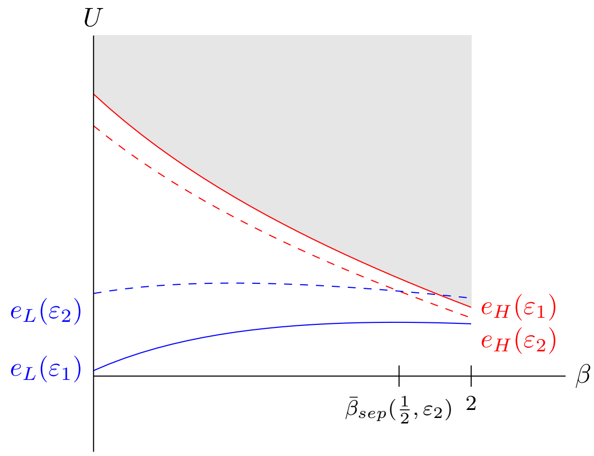
Lemma 4′. *Suppose Assumption 4 holds and $\varepsilon > \hat{\varepsilon}$. For $\beta \in \beta_H^B(\varepsilon) \coloneqq (\underline{\beta}_{sep}(p,\varepsilon), \bar{\beta}_{sep}(p,\varepsilon)]$ where $\underline{\beta}_{sep}(p,\varepsilon) < \bar{\beta}_{sep}(p,\varepsilon)$, a partially separating equilibrium exists in which high-ability applicants exert high effort and low-ability applicants exert low effort.*

Lemma 4′ implies that, for a fixed prior, once a certain degree of performance uncertainty is reached, partial separation is an equilibrium for a range of biases.[16] As the prior enters the applicant's expected utility via the conditional probability that she is of high ability given a high-quality performance, it is instructive to fix $p = \frac{1}{2}$ (Figure 7). An increase in performance uncertainty from ε_1 to $\varepsilon_2 \coloneqq \frac{3}{10}$ makes exerting low effort relatively more attractive for both high- and low-ability applicants. As a result, it reduces the lower bound of the partially separating equilibrium via the effort responses of the less able. Beyond a critical level of approximately 0.19, an increase in performance uncertainty also reduces the upper bound of the partially separating equilibrium via the effort responses of the highly able.

[16] At $\varepsilon_0 = 0$, low-ability applicants are indifferent between exerting low effort and not participating if the evaluator's bias is maximal, $\beta = 2$. Thus, I defined $\beta_H^B \coloneqq (\sqrt{17} - 3, 2)$ in Section 4 to support the fully separating equilibrium and neglected the possibility of partial separation at $\beta = 2$.



(a) Low-ability applicant.



(b) High-ability applicant.

Figure 7: Effort choices in a partially separating blind audition under performance uncertainty.

For the evaluator's belief that high-ability applicants exert high effort and low-ability applicants exert low effort to be consistent with the applicants' effort decision, he needs to have a sufficiently high bias, $\beta \in \beta_H^B(\varepsilon)$, and there needs to be randomness $\varepsilon > \hat{\varepsilon}$ in the environment.

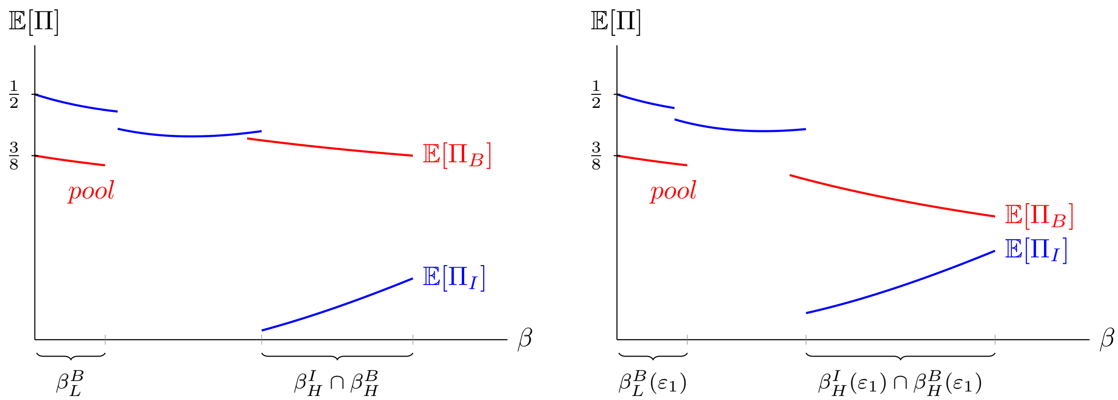
Proposition 2′. *Suppose Assumption 4 holds, $\varepsilon > \hat{\varepsilon}$ and $\beta \in \beta_H^B(\varepsilon)$ where $\beta_H^B(\varepsilon)$ is defined as in Lemma 4′. Then, $\mathbb{E}[\Pi_B | \beta \in \beta_H^B(\varepsilon)] \gtrless 0$.*

Proposition 2′ highlights that the evaluator's expected net utility in a partially separating equilibrium need not be positive.

6.3 Comparison of Auditions under Performance Uncertainty

Having discussed the effect of performance uncertainty on the evaluator's net utility in both audition forms, I can conclude under which conditions on the bias, the prior, and the degree of performance uncertainty my results on the evaluator's preferences continue to hold.

First, as full separation under $\varepsilon > \hat{\varepsilon}$ is not possible, blind auditions do not have the same fully fledged effect as under certainty; that is, blind auditions cannot provide targeted effort incentives when the evaluator is highly biased. This dampens the evaluator's expected net utility. For a fixed prior, compare, for example, the evaluator's full separation net utility when $\varepsilon_0 = 0$ in Figure 8a with his partial separation net utility when $\varepsilon_1 = \frac{1}{10}$ in Figure 8b: while a highly biased evaluator still finds a blind audition more profitable for this ability composition of the applicant pool and this degree of performance uncertainty, the expected net gain is smaller.



(a) $\Pr(\eta_H) = \frac{1}{2}$ and $\varepsilon_0 = 0$.

(b) $\Pr(\eta_H) = \frac{1}{2}$ and $\varepsilon_1 = \frac{1}{10}$.

Figure 8: Evaluator's expected net utility in a blind and informed audition under performance uncertainty.

Second, under $\varepsilon > \hat{\varepsilon}$, blind auditions are not guaranteed to be more profitable than informed auditions when the evaluator is highly biased (Figure 9). However, for $\beta \in \beta_H^B(\varepsilon)$, blind auditions are still guaranteed to be more profitable for a sufficiently high prior approximately greater than 0.46. Intuitively, while the less able participate in the blind audition, the highly biased evaluator can, at least, provide effort incentives for close to the majority of the highly able.

Third, full separation insured the highly biased evaluator against negative net utility in a blind audition. Under $\varepsilon > \hat{\varepsilon}$ and partial separation, the evaluator's net utility may be negative for very low priors. In fact, there are bias-prior-uncertainty combinations for which neither blind nor informed auditions are profitable. For $\varepsilon_1 = \frac{1}{10}$, these combinations are the grey-shaded areas in Figure 9.

To gain some intuition behind the evaluator's distribution of preferences, suppose that, if the degree of performance uncertainty ε_1 is moderate, the evaluator's bias and the prior on high ability are drawn uniformly from their respective supports. Then, before the three-stage game under performance uncertainty is played, the evaluator prefers a blind audition approximately fifty percent and an informed audition approximately forty-five percent of the time. Neither audition is preferred approximately five percent of the time (Figure 9). First, this highlights the sizeable risk of market failure under performance uncertainty: the evaluator might prefer to not hold an audition at all. Second, this highlights that an informed audition gains only about nine while a blind audition loses about fourteen percentage points in the move from a certain to a moderately uncertain environment. In other words, the evaluator is worse off as the performance uncertainty reduces the attractiveness of a blind audition by more than it increases the attractiveness of an informed audition. Taken together, the welfare loss of asymmetric performance uncertainty comes from the possibility of market failure: the no-audition scenario did not exist under Assumption 3 in Figure 3. At a macroeconomic level, the moderate performance uncertainty combined with this simple form of heterogeneity in the bias across evaluators as well as in the ability composition of applicant pools may rationalise the co-existence of blind and informed auditions in more equal proportions.

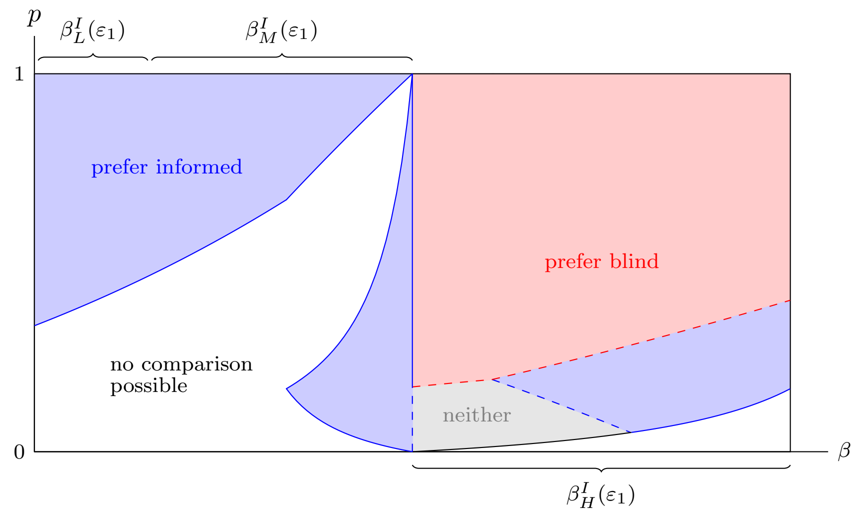


Figure 9: Evaluator's preferences over auditions for different biases and priors for $\varepsilon_1 = \frac{1}{10}$.

6.4 Policy Recommendations under Performance Uncertainty

If performance uncertainty is an inherent feature of the environment and cannot be alleviated, then policy should ensure that the applicant pool is of sufficiently high ability. Examples could be early childhood interventions to identify talent and to build performance excellence gradually via deliberate practice and, thereafter, merit scholarships for formal training to secure a steady influx of highly able musicians into the applicant pool. Direct interventions could target artistic poverty and the necessity for multi-jobbing, often in teaching, to earn a subsistence income as main barriers to human capital investment later in life. One could ask whether "auditioning, networking, keeping fit, practising and unpaid rehearsing [should] be counted as part of the artists' labo[u]r supply" (Towse, 1996, p.102) to reward human capital investment.

Under performance uncertainty, such ability-targeting policy is beneficial for two reasons: first, it guarantees the profitability of the partially separating blind audition when the evaluator is highly biased. Second, it guarantees that blind auditions outperform informed auditions. This may be desirable for equality of opportunity. Intuitively, under performance uncertainty, an applicant pool of sufficiently high ability helps counteract that blind auditions only achieve partial separation. Furthermore, it helps avoiding market failure, which may arise if neither informed nor blind auditions are profitable. In this case, it would seem natural for the evaluator to revert to the outside option immediately without holding an audition at all. This would lead to continual subcontracting or zero-hour contracts in the performing arts, reinforcing gender inequality via the difficulty of combining precarious employment with motherhood and caring responsibilities (Conor et al., 2015).

The recommendation for government to stimulate the acquisition of skills is in line with existing research on effective interventions in the presence of low-skill bad-job equilibria (Snower, 1994): when there is a small proportion of highly able types, the evaluator has little incentive to fill the position permanently, which, in turn, reinforces the underprovision of skilled labour. Furthermore, a training supply externality arises because an increase in the number of high-ability types in the population raises the probability that the evaluator will face and hire a highly able applicant, which raises his expected payoff from holding the audition. There may also be a rationale for speed if market failure leads the intervention to be less effective (Oberholzer-Gee, 2008). The policy recommendation to promote efficiency and equity under performance uncertainty finds long-standing empirical support in a number of countries: state-run music conservatoires and departments of music and drama as part of more general educational institutions provide education opportunities. Training orchestras support the professional aspects of the performing arts (Throsby and Withers, 1979).

Market failure may have adverse and wide-ranging consequences for welfare beyond gender inequality. One mechanism could be reduced civic engagement. Research by the National Endowment For The Arts (2009) finds that "Americans who create or perform art are more civically active than the general U.S. adult population" (p.6). A second mechanism could be reduced spillover effects accruing to the neighbourhood in which musicians reside and work. Research by the Social Impact of the Arts Project (2017) at the University of Pennsylvania, School of Social Policy and Practice, finds that cultural resources positively affect a neighbourhood's health and crime rate, and the outcomes of its schools. While this is not a causal relationship, cultural resources, such as artists, are argued to be vital for an environment that promotes social wellbeing.

7 Agency Cost

Equal opportunity and efficiency are commonly argued to be conflicting policy objectives (e.g., Sowell, 2004). To analyse whether this trade-off arises under taste-based discrimination, I measure efficiency through the evaluator's agency cost in the two audition forms; that is, the evaluator's loss in expected net utility from distorted rather than targeted effort incentives.[17]

Definition 1.

$$AC_I(\beta, p) \coloneqq \frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right)+\left(1+\frac{\beta}{2}\right)\right] - \mathbb{E}[\Pi_I|\beta \in \beta_k^I] \quad \text{for} \quad k = L, M, H, \quad \text{and}$$

$$AC_B(\beta, p) \coloneqq p\frac{4+\beta}{4+2\beta} - \mathbb{E}[\Pi_B|\beta \in \beta_j^B] \quad \text{for} \quad j = L, H.$$

[17]In the literature, agency cost is defined as the sum of the principal's monitoring expenditures, the bonding expenditures by the agent, and the residual loss that arises from a divergence between the agent's decisions and those decisions which would maximise the principal's welfare (Jensen and Meckling, 1976). In my model, the agency cost is purely driven by the residual loss arising from distorted effort incentives.

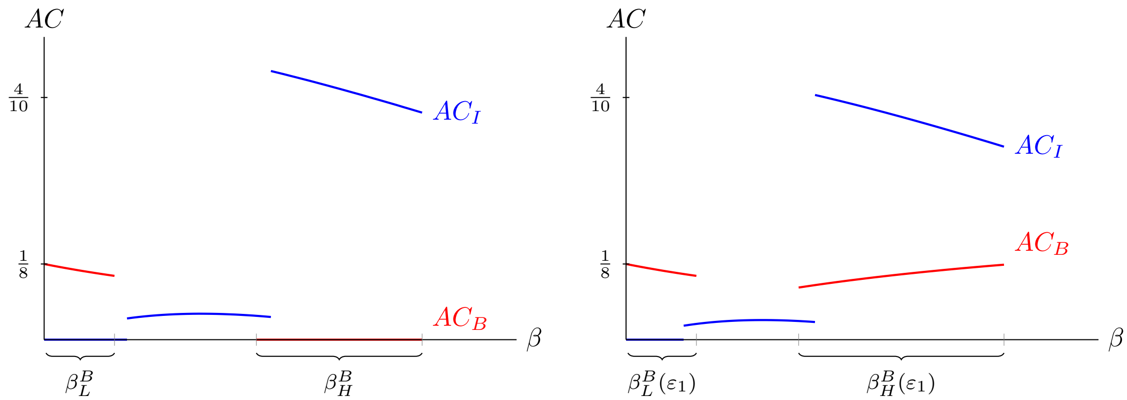
In particular, for a given bias, this agency cost is the difference between the evaluator's hypothetical payoff when only highly able applicants participate and exert high effort in the audition form and the evaluator's actual expected net utility. In an informed audition, the hypothetical payoff is derived from extrapolating $\mathbb{E}[\Pi_I|\beta \in \beta_L^I]$ to higher biases. In a blind audition, the hypothetical payoff is derived from extrapolating $\mathbb{E}[\Pi_B|\beta \in \beta_H^B]$ to lower biases in the absence of performance uncertainty.

Proposition 4. *Suppose Assumption 3 holds. Then, $AC_I(\beta, p) = 0$ if $\beta \in \beta_L^I$ and $AC_I(\beta, p) > 0$ if $\beta \in \beta_M^I \cup \beta_H^I$. Moreover, $AC_B(\beta, p) = 0$ if $\beta \in \beta_H^B$ and $AC_B(\beta, p) > 0$ if $\beta \in \beta_L^B$.*

In the absence of performance uncertainty, if the evaluator's bias against female applicants is low, the agency cost is zero in an informed audition due to targeted effort incentives. In contrast, when the bias is moderate, there is an agency cost from attracting low-ability males who exert low effort. When highly biased, there is an agency cost from attracting low-ability-low-effort males and providing only low rather than high effort incentives for highly able applicants. Therefore, the agency cost is greater when the evaluator is highly rather than moderately biased in an informed audition. In a blind audition, the agency cost is zero if the evaluator's bias is high. Conversely, when the bias is low, an agency cost arises from attracting also low-ability applicants who exert high effort. Figure 10a depicts the agency cost in both audition forms for a prior of one-half.

Consequently, above a certain threshold bias, a blind audition is an efficient mechanism to screen applicants by ability and to provide targeted effort incentives. What is more, equal opportunity and targeted effort incentives are complementary objectives: there is no trade-off between implementing blind auditions as a policy to counteract first impression biases and efficiency due to adverse effects on targeted effort provision. For a low bias, in contrast, an informed audition poses an efficient mechanism. In this case, equal opportunity and targeted effort incentives are conflicting objectives: while blind auditions serve as a policy to counteract biases, they may lead to an avalanche of applicants and efficiency loss as unintended consequences.

Under asymmetric performance uncertainty, however, a blind audition no longer poses an efficient mechanism: partial separation leads to a positive agency cost for a highly biased evaluator (Figure 10b). Given that this agency cost is decreasing in the prior, ability-targeting interventions reduce the inefficiency. The agency cost in an informed audition for a moderate and high bias is lower relative to certainty. Intuitively, the evaluator prefers to hire an applicant who delivers a high-quality performance. Under certainty, this objective coincides with the provision of high effort incentives. Under performance uncertainty, this is no longer the case and the agency cost from a low effort decision is reduced due to the possibility that low effort still results in a high-quality performance. Due to the asymmetry in Assumption 4, the agency cost in the high-effort pooling equilibrium remains unchanged.



(a) $\Pr(\eta_H) = 0.5$ and $\varepsilon_0 = 0$.

(b) $\Pr(\eta_H) = 0.5$ and $\varepsilon_1 = \frac{1}{10}$.

Figure 10: Agency cost in a blind and informed audition.

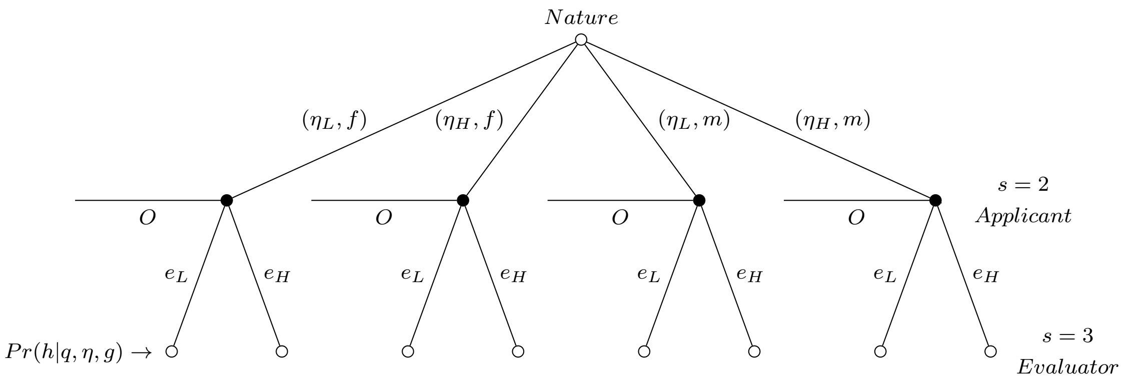
8 Conclusion

My paper opens up intriguing avenues to study in more depth the potential trade-off between policies mitigating biases and effort incentives for applicants. In Appendix B, I take a first look at quotas and subsidies. Another example is a setting in which the evaluator's bias is not common knowledge: what if applicants are uncertain or underestimate the evaluator's bias? Specifically, applicants perceiving their identity more strongly may attend to the evaluator's bias more (Antecol and Cobb-Clark, 2008). What if the evaluator is partially sophisticated or naive about his bias when choosing the audition form? This enquiry is motivated by evidence that many forms of bias work at a subconscious level; for example, via a vision heuristic (Footnote 8). Few studies examine the implications of competition among applicants, allowing for potentially more complex biases in an informed audition (Page and Page, 2010). A first point of departure may be a tournament model à la Cornell and Welch (1996). Another promising avenue is to microfound the evaluator's bias; for example, via a categorical model of cognition (Fryer and Jackson, 2008).

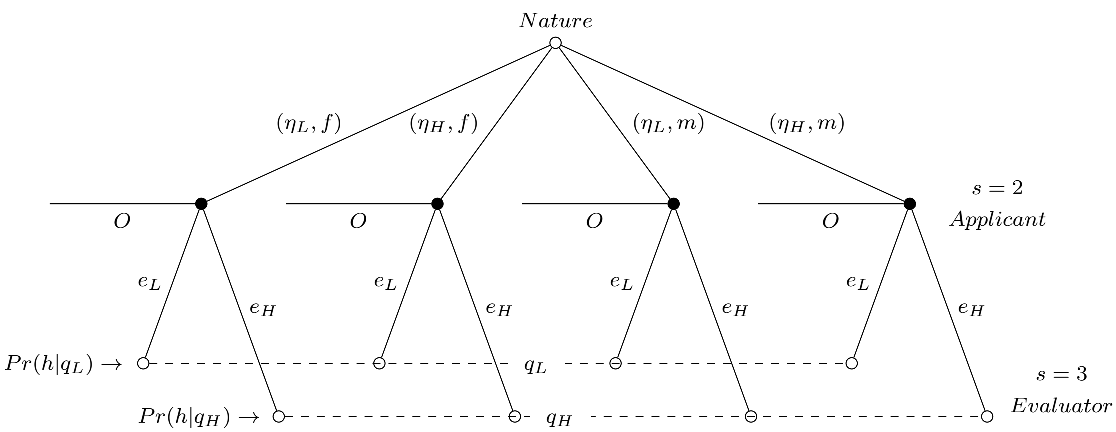
Appendices

A Graphical Representation of Auditions

The stages are denoted $s \in S = \{1, 2, 3\}$. Payoffs are suppressed for ease of exposition.



(a) Four proper subgames in an informed audition.



(b) Two information sets in a blind audition.

B Blind Audition vs Affirmative Action

A blind audition serves as a policy to counteract first impression biases. As a measure that eliminates the effect of the evaluator's taste for male applicants on his hiring decision, it creates an environment of *equal opportunity* for females and males: conditional on ability and performance quality, females and males have the same hiring probability. Yet, government policy often goes further, imposing *affirmative action*: "any measure, beyond simple termination of a discriminatory practice, adopted to correct or compensate for past or present discrimination or to prevent discrimination from recurring in the future" (U.S. Commission on Civil Rights, 1977, p.2). Examples are reverse discrimination, preferential treatment and quotas. A natural question is, therefore, how blind auditions as an equal opportunity policy compare to these more drastic policies aimed at mitigating biases.

B.1 Simple Quota

A number of governments impose quotas to increase female representation in the labour market. Since 2006, for example, Norway enforces a previously voluntary quota of 40 percent for the boards of directors of publicly listed companies (Bertrand et al., 2019). In my model, such a simple quota may be implemented as the constraint that a female applicant is guaranteed to be hired with some probability $\underline{x} \leq \frac{1}{2}$. This puts a floor on the hiring probabilities of females in an informed audition:

$$\begin{aligned}
\Pr(h|q_L, \eta_L, f) &= \underline{x}, \\
\Pr(h|q_H, \eta_L, f) &= \max\left\{\underline{x}, \frac{1}{2+\beta}\right\}, \\
\Pr(h|q_L, \eta_H, f) &= \max\left\{\underline{x}, \frac{1}{2+\beta}\right\}, \\
\Pr(h|q_H, \eta_H, f) &= \max\left\{\underline{x}, \frac{2}{2+\beta}\right\} = \frac{2}{2+\beta} \quad \forall \quad \beta \in [0, 2).
\end{aligned}$$

Specifically, if $\underline{x} = \frac{4}{10}$, then low-ability females exerting low effort are always hired with this probability; that is, the quota always binds. Furthermore,

$$\Pr(h|q_H, \eta_L, f) = \Pr(h|q_L, \eta_H, f) = \begin{cases} \frac{1}{2+\beta} & \text{if } \beta \leq \frac{1}{2}, \\ \frac{4}{10} & \text{otherwise.} \end{cases}$$

As a result, the simple quota affects the participation and incentive compatibility constraints of female applicants. In particular, for low-ability females,

$$U(e_L, \eta_L, f) = \frac{4}{10}w - \frac{1}{2}, \qquad\qquad U(e_H, \eta_L, f) = \begin{cases} \frac{1}{2+\beta}w - 2 & \text{if } \beta \leq \frac{1}{2}, \\ \frac{4}{10}w - 2 & \text{otherwise,} \end{cases}$$

where $w \coloneqq \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$. The quota alters the participation constraint of low-ability females: low effort yields a positive payoff for all biases. High effort, in contrast, always yields a negative payoff. A policy of guaranteeing females a hiring probability of 40 percent, therefore, induces low-ability females to exert low effort for all levels of bias, and forces a loss on the evaluator in this subgame. What is more, a simple quota may go beyond equal opportunity for low-ability females and males; that is, for $\beta < \frac{4}{3}$, it results in reverse discrimination or preferential treatment:

$$\Pr(h|q_L, \eta_L, m) = \frac{\beta}{2+\beta} < \frac{4}{10} = \underline{x} = \Pr(h|q_L, \eta_L, f) \quad \text{if} \quad \beta < \frac{4}{3}.$$

For high-ability females,

$$U(e_L, \eta_H, f) = \begin{cases} \frac{1}{2+\beta} w - \frac{1}{4} & \text{if } \beta \leq \frac{1}{2}, \\ \frac{4}{10} w - \frac{1}{4} & \text{otherwise,} \end{cases} \qquad U(e_H, \eta_H, f) = \frac{2}{2+\beta} w - 1,$$

where $w \coloneqq \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$. The quota alters the incentive compatibility constraint of high-ability females: low effort yields a higher payoff than high effort for biases exceeding $\frac{51-\sqrt{1929}}{8} \approx 0.89$. As a result, the threshold bias beyond which effort incentives for a highly able female are distorted is lower. For moderate biases, $\beta \in (\frac{51-\sqrt{1929}}{8}, \frac{6}{5}]$, the quota, thus, has unintended consequences: highly able females are hired less often due to the quota's effect on effort incentives. Moreover, this hiring probability is precisely the quota for such moderate biases (Figure 12).

In consequence, simple quotas cannot provide equal opportunity and targeted effort incentives in my model. Moreover, my results echo the findings of Coate and Loury (1993) and Moro and Norman (2003) in that quotas can hurt the intended beneficiaries. In my setting, the quota causes the hiring probability of highly able females to fall for a moderate range of biases before it achieves its aim of putting a floor on the hiring probability for higher biases.

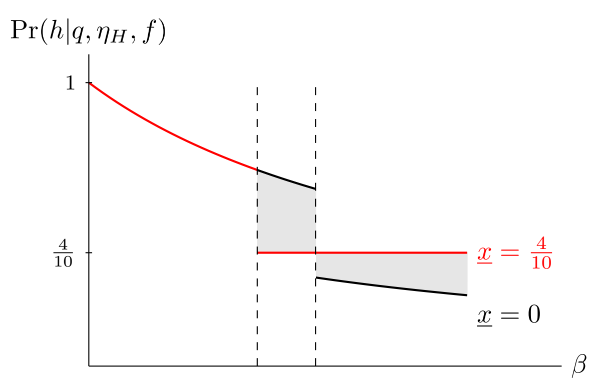


Figure 12: Effect of a simple quota on the hiring probability of a high-ability female via her effort response.

B.2 Beyond Simple Quotas

Simple quotas are not sufficient for equal opportunity and targeted effort incentives when they affect the behaviour of the target group and, as a consequence, the behaviour of the evaluator. An alternative is to force the evaluator to hire females a priori (across subgames) with some probability $\underline{x}$. The evaluator then has discretion to adjust the hiring probabilities within subgame (η_L, f) and (η_H, f) to provide targeted effort incentives. In particular, to avoid attracting low-ability females, he can hire exclusively highly able females more often than demanded by the hiring rule (3) in order to fulfil the quota. Given effort responses in stage 2, the probability of hiring female applicants across subgames is

$$\Pr(h|f) = \begin{cases} \frac{2p}{2+\beta} & \text{if } \beta \leq \frac{6}{5}, \\ \frac{p}{2+\beta} & \text{otherwise.} \end{cases}$$

For low biases, therefore, the quota is binding if $\underline{x} > \frac{2p}{2+\beta}$. For example, when $\underline{x} = \frac{4}{10}$ and $p = \frac{1}{2}$, the quota is binding for biases exceeding one-half, and the evaluator is forced to hire highly able females with probability $\underline{x}/p$ in subgame (η_H, f) to fulfil the quota. As a corollary, such a quota is only feasible if it does not exceed the prior that the applicant is of high ability.

B.3 Employment Subsidy

An alternative practice is to pay subsidies to firms who employ a certain type of worker (e.g., Card et al., 2010, 2017). In my model, this may be implemented as a subsidy of at most β conditional on hiring a female applicant in the audition. The outside option remains unchanged; that is, the evaluator does not receive the employment subsidy if he hires a substitute that turns out to be a female. The evaluator's gross utility (1) changes to

$$V(q, \eta, g) + \alpha\beta g = f(q, \eta) - (1 - \alpha)\beta g,$$

where $\alpha = 1$ represents a full employment subsidy. Given the altered gross utility and no change in the outside option, as $\alpha \uparrow 1$, the conditional hiring probabilities of females approach the ones of males. In fact, under a full subsidy, if $\beta \in \beta_L^I$, only high-ability applicants participate and exert high effort. If $\beta \in \beta_M^I$, low-ability applicants also participate and exert low effort. If $\beta \in \beta_H^I$, all applicants participate and exert low effort. For low biases, the full employment subsidy can, therefore, achieve both targeted effort incentives and equal opportunity. For moderate and high biases, equal opportunity is achieved at the expense of attracting low-ability females and males alike.

C Refinements in Separating Blind Audition

For the evaluator's belief that only high-ability applicants exert high effort to be consistent, he needs to have a sufficiently high bias; that is, $\beta \in \beta_H^B := (\sqrt{17}-3, 2)$. In this case, low-ability applicants do not participate and the information set q_L is not reached. Therefore, the evaluator's belief at q_L is not determined by equilibrium play; in other words, perfect Bayesian equilibrium does not place restrictions on this belief as it is off the equilibrium path.

Furthermore, note that the Intuitive Criterion (Cho and Kreps, 1987) is moot. In the separating blind audition, exerting low effort is equilibrium dominated for all types. In particular, for a low-ability applicant, the equilibrium payoff from dropping out is greater than the highest possible payoff from exerting low effort. For a high-ability applicant, the equilibrium payoff from exerting high effort is greater than the highest possible payoff from exerting low effort. Therefore, the requirement that the evaluator's belief at q_L places zero probability on nodes that are reached only if an applicant plays an equilibrium dominated strategy does not apply. It is not possible for the belief at q_L to place zero probability on all four nodes simultaneously.

C.1 Refinement based on Deviation Payoffs

I argue, however, that the evaluator's belief that the applicant is of low ability when observing a deviation to q_L is a reasonable restriction. Suppose to the contrary that, for a given bias $\beta \in \beta_H^B$, in the separating blind audition, the evaluator also believes the applicant to be of high ability if she delivers a low-quality performance behind the curtain. This essentially means that, if a low-quality performance is to be observed, it is because a high-ability applicant has trembled and chosen an easy piece by accident, or she rests on her laurels of being believed to be of high ability irrespective of the difficulty of the piece performed. In other words, a low-quality performance is not observed because a low-ability applicant is attracted to the audition to exploit the evaluator's belief at q_L. This perturbation of the evaluator's belief implies that, he expects a higher gross utility of

$$\mathbb{E}[V|q_L] = q_L + \mathbb{E}[\eta|q_L] - \frac{\beta}{2} = 1 + 2 - \frac{\beta}{2}$$

from hiring the applicant at q_L. Therefore, the probability of being hired at this information set changes to

$$\Pr(\text{hired}|q_L) = \Pr\left(\bar{U} \leq 3 - \frac{\beta}{2}\right) = \frac{2+\beta}{4+2\beta}.$$

Note that the hiring probability at q_L is higher than the one under the evaluator's original belief, $\frac{\beta}{4+2\beta}$. Intuitively, if the evaluator believes the applicant behind the curtain to be of high ability when hearing an easy piece, he should be more willing to hire her and overlook her mistake. Due to the altered hiring probability, the applicant's effort incentives change to

$$\begin{aligned}
U(e_L, \eta_L) &= \frac{2+\beta}{4+2\beta} w - \frac{1}{2}, \\
U(e_H, \eta_L) &= \frac{4+\beta}{4+2\beta} w - 2, \\
U(e_L, \eta_H) &= \frac{2+\beta}{4+2\beta} w - \frac{1}{4}, \\
U(e_H, \eta_H) &= \frac{4+\beta}{4+2\beta} w - 1,
\end{aligned}$$

where $w \coloneqq \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$.

First, consider a low-ability applicant under the perturbed belief at q_L. Before, this type was deterred from participating for $\beta \in \beta_H^B$. Now, exerting low effort is worthwhile for all biases in this interval (Figure 13a). The low-ability applicant is, in fact, exploiting the evaluator's belief; it plays out in her favour. For $\beta \in \beta_H^B$, the utility gain from deviating from O to e_L is given by

$$\big[U(e_L, \eta_L) - U(O, \eta_L)\big] = 1 - \frac{\beta}{4},$$

which is monotonically decreasing in the bias for all possible values. Therefore, the lowest possible utility gain from deviating to e_L occurs as β approaches its maximum:

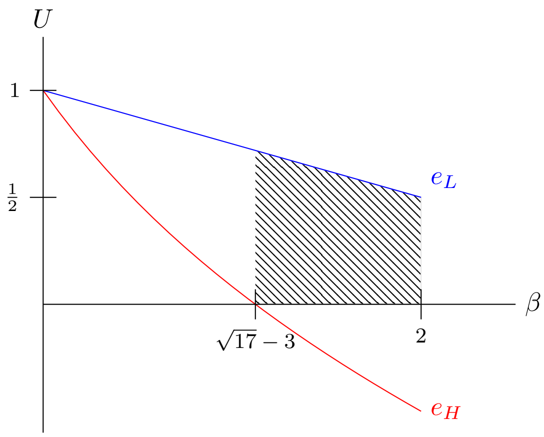
$$\lim_{\beta \uparrow 2} \big[U(e_L, \eta_L) - U(O, \eta_L)\big] = \frac{1}{2}. \tag{10}$$

Second, consider a high-ability applicant under the perturbed belief at q_L. Before, this type was exerting high effort for $\beta \in \beta_H^B$. Now, exerting high effort is only worthwhile if the bias does not exceed $\frac{6}{5}$. Exerting low effort is optimal for any bias exceeding this threshold (Figure 13b). The high-ability applicant essentially avoids the higher cost of effort and rests on her laurels by preparing an easy piece. For $\beta \in \beta_H^B$, the utility gain from deviating from e_H to e_L is given by

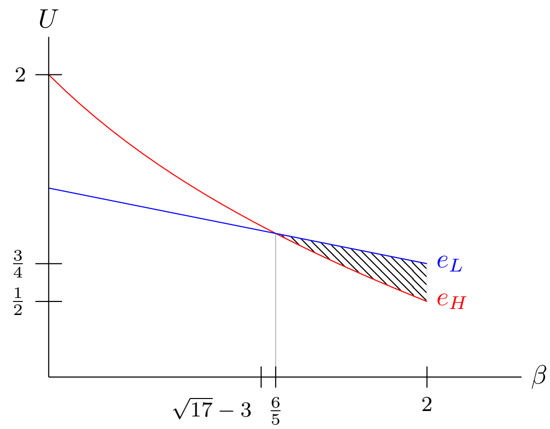
$$\big[U(e_L, \eta_H) - U(e_H, \eta_H)\big] = \frac{5}{4} - \frac{4}{2+\beta},$$

which is monotonically increasing in the bias for all possible values. Therefore, the greatest possible utility gain from deviating to e_L occurs as β approaches its maximum:

$$\lim_{\beta \uparrow 2} \big[U(e_L, \eta_H) - U(e_H, \eta_H)\big] = \frac{1}{4}. \tag{11}$$



(a) Low-ability applicant.



(b) High-ability applicant.

Figure 13: Effort choices in a separating blind audition.

Finally, observe that for $\beta \in (\frac{6}{5}, 2)$, both high- and low-ability applicants gain from deviating to low effort under the perturbed belief. The utility gain for low-ability from deviating, however, is always greater than the utility gain for high-ability applicants from deviating. This follows immediately because the lowest possible utility gain for the former in equation (10) exceeds the largest possible utility gain for the latter in equation (11). As a result, the evaluator should say to himself that the applicant behind the curtain is more likely to be a low-ability applicant exploiting his belief. Put differently, a high-ability applicant trembling to an easy piece or resting on her laurels of being believed to be of high ability irrespective of the difficulty of the piece is less likely.

Observe also that for $\beta \in (\sqrt{17}-3, \frac{6}{5}]$, only low-ability applicants have an incentive to deviate to low effort under the perturbed belief. High-ability applicants exert high effort. For this range of bias, by the Intuitive Criterion, the evaluator should believe the applicant to be of low-ability with probability one when observing a low-quality performance.

C.2 Refinement based on D1-Criterion

Under D1, similar to the Intuitive Criterion, deviations of the applicant emerge as the consequence of a rational decision. D1, however, is capable to put more structure on the evaluator's belief at q_L in the separating blind audition: it restricts the off-path belief to be a point belief with all mass on the type who is most likely to deviate.

Define $D(\theta, T, e_L)$ to be the set of the evaluator's mixed strategy best responses to action e_L and beliefs concentrated on T that make type θ strictly prefer e_L to her equilibrium strategy. Let $D^0(\theta, T, e_L)$ be the set of mixed best responses that make type θ exactly indifferent.

Definition 2. A type θ is deleted for strategy e_L under the D1-Criterion if there is a θ' such that

$$\{D(\theta, \Theta, e_L) \cup D^0(\theta, \Theta, e_L)\} \subset D(\theta', \Theta, e_L).$$

From Definition 2 follows that, if the set of the evaluator's mixed best responses (that is, the range of hiring probabilities) that make high-ability applicants willing to deviate to low effort is strictly smaller than the set of best responses that make low-ability applicants willing to deviate, then the evaluator should believe that low-ability applicants are infinitely more likely to deviate to low effort than their high-ability counterparts are. In other words, D1 tests a deviation to low effort for a given type with respect to each particular mixed best response of the evaluator (Fudenberg and Tirole, 1991, p.451-452).

Proposition 5. *After observing q_L, the set of the evaluator's best responses improving the expected equilibrium utility of low-ability applicants is a superset of the set of best responses improving the expected equilibrium utility of high-ability applicants. Therefore, the evaluator should infer that he deals with the former and put zero weight on the latter.*

Proof. First, consider low-ability males and females in the separating blind audition. The minimal hiring probability at the low-performance information set that induces these types to deviate from O to e_L is given by

$$\begin{aligned} \Pr(\text{hired}|q_L)w - \frac{1}{2} &\geq 0, \\ \Rightarrow \Pr(\text{hired}|q_L) &\geq \frac{1}{6-\beta}. \end{aligned} \tag{12}$$

Second, consider high-ability males and females in the separating blind audition. The minimal hiring probability at the low-performance information set that induces these types to deviate from e_H to e_L is given by

$$\begin{aligned} \Pr(\text{hired}|q_L)w - \frac{1}{4} &\geq \Pr(\text{hired}|q_H)w - 1, \\ \Rightarrow \Pr(\text{hired}|q_L) &\geq \frac{4+\beta}{4+2\beta} - \frac{3}{12-2\beta}, \end{aligned} \tag{13}$$

where the probability of being hired at the high-performance information set is fixed at its equilibrium value, $\frac{4+\beta}{4+2\beta}$.

Finally, for a given bias, compare inequality (12) with inequality (13) to conclude that

$$\{D((\eta_H, \cdot), \Theta, e_L) \cup D^0((\eta_H, \cdot), \Theta, e_L)\} \subset D((\eta_L, \cdot), \Theta, e_L).$$

□

Figure 14 shows graphically that the set of the evaluator's mixed best responses to e_L that make low-ability applicants prefer low effort to their equilibrium strategy (light and dark grey area) strictly contains the set of mixed best responses for their high-ability counterparts (dark grey area) for all possible values of bias. By Definition 2, therefore, a deviation to low effort must be interpreted as coming from low-ability applicants.

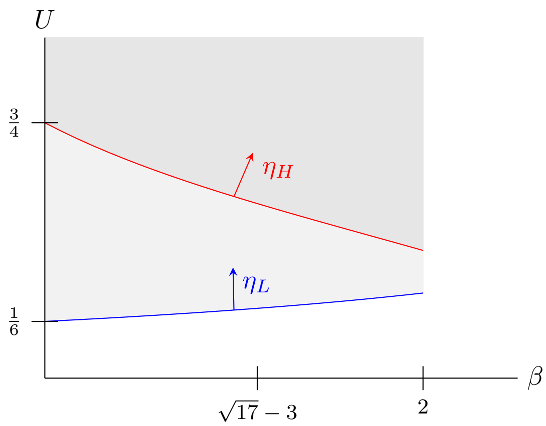


Figure 14: Set of the evaluator's mixed best responses to low effort inducing a deviation of low- and high-ability applicants.

D Proofs

Proof of Lemma 1. First, note that substituting for the hiring probabilities in equation (2) yield

$$
\begin{aligned}
U(e_L,\eta_L,f) &= -\frac{1}{2}, & U(e_L,\eta_L,m) &= \frac{\beta}{2+\beta}w-\frac{1}{2},\\
U(e_H,\eta_L,f) &= \frac{1}{2+\beta}w-2, & U(e_H,\eta_L,m) &= \frac{1+\beta}{2+\beta}w-2,\\
U(e_L,\eta_H,f) &= \frac{1}{2+\beta}w-\frac{1}{4}, & U(e_L,\eta_H,m) &= \frac{1+\beta}{2+\beta}w-\frac{1}{4},\\
U(e_H,\eta_H,f) &= \frac{2}{2+\beta}w-1, & U(e_H,\eta_H,m) &= w-1
\end{aligned}
$$

in an informed audition, where $w \coloneqq \mathbb{E}[\bar{U}] = 3-\frac{\beta}{2}$.

Low-ability females drop out of the audition for all possible biases (Figure 15a). High-ability females exert high effort if $\beta \in [0, \frac{6}{5}]$ and low effort if $\beta \in (\frac{6}{5}, 2]$ (Figure 15b). Low-ability males drop out if β is strictly lower than $\frac{5-\sqrt{17}}{2}$, and exert low effort if $\beta \in [\frac{5-\sqrt{17}}{2}, 2]$ (Figure 15c). High-ability males exert high effort if $\beta \in [0, \frac{6}{5}]$ and low effort if $\beta \in (\frac{6}{5}, 2]$ (Figure 15d). Note the gender differences for low-ability applicants: $U(e_L,\eta_L,m)$ is increasing in the evaluator's bias while

$U(e_L, \eta_L, f)$ is negative and independent of the bias.

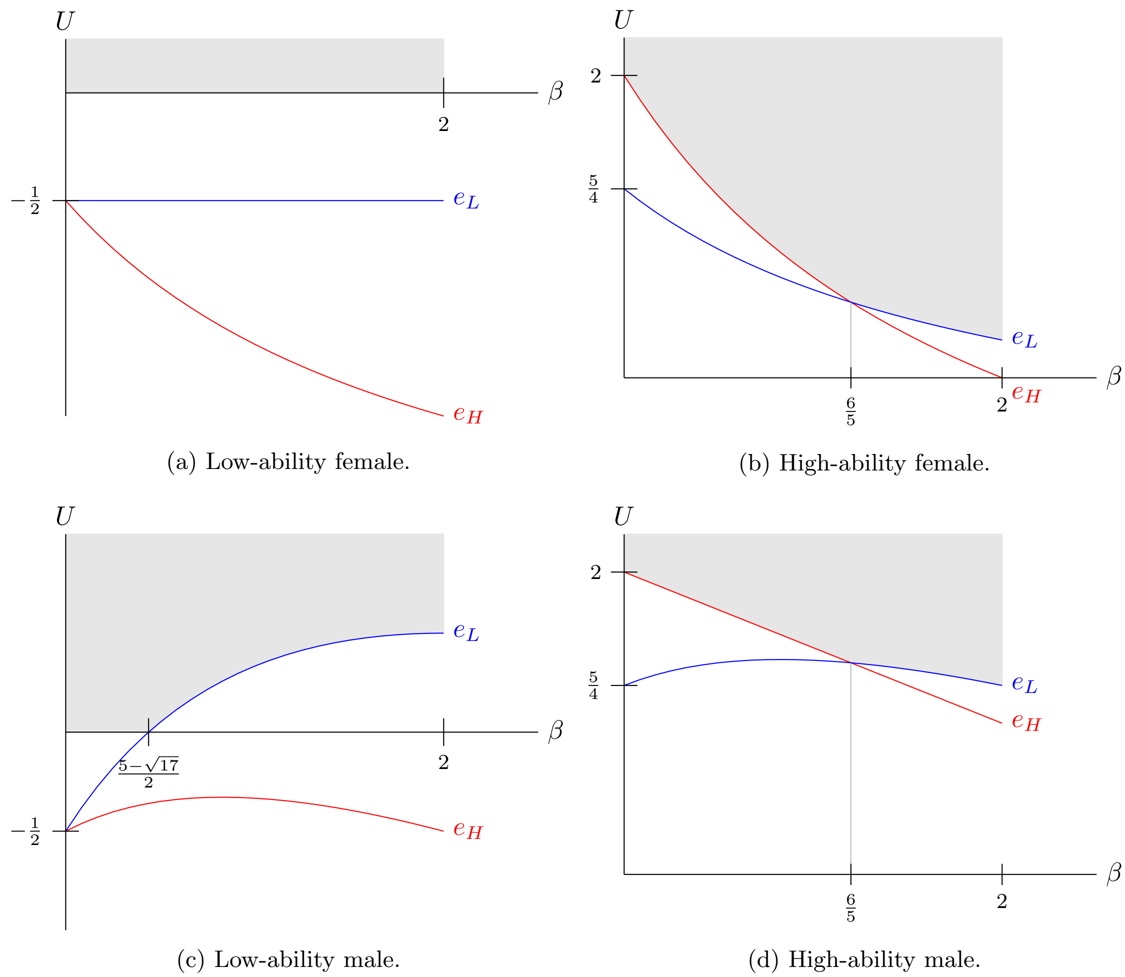


Figure 15: Effort choices in an informed audition.

□

Proof of Proposition 1. Suppose the evaluator's bias against female applicants is low; that is, $\beta \in \beta_L^I$ where β_L^I is defined as in Lemma 1(i). Then, low-ability males and females do not participate and high-ability males and females exert high effort. In subgame (η_L, f) and (η_L, m), the evaluator, therefore, hires the outside option with probability one. With a slight abuse of notation, the evaluator's expected gross utility is the expected value of the outside option:

$$\mathbb{E}[V|O, \eta_L, f] = \mathbb{E}[V|O, \eta_L, m] = \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}.$$

As $w := \mathbb{E}[\bar{U}]$, the evaluator, by construction, breaks even after accounting for wage costs in these two subgames. In subgame (η_H, f), the evaluator's gross utility from hiring the applicant is $4-\beta$ with corresponding hiring probability $\frac{2}{2+\beta}$. The evaluator hires the outside option with expected value $3-\frac{\beta}{2}$ with complementary probability $\frac{\beta}{2+\beta}$. The evaluator's expected gross utility in subgame (η_H, f) can then be calculated as the probability that he hires the applicant times the utility from hiring her plus the probability that he hires the outside option times the expected value of the outside option:[18]

$$\begin{aligned}
\mathbb{E}[V|q_H, \eta_H, f] &= \Pr(h|q_H, \eta_H, f)V(q_H, \eta_H, f) + [1-\Pr(h|q_H, \eta_H, f)]\mathbb{E}[\bar{U}], \\
&= \frac{2}{2+\beta}(4-\beta) + \frac{\beta}{2+\beta}\left(3-\frac{\beta}{2}\right), \\
&= 2-\frac{\beta}{2}+\frac{4}{2+\beta}.
\end{aligned}$$

In subgame (η_H, m), the evaluator's gross utility from hiring the applicant is 4 with corresponding hiring probability 1. His expected gross utility in this subgame, therefore, is

$$\mathbb{E}[V|q_H, \eta_H, m] = \Pr(h|q_H, \eta_H, m)V(q_H, \eta_H, m) = 4.$$

Under the common prior assumption, the evaluator's overall expected gross utility in stage 1 in an informed audition is

$$\begin{aligned}
\mathbb{E}[V|\beta] &= \frac{1-p}{2}\Big[\mathbb{E}[V|O, \eta_L, f] + \mathbb{E}[V|O, \eta_L, m]\Big] + \frac{p}{2}\Big[\mathbb{E}[V|q_H, \eta_H, f] + \mathbb{E}[V|q_H, \eta_H, m]\Big], \\
&= \frac{1-p}{2}\left[\left(3-\frac{\beta}{2}\right) + \left(3-\frac{\beta}{2}\right)\right] + \frac{p}{2}\left[\left(2-\frac{\beta}{2}+\frac{4}{2+\beta}\right) + 4\right].
\end{aligned}$$

After subtracting wage costs, the evaluator's expected net utility is

$$\mathbb{E}[\Pi_I|\beta \in \beta_L^I] := \mathbb{E}[V|\beta \in \beta_L^I] - w = \frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right) + \left(1+\frac{\beta}{2}\right)\right] > 0.$$

Suppose the evaluator is moderately biased against female applicants; that is, $\beta \in \beta_M^I$ where β_M^I is defined as in Lemma 1(ii). Then, subgame (η_L, f), (η_H, f) and (η_H, m) remain unchanged. Low-ability males participate and exert low effort. The evaluator's gross utility from hiring the applicant in subgame (c) changes to 2 with corresponding hiring probability $\frac{\beta}{2+\beta}$. The evaluator hires the outside option with expected value $3-\frac{\beta}{2}$ with complementary probability $\frac{2}{2+\beta}$. The evaluator's

[18] Recall that, by Assumption 2, the value of $\bar{U}$ is unknown to the evaluator when making the hiring decision. Therefore, all calculations use the *unconditional* expected value of the outside option. The model's results are robust to altering the timing and using the *conditional* expected value. However, when engaging a substitute from an agency, it is more appropriately interpreted as a gamble as done here.

expected gross utility in subgame (η_L, m), therefore, becomes

$$\begin{aligned}\mathbb{E}[V|q_L,\eta_L,m] &= \Pr(h|q_L,\eta_L,m)V(q_L,\eta_L,m) + [1-\Pr(h|q_L,\eta_L,m)]\mathbb{E}[\bar{U}],\\ &= \frac{\beta}{2+\beta}2 + \frac{2}{2+\beta}\left(3-\frac{\beta}{2}\right),\\ &= 1+\frac{4}{2+\beta},\end{aligned}$$

which is strictly less than $\mathbb{E}[\bar{U}]$ for all β. Because $w \coloneqq \mathbb{E}[\bar{U}]$, the evaluator's expected utility net of wage costs is, thus, negative in subgame (η_L, m) when he is moderately biased. The evaluator's overall expected gross utility becomes

$$\begin{aligned}\mathbb{E}[V|\beta\in\beta_M^I] &= \frac{1-p}{2}\Big[\mathbb{E}[V|O,\eta_L,f]+\mathbb{E}[V|q_L,\eta_L,m]\Big] + \frac{p}{2}\Big[\mathbb{E}[V|q_H,\eta_H,f]+\mathbb{E}[V|q_H,\eta_H,m]\Big],\\ &= \frac{1-p}{2}\left[\left(3-\frac{\beta}{2}\right)+\left(1+\frac{4}{2+\beta}\right)\right]+\frac{p}{2}\left[\left(2-\frac{\beta}{2}+\frac{2}{2+\beta}\right)+4\right].\end{aligned}$$

After subtracting wage costs, the evaluator's expected net utility is

$$\begin{aligned}\mathbb{E}[\Pi_I|\beta\in\beta_M^I] &\coloneqq \mathbb{E}[V|\beta\in\beta_M^I]-w,\\ &= \frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right]+\frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right)+\left(1+\frac{\beta}{2}\right)\right]\gtrless 0.\end{aligned}$$

Suppose the evaluator is highly biased against female applicants; that is, $\beta\in\beta_H^I$ where β_H^I is defined as in Lemma 1(iii). Then, subgame (η_L, f) and (η_L, m) remain unchanged. High-ability females and males exert low effort. The evaluator's gross utility from hiring the applicant in subgame (η_H, f) changes to $3-\beta$ with corresponding hiring probability $\frac{1}{2+\beta}$. The evaluator hires the outside option with expected value $3-\frac{\beta}{2}$ with complementary probability $\frac{1+\beta}{2+\beta}$. The evaluator's expected gross utility in subgame (η_H, f), therefore, falls to

$$\begin{aligned}\mathbb{E}[V|q_L,\eta_H,f] &= \Pr(h|q_L,\eta_H,f)V(q_L,\eta_H,f)+[1-\Pr(h|q_L,\eta_H,f)]\mathbb{E}[\bar{U}],\\ &= \frac{1}{2+\beta}(3-\beta)+\frac{1+\beta}{2+\beta}\left(3-\frac{\beta}{2}\right),\\ &= \frac{5}{2}-\frac{\beta}{2}+\frac{1}{2+\beta}.\end{aligned}$$

The evaluator's gross utility from hiring the applicant in subgame (η_H, m) changes to 3 with corresponding hiring probability $\frac{1+\beta}{2+\beta}$. The evaluator hires the outside option with expected value $3-\frac{\beta}{2}$ with complementary probability $\frac{1}{2+\beta}$. The evaluator's expected gross utility in subgame (η_H, m), therefore, falls to

$$\begin{aligned}\mathbb{E}[V|q_L,\eta_H,m] &= \Pr(h|q_L,\eta_H,m)V(q_L,\eta_H,m) + [1-\Pr(h|q_L,\eta_H,m)]\mathbb{E}[\bar{U}],\\ &= \frac{1+\beta}{2+\beta}3 + \frac{1}{2+\beta}\left(3-\frac{\beta}{2}\right),\\ &= \frac{5}{2} + \frac{1}{2+\beta}.\end{aligned}$$

The evaluator's overall expected gross utility becomes

$$\begin{aligned}\mathbb{E}[V|\beta\in\beta_H^I] &= \frac{1-p}{2}\Big[\mathbb{E}[V|O,\eta_L,f] + \mathbb{E}[V|q_L,\eta_L,m]\Big] + \frac{p}{2}\Big[\mathbb{E}[V|q_L,\eta_H,f] + \mathbb{E}[V|q_L,\eta_H,m]\Big],\\ &= \frac{1-p}{2}\left[\left(3-\frac{\beta}{2}\right) + \left(1+\frac{4}{2+\beta}\right)\right] + \frac{p}{2}\left[\left(\frac{5}{2}-\frac{\beta}{2}+\frac{1}{2+\beta}\right) + \left(\frac{5}{2}+\frac{1}{2+\beta}\right)\right].\end{aligned}$$

After subtracting wage costs, the evaluator's expected net utility is

$$\begin{aligned}\mathbb{E}[\Pi_I|\beta\in\beta_H^I] &:= \mathbb{E}[V|\beta\in\beta_H^I] - w,\\ &= \frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right] + \frac{p}{2}\left[\frac{1}{2+\beta}\left(-\frac{\beta}{2}\right) + \frac{1+\beta}{2+\beta}\left(\frac{\beta}{2}\right)\right] \gtrless 0.\end{aligned}$$

□

Proof of Lemma 2. First, note that substituting for the two hiring probabilities in equation (2) yield

$$\begin{aligned}U(e_L,\eta_L) &= \frac{\beta}{4+2\beta}w - \frac{1}{2},\\ U(e_H,\eta_L) &= \frac{2(1+p)+\beta}{4+2\beta}w - 2,\\ U(e_L,\eta_H) &= \frac{\beta}{4+2\beta}w - \frac{1}{4},\\ U(e_H,\eta_H) &= \frac{2(1+p)+\beta}{4+2\beta}w - 1\end{aligned}$$

for both female and male applicants in a pooling blind audition, where $w := \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$.

(i) For $p < \frac{1}{3}$, I show that $U(e_H,\eta_L)$ is strictly negative for all possible values of β. It is always better for low-ability applicants to not participate. First, note that $U(e_H,\eta_L)$ is strictly decreasing in β:

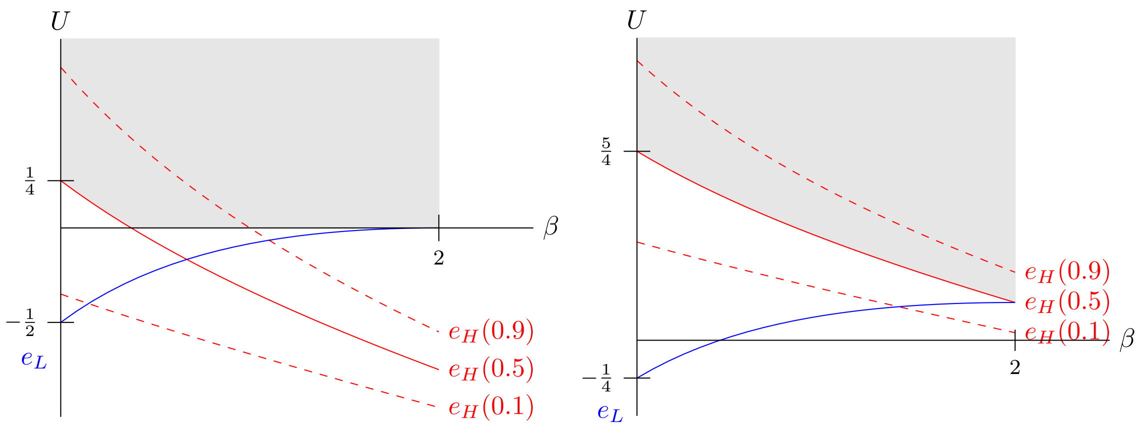
$$\frac{\partial U(e_H,\eta_L)}{\partial\beta} = -\frac{4p}{(4+2\beta)^2}\left(3-\frac{\beta}{2}\right) - \frac{2(1+p)+\beta}{8+4\beta} < 0 \;\forall\; \beta\in[0,2].$$

This implies that, if $U(e_H,\eta_L) < 0$ at $\beta = 0$, then $U(e_H,\eta_L) < 0$ for all $\beta \in [0,2]$. I can use this condition to solve for the corresponding prior:

$$U(e_H, \eta_L)\Big|_{\beta=0} = \frac{1+p}{2}3 - 2 < 0 \Rightarrow p < \frac{1}{3}.$$

Thus, for $p < \frac{1}{3}$, pooling on high effort is never possible.

(ii) For $p = \frac{1}{3}$, $U(e_H, \eta_L) = 0$ at $\beta = 0$. By the previous argument, $U(e_H, \eta_L) < 0$ for all $\beta \in (0, 2]$. This implies that low-ability applicants are indifferent between exerting high effort and not participating only if the evaluator is unbiased. Furthermore, it is optimal for high-ability applicants to exert high effort whenever it is optimal for low-ability applicants to exert high effort. This is because $U(e_L, \cdot)$ shifts up by $\frac{1}{4}$ while $U(e_H, \cdot)$ shifts up by 1 in the move from η_L to η_H (Figure 16a and Figure 16b, respectively). Thus, pooling on high effort is possible at $p = \frac{1}{3}$ if $\beta = 0$.



(a) Low-ability applicant.

(b) High-ability applicant.

Figure 16: Effort choices in a pooling blind audition for different priors.

(iii) For $\frac{1}{3} < p < 1$, there exists a range of biases for which $U(e_H, \eta_L)$ is positive. The upper bound on β for which a pooling equilibrium can be supported is determined by the indifference condition

$$U(e_H, \eta_L) = \frac{2(1+p)+\beta}{4+2\beta}\left(3 - \frac{\beta}{2}\right) - 2 = 0.$$

Given that $\beta \in [0, 2]$, the above equation is uniquely solved by $\beta(p) \coloneqq \sqrt{p^2 + 16p} - p - 2$. The upper bound $\beta(p)$ is strictly increasing in p:

$$\frac{d\beta(p)}{dp} = \frac{p+8}{\sqrt{p(p+16)}} - 1 > 0 \; \forall \; 0 < p < 1.$$

Taking the limit of $\beta(p)$ yields

$$\lim_{p\uparrow 1}\beta(p) = \sqrt{17} - 3 > 0.$$

$\square$

Proof of Proposition 2. Suppose the evaluator's bias against female applicants is low; that is, $\beta \in \beta_L^B$ with $\frac{1}{3} \leq p < 1$ where β_L^B is defined as in Lemma 2. His expected utility from hiring the applicant at the information set q_H is $3+p-\frac{\beta}{2}$ with corresponding hiring probability $\frac{2(1+p)+\beta}{4+2\beta}$. The evaluator hires the outside option with expected value $3-\frac{\beta}{2}$ with complementary probability $\frac{2(1-p)+\beta}{4+2\beta}$. Given the evaluator's beliefs, his overall expected gross utility in stage 1 in a pooling blind audition is

$$\begin{aligned}
\mathbb{E}[V|\beta \in \beta_L^B] &= \Pr(h|q_H)\mathbb{E}[V|q_H] + [1-\Pr(h|q_H)]\mathbb{E}[\bar{U}],\\
&= \frac{2(1+p)+\beta}{4+2\beta}\left(3+p-\frac{\beta}{2}\right) + \frac{2(1-p)+\beta}{4+2\beta}\left(3-\frac{\beta}{2}\right).
\end{aligned}$$

After subtracting wage costs, the evaluator's expected net utility is

$$\begin{aligned}
\mathbb{E}[\Pi_B|\beta \in \beta_L^B] &\coloneqq \mathbb{E}[V|\beta \in \beta_L^B] - w,\\
&= \frac{2(1+p)+\beta}{4+2\beta}\left[3+p-\frac{\beta}{2}-\left(3-\frac{\beta}{2}\right)\right],\\
&= p\frac{2(1+p)+\beta}{4+2\beta} > 0.
\end{aligned}$$

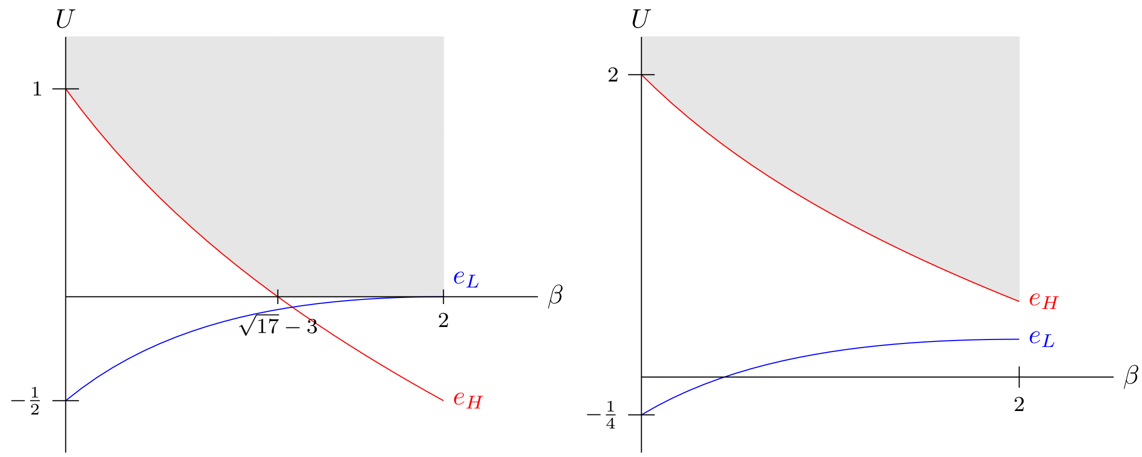
$\square$

Proof of Lemma 3. First, note that substituting for the two hiring probabilities in the applicant's expected utility (2) yield

$$\begin{aligned}
U(e_L,\eta_L) &= \frac{\beta}{4+2\beta}w - \frac{1}{2},\\
U(e_H,\eta_L) &= \frac{4+\beta}{4+2\beta}w - 2,\\
U(e_L,\eta_H) &= \frac{\beta}{4+2\beta}w - \frac{1}{4},\\
U(e_H,\eta_H) &= \frac{4+\beta}{4+2\beta}w - 1
\end{aligned}$$

for both male and female applicants in a separating blind audition, where $w \coloneqq \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$.

For $\beta \in [0, \sqrt{17}-3]$, low-ability applicants exert high effort (Figure 17a). For $\beta \in (\sqrt{17}-3, 2)$, low-ability applicants do not participate in the audition (Figure 17a). For $\beta \in [0, 2]$, high-ability applicants exert high effort in the audition (Figure 17b).



(a) Low-ability applicant.

(b) High-ability applicant.

Figure 17: Effort choices in a separating blind audition.

□

Proof of Proposition 3. Suppose the evaluator's bias against female applicants is high; that is $\beta \in \beta_H^B$ where β_H^B is defined as in Lemma 3. The evaluator's expected utility from hiring the applicant at the information set q_H is $4 - \frac{\beta}{2}$ with corresponding hiring probability $\frac{4+\beta}{4+2\beta}$. The evaluator hires the outside option with expected value $3 - \frac{\beta}{2}$ with complementary probability $\frac{\beta}{2+\beta}$. If the applicant is a low-ability male or female, the evaluator hires the outside option with probability one as those types do not participate. In this case, the evaluator's expected utility is the expected value of the outside option:

$$\mathbb{E}[V|O] = \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}.$$

As $w \coloneqq \mathbb{E}[\bar{U}]$, the evaluator breaks even by construction after accounting for wage costs. Given the evaluator's beliefs, his overall expected gross utility in stage 1 in a separating blind audition is

$$\begin{aligned}\mathbb{E}[V|\beta \in \beta_H^B] &= p\Big[\Pr(h|q_H)\mathbb{E}[V|q_H] + [1 - \Pr(h|q_H)]\mathbb{E}[\bar{U}]\Big] + (1-p)\Big[\mathbb{E}[\bar{U}]\Big], \\ &= p\left[\frac{4+\beta}{4+2\beta}\left(4 - \frac{\beta}{2}\right) + \frac{\beta}{2+\beta}\left(3 - \frac{\beta}{2}\right)\right] + (1-p)\left[3 - \frac{\beta}{2}\right].\end{aligned}$$

After subtracting wage costs, the evaluator's expected net utility is

$$\begin{aligned}\mathbb{E}[\Pi_B|\beta\beta_H^B] &:= \mathbb{E}[V|\beta \in \beta_H^B] - w,\\ &= p\left[\frac{4+\beta}{4+2\beta}\left(4-\frac{\beta}{2}-\left(3-\frac{\beta}{2}\right)\right)\right],\\ &= p\frac{4+\beta}{4+2\beta} > 0.\end{aligned}$$

□

Proof of Theorem 1. (i) For $\beta \in \beta_L^B := [0, \sqrt{p^2+16p}-p-2]$, I show that the evaluator's expected net utility in a blind audition is strictly lower than his expected net utility in an informed audition. First, from Lemma 2(iii), it follows that $\frac{5-\sqrt{17}}{2} < \lim_{p\uparrow 1}\beta(p) < \frac{5}{4}$; that is, the highest bias for which a pooling equilibrium can be supported lies in the interval corresponding to β_M^I in an informed audition (see Figure 2a for an example). Therefore, I need to compare $\mathbb{E}[\Pi_B|\beta \in \beta_L^B]$ with $\mathbb{E}[\Pi_I|\beta \in \beta_L^I]$ and $\mathbb{E}[\Pi_I|\beta \in \beta_M^I]$ to make the above conclusion. From Proposition 1(i) and Proposition 2,

$$\begin{aligned}&\mathbb{E}[\Pi_I|\beta \in \beta_L^I] > \mathbb{E}[\Pi_B|\beta \in \beta_L^B],\\ \Rightarrow\ &\frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right)+\left(1+\frac{\beta}{2}\right)\right] > \frac{2(1+p)+\beta}{4+2\beta}p,\end{aligned}$$

which is true for any $0 < p < 1$ and $\beta > -2$. From Proposition 1(ii) and Proposition 2,

$$\begin{aligned}&\mathbb{E}[\Pi_I|\beta \in \beta_M^I] > \mathbb{E}[\Pi_B|\beta \in \beta_L^B],\\ \Rightarrow\ &\frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right]+\frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right)+\left(1+\frac{\beta}{2}\right)\right] > \frac{2(1+p)+\beta}{4+2\beta}p,\end{aligned}$$

which is true for any $\frac{1}{5} < p < 1$ and $\beta > -2$. By Lemma 2, the lower bound on the prior is more restrictive to support any pooling equilibrium. By assumption, the evaluator's bias is non-negative. Therefore, both inequalities are always satisfied and the evaluator's expected net utility in a blind audition is strictly lower.

(ii) For $\beta \in \beta_H^I \cap \beta_H^B = (\frac{6}{5}, 2)$, I show that the evaluator's net utility in a blind audition is strictly greater than in an informed audition. From Proposition 1(iii) and Proposition 3,

$$\begin{aligned}&\mathbb{E}[\Pi_B|\beta \in \beta_H^B] > \mathbb{E}[\Pi_I|\beta \in \beta_H^I],\\ \Rightarrow\ &p\frac{4+\beta}{4+2\beta} > \frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right]+\frac{p}{2}\left[\frac{1}{2+\beta}\left(-\frac{\beta}{2}\right)+\frac{1+\beta}{2+\beta}\left(\frac{\beta}{2}\right)\right],\end{aligned}$$

which is true for any $-\frac{1}{8} < p \leq 1$ and $1-\sqrt{8p+1} < \beta < \sqrt{8p+1}+1$. By assumption, the lower and upper bound on the prior are more restrictive, and the evaluator's bias lies in the interval $[0, 2]$. Therefore, the above inequality is always satisfied.

(iii) For $\beta \in \beta_M^I \cap \beta_H^B = (\sqrt{17}-3, \frac{6}{5}]$, I show that the evaluator's net utility in a blind audition is strictly greater than his expected utility in an informed audition if $0 < p < \frac{2-\beta}{2}$. From Proposition 1(ii) and Proposition 3,

$$\mathbb{E}[\Pi_B|\beta \in \beta_H^B] > \mathbb{E}[\Pi_I|\beta \in \beta_M^I],$$
$$\Rightarrow p\frac{4+\beta}{4+2\beta} > \frac{1-p}{2}\left[\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right)\right] + \frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right) + \left(1+\frac{\beta}{2}\right)\right],$$

which is true for any $p \leq 1$ and $0 < \beta < 2-2p$.

(iv) For $\beta \in \beta_M^I \cap \beta_H^B = (\sqrt{17}-3, \frac{6}{5}]$, it follows from (iii) that the strict reverse inequality

$$\mathbb{E}[\Pi_I|\beta \in \beta_M^I] > \mathbb{E}[\Pi_B|\beta \in \beta_H^B]$$

holds for any $p \leq 1$ and $\beta > 2-2p$. □

Proof of Theorem 2. (i) For $\beta \in \beta_L^B := [0, \sqrt{p^2+16p}-p-2]$ and $\frac{1}{3} \leq p < 1$, the applicant's expected utility is weakly greater in an blind audition:

$$U(e_H, \eta_L) \geq U(O, \eta_L, f),$$
$$\Rightarrow \frac{2(1+p)+\beta}{4+2\beta}w - 2 \geq 0.$$

By Lemma 2, the above inequality is the constraint on the range of β for which a pooling equilibrium can be supported and, therefore, always satisfied.

(ii) For $\beta \in \beta_H^B := (\sqrt{17}-3, 2)$, the applicant does not participate in either of the auditions and her expected utility is zero, as shown in Figure 4a. □

Proof of Theorem 3. (i) First, note that, for $\beta \in [0, 2(1-p)]$, the applicant's expected utility is weakly greater in an informed audition:

$$U(e_H, \eta_H, f) \geq U(e_H, \eta_H),$$
$$\Rightarrow \frac{2}{2+\beta} \geq \frac{2(1+p)+\beta}{4+2\beta},$$
$$\Rightarrow \beta \leq 2(1-p).$$

However, because the upper bound $\beta(p) := \sqrt{p^2+16p}-p-2$, for which a pooling equilibrium can be supported, may be more restrictive than the above inequality, I need to find the range of priors for which either constraint is more restrictive. The indifference condition is

$$\sqrt{p^2+16p}-p-2 = 2(1-p),$$
$$\Rightarrow p^* = \frac{25-\sqrt{561}}{2} \approx 0.65728.$$

For priors below p^*, $\beta(p)$ is the more restrictive constraint. For priors above p^*, the upper bound for which a high-ability female prefers an informed audition is given by $\beta \leq 2(1-p)$.

(ii) For $\beta \in \beta_H^B := (\sqrt{17}-3, 2)$, the applicant's expected utility is strictly greater in a blind audition, as shown in Figure 4b. $\square$

Proof of Theorem 4. (i) First, note that, for $\beta \in [0, \frac{5-\sqrt{17}}{2})$, the applicant does not participate in an informed audition. If $\beta \geq \frac{5-\sqrt{17}}{2}$, the applicant exerts low effort in an informed audition. Therefore, I need to compare

$$U(e_H, \eta_L) \geq U(e_L, \eta_L, m),$$
$$\Rightarrow \frac{2(1+p)+\beta}{4+2\beta}w - 2 \geq \frac{\beta}{2+\beta}w - \frac{1}{2},$$
$$\Rightarrow \beta \leq -\sqrt{p^2+2p+49}+p+7.$$

However, because the upper bound $\beta(p) := \sqrt{p^2+16p}-p-2$ for which a pooling equilibrium can be supported may be more restrictive than the above inequality, I need to find the range of priors for which either constraint is more restrictive. The indifference condition is

$$\sqrt{p^2+16p}-p-2 = -\sqrt{p^2+2p+49}+p+7,$$
$$\Rightarrow p^{**} = \frac{31-7\sqrt{17}}{4} \approx 0.53457.$$

For priors below p^{**}, $\beta(p)$ is the more restrictive constraint. For priors above p^{**}, the upper bound for which a low-ability male prefers a blind audition is given by $\beta \leq -\sqrt{p^2+2p+49}+p+7$.

(ii) For $\beta \in \beta_H^B := (\sqrt{17}-3, 2)$, the applicant's expected utility is strictly greater in an informed audition, as shown in Figure 4c. $\square$

Proof of Theorem 5. (i) For $\beta \in \beta_L^B := [0, \sqrt{p^2+16p}-p-2]$ and $\frac{1}{3} \leq p < 1$, the applicant's expected utility is strictly greater in an informed audition audition:

$$U(e_H, \eta_H, m) > U(e_H, \eta_H),$$
$$\Rightarrow 1 > \frac{2(1+p)+\beta}{4+2\beta},$$
$$\Rightarrow \beta > 2(p-1).$$

Given Lemma 2 and the assumption that evaluator's bias is non-negative, the inequality is always satisfied. (ii) For $\beta \in \beta_H^B := (\sqrt{17}-3, 2)$, the applicant's expected utility is also strictly greater in an informed audition, as shown in Figure 4d. $\square$

Proof of Lemma 1′. First, note that, when taking into account the performance uncertainty in the mapping from low effort to performance quality, the expected utilities of the four types of applicants are

$$
\begin{aligned}
U(e_L,\eta_L,f) &= \frac{\varepsilon}{2+\beta}w-\frac{1}{2}, & U(e_L,\eta_L,m) &= \left[\frac{\beta(1-\varepsilon)}{2+\beta}+\frac{(1+\beta)\varepsilon}{2+\beta}\right]w-\frac{1}{2},\\
U(e_H,\eta_L,f) &= \frac{1}{2+\beta}w-2, & U(e_H,\eta_L,m) &= \frac{1+\beta}{2+\beta}w-2,\\
U(e_L,\eta_H,f) &= \left[\frac{1-\varepsilon}{2+\beta}+\frac{2\varepsilon}{2+\beta}\right]w-\frac{1}{4}, & U(e_L,\eta_H,m) &= \left[\frac{(1+\beta)(1-\varepsilon)}{2+\beta}+\varepsilon\right]w-\frac{1}{4},\\
U(e_H,\eta_H,f) &= \frac{2}{2+\beta}w-1, & U(e_H,\eta_H,m) &= w-1
\end{aligned}
$$

in an informed audition, where $w := \mathbb{E}[\bar{U}] = 3-\frac{\beta}{2}$. Next, I consider the effect of performance uncertainty on incentive compatibility and participation constraints for all four types of applicants.

For low-ability females, a combination of high performance uncertainty and low bias makes participating and exerting low effort in an informed audition worthwhile. In particular, low-ability females exert low effort instead of dropping out if

$$U(e_L,\eta_L,f)\geq 0 \Rightarrow 0\leq\beta\leq\frac{2(3\varepsilon-1)}{\varepsilon+1}.$$

Given that the bias is constrained to be non-negative, this results in the threshold $\bar{\beta}_{LF}(\varepsilon) := \frac{2(3\varepsilon-1)}{\varepsilon+1}$ for $\varepsilon\in[\frac{1}{3},\frac{1}{2})$ and $\bar{\beta}_{LF} := 0$ for $\varepsilon\in[0,\frac{1}{3})$. At $\bar{\varepsilon} := \frac{1}{3}$, low effort is worthwhile if the evaluator is impartial. Beyond this critical value, the threshold bias for participation is increasing in ε:

$$\frac{d\bar{\beta}_{LF}(\varepsilon)}{d\varepsilon}=\frac{8}{(\varepsilon+1)^2}>0\ \forall\ \varepsilon\in\left[\frac{1}{3},\frac{1}{2}\right).$$

In other words, beyond a critical level of performance uncertainty, the evaluator can be increasingly biased against female applicants and still make low effort worthwhile. This is depicted in Figure 18a, where $\varepsilon_0 = 0$.

In contrast, performance uncertainty has an adverse effect on high-ability females. In particular, high-ability females exert low rather than high effort if

$$U(e_L,\eta_H,f)\geq U(e_H,\eta_H,f)\Rightarrow\beta\geq\frac{6-12\varepsilon}{5-2\varepsilon}.$$

Thus, $\bar{\beta}_{HF}(\varepsilon) := \frac{6-12\varepsilon}{5-2\varepsilon}$ for $\varepsilon\in[0,\frac{1}{2})$. For all levels of performance uncertainty, this threshold bias is decreasing in ε:

$$\frac{d\bar{\beta}_{HF}(\varepsilon)}{d\varepsilon}=-\frac{48}{(5-2\varepsilon)^2}<0\ \forall\ \varepsilon\in\left[0,\frac{1}{2}\right).$$

In fact, as $\varepsilon\uparrow\frac{1}{2}$, the threshold bias approaches zero (Figure 18b). Intuitively, the more uncertain the environment, the lower the bias has to be to distort effort incentives for a highly able female.

For low-ability males, the threshold bias, beyond which participating and exerting low effort is worthwhile, falls with the introduction of performance uncertainty to the environment. In particular, low-ability males exert low effort instead of dropping out if

$$U(e_L, \eta_L, m) \geq 0 \Rightarrow \beta \geq \frac{5 - \varepsilon - \sqrt{\varepsilon^2 + 14\varepsilon + 17}}{2} \geq 0.$$

Thus, $\bar{\beta}_{LM}(\varepsilon) \coloneqq \frac{5-\varepsilon-\sqrt{\varepsilon^2+14\varepsilon+17}}{2}$ for $\varepsilon \in [0, \frac{1}{3})$ and $\bar{\beta}_{LM} \coloneqq 0$ for $\varepsilon \in [\frac{1}{3}, \frac{1}{2})$. For $\varepsilon < \bar{\varepsilon}$, this threshold bias is decreasing in ε:

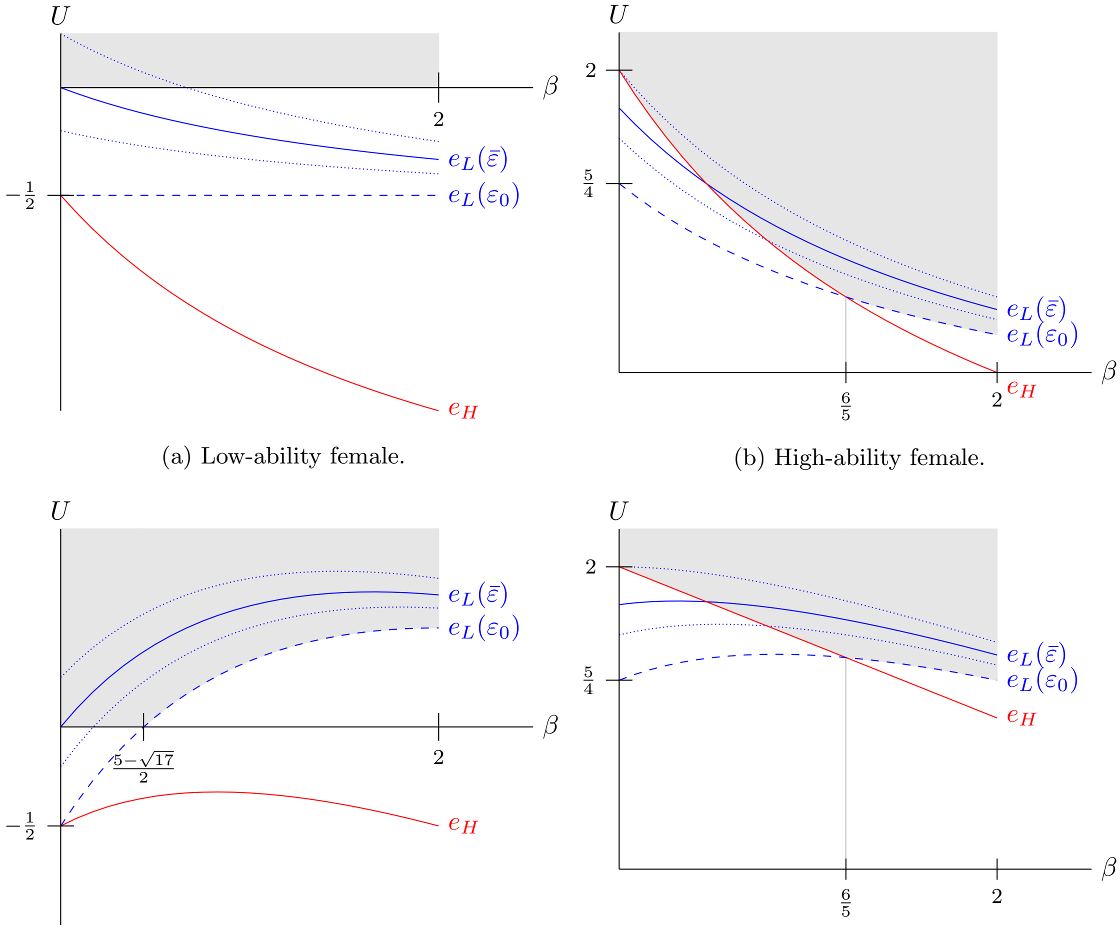
$$\frac{d\bar{\beta}_{LM}(\varepsilon)}{d\varepsilon} = -\frac{1}{2}\left[1 + \frac{\varepsilon + 7}{\sqrt{\varepsilon^2 + 14\varepsilon + 17}}\right] < 0 \;\forall\; \varepsilon \in \left[0, \frac{1}{3}\right).$$

For $\varepsilon \geq \bar{\varepsilon}$, low-ability males are always induced to participate and exert low effort even if the evaluator is impartial (Figure 18c).

Performance uncertainty has an adverse effect on high-ability males. In particular, high-ability males exert low rather than high effort if

$$U(e_L, \eta_H, m) \geq U(e_H, \eta_H, m) \Rightarrow \beta \geq \frac{6 - 12\varepsilon}{5 - 2\varepsilon}.$$

Thus, $\bar{\beta}_{HM}(\varepsilon) \coloneqq \frac{6-12\varepsilon}{5-2\varepsilon}$ for $\varepsilon \in [0, \frac{1}{2})$. Because this threshold bias coincides with the one derived for high-ability females, it follows immediately that $\bar{\beta}_{HM}(\varepsilon)$ is decreasing in ε. Similarly, as $\varepsilon \uparrow \frac{1}{2}$, the threshold bias approaches zero (Figure 18d). I define $\bar{\beta}_{HA}(\varepsilon) \coloneqq \bar{\beta}_{HF}(\varepsilon) = \bar{\beta}_{HM}(\varepsilon)$ to highlight that the thresholds for high-ability females and males coincide.



(a) Low-ability female.

(b) High-ability female.

(c) Low-ability male.

(d) High-ability male.

Figure 18: Effort choices in an informed audition under performance uncertainty.

□

Proof of Proposition 1′. Suppose the evaluator's bias against female applicants is low; that is, $\beta \in \beta_L^I(\varepsilon)$ where $\beta_L^I(\varepsilon)$ is defined as in Lemma 1′(i). Then, the evaluator's expected net utility (4) is not affected by performance uncertainty because the bias-uncertainty combination is sufficiently low as to provide targeted effort incentives.

The proof for a moderate and high bias follows the steps detailed in the proof of Proposition 1 when there is no performance uncertainty. In particular, suppose the evaluator is moderately biased against female applicants; that is, $\beta \in \beta_M^I(\varepsilon)$ where β_M^I is defined as in Lemma 1′(ii). Then,

$$\mathbb{E}[\Pi_I|\beta \in \beta_M^I(\varepsilon)] = \frac{1-p}{2}\left[(1-\varepsilon)\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right) + \varepsilon\frac{1+\beta}{2+\beta}\left(\frac{\beta}{2}\right)\right] \\ + \frac{p}{2}\left[\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right) + \left(1+\frac{\beta}{2}\right)\right] \gtrless 0.$$

Suppose the evaluator is highly biased against female applicants; that is, $\beta \in \beta_H^I(\varepsilon)$ where β_H^I is defined as in Lemma 1′(iii). Then,

$$\mathbb{E}[\Pi_I|\beta \in \beta_H^I(\varepsilon)] = \frac{1-p}{2}\left[(1-\varepsilon)\frac{\beta}{2+\beta}\left(\frac{\beta}{2}-1\right) + \varepsilon\frac{1+\beta}{2+\beta}\left(\frac{\beta}{2}\right)\right] \\ + \frac{p}{2}\left[(1-\varepsilon)\frac{1}{2+\beta}\left(-\frac{\beta}{2}\right) + \varepsilon\frac{2}{2+\beta}\left(1-\frac{\beta}{2}\right) + (1-\varepsilon)\frac{1+\beta}{2+\beta}\left(\frac{\beta}{2}\right) + \varepsilon\left(1+\frac{\beta}{2}\right)\right] \gtrless 0.$$

□

Proof of Lemma 2′. First, note that, when taking into account the performance uncertainty in the mapping from low effort to performance quality, the expected utilities are

$$\begin{aligned} U(e_L,\eta_L) &= \left[\frac{\beta}{4+2\beta}(1-\varepsilon) + \frac{(2(1+p)+\beta)}{4+2\beta}\varepsilon\right]w - \frac{1}{2}, \\ U(e_H,\eta_L) &= \frac{2(1+p)+\beta}{4+2\beta}w - 2, \\ U(e_L,\eta_H) &= \left[\frac{\beta}{4+2\beta}(1-\varepsilon) + \frac{(2(1+p)+\beta)}{4+2\beta}\varepsilon\right]w - \frac{1}{4}, \\ U(e_H,\eta_H) &= \frac{2(1+p)+\beta}{4+2\beta}w - 1 \end{aligned}$$

in a pooling blind audition, where $w := \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$. I now consider the three cases separately.

(i) First, note that $U(e_H,\eta_L)$ is independent of ε. Therefore, by Lemma 2(i), for $p < \frac{1}{3}$, pooling on high effort is never possible.

(ii) For $p = \frac{1}{3}$, $U(e_H,\eta_L) = 0$ at $\beta = 0$. By Lemma 2(i), $U(e_H,\eta_L) < 0$ for all $\beta \in (0,2]$. This implies that the low-ability applicant is indifferent between exerting high effort and not participating only if the evaluator is unbiased. Under performance uncertainty, I also need to ensure incentive compatibility. Because it is optimal for high-ability applicants to exert high effort whenever it is optimal for low-ability applicants to exert high effort, this constraint is given by

$$U(e_H,\eta_L)\Big|_{\beta=0,p=\frac{1}{3}} \geq U(e_L,\eta_L)\Big|_{\beta=0,p=\frac{1}{3}} \Rightarrow \varepsilon \leq \frac{1}{4}.$$

Thus, pooling on high effort is possible at $p = \frac{1}{3}$ if $\beta = 0$ and $\varepsilon \leq \frac{1}{4}$.

(iii) For $\frac{1}{3} < p < 1$, for low degrees of performance uncertainty, the upper bound on β for which a pooling equilibrium can be supported is determined by the indifference condition

$$U(e_H, \eta_L) = \frac{2(1+p)+\beta}{4+2\beta}\left(3 - \frac{\beta}{2}\right) - 2 = 0.$$

Given that $\beta \in [0, 2]$, the above equation is uniquely solved by $\beta(p) \coloneqq \sqrt{p^2 + 16p} - p - 2$. For larger degrees of performance uncertainty, the upper bound on β for which a pooling equilibrium can be supported is determined by the indifference condition

$$U(e_H, \eta_L) = U(e_L, \eta_L).$$

Given that $\beta \in [0, 2]$, $\varepsilon \in [0, \frac{1}{2})$ and $p \in (0, 1)$, the above equation is uniquely solved by $\beta(p, \varepsilon) \coloneqq \frac{6(p\varepsilon - p + \varepsilon)}{p\varepsilon - p + \varepsilon - 4}$. Therefore, the upper bound on a high-effort pooling equilibrium is given by $\bar{\beta}_{pool}(p, \varepsilon) \coloneqq \min\{\beta(p), \beta(p, \varepsilon)\}$, provided that $\bar{\beta}_{pool}(p, \varepsilon)$ is non-negative. Otherwise, no high-effort pooling equilibrium exists. □

Proof of Lemma 3′. First, note that when taking into account the performance uncertainty in the mapping from low effort to performance quality, the expected utilities are

$$\begin{aligned}
U(e_L, \eta_L) &= \left[\frac{\beta}{4+2\beta}(1-\epsilon) + \frac{4+\beta}{4+2\beta}\epsilon\right] w - \frac{1}{2} \\
U(e_H, \eta_L) &= \frac{4+\beta}{4+2\beta} w - 2 \\
U(e_L, \eta_H) &= \left[\frac{\beta}{4+2\beta}(1-\epsilon) + \frac{4+\beta}{4+2\beta}\epsilon\right] w - \frac{1}{4} \\
U(e_H, \eta_H) &= \frac{4+\beta}{4+2\beta} w - 1
\end{aligned}$$

in a fully separating blind audition, where $w \coloneqq \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$. In now show that, for $\varepsilon > \hat{\varepsilon}$, there is no range of biases that can support a separating equilibrium in which low-ability applicants do not participate.

First, note that low-ability applicants must find it optimal to drop out of the audition. This gives the lower bound $\underline{\beta}_{full}$ and the upper bound $\bar{\beta}_{full}(\varepsilon)$ for which a fully separating equilibrium can be supported. Given that $\frac{\partial U(e_H, \eta_L)}{\partial \beta} < 0$ and $\frac{\partial U(e_L, \eta_L)}{\partial \beta} > 0$, the lower bound is determined by the indifference condition

$$U(e_H, \eta_L) = 0.$$

For $\beta \in [0, 2]$, the above equation is uniquely solved by $\underline{\beta}_{full} = \sqrt{17} - 3$. The upper bound is determined by the indifference condition

$$U(e_L, \eta_L) = 0.$$

For $\beta \in [0,2]$ and $\epsilon \in [0, \frac{1}{2})$, the above equation is uniquely solved by $\bar{\beta}_{full}(\varepsilon) = 2(1-\varepsilon) - 2\sqrt{\varepsilon(4+\varepsilon)}$. Therefore, for $\beta \in [0, \underline{\beta}_{full}]$, low-ability applicants exert high effort. For $\beta \in (\underline{\beta}_{full}, \bar{\beta}_{full}(\varepsilon))$, low-ability applicants do not participate and, for $\beta \in [\bar{\beta}_{full}(\varepsilon), 2]$, low-ability applicants exert low effort.

Second, note that the lower bound $\underline{\beta}_{full}$ is independent of ε whereas the upper bound is strictly decreasing in ε:

$$\frac{d\bar{\beta}_{full}(\varepsilon)}{d\varepsilon} = -2 - \frac{4+2\varepsilon}{\sqrt{\varepsilon(4+\varepsilon)}} < 0 \ \forall \ \varepsilon \in \left[0, \frac{1}{2}\right).$$

Therefore, the interval $(\underline{\beta}_{full}, \bar{\beta}_{full}(\varepsilon))$ in which low-ability applicants drop out of the audition is strictly decreasing in ε. In particular, if performance uncertainty exceeds a threshold, the interval is a zero-measure set: the upper bound falls below the lower bound and there is no range of biases that can support a fully separating equilibrium. This performance uncertainty treshold solves

$$\underline{\beta}_{full} \coloneqq \sqrt{17} - 3 = 2(1-\hat{\varepsilon}) - 2\sqrt{\hat{\varepsilon}(4+\hat{\varepsilon})} =: \bar{\beta}_{full}(\hat{\varepsilon}),$$

and is uniquely given by $\hat{\varepsilon} = \frac{13-3\sqrt{17}}{16}$.

Finally, note that I can neglect high-ability applicants in the analysis. Their participation is guaranteed: $U(e_H, \eta_H) > 0$. Moreover, for all $\varepsilon \in [0, \frac{1}{2})$, the upper bound $\beta(\varepsilon) = \frac{6(4\varepsilon-3)}{4\varepsilon-7}$ implied by the incentive compatibility constraint of high-ability applicants, $U(e_H, \eta_H) = U(e_L, \eta_H)$, is less stringent than the upper bound $\bar{\beta}_{full}(\varepsilon)$ implied by the participation constraint of low-ability applicants. □

Proof of Lemma 4′. First, by Bayes' rule, when observing a high-quality performance, the evaluator believes the applicant to be of high ability with probability

$$\Pr(\eta_H | q_H) = \frac{p}{p + \varepsilon(1-p)} \coloneqq \gamma,$$

and of low ability with complementary probability. At q_H, the evaluator, therefore, expects gross utility

$$\begin{aligned}
\mathbb{E}[V|q_H] &= q_H + \mathbb{E}[\eta|q_H] - \frac{\beta}{2} = 2 + \left[\frac{\varepsilon(1-p)}{p+\varepsilon(1-p)} + \frac{2p}{p+\varepsilon(1-p)}\right] - \frac{\beta}{2}, \\
&= 2 + \left[1 + \frac{p}{p+\varepsilon(1-p)}\right] - \frac{\beta}{2}, \\
&= 3 + \gamma - \frac{\beta}{2}
\end{aligned}$$

from hiring the applicant. Thus, the hiring probability at q_H modifies to

$$\Pr(h|q_H) = \Pr(\bar{U} \leq 3 + \gamma - \frac{\beta}{2}) = \frac{2(1+\gamma)+\beta}{4+2\beta}.$$

When taking into account the performance uncertainty in the mapping from low effort to performance quality, the expected utilities are

$$
\begin{aligned}
U(e_L, \eta_L) &= \left[\frac{\beta}{4+2\beta}(1-\varepsilon) + \frac{2(1+\gamma)+\beta}{4+2\beta}\varepsilon\right]w - \frac{1}{2},\\
U(e_H, \eta_L) &= \frac{2(1+\gamma)+\beta}{4+2\beta}w - 2,\\
U(e_L, \eta_H) &= \left[\frac{\beta}{4+2\beta}(1-\varepsilon) + \frac{2(1+\gamma)+\beta}{4+2\beta}\varepsilon\right]w - \frac{1}{4},\\
U(e_H, \eta_H) &= \frac{2(1+\gamma)+\beta}{4+2\beta}w - 1,
\end{aligned}
$$

in a partially separating blind audition, where $w := \mathbb{E}[\bar{U}] = 3 - \frac{\beta}{2}$. I now show that, for $\beta \in \beta_H^B(\varepsilon) := (\underline{\beta}_{sep}(p,\varepsilon), \bar{\beta}_{sep}(p,\varepsilon)]$ where $\underline{\beta}_{sep}(p,\varepsilon) < \bar{\beta}_{sep}(p,\varepsilon)$, a partially separating equilibrium exists.

First, note that low-ability applicants must find it optimal to exert low effort. This gives the lower bound $\underline{\beta}_{sep}(p,\varepsilon)$ for which a partially separating equilibrium can be supported. For low degrees of performance uncertainty, the lower bound is determined by the indifference condition

$$U(e_L, \eta_L) = 0.$$

Given that $\beta \in [0,2]$, $\varepsilon \in [0, \frac{1}{2})$ and $p \in (0,1)$, the above equation is uniquely solved by $\underline{\beta}_{sep'}(p,\varepsilon) := \frac{\sqrt{p^2\varepsilon^4+4p^2\varepsilon^3-20p^2\varepsilon^2+16p^2\varepsilon-2p\varepsilon^4-12p\varepsilon^3+24p\varepsilon^2+\varepsilon^4+8\varepsilon^3}-p\varepsilon^2+4p\varepsilon-2p+\varepsilon^2-2\varepsilon}{p\varepsilon-p-\varepsilon}$. For larger degrees of performance uncertainty, the lower bound is determined by the indifference condition

$$U(e_L, \eta_L) = U(e_H, \eta_L).$$

Given that $\beta \in [0,2]$, $\varepsilon \in [0, \frac{1}{2})$ and $p \in (0,1)$, the above equation is uniquely solved by $\underline{\beta}_{sep''}(p,\varepsilon) := \frac{6(p\varepsilon^2-2p\varepsilon+p-\varepsilon^2)}{p\varepsilon^2-6p\varepsilon+5p-\varepsilon^2+4\varepsilon}$. Therefore, the lower bound of the partially separating equilibrium is given by $\underline{\beta}_{sep}(p,\varepsilon) := \max\{0, \underline{\beta}_{sep'}(p,\varepsilon), \underline{\beta}_{sep''}(p,\varepsilon)\}$.

Second, note that high-ability applicants must find it optimal to exert high effort. This gives the upper bound $\bar{\beta}_{sep}(p,\varepsilon)$ for which a partially separating equilibrium can be supported. For high degrees of performance uncertainty, the upper bound is determined by the indifference condition

$$U(e_L, \eta_H) = U(e_H, \eta_H).$$

Given that $\beta \in [0,2]$, $\varepsilon \in [0, \frac{1}{2})$ and $p \in (0,1)$, the above equation is uniquely solved by $\bar{\beta}_{sep'}(p,\varepsilon) := \frac{6(2p\varepsilon^2-5p\varepsilon+3p-2\varepsilon^2+\varepsilon)}{2p\varepsilon^2-9p\varepsilon+7p-2\varepsilon^2+5\varepsilon}$. Therefore, the upper bound of the partially separating equilibrium is given by $\bar{\beta}_{sep}(p,\varepsilon) := \min\{2, \bar{\beta}_{sep'}(p,\varepsilon)\}$. □

Proof of Proposition 2′. The proof follows the steps detailed in the proof of Proposition 3 when there is no performance uncertainty. The evaluator's expected net utility is then obtained from simplifying

$$\begin{aligned}
&\mathbb{E}[\Pi_B|\beta \in \beta_H^B(\varepsilon)] = \\
&\quad (1-p)\left[\frac{\beta}{4+2\beta}(1-\varepsilon)\left(2-\frac{\beta}{2}-\left(3-\frac{\beta}{2}\right)\right)+\frac{2(1+\gamma)+\beta}{4+2\beta}\varepsilon\left(3-\frac{\beta}{2}-\left(3-\frac{\beta}{2}\right)\right)\right] \\
&\qquad + p\left[\frac{2(1+\gamma)+\beta}{4+2\beta}\left(4-\frac{\beta}{2}-\left(3-\frac{\beta}{2}\right)\right)\right], \\
&\qquad\qquad = (1-p)\left[-\frac{\beta}{4+2\beta}(1-\varepsilon)\right]+p\left[\frac{2(1+\gamma)+\beta}{4+2\beta}\right] \gtrless 0.
\end{aligned}$$

□

Proof of Proposition 4. Under Assumption 3, the agency cost in an informed audition is calculated by substituting the evaluator's expected net utility for a low, moderate and high bias, detailed in Proposition 1, into Definition 1:

$$AC_I(\beta,p) = \begin{cases} 0 & \text{if } \beta \in \beta_L^I, \\ \frac{1-p}{2}\frac{\beta}{2+\beta}\left(1-\frac{\beta}{2}\right) & \text{if } \beta \in \beta_M^I, \\ \frac{1-p}{2}\frac{\beta}{2+\beta}\left(1-\frac{\beta}{2}\right)+\frac{p}{2}\left(\frac{4+\beta}{2+\beta}\right) & \text{if } \beta \in \beta_H^I. \end{cases}$$

The agency cost in a blind audition is calculated by substituting the evaluator's expected net utility for a low bias, detailed in Proposition 2, and for a high bias, detailed in Proposition 3, into Definition 1:

$$AC_B(\beta,p) = \begin{cases} 0 & \text{if } \beta \in \beta_H^B, \\ \frac{2p(1-p)}{4+2\beta} & \text{if } \beta \in \beta_L^B. \end{cases}$$

□

References

Abeles, Hal, "Are Musical Instrument Gender Associations Changing?," *Journal of Research in Music Education*, 2009, *57* (2), 127–139.

Adler, Moshe, "Stardom and Talent," *The American Economic Review*, March 1985, *75* (1), 208–212.

Allmendinger, Jutta and J. Richard Hackman, "The More, the Better? A Four-Nation Study of the Inclusion of Women in Symphony Orchestras," *Social Forces*, 1995, *74* (2), 423–460.

Antecol, Heather and Deborah A. Cobb-Clark, "Identity and Racial Harassment," *Journal of Economic Behavior & Organization*, 2008, *66* (3), 529 – 557.

Anwar, Shamena, "Testing for Discrimination: Evidence from the Game Show Street Smarts," *Journal of Economic Behavior & Organization*, 2012, *81* (1), 268 – 285.

Bagues, Manuel and Maria J. Perez-Villadoniga, "Do Recruiters prefer Applicants with similar Skills? Evidence from a Randomized Natural Experiment," *Journal of Economic Behavior & Organization*, 2012, *82* (1), 12 – 20.

Becker, Gary S., *The Economics of Discrimination*, 2 ed., Chicago: University of Chicago Press, 1971.

Bertrand, Marianne and Sendhil Mullainathan, "Are Emily and Greg More Employable Than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination," *The American Economic Review*, September 2004, *94* (4), 991–1013.

_ , Sandra E. Black, Sissel Jensen, and Adriana Lleras-Muney, "Breaking the Glass Ceiling? The Effect of Board Quotas on Female Labour Market Outcomes in Norway," *The Review of Economic Studies*, 2019, *86* (1), 191–239.

Cain Miller, Claire, "Is Blind Hiring the Best Hiring?," *The New York Times Magazine*, 25 February 2016. Available at `https://www.nytimes.com/2016/02/28/magazine/is-blind-hiring-the-best-hiring.html`. Accessed: 24 February 2019.

Card, David, Jochen Kluve, and Andrea Weber, "Active Labour Market Policy Evaluations: A Meta-Analysis*," *The Economic Journal*, 2010, *120* (548), F452–F477.

_ , _ , and _ , "What Works? A Meta Analysis of Recent Active Labor Market Program Evaluations," *Journal of the European Economic Association*, June 2017, *16* (3), 894–931.

Castiglione, Lawrence V., "Performance, Practice, and Policy Considerations," *Design For Arts in Education*, September / October 1985, *1* (87), 31–37.

Cho, In-Koo and David M. Kreps, "Signaling Games and Stable Equilibria," *The Quarterly Journal of Economics*, May 1987, *102* (2), 179–221.

Coate, Stephen and Glenn C. Loury, "Will Affirmative-Action Policies Eliminate Negative Stereotypes?," *The American Economic Review*, 1993, *83* (5), 1220–1240.

Conor, Bridget, Rosalind Gill, and Stephanie Taylor, "Gender and Creative Labour," *The Sociological Review*, 2015, *63* (S1), 1–22.

Cornell, Bradford and Ivo Welch, "Culture, Information, and Screening Discrimination," *Journal of Political Economy*, 1996, *104* (3), 542–71.

Elliott, Charles A., "Race and Gender as Factors in Judgments of Musical Performance," *Bulletin of the Council for Research in Music Education*, 1995, *127* (Winter), 50–56.

Ericsson, K. A., "The Influence of Experience and Deliberate Practice on the Development of Superior Expert Performance," in K. A. Ericsson, N. Charness, P. J. Feltovich, and R. R. Hoffman, eds., *The Cambridge Handbook of Expertise and Expert Performance*, Cambridge: Cambridge University Press, 2006, chapter 38, pp. 683–703.

_ , R. T. Krampe, and C. Tesch-Romer, "The Role of Deliberate Practice in the Acquisition of Expert Performance," *Psychological Review*, July 1993, *3* (100), 363–406.

Fryer, Roland and Matthew Jackson, "A Categorical Model of Cognition and Biased Decision Making," *The B.E. Journal of Theoretical Economics*, 2008, *8* (1), 1–44.

Fudenberg, Drew and Jean Tirole, *Game Theory*, Cambridge, MA: MIT Press, 1991.

Gallwey, W. Timothy, *The Inner Game of Tennis*, New York: Random House, 1974.

Gladwell, Malcolm, *Blink: The Power of Thinking without Thinking*, New York: Little, Brown & Company, 2005.

Glazebrook, Kate, "What is Blind Hiring?," https://www.beapplied.com/post/what-is-blind-hiring 22 July 2019. Accessed: 18 November 2019.

Goldin, Claudia and Cecilia Rouse, "Orchestrating Impartiality: The Impact of "Blind" Auditions on Female Musicians," *The American Economic Review*, September 2000, *90* (4), 715–741.

Grossman, Sanford J., "An Introduction to the Theory of Rational Expectations Under Asymmetric Information," *Review of Economic Studies*, October 1981, *48* (4), 541–559.

Günther, Christina, Neslihan Arslan Ekinci, Christiane Schwieren, and Martin Strobel, "Women can't jump?—An Experiment on Competitive Attitudes and Stereotype Threat," *Journal of Economic Behavior & Organization*, 2010, *75* (3), 395 – 401.

Hart, Philip, *Orpheus in the New World: The Symphony Orchestras as an American Cultural Institution— its Past, Present, and Future*, New York: W.W. Norton & Company, 1973.

Hays, Kate F. and Charles H. Brown, *You're on! Consulting for Peak Performance*, Washington, DC: American Psychological Association, 2006.

Hewstone, Miles, Mark Rubin, and Hazel Willis, "Intergroup Bias," *Annual Review of Psychology*, 2002, *53* (1), 575–604.

Holland, Bernard, "The Fair, New World of Orchestra Auditions," *The New York Times*, 11 January 1981.

Jensen, Michael C. and William H. Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics*, 1976, *3*, 305–360.

Kamakura, Wagner A. and Carl W. Schimmel, "Uncovering Audience Preferences for Concert Features from Single-Ticket Sales with a Factor-Analytic Random-Coefficients Model," *International Journal of Research in Marketing*, June 2013, *30* (2), 129–142.

Laffont, Jean-Jacques and Jean Tirole, "Using Cost Observation to Regulate Firms," *Journal of Political Economy*, 1986, *94* (3), 614–641.

Levinson, Gary, "Preparing for an Orchestral Audition: the Basics," https://www.thestrad.com/preparing-for-an-orchestral-audition-the-basics/6964.article July 2017. Accessed: 22 February 2019.

Makoff-Clark, Annie, "Is Blind Recruitment the Secret to the Perfect Hire?," *People Management*, 24 January 2019. Available at https://www.peoplemanagement.co.uk/long-reads/articles/blind-recruitment-secret-perfect-hire. Accessed: 14 November 2019.

Manzoni, John, "Name-Blind Recruitment – A Commitment to Diversity," https://civilservice.blog.gov.uk/2015/11/05/name-blind-recruitment-a-commitment-to-diversity/ 5 November 2015. Accessed: 18 November 2019.

McPherson, Gary E. and Emery Schubert, "Measuring Performance Enhancement in Music," in Aaron Williamon, ed., *Musical Excellence: Strategies and Techniques to Enhance Performance*, Oxford: Oxford University Press, 2004, chapter 4, pp. 61–82.

Meyer, Margaret A. and John Vickers, "Performance Comparisons and Dynamic Incentives," *Journal of Political Economy*, 1997, *105* (3), 547–581.

Milgrom, Paul R., "Good News and Bad News: Representation Theorems and Applications," *The Bell Journal of Economics*, Autumn 1981, *12* (2), 380–391.

Moro, Andrea and Peter Norman, "Affirmative Action in a Competitive Economy," *Journal of Public Economics*, 2003, *87* (3), 567 – 594.

Musicians' Union, "Employment Agreements: Negotiated Rates," https://www.musiciansunion.org.uk/Home/Advice/Playing-Live/Orchestral-Work/Pay-Conditions/Employment-Agreements. Accessed: 23 February 2019.

National Endowment For The Arts, "Art-Goers in Their Communities: Patterns of Civic and Social Engagement," https://www.arts.gov/sites/default/files/98.pdf October 2009. Accessed: 09 March 2019.

Oberholzer-Gee, Felix, "Nonemployment Stigma as Rational Herding: A Field Experiment," *Journal of Economic Behavior & Organization*, 2008, *65* (1), 30 – 40.

Page, Lionel and Katie Page, "Last shall be First: A Field Study of Biases in Sequential Performance Evaluation on the Idol Series," *Journal of Economic Behavior & Organization*, 2010, *73* (2), 186 – 198.

Purkiss, Sharon L. Segrest, Pamela L. Perrewé, Treena L. Gillespie, Bronston T. Mayes, and Gerald R. Ferris, "Implicit Sources of Bias in Employment Interview Judgments and Decisions," *Organizational Behavior and Human Decision Processes*, 2006, *101* (2), 152 – 167.

Rosen, Sherwin, "The Economics of Superstars," *The American Economic Review*, December 1981, *71* (5), 845–58.

Seltzer, George, *Music Matters: The Performer and the American Federation of Musicians*, Metuchen, NJ: Scarecrow Press, 1989.

Sergeant, Desmond Charles and Evangelos Himonides, "Orchestrated Sex: The Representation of Male and Female Musicians in World-Class Symphony Orchestras," *Frontiers in Psychology*, 2019, *10*, 1–18.

Snower, Dennis J., "The Low-Skill, Bad-Job Trap," *CEPR Discussion Paper Series, Centre for Economic Policy Research*, 1994, *999*, 1–21.

Social Impact of the Arts Project, "Culture and Social Wellbeing in New York City: Highlights of a Two-Year Research Project," https://repository.upenn.edu/siap_culture_nyc/2 February 2017. Accessed: 09 March 2019.

Sowell, Thomas, *Affirmative Action around the World: An Empirical Study*, New Haven, CT: Yale University Press, 2004.

Spence, Michael, "Job Market Signaling," *The Quarterly Journal of Economics*, August 1973, *87* (3), 355–374.

Starr, Susan, "The Prejudice Against Women," *Music Journal*, 1 March 1974, *32* (3), 14–15, 28.

Stronsick, Lisa M., Samantha E. Tuft, Sara Incera, and Conor T. McLennan, "Masculine Harps and Feminine Horns: Timbre and Pitch Level influence Gender Ratings of Musical Instruments," *Psychology of Music*, 2018, *46* (6), 896–912.

Taylor, Curtis R. and Huseyin Yildirim, "Subjective Performance and the Value of Blind Evaluation," *The Review of Economic Studies*, April 2011, *78* (2), 762–794.

The Economist, "All Ears," *The Economist*, 30 November 1996, *341* (7994), 89–90; UK 135–136.

Thorngate, Warren, Robyn M. Dawes, and Margaret Foddy, *Judging Merit*, New York: Psychology Press, 2010.

Throsby, Charles D. and Glenn A. Withers, *The Economics of the Performing Arts*, London: Edward Arnold Publishers, 1979.

Towse, Ruth, "Market Value and Artists' Earnings," in Arjo Klamer, ed., *The Value of Culture: On the Relationship between Economics and Arts*, Amsterdam: Amsterdam University Press, 1996, chapter 6, pp. 96–107.

_ , *A Textbook of Cultural Economics*, Cambridge, UK: Cambridge University Press, 2010.

Tsay, Chia-Jung, "Sight over Sound in the Judgment of Music Performance," *PNAS*, 3 September 2013, *110* (36), 14580–14585.

_ **and Mahzarin R. Banaji**, "Naturals and Strivers: Preferences and Beliefs about Sources of Achievement," *Journal of Experimental Social Psychology*, 2011, *47* (2), 460–465.

Universal Music Group, "Universal Music Group signs Global Recording, Artist Services Agreement for New TV Music Sensation, 'The Voice of ...'," https://www.universalmusic.com/universal-music-group-signs-global-recording-artist-services-agreement-for-new-tv-music-sensation-the-voice-of/ 19 January 2011. Accessed: 22 February 2019.

U.S. Commission on Civil Rights, "Statement on Affirmative Action," *Clearinghouse Publication No. 54*, 1977, pp. 1–12.

Vernos, Isabelle, "Quotas are Questionable," *Nature*, 7 March 2013, *495*, 39.