Received: 23 March 2023 | Accepted: 27 August 2023
DOI: 10.1002/mde.4003

RESEARCH ARTICLE

WILEY

Performance contests and merit pay with empathic employees

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Abstract

This paper studies the behavioral responses of employees who are endowed with empathic abilities to different institutional designs of incentive pay. Empathic abilities motivate altruistic behavior by sensing the other's feelings toward oneself. In performance contests, empathic individuals withhold effort, most (less) strongly when facing a non-empathic (empathic) contestant. Effort levels of both non-empathic and empathic individuals increase with a higher probability that the contestant is of their own type. By developing a theoretical model, our analysis contributes to understanding observed individual behavior in experiments and corresponding econometric evidence. With direct merit pay, effort choices only depend on the signaling quality of the performance measure. Individuals with stronger empathic abilities may shy away from performance contests to, instead, receive merit pay. If gender governs empathic abilities, setting incentives by performance contests cannot simultaneously ensure equal pay and equal opportunities.

JEL CLASSIFICATION
J78, K10, M51

1 | INTRODUCTION

To a considerable extent, economy-wide wage inequality reflects performance pay for employees who share the same job description within their firms (Lemieux et al., 2009). In its own virtue, such inequality affects the competitive behavior of individuals who possess other-regarding preferences (Bolton & Ockenfels, 2000; Fehr & Schmidt, 1999). While this link between such individuals' behavior and induced outcomes is obvious, the effects of different incentive designs on employees' effort choices are only rarely analyzed.[1] Moreover, the existing literature is overwhelmingly experimental in nature. We develop a theoretical model to study the behavioral responses of employees who are endowed with empathic abilities to different institutional designs of incentive pay. Our analysis contributes to, in a decision-theoretic sense, understanding observed individual behavior in experiments and corresponding econometric evidence. It further allows forming expectations regarding the consequences of policy interventions to reduce pay inequality and enforce equal opportunities in performance contests for bonuses.

Social preferences are typically modeled by letting an individual's instantaneous utility depend on other individuals' income or utility (Camerer, 2003; Frey & de Rijt, 2016).[2] However, emotions are what motivates individuals to engage in social activities; hence, they shape an individual's social preferences (Kirman et al., 2010; Kirman & Teschl, 2010). Empathy, being an emotional ability, has been found to motivate altruistic behavior in economic contexts (Kaltwasser et al., 2017; Klimecki et al., 2016). Specifically, employees may emotionally connect with their colleagues and develop empathy toward them. In our model, we let risk-neutral individuals differ in regard to their empathic abilities when they choose to enter either of the two institutional incentive designs and, subsequently, when they decide on their effort supplies. In case they develop empathy, their intensities of subsequent altruistic feelings and, hence, their behavioral responses can also differ. In particular, we contrast the effects of incentive designs which either introduce inter-personal bonus competition or rely on straight merit pay.

Generally, both emotions and rationality jointly govern human choices (Kirman et al., 2010; Kirman & Teschl, 2010). This observation bears two consequences for our analysis. First, even employees who develop empathy toward their colleagues still form rational expectations regarding others' behavioral responses. Second, employees rationally anticipate their own behavior under each of the two incentive designs when they decide on their participation. One strand of literature notices that this ability to rationally calculate their own behavioral responses leads individuals to deceive themselves of their potential altruistic utility gains when asked to enter situations where this trait is at risk of being exploited by others (Exley & Kessler, 2017; Exley & Petrie, 2018). Thus, whether or not employees deceive themselves when taking the participation decision constitutes a third determinant of their participation decision, adding to the before-mentioned impacts of empathic abilities and the signaling quality of the key performance indicator (KPI).

Taking exactly the same starting point that has sparked off our interest in the topic—namely, that the interdependence between the induced inequalities of wage competition and individual participation decisions is under-researched—Dasgupta et al. (2019) indicate that other-regarding, altruistic behavior is rather a female trait. Their experimental study finds that "gender differences in distributional preferences explain observed variations in competitiveness" (p.11). In contrast, Niederle and Vesterlund (2011) conclude that "there is little evidence that gender differences in [..] other-regarding preferences play a systematic and robust role in explaining the gap [in tournament entry]" (p. 611). Given this controversy, we discuss our analytic results in the light of the relevant gender economics findings and discuss their consequences for affirmative action policy.

Our paper proceeds as follows: Upon formally introducing the model set-up in the next section, Section 3 investigates performance gaps resulting from developing empathy toward colleagues: Clearly, empathic abilities do not affect employees' effort supplies given the merit pay incentive design; choices only depend on the precision of measuring effort supplies via KPIs. Establishing perfect dichotomy then, effort choices are exclusively governed by the individuals' other-regarding preferences in the contest setting; that is, the signaling quality of the performance measure is irrelevant for individual effort decisions. Non-empathic individuals strive hardest to outperform their opponents. Empathic abilities induce individuals to withhold effort: In particular, individuals who develop such feelings toward the other supply the least effort when competing against non-empathic individuals and increase their effort supplies when facing empathic contestants. Non-empathic individuals also reduce their effort supplies below the first-best level but always work hardest. Hence, both non-empathic and empathic individuals perform better if facing contestants who resemble their own type with a higher probability.

To close our model, we assume that competition in product markets drives the expected profits of firms to zero. In Section 4, we then show that individuals with stronger empathic abilities may prefer merit pay over performance contests, depending on the precision of the KPI in measuring the individual effort supplies and the composition of the contestant group in regard to its members' empathic abilities. Hence, they may self-select over firms offering different institutional incentive designs. Also, this general conclusion is independent of whether individuals deceive themselves of their empathic abilities or not when deciding about their participation. Lastly, in Section 5, we apply our results to discuss current societal perceptions of gender pay differentials: Specifically, we show that equal opportunity and equal pay are conflicting policy goals in economies where effort incentives are increasingly set by administering performance contests. Section 6 concludes.

2 | FOUNDATIONS OF THE ANALYTIC APPROACH

2.1 | Empathy and altruism

Reciprocity and empathy have been identified as two distinct drivers of altruistic behavior (Hein et al., 2016). Since reciprocal kickbacks for competitors in bonus contests are clearly illegal, we confine our attention to the effect of empathy. Psychological concepts of empathy distinguish two empathic abilities. Cognitive empathy refers to an individual's ability to understand the feelings of someone else, that is, to *mentalize* about the other. Affective empathy is the ability to emotionally respond to the feelings of someone else (Cuff et al., 2016). These two abilities develop on separate neuronal pathways and at different times. Affective responses evolve between 18 and 24 months of age with newborns already showing first traces through contagious crying. *Mentalizing* abilities develop after age four and continuously evolve over a lifetime (Singer, 2006). From a psychological and neuronal perspective, there is a close interaction between affective and cognitive empathic abilities (Cuff et al., 2016; Preckel et al., 2018; Singer, 2006). Jointly, they lead to decision-making in the pursuit of social preferences, in our case, inducing altruistic behavior (Andreoni et al., 2017; Batson et al., 1991; Edele et al., 2013; Kaltwasser et al., 2017; Klimecki et al., 2016; Preckel et al., 2018; Zaki, 2014).[3]

On the one hand, empathic abilities can be elicited automatically and outside of awareness. On the other hand, individuals' characteristics and situational factors influence empathy (Cuff et al., 2016; Zaki, 2014). Following Zaki (2014), individuals are motivated to avoid or embrace empathy by estimating, ahead of time, its psychological costs and benefits. Empathic individuals apply regulatory strategies, such as potentially deciding not to engage in situations where their empathy may be called upon.[4] Since the benefits and costs of empathy also depend on situational factors, there is a "tension between automaticity and context-dependency".[5] In terms of cognitive and affective empathy, context can have an effect on both: To a certain degree, the intensity with which an individual infers another person's thoughts and feelings as well as the intensity of the behavioral response depend on situational factors (Zaki, 2014).

Our stylized economic model places two employees who are endowed with individual empathic abilities in a performance contest or, alternatively, subjects them to merit pay in order to incentivize productive effort. The employees may *mentalize* about their colleague's feelings and then develop affective empathy, leading to altruistic behavior toward their colleague. The intensity of such feelings, if realized, governs their behavioral responses in the contest and, jointly with the probability of developing empathy toward their colleagues, their choices of incentive design. Behavior under the alternative incentive design, that is, merit pay, is determined by the effect of effort on the probability of meeting the KPI.

2.2 | Model assumptions and definitions

Consider a firm which generates revenue $r(e_i)$, with $r' > 0$ and $r'' < 0$, if an employee i provides effort $e_i \geq 0$, $i = 1,2,\ldots,n$. As it is typical for management tasks, revenue $r(e_i)$ and effort e_i are not verifiable. Thus, the firm will incentivize its employees to supply effort. For this purpose, firms use a costless monitoring technology that generates the verifiable performance signal $z_i = e_i\theta_i$. Following Jia (2008) and Jia et al. (2013), we assume that the random variables θ_i, $i = 1,2,\ldots,n$, are i.i.d. according to a standard inverse exponential distribution; that is, the identical probability density function is given by $h(\theta) = \alpha\theta^{-2}\exp\left\{-\frac{\alpha}{\theta}\right\}I_{[\theta>0]}$ where I equals 1 if $\theta > 0$ and 0 otherwise.[6] With increasing α, the density function flattens and probability mass is shifted toward higher values of θ, making higher realizations of the performance measure z_i more likely for given effort supplies e_i, $i = 1,2,\ldots,n$.

In order to allow for direct comparisons with results derived under the assumptions of the standard Lazear–Rosen tournament model, we focus on the case with two employees and set $n = 2$ in the following.[7] We assume that the two employees currently share the same hierarchical position within the firm. Let w denote their salary before they are subjected to an incentive design. Employees always retain this salary but can earn bonus pay. We investigate the employees' behavior and choices if facing either of two different institutional incentive designs:

- *Merit pay*: Employee $i, i = 1,2,$ receives the bonus b_i if $z_i \geq Z_i$, where Z_i denotes a KPI.[8]
- *Performance contest*: Employee $i, i = 1,2,$ receives the bonus Δ_i if $z_i > z_j$, where $j = 1,2$ and $i \neq j$.

Throughout our analysis, we assume that firms cannot condition bonus pay and KPIs on non-verifiable individual preferences or characteristics; thus, $b_i = b$, $Z_i = Z$, and $\Delta_i = \Delta$, $i = 1,2$.

Recalling the distributional assumptions regarding the performance measurement shock θ, the probability that employee i receives the bonus b under the merit pay design is given by

$$q_i(e_i) = prob(z_i \geq Z) = 1 - \exp\left\{-\frac{\alpha e_i}{Z}\right\},\ i = 1,2 \tag{1}$$

At the same time, the probability for employee i to succeed in the contest against his or her colleague j can be obtained by the specific linear Tullock contest success function[9]

$$Q_i(e_i, e_j) = \frac{e_i}{e_i + e_j}, i,j = 1,2 \text{ and } i \neq j \tag{2}$$

Thus, a firm that uses performance contests simultaneously forces a particular distribution of bonus pay: Assuming that—as could be the case in, for example, tournaments that tie the receipt of bonuses to promotions—firms would let only pairs of contestants compete against each other, 50% of the employees would receive the bonus. At the same time, the other 50% of the employees are excluded from bonus pay.[10] With merit pay, either all, none, or half of the employees could receive the bonus, depending only on whether their individual performances meet the KPI. These characteristic distributions of pay echo that the two designs appeal to different incentive mechanisms: Using the analogy to, for example, racing competitions, merit pay rewards finishing in record time, while the performance contest incentivizes individuals to be faster than the other(s). In other words, merit pay is impersonal while performance contests induce inter-personal competition.

The timeline of decision-making and changes in the information structure are as follows. In the first stage, a firm announces whether it will implement a merit pay design or administer a performance contest. In the former case, it also announces the KPIs which we assume to constitute public information. At this stage, let s_i denote the set of employee i's observable social and other relevant characteristics and $S = \{s_i, s_j\}$, with $i,j = 1,2$ and $i \neq j$, be common knowledge. Then, denote by $p_i(S)$ the probability that individual i, $i = 1,2$, develops empathy toward his or her colleague. The probability $p_i(S)$ captures individual i's cognitive empathy ability since an individual first has to *metalize* about the vis-à-vis before being able to respond altruistically. Hereinafter, we use the term *empathic accuracy* to refer to the intensity of cognitive empathy (Zaki, 2014). Further, $p_j^i(S)$, $i,j = 1,2$ and $i \neq j$, is individual i's belief regarding his or her colleague j's probability of *mentalizing* about him or herself.[11] Given $p_i(S)$, $p_j^i(S)$ and his or her anticipation of outcomes, individual i decides on whether to accept the firm's offer or to join another firm.

Next stage, the employees begin to work on their projects. This work takes time and the individuals can interact with each other. In this stage, the employees' empathic abilities are either called forth or not. Empathic individuals are able to sense their opponent's preferences, that is, whether the opponent's empathic abilities are also called forth or not, and—being rational—to condition their behavior on this knowledge. Non-empathic individuals remain ignorant in this regard; they continue to use their belief $p_j^i(S)$ regarding the other's *empathic accuracy* when choosing their effort. In the third stage, the firm observes its employees' performances and awards the bonus pay according to its incentive design. Throughout our subsequent analysis, we assume that contestants' beliefs regarding their opponents' *empathic accuracy* are consistent, that is, $p_j^i(S) = p_j(S)$, $i,j = 1,2$ and

$i \neq j$. In particular, if employees share the same social characteristics, that is, if $s_i = s_j$, $p_i(S) = p_j(S) = p$, $i,j = 1,2$. For convenience, we use the notation $p_i(S) = p_i$ in the following.

Let $W \in \{w, w+b, w+\Delta\}$ denote a possible realization of pay to employees under either of the two incentive designs. Individuals are taken to be liquidity-constrained and must receive non-negative pay with certainty, that is, $W \geq 0$. Recall that, able to *mentalize* about the other, an empathic individual also behaves altruistically. This feature manifests in the following sense: First, empathic employees put themselves in the shoes of their colleagues, and second, their affective empathy leads to shared positive feelings in case their colleague receives the bonus pay. These positive feelings provide an additional altruistic utility gain for empathic individuals.[12] From above, also recall that empathy-driven altruistic behavior does not depend on reciprocal responses. Thus, we define instantaneous utilities as follows: In the case that employee i remains non-empathic toward his or her colleague, he or she receives utility $u_i^{NE} = W - ce_i$. Marginal costs of effort are generally assumed to be constant and denoted by $c > 0$.

The utility function of an empathic employee is different. Let m_i denote the intensity of an empathic individual i's altruistic feelings toward his or her colleague j. In other words, m_i captures i's ability of affective empathy, which we refer to as *motivated attention*. In case colleague j attains a bonus pay, individual i realizes an altruistic utility gain proportional to j's bonus, namely, $m_i b$ or $m_i \Delta$, respectively. Let Υ denote a dummy variable which equals 1 if the colleague gets the bonus and 0 if not. Then, the instantaneous utility of an empathic employee i is given by $u_i^E = W + m_i \left\{ \begin{matrix} b \\ \Delta \end{matrix} \right\} \Upsilon - ce_i$, $i \neq j$, where $0 < m_i < 1$. For simplicity, we assume that m_i, for all i, is common knowledge. Taken together, the tuple (m_i, p_i) characterizes an individual i's empathic abilities. It captures the two dimensions of empathy—*empathic accuracy*, that is, the ability to *mentalize* about the other, and *motivated attention*, which governs the intensity of the subsequent altruistic response.

We complete the model by assuming that (i) individuals maximize their expected utilities, (ii) firms maximize their expected profits, and (iii) product competition among firms implies that (maximized) expected profits equal zero. For parsimony, we let $r(e) = A\sqrt{e}$, with $A > 0$. In this case, A simply reflects the price of the firm's product. In other words, we assume that, with product market competition, firms must adjust A such that maximized expected profits are equal to 0. We solve the game by backward induction. Thus, the next section analyzes on-the-job effort supplies under either of the two incentive designs. Subsequently, we investigate individual choices between institutional designs to set effort incentives.

3 | INCENTIVE DESIGNS AND EFFORT SUPPLIES

3.1 | The performance gap

Empathy is often seen to constitute rather a female personality trait; cultural and environmental factors, possibly reinforced by innate biological differences between the sexes, explain gender differences in empathic abilities (Warrier et al., 2018). Thus, in regard to gender differences, context—for example, whether the required task is perceived as feminine or masculine—affects both the individual's *empathic accuracy* in inferring the other's thoughts and feelings and his or her *motivated attention*, which governs the intensity of the behavioral response (Zaki, 2014). At the same time, women are generally more context-sensitive than men.[13] Only jointly do these findings explain that empathy is often understood as a typical female personality trait in economic encounters (Baron-Cohen et al., 2015; Christov-Moore et al., 2014; Schulte-Rüther et al., 2008; Vellante et al., 2013).[14]

Empirical work on the performance effect of different incentive designs often investigates gender differences. Laboratory experiments by Gneezy et al. (2003) and Gneezy and Rustichini (2004) are the first to report that men outperform women when subjected to tournament incentives rather than direct performance pay. This result is confirmed in a field experiment by Delfgaauw et al. (2013) where, for sales personnel in a retail chain, commission pay is replaced by a bonus competition.[15] Evidence from student admission tests shows that this so-called gender performance gap widens with more competition for admission slots (Jurajda & Münich, 2011; Morin, 2015; Ors et al., 2013).[16]

Healy and Pate (2011) find that, if women compete as members of teams, gender differences in task performances vanish. Also, it does not matter whether their own team is mixed-gender or only female. However, Price (2008) and Ivanova-Stenzel and Kübler (2011) show that the performance gap is larger when competing against mixed-gender teams. Experiments by Bracha et al. (2018) form groups each consisting of two men and two women who solve GRE tasks. Performance rankings within treatment groups must comply with an affirmative action rule; that is, at least one woman must be ranked top. The performance effect of this rule is negative for high-ability women and positive for low-ability women.

In the following, we derive the individuals' optimal effort supplies under merit pay and with performance contests.

3.2 | Effort choices under merit pay

At stage 2, employees realize their empathic abilities.[17] Given that employee i remains non-empathic, his expected utility equals

$$EU_i^{ne} = w + q_i\left(e_i^{ne}\right)b - c\, e_i^{ne}; i = 1,2. \tag{3}$$

If employee i develops empathy toward her colleague, her expected utility is given by

$$EU_i^{e} = w + q_i\left(e_i^{e}\right)b + q_j\left(\bar{e}_j\right)m_i b - c\, e_i^{e}; i, j = 1,2 \text{ with } i \neq j. \tag{4}$$

e_i^{ne}, e_i^{e} denotes the employee's effort choice, respectively. Moreover, an empathic individual can sense the other's feelings toward herself. Hence, $\bar{e}_j = \left\{e_j^{ne}, e_j^{e}\right\}$, depending on whether the colleague remains non-empathic or develops empathy herself.

Incentive compatibility implies that individuals choose effort levels that maximize their expected utility. Obviously, the respective first-order conditions are identical for empathic and non-empathic employees. Therefore, merit pay never triggers altruistic responses. It follows that $e_i^{ne} = e_i^{e}$, $i = 1,2$, Moreover, the employees face the same merit pay system and performance signals follow identical distributions. Thus, let their common incentive-compatible effort supply be denoted by $\tilde{e} = \tilde{e}(b,Z)$. Then, the first-order condition characterizing this effort level can be rearranged to yield:

$$b = b(\tilde{e}) = \frac{cZ}{\alpha \exp\{-\alpha\frac{\tilde{e}}{Z}\}}. \quad (5)$$

The firm maximizes its expected profit $E\pi^m = 2\left[A\sqrt{\tilde{e}} - w - q(\tilde{e})b(\tilde{e})\right]$ subject to the employee's liquidity constraint. In the following, $\breve{e}$ denotes the profit-maximizing effort supply of each employee. Inserting from (5) into the firm's expected profit function ensures incentive compatibility. Then, the first-order condition characterizing $\breve{e}$ can be obtained as

$$\frac{A}{2}\breve{e}^{-\frac{1}{2}} - \frac{c}{\exp\{-\alpha\frac{\breve{e}}{Z}\}} = 0. \quad (6)$$

It immediately follows:

Proposition 1. Denote by $\breve{w}$ and $\breve{b}$ the profit-maximizing fixed salary and merit pay. Then, $\breve{w} = 0$ and $\breve{b} = cZ/\alpha \exp\{-\alpha\frac{\breve{e}}{Z}\}$, where the profit-maximizing effort level $\breve{e}$ is determined by (6). Consequently, for $\alpha > 0$, an optimal merit pay contract can never implement first-best effort supplies.

Sketch of proof. Since the bonus is not paid out if the employee fails to meet the KPI, the liquidity constraint implies that fixed salary w must be non-negative. However, a positive salary decreases profits while not affecting the employees' effort choices and firm revenue. In the profit-maximum, fixed salary must therefore be equal to zero. Then, recall that ensuring positive density over the signal distribution requires $\alpha > 0$. Thus, by virtue of (5), bonus pay converges to infinity—hence, expected profits must become negative—as the KPI Z converges to infinity. The remainder of the proposition follows directly from (5) and (6).

Note that, by Equation (5), bonus pay must be strictly positive to induce positive effort supplies. Intuitively, a merit pay system with exclusively positive bonuses and some uncertainty regarding the signaling of effort supplies could only implement the first-best if employees could be forced to invest in the production opportunity, that is, if their fixed salary could become negative. However, this possibility is excluded by the employees' liquidity constraints, which leaves merit pay contracts incomplete. Investigating (6) further reveals that the optimal merit pay contract induces inefficiently low effort supplies, as is typical in moral hazard problems with asymmetric ex-post information.

3.3 | Effort choices during the performance contest

We now investigate the employees' contest behavior. In order to indicate individual types and the possible type-matches in contests, superscript N denotes an individual who, at stage two, has not developed empathy toward his opponent. In contrast, superscript M indicates an empathic individual. Thus, there are three possible type-matches, $\{(M,M),(M,N),(N,N)\}$. Accordingly, e_i^{MM} denotes the effort of individual i who has realized her empathic abilities and senses that her opponent j shares her feelings. In this case, i's in-contest expected utility is given by

$$EU_i^{MM} = w + \frac{e_i^{MM}}{e_j^{MM} + e_i^{MM}}\Delta + \left(1 - \frac{e_i^{MM}}{e_j^{MM} + e_i^{MM}}\right)m_i\Delta - c\,e_i^{MM}; i,j = 1,2 \text{ with } i \neq j. \quad (7)$$

Alternatively, if individual i senses that the opponent j is non-empathic, her in-contest expected utility is given by

$$EU_i^{MN} = w + \frac{e_i^{MN}}{e_i^{MN} + e_j^{N}}\Delta + \left(1 - \frac{e_i^{MN}}{e_i^{MN} + e_j^{N}}\right)m_i\Delta - ce_i^{MN}; i,j = 1,2 \text{ with } i \neq j. \quad (8)$$

In (7) and (8), it is important to note again that the *motivated attention* toward the contest opponent does not depend on receiving a reciprocal response. Lastly, individual i may not realize his empathic abilities upon participating in the particular contest and being matched up with an opponent. Nevertheless, i rationally anticipates that his opponent j is empathic with probability p_j. Hence, individual i's in-contest expected utility can be obtained as

$$EU_i^{N} = w + \left[p_j\frac{e_i^{N}}{e_i^{N} + e_j^{MN}} + (1 - p_j)\frac{e_i^{N}}{e_i^{N} + e_j^{N}}\right]\Delta - ce_i^{N}; i,j = 1,2 \text{ with } i \neq j. \quad (9)$$

We begin by assuming that $w \geq 0$ and $\Delta > 0$ and determine the respective optimal values later in our analysis. Then, suppose that, during stage two, both contestants realize their empathic abilities and choose their contest efforts such as to maximize (7). In this case, the first-order conditions can be obtained as

$$\begin{aligned} &\frac{e_j^{MM}}{\left(e_i^{MM} + e_j^{MM}\right)^2}(1 - m_i)\Delta - c = 0 \\ \rightarrow &\frac{e_i^{MM}e_j^{MM}}{\left(e_i^{MM} + e_j^{MM}\right)^2}\frac{(1 - m_i)\Delta}{c} = e_i^{MM}; i,j = 1,2 \text{ with } i \neq j. \end{aligned} \quad (10)$$

If individual i realizes her empathic abilities in the contest but senses that the contest opponent j is non-empathic, she still conditions her effort supply on this information but, now, chooses her effort level to maximize (8). The corresponding first-order conditions for empathic individuals in such asymmetric contest matches are given by

$$\frac{e_j^N}{\left(e_j^N+e_i^{MN}\right)^2}(1-m_i)\Delta-c=0$$
$$\rightarrow\frac{e_j^N e_i^{MN}}{\left(e_j^N+e_i^{MN}\right)^2}\frac{(1-m_i)\Delta}{c}=e_i^{MN};i,j=1,2\text{ with }i\neq j. \tag{11}$$

Given that contestant i is non-empathic toward his opponent, he cannot sense his opponent's preferences. Such non-empathic individuals cannot condition their effort supply and therefore maximize (9); the respective first-order conditions can be obtained as

$$\left[p_j\frac{e_j^{MN}}{\left(e_j^{MN}+e_i^N\right)^2}+(1-p_j)\frac{e_j^N}{\left(e_j^N+e_i^N\right)^2}\right]\Delta-c=0$$
$$\rightarrow\left[p_j\frac{e_j^{MN}e_i^N}{\left(e_j^{MN}+e_i^N\right)^2}+(1-p_j)\frac{e_j^N e_i^N}{\left(e_j^N+e_i^N\right)^2}\right]\frac{\Delta}{c}=e_i^N;i,j=1,2\text{ with }i\neq j. \tag{12}$$

Note that (10)–(12) state six first-order conditions, three for each of the two contestants. Although these conditions are structurally identical, they are not easily disentangled. In particular, individual i's choices e_i^{MN} and e_i^N, which are characterized by Equations (11) and (12), enter into the respective first-order conditions for the opponent j in a non-linear way. However, by investigating the full set of first-order conditions, we can analytically prove the following proposition:

Proposition 2. Denote optimal effort choices by $\tilde{e}_i^{MM}$, $\tilde{e}_i^{MN}$, and $\tilde{e}_i^N$, and suppose that all of these contest efforts are positive given (w,Δ).

Let the two contestants share the same empathic abilities, that is, $(p_i,m_i)=(p,m)$, $i=1,2$, and therefore $\tilde{e}_1^X=\tilde{e}_2^X=\tilde{e}^X$ with $X\in\{MM,MN,N\}$. Then, $\tilde{e}^{MN}<\tilde{e}^{MM}<\tilde{e}^N$.

Proof: see Appendix A.

We relegate the formal proof of the proposition to Appendix A, and instead provide an intuitive discussion on contest incentives and induced behaviors. Proposition 2 refers to the benchmark case in which both contestants share the same observable social characteristics. First, consider a match between two individuals of whom only one—say, i—realizes her empathic abilities. Recall that we rule out reciprocity as a driver of altruistic behavior in a performance contest setting. Then, while i senses that her opponent is non-empathic, she still enjoys the utility gain $m_i\Delta$ even if she loses the contest. Consequently, she altruistically reduces her own contest effort—thereby also the probability to succeed in the competition—below that of her opponent, that is, $\tilde{e}^{MN}<\tilde{e}^N$.

Next, if both individuals realize their empathic abilities, either of them will receive the altruistic utility gain $m_i\Delta$, $i=1,2$ if they lose. As before, the direct effect implies that both contestants altruistically reduce their contest effort. However, each individual also rationally knows that her opponent will behave altruistically. Given the anticipated behavior of the opponent, it is therefore less costly to increase the probability to win and enjoy the winner's full utility from the bonus Δ. In other words, in contest equilibrium, there is an additional indirect effect, an "egoistic" counter-incentive for empathic individuals who are matched up against each other. This effect implies that individuals who both realize their empathic abilities compete harder than when being matched up with an opponent who is non-empathic.[18] It follows that $\tilde{e}^{MN}<\tilde{e}^{MM}$.

Lastly, $\tilde{e}^{MM}<\tilde{e}^N$ reflects that non-empathic contestants choose their contest effort to simply equalize their expected marginal benefit of winning the bonus with their marginal costs of effort. In doing so, they anticipate that their opponents may realize their empathic abilities with probability p_j. It follows that their contest effort is distorted downward by the mere presence of potentially empathic opponents. In order to confirm this effect, let p_j approach 0 in (12), and compare (10) and (12); non-empathic individuals would supply more effort if they were sure that there were no empathic contestants.

Given that women are a social group with higher empathic abilities than men in contest settings, the results of Proposition 2 correspond well with the experimental and econometric findings on the gender performance gap: Exposed to interpersonal competition, a potentially more empathic group generally underperforms because its members respond by altruistically withholding contest effort more frequently and/or more strongly. This effect is reinforced if a member of the group is matched up with a member of a social group which is characterized by less frequent or less intense empathic abilities. In contrast, if matched up with a member of their own, more empathic group, they actually compete harder and perform better. Lastly, pooling into groups consisting of two types reduces the group-average effort level and performance.

Contest bonuses or tournament rewards do not conflict with the employees' liquidity constraints. Hence, the performance contest can—in contrast to merit pay and just as in the Lazear–Rosen tournament case—in principle implement the first-best. However, (at least) one of two conditions would have to be met: either the opponents' *motivated attention* m_i equals 0 or there are no potentially empathic individuals in the group of contest participants, that is, p_i equals 0. Note that these two conditions are not necessarily identical. Developing affective empathy toward others may be trainable; thus, the intensity m_i may be subject to a firm's choice of Human Resources practices applied to its employees. The second condition though points at selecting employees according to their empathic abilities by adopting one or the other incentive design. Clearly, this strategic option pre-supposes that both merit pay and performance contest schemes can co-exist when firms need to attract employees in competitive equilibrium.

4 | EQUILIBRIUM INCENTIVE DESIGNS AND PARTICIPATION DECISIONS

4.1 | Competitiveness, shying away, and avoiding the ask

Niederle and Vesterlund (2007) report on laboratory experiments in which individuals choose between entering a bonus tournament and receiving direct performance pay. Controlling for overconfidence, risk attitudes, and aversion against receiving performance feedback, the study shows that the tournament is chosen by 73% of the men but only by 35% of the women. This seminal work has established a new strand of research on competition aversion and women's shying away from inter-personal competition. Varying the basic experimental design, Cason et al. (2010), Niederle and Vesterlund (2010), Dohmen and Falk (2011), Balafoutas and Sutter (2012), and Gupta et al. (2013) confirm that women tend to be more averse to contest or tournament competition than men.

Buser et al. (2014) show that their experimentally derived measure of competition aversion predicts secondary school students' selection into more or less prestigious academic tracks. According to Fernandez-Mateo and Fernandez (2016), this shying away largely explains the underrepresentation of women in top management recruitment processes that are organized by external headhunters. Notably, Apicella et al. (2017) find that gender differences in competition aversion vanish when individuals compete against themselves, in other words, if interpersonal competition is ruled out in a tournament setting while retaining the basic incentive design.

Behavioral research further explores personality traits as determinants of women's aversion to competition. Dohmen and Falk (2011) find no relationship between reciprocity and trust and choices between remuneration schemes. According to Kamas and Preston (2015), gender continues to affect such choices even when one controls for other-regarding preferences. However, under-confidence in one's own ability[19] and risk aversion[20] strongly affect decisions about whether or not to enter into tournament competition. Reflecting on this research, Niederle and Vesterlund (2011) and Niederle (2017) conclude that higher frequencies of these two traits among women jointly explain their shying away behavior. Note, though, that risk aversion positively correlates with inequity aversion (Müller & Rau, 2016). Then, Erkal et al. (2011) show that preferences for egalitarian outcomes induce less competitive behavior.[21] Lastly, Balafoutas et al. (2012) and Mani et al. (2017) find that, upon controlling for such differences in individual preferences, gender ceases to distinctly affect choices between tournaments and explicit performance pay as incentive designs.[22]

Policy discussions of women's shying away behavior are mostly confined to labor market regulations and the education system. With an entirely different focus, Kranich (2022) investigates the behavioral consequences of other-regarding preferences in charity-giving games; the study confirms re-enforcing effects on behavior in simultaneous as well as sequential equilibria. Then, behavioral economics research also shows that individuals who give a lot to charity avoid being asked to donate (Andreoni et al., 2017; DellaVigna et al., 2012). Such avoiding-the-ask behavior can be interpreted as the mirror image of shying away from employment offers, which has been documented in econometric studies (Bani & Giussani, 2010; Misje et al., 2010) and laboratory experiments (Lazear et al., 2012) and is particularly well-established in field experiments (Andreoni et al., 2017; Kamdar et al., 2015; Karlan et al., 2011; Trachtman et al., 2015). Following Exley and Petrie (2018) and Exley and Kessler (2017), anticipating the possible gain from suppressing their altruistic motives, individuals construct excuses and ignore relevant information to avoid entering into situations where they need to decide on their specific donation.[23] Misje et al. (2010), while reporting significant cultural differences, and DellaVigna et al. (2013) address the effect of differences in the distribution of personality traits between social groups: Women avoid being asked for charitable contributions more frequently than men. However, conditional on their choice to participate, women donate more than men.

Assuming that firms earn zero expected profits in competitive product market equilibrium, we subsequently derive conditions under which employees prefer to enter firms that either offer merit pay or administer performance contests. The firms' labor forces are taken to be homogeneous in regard to their empathic abilities.

4.2 | Participation choices

Returning to the analysis, we first focus on an individual's choice to enter into a firm that administers a performance contest to set effort incentives. Note that, maximizing their in-contest expected utilities, individuals also maximize their pre-contest expected utility which we denote by V_i^C. Hence,

$$V_i^C = p_i \left[p_j E\tilde{U}_i^{MM} + (1-p_j) E\tilde{U}_i^{MN} \right] + (1-p_i) E\tilde{U}_i^N; i,j = 1,2, i \neq j, \qquad (13)$$

where (13) is obtained by inserting the incentive-compatible effort levels $\tilde{e}_i^{MM}$, $\tilde{e}_i^{MN}$, and $\tilde{e}_i^N$ into (7)–(9). Remember, the tuple (m_i, p_i) characterizes individual i's empathic abilities. From Proposition 1, recall that $\breve{e}$ is the common incentive-compatible effort level of all employees in firms that offer merit pay. In particular, this effort level does not depend on whether the individual does or does not develop empathy toward his or her colleague. Hence, when deciding on entering such a firm, i's expected utility V_i^m is given by

$$V_i^m = p_i E\breve{U}_i^e + (1-p_i) E\breve{U}_i^{ne} = w + q(\breve{e}) b(\breve{e}) + p_i q(\breve{e}) m_i b(\breve{e}) - c\,\breve{e}; i = 1,2 \qquad (14)$$

The discussion of avoiding-the-ask scenarios of charitable giving suggests that potentially empathic but rational individuals may not appreciate their expected altruistic utility gain when deciding about their participation. Such self-deception leads them to ignore their altruistic utility gain when evaluating the benefits of the contest. Rationally anticipating their behavior in the situation, they only look at the pay consequences when deciding on whether to enter into the situation or not.

Following this reasoning, we suggest the following alternative participation criterion for self-deceiving individuals:

$$P_i^C = p_i \left[p_j \left(w + \frac{\tilde{e}_i^{MM}}{\tilde{e}_i^{MM} + \tilde{e}_j^{MM}} \Delta - c\,\tilde{e}_i^{MM} \right) + (1-p_j) \left(w + \frac{\tilde{e}_i^{MN}}{\tilde{e}_i^{MN} + \tilde{e}_j^{N}} \Delta - c\tilde{e}_i^{MN} \right) \right]$$
$$+ (1-p_i) \left[w + \left[p_j \frac{\tilde{e}_i^N}{\tilde{e}_i^N + \tilde{e}_j^{MN}} + (1-p_j) \frac{\tilde{e}_i^N}{\tilde{e}_i^N + e_j^N} \right] \Delta - c\tilde{e}_i^N \right]; i,j = 1,2, i \neq j. \qquad (15)$$

In order to evaluate P_i^C, we insert the individual's in-contest effort supplies, that is, the effort levels $\tilde{e}_i^{MM}$, $\tilde{e}_i^{MN}$, and $\tilde{e}_i^N$, which maximize

(7)–(9), but set the altruistic utility gain $m_i\Delta$ equal to 0. Given that another firm administers a merit pay incentive system, the individuals would then compare P_i^C to

$$P^m = w + q(\check{e})b(\check{e}) - c\check{e} \tag{16}$$

when they decide on where to seek employment. Note that P^m is equal to the second-best utility for the employee which would result in a standard incomplete contract model with moral hazard.[24]

4.3 | Optimal performance contests merit pay in competitive equilibrium

Upon administering the contest to incentivize its employees, the firm's expected profit is given by

$$\begin{aligned} E\pi^C = {} & p_i p_j \left[r\left(e_i^{MM}\right) + r\left(e_j^{MM}\right)\right] + p_i(1-p_j)\left[r\left(e_i^{MN}\right) + r\left(e_j^{N}\right)\right] \\ & + p_j(1-p_i)\left[r\left(e_j^{MN}\right) + r\left(e_i^{N}\right)\right] + (1-p_i)(1-p_j)\left[r\left(e_i^{N}\right) + r\left(e_j^{N}\right)\right] - 2w - \Delta. \end{aligned} \tag{17}$$

For parsimony, w let $r(e) = A\sqrt{e}$ in the following. Then, recall the assumption that firms operate under product market competition such that A reflects the price of the firm's product or service to customers and adjusts until expected profits (17) equal 0.

In the remainder of this section, we further focus on the case where contestants are drawn from a homogenous population. Equilibrium values of variables are indicated by the notation ˇ. Using the contestants' first-order Conditions (10)–(12), we can then state the following:

Proposition 3. Let contestants be characterized by $\{p_i, m_i\} = \{p, m\}$, $i = 1, 2$. Further, assume that $m \in \left(0, \frac{3+p}{4}\right)$. Then, there exists a contest equilibrium with positive effort levels of all contestants, in which expected firm profits are equal to 0. In this equilibrium, $\check{w} = 0$ and $\check{\Delta}$ is determined by

$$\check{\Delta} = \frac{A^2(1-m)}{c}\left(p^2 + p(1-p)\sqrt{\Phi(p,m)} + (1-p)\sqrt{\Psi(p,m)}\right)^2, \tag{18}$$

where

$$\Phi(p,m) = \frac{2(1-m)\left(p + \sqrt{1-m(1-p)}\right) + p^2 - 1 + m(1-p)}{(1-m+p)^2} < 1 \tag{19}$$

and

$$\Psi(p,m) = \left(\frac{p + \sqrt{1-m(1-p)}}{1-m+p}\right)^2 > 1. \tag{20}$$

The equilibrium contest effort supplies can be obtained as

$$\check{e}^{MM} = \frac{(1-m)\check{\Delta}}{4c}, \tag{21}$$

$$\check{e}^{MN} = \frac{(1-m)\check{\Delta}}{4c}\Phi(p,m), \tag{22}$$

$$\check{e}^{N} = \frac{(1-m)\check{\Delta}}{4c}\Psi(p,m). \tag{23}$$

Proof: See Appendix B.

Since $\Phi(p,m) < 1$ and $\Psi(p,m) > 1$, it is easily verified that $\check{e}^{MN} < \check{e}^{MM} < \check{e}^{N}$, as stated in Proposition 2. The restriction $m \in \left(0, \frac{3+p}{4}\right)$ implies that, if *empathic accuracy* is high among the contestants, and, simultaneously, they are strongly motivated to appreciate each other's feelings, winning the contest is not a dominant goal anymore. Hence, contestants would optimally choose zero contest efforts even with positive bonuses. This behavior would yield negative expected profits for the firm. However, given that the condition is satisfied, our model determines the optimal contest bonus and effort supplies in competitive firm equilibrium as functions of the population's characteristic empathic abilities (p,m).

A firm that administers a merit pay system to induce effort supplies generates expected profit

$$E\pi^m = 2\left(r(\check{e}) - \check{w} - q(\check{e})\,b(\check{e})\right) \tag{24}$$

with two employees. Again, competition in the product market implies that this expected profit must equal zero if, in such equilibrium, there should exist firms that use either of the two incentive designs. However, effort supplies in firms that administer merit pay designs depend only on the quality of the signaling technology, while they depend—just as exclusively—on the empathic abilities of individuals in firms that use performance contests to incentivize their employees.

Hence, a price A which implies that (17) equals 0 is not necessarily equal to the price which would ensure that (24) equals 0 as well. Given our model framework though, the KPI Z under merit pay can still adjust to guarantee that (17) and (24) can simultaneously equal 0 in equilibrium. Recall that we assume that the KPIs are publicly announced and, therefore, constitute common knowledge. Then, given that firms offering merit pay maximize their expected profits by choice of incentive-compatible merit pay,

$$\partial V^m/\partial Z = (1+pm)\left(-\frac{\exp\{\alpha\check{e}\}}{Z^2}\right)b(\check{e}) < 0; \; \partial P^m/\partial Z = \left(-\frac{\exp\{\alpha\check{e}\}}{Z^2}\right)b(\check{e}) < 0. \tag{25}$$

Hence, if there exists an equilibrium in which product competition drives prices such that expected profits equal 0, firms that would raise their KPIs to earn higher expected profits would not be able to attract employees. This conclusion holds true for self-deceiving employees as well as for expected utility-maximizing individuals.

4.4 | Calibrating the model

Despite its simplifying assumptions, our model's implications regarding the effects of empathy on equilibrium outcomes are not easily assessed. Hence, we proceed by calibrating the system and applying *Mathematica* to an example. Specifically, we set $A=2$ and $c=1$ in the following and indicate calibrated values of variables by using the notation ^. In the first step, we calculate the respective optimal effort supplies, the equilibrium merit pay, and the KPIs for $\alpha \in \{0.9, 1, 1.1\}$. Table 1 reports the results as well as the corresponding equilibrium probabilities to receive the merit pay and the values of the participation criterion $\widehat{P}^m$, which, as stated above, reflects an employee's second-best utility in a standard principal agent model without empathy.

Next, we illustrate the effect of empathic abilities in a homogenous population on effort supplies and bonus opportunities if competitive firms administer performance contests. The plots in Figure 1a–c show the equilibrium behavioral responses when varying the model parameters m and p. Also, the flat planes in these displays always depict the calibrated effort level $\widehat{e}^m$, which is realized in firms that offer merit pay. Specifically, we use our calculations for $\alpha=1.1$; as shown in Table 1, this case yields the lowest $\widehat{P}^m$ value among the three cases that we calibrate.

Clearly, whether or not effort supplies are higher under this merit pay scheme compared to those upon administering a performance contest depends on the strength of the distortions induced by empathic abilities in the contest setting. As discussed before, reflecting the Lazear–Rosen tournament model, contests can, in principle, implement the value-maximizing, first-best solution. Yet, they can only do so in the absence of empathy among contestants. In our case, this implies that all effort levels in the contest setting approach $\widehat{e}=1$ and Δ converges to $\widehat{\Delta}=4$ as $p \to 0$ or $m \to 0$. Note that the contest effort responses characterized in Propositions 2 and 3 carry over to equilibrium supplies. In other words, increasing *motivated attention*, m, reduces contest efforts in all three possible matches of individual types. Also, increasing *empathic accuracy*, p, decreases the non-conditional contest effort of non-empathic contestants, $\widehat{e}^N$.

Next, recall that the optimal effort supplies of empathic contestants $\tilde{e}^{MM}$ and $\tilde{e}^{MN}$ strictly decrease with lower bonuses Δ. Since we evaluate behavioral responses in equilibrium, the mere existence of potentially empathic opponents along with non-empathic individuals' behavioral responses to such contestants' effort choices, reduces the attainable contest bonus. Consequently, as an indirect effect, both equilibrium effort levels $\widehat{e}^{MM}$ and $\widehat{e}^{MN}$ decrease with higher p-values as well. Accordingly, the plot in Figure 1d confirms that the equilibrium bonus $\widehat{\Delta}$ strictly decreases with higher *motivated attention* toward the opponent and higher *empathic accuracy*. Setting $\alpha=1.1$ again, the flat plane in Figure 1d depicts the optimal merit pay in competitive equilibrium. Reflecting the strength of the distortionary impacts of empathic abilities on effort supplies in performance contests, merit pay exceeds the contest bonuses if empathic abilities are high.

In Figure 2a,b, we show the corresponding differences in pre-contest expected utilities and participation criteria for self-deceiving employees. Focusing on Figure 2a, both types of individuals—that is, those who realize their empathic abilities as well as those who remain non-empathic—clearly prefer to earn higher contest bonuses. The trade-off between losses in the equilibrium bonus and increasing altruistic utility gains yields the non-monotonic reactions of the pre-contest expected utility $\widehat{V}^C$ to variations of *motivated attention m* and *empathic accuracy p*. With merit pay, effort supply distortions exclusively reflect the quality of the signaling technology, that is, the value of α. However, the ex-ante expected utilities of potential employees $\widehat{V}^m$ still reflect their direct altruistic utility gains. Thus, if empathic abilities are high, this expected utility under merit pay exceeds the pre-contest expected utilities $\widehat{V}^C$.

Hence, contrary to the dominating view in the relevant literature, we show that altruistic behavior can induce sufficiently strong effort supply distortions in performance contests to imply that potentially empathic individuals prefer merit pay. In particular, it is not necessary to assume self-deceiving choices to arrive at this conclusion. In fact, the calibration results depicted in Figure 2b only illustrate that the same conclusion applies if individuals deceive themselves of their empathic abilities. In this case though, the differences in the values of the participation criteria $\widehat{P}^C$ and $\widehat{P}^m$ are exclusively driven by the effort supply distortions that arise in contests.

Our calibrations are carried out under conditions of perfect product market competition between firms. Then, consider a workforce that consists of two rather homogenous social groups comprising more or less empathic individuals, that is, women and men. In this case, members of the former group may prefer to perform under merit pay, while members of the latter group enter firms that incentivize using performance contests.[25] Hence, women and men may choose

TABLE 1 Optimal merit pay, effort supplies, and expected utility in competitive equilibria.

The signaling technology is characterized by	$\alpha=0.9$	$\alpha=1$	$\alpha=1.1$
Optimal effort $\widehat{e}$	0.7378	0.5484	0.4153
Optimal bonus $\widehat{b}$	2.4504	0.8213	1.3421
Equilibrium KPI $\widehat{Z}$	0.3745	0.3151	0.2673
Equilibrium probability to earn the bonus $q(\widehat{e})$	0.8302	0.8246	0.8189
Equilibrium value of participation criterion $\widehat{P}^m$	1.2965	0.9327	0.6838

Note: Calibrations assuming $c=1$ and $A=2$. Numbers are rounded to four digits.

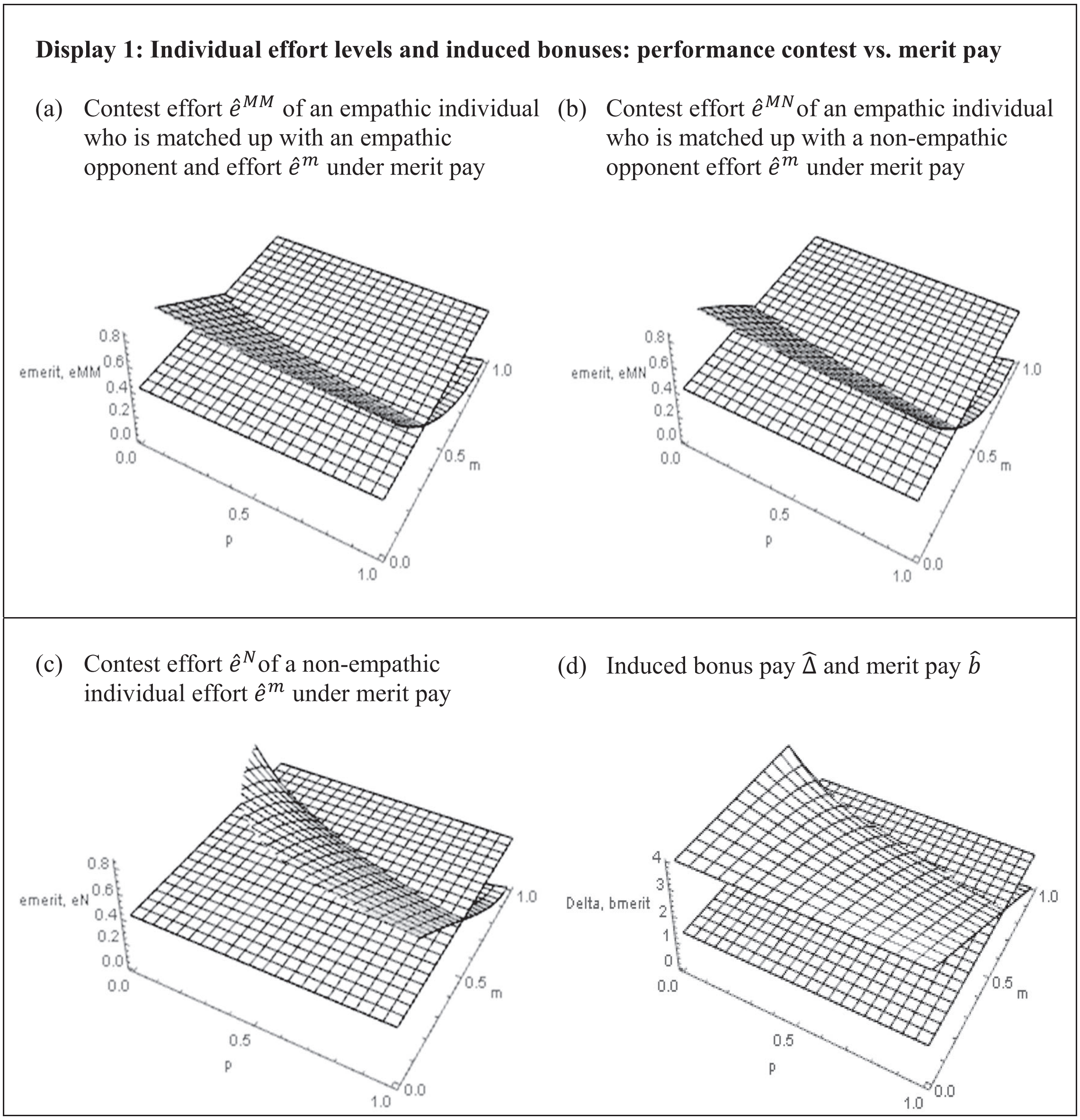


FIGURE 1 Individual effort levels and induced bonuses: performance contest versus merit pay.

to pursue segregated career paths in an economy in which firms offer both incentive designs. Their different career choices would reflect that contests give rise to a performance gap that, with product competition among firms, results in a pay gap. In other words, the prevailing institutions of incentive setting can by themselves cause a sorting into firms, industries, occupations, and professions.

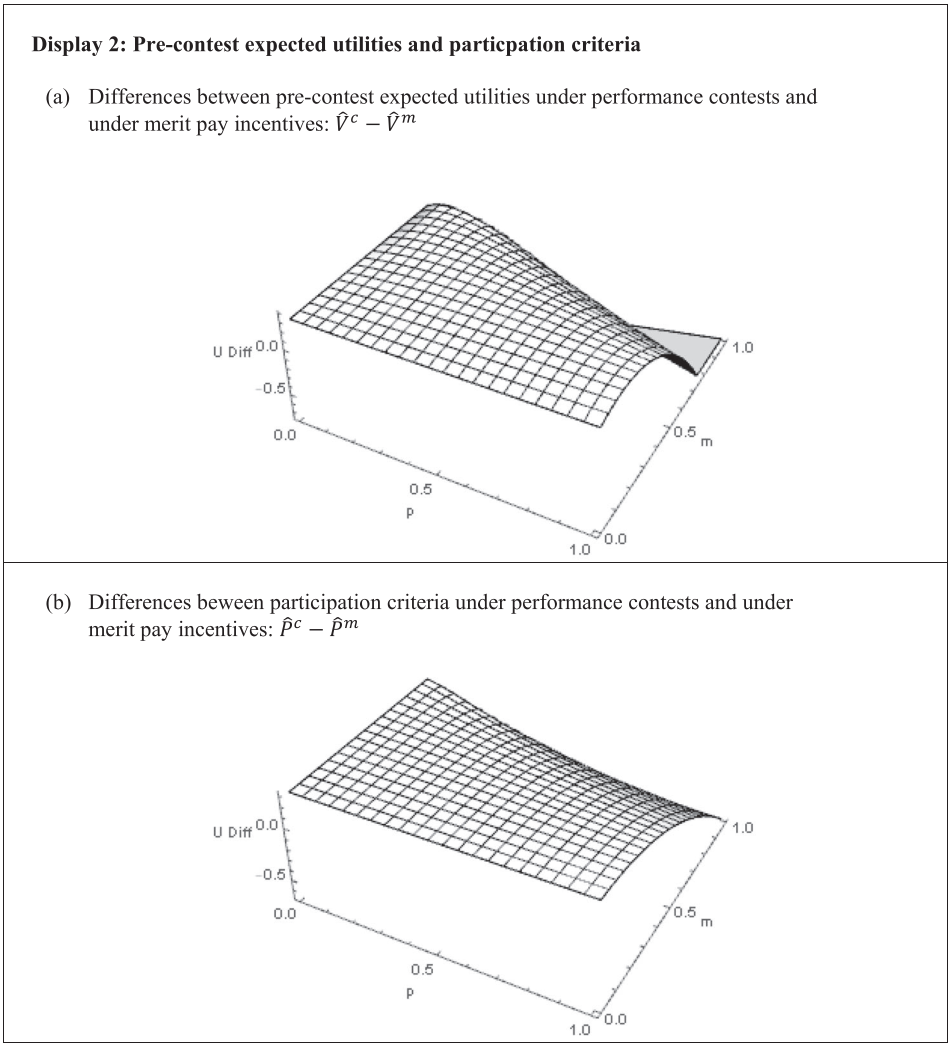
5 | AFFIRMATIVE ACTION POLICY—AN APPLICATION

5.1 | Pay gap and gender quota

Increasingly, research in behavioral economics also provides a scientific foundation for affirmative action or—from a European perspective, rather—equal opportunities policies (Balafoutas & Sutter, 2012; Czibor & Dominguez-Martinez, 2017; Ibañez & Riener, 2018; Niederle et al., 2013). In competitive career settings, such policies aim at simultaneously creating equal promotion opportunities and enforcing equal pay. They reflect that the economy-wide gender pay gap is partially driven by the underrepresentation of women among top earners (Fortin et al., 2017).[26] At the same time, career tournaments appear to be increasingly used for the purpose of incentive setting (Connelly et al., 2014). Firms even adapt their organizational structures at the expense of inefficiently fabricating additional higher ranked positions in order to implement performance incentives (Ke et al., 2018).

Forced ranking or forced distribution systems constitute a particularly drastic variant of such tournaments (Berger et al., 2013). Typically applied in subjective performance evaluations for management, the systems rely solely on relative performance appraisal and force

FIGURE 2 Pre-contest expected utilities and participation criteria. *Note*: model assumes expected profits of firms equal 0; calibrations for $\alpha = 1.1$, $A = 2$, and $c = 1$.



supervisors to assign predetermined percentages of their employees to performance categories. Then, top performers receive multiples of standard pay as bonuses, while lower ranked employees are excluded from that. Often associated with Jack Welch's management style at General Electric, forced ranking has increased and dwindled in popularity with firms over time,[27] while remaining key to high-performance management in many top companies (Kampkötter & Sliwka, 2018; Moon et al., 2016; Scullen et al., 2005).

Such systems' perceived "unfairness" continues to raise questions in regard to their motivational effects on employees (Berger et al., 2013; Moon et al., 2016) and imposes legal risks on these firms (Stewart et al., 2010). Reflecting on respective class-action lawsuits—in particular, reinvestigating Microsoft's infamous "stack-ranking" system which, following such suits, was given up in 2014—Cahn et al. (2018), for example, conclude that these incentive designs unfairly disadvantage women and give way to new forms of discrimination. Lastly, we therefore proceed in our analysis by investigating the effect of affirmative action police striving to ensure equal opportunities and equal pay, given that firms increasingly use performance contests to set effort incentives. For this analysis, we must allow for heterogeneity in regard to individuals' empathic abilities.

5.2 | Quotas and pay equality with heterogeneous contest participants

Recall that four of the first-order conditions that characterize contestants' optimal effort choices—namely, Conditions (11) and (12) for the two contestants *i* and *j*—are cross-related in a non-linear way. Thus, extending our analysis to contests between individuals who are drawn from a heterogeneous group, we can analytically only investigate how matching up more diverse individuals affects their contest behaviors:

Proposition 4. Consider two contestants $i = 1,2$ with different empathic abilities. Denote their optimal effort choices by $\tilde{e}_i^{MM}$, $\tilde{e}_i^{MN}$, and $\tilde{e}_i^{N}$, and suppose that all of these contest effort levels are positive given a value of Δ.

a. Assume that $p_i = p$, $i = 1,2$, but, without loss of generality, let $m_1 > m_2 \geq 0$.[28] Then:

i. $\tilde{e}_1^{MM} < \tilde{e}_2^{MM}$
ii. $\frac{\partial \tilde{e}_1^{MM}}{\partial m_2} > 0$ and $\frac{\partial \tilde{e}_2^{MM}}{\partial m_2} < 0$

iii. $\frac{\partial \hat{e}_1^{MN}}{\partial m_1} < 0$ and $\frac{\partial \hat{e}_2^{N}}{\partial m_1} < 0$

b. Suppose that contestant 1 realizes his empathic abilities while contestant 2 does not. In this case, $\frac{\partial \hat{e}_1^{MN}}{\partial p_1} > 0$ and $\frac{\partial \hat{e}_2^{N}}{\partial p_1} < 0$.

Proof: see Appendix C.

We relegate the formal proof of the proposition to Appendix C and, again, provide an intuitive discussion of contest behaviors. Part (a) of Proposition 4 focuses on contests that match up individuals with different levels of *motivated attention*, that is, different intensities of altruistic responses. In the case that both contestants realize their empathic abilities, (10) immediately implies result (i): individuals with higher levels of *motivated attention* altruistically reduce their contest effort more strongly. Next, (ii) confirms that this direct altruistic effect is always stronger than the aforementioned "egoistic" counter-effect in contest equilibrium. Hence, effort levels monotonically converge to reach an identical level at $m_1 = m_2$. Lastly, (iii) applies to the case where only contestant 1 is motivated to direct attention to her opponent. With increasing altruistic intensity m_1 contestant 1 reduces her effort supply further. Individual 2 anticipates the behavior of contestant 1 and, realizing that winning the contest has become easier, also decreases contest effort.

Part (b) assumes that a non-empathic contestant 2 faces an empathic opponent 1. Notably, although the empathic contestant can condition her effort supply, she responds to changes in the ex-ante probability of being matched up with a non-empathic contestant. The mechanism operates as follows: With higher probability p_1, the non-empathic contestant 2 expects to win more frequently. Thus, he reduces his contest effort. However, in contest equilibrium, this behavioral choice makes winning less costly for the empathic contestant 1. It follows that, in such a match, the empathic contestant 1 responds by increasing her contest effort.

Applying our results to affirmative action policies, we look at the two goals – equal pay and equal opportunity – separately. In order to construct the line of arguments, let men (individuals *j*) be characterized by lower *motivated attention* and, consequently, less intensive altruistic behavior than women (individuals *i*) during the contest, that is, $0 \le m_j < m_i$. Then, first, with the enforcement of equal pay, individual *i* and the rest of the population must still receive the same bonus, but success probabilities may differ. Our results on optimal effort supplies (Propositions 2 and 3) show that women will have to accept lower success probabilities to move toward equal pay: With equal bonuses, more empathic women will provide lower effort than less empathic men, lowering their chance of winning.

Second, to enforce equal promotion opportunities, the probability of contest success must remain constant at ½, but bonuses may differ. Again, analyzing the optimal effort supplies of more and less empathic individuals shows that men will have to accept lower bonus pay in order for the two genders to converge to a state of equal opportunities. This finding reflects that women's bonuses need to be increased to the point where men and women provide the same level of effort in order to ensure equal chances to succeed in the contest. Specifically, larger differences between men's and women's *motivated attention*, that is, $m_i - m_j$, imply larger bonus gaps.

6 | SUMMARY AND CONCLUDING COMMENTS

Analogous to Lazear and Rosen (1981), we study the effects of direct incentive pay—in our case, taking the form of target-based merit pay—and relative pay which reflects an individual's contest success. We assume that individuals are endowed with empathic abilities. Empathic individuals are able to *mentalize*, sensing their vis-à-vis feelings, and to respond emotionally to these feelings. As a consequence, they accept the cost of taking altruistic actions to support or protect their vis-à-vis. In a contest setting, altruistic behavior takes the form of reduced contest effort. Specifically, empathic individuals condition their contest effort on the opponent's feelings toward them: Anticipating that an empathic opponent who does not succeed will realize an altruistic utility gain as well as counteract the direct effort-reducing effect of empathy. Hence, empathic individuals compete harder when they are matched up with another empathic instead of a non-empathic opponent. However, as long as winning the contest and actually receiving the bonus is preferred over losing, this "egoistic" counter-effect is only of second-order importance. Non-empathic individuals always compete hardest.

In cases where contestants exhibit strong empathic abilities, the productive effort of the group will decrease, and so will the attainable monetary reward given that firms face price competition in product markets. In contrast, with merit pay, effort choices only depend on the quality of the performance signal in allowing inferences regarding effort supplies. Hence, given the quality of monitoring employees' effort levels, individuals may prefer to receive direct incentive pay over participating in a performance contest. This general conclusion does not depend on whether or not individuals deceive themselves of their empathic abilities when deciding on participation. Since empathy is typically associated with female rather than male personality traits, competitive product markets can therefore induce and sustain the gender performance and pay gaps that result from professionally segregated career paths of more empathic women and less empathic men.

For example, in the form of forced ranking or forced distribution schemes, performance contests are increasingly used to incentivize employees. At the same time, human resources policies strive to enforce equal pay and—since higher pay typically comes with promotion—equal opportunities in performance contests (e.g., for management positions). This development leads to more diversity in such contests. Hence, we further investigate the behavioral responses to marginal changes in the competitor's empathic abilities, that is, the effects of marginal changes toward diverse empathic abilities in groups of contestants. We conclude that the two pillars of affirmative action policies—creating equal opportunities and ensuring equal pay—

are internally inconsistent policy goals if firms administer promotion contests to set effort incentives.

Reflecting on current policy debates, Niederle (2017, p. 117) notes that "[g]iven the role of competitiveness on the economic gender gap, one potential policy implication might be to 'change the women', make them more competitive …." In terms of our model, women would need training to reduce their *motivated attention* in contest situations. Klimecki et al. (2016, p. 4) show that situational orientation toward more empathy can in fact be achieved. However, the authors' policy conclusion rather addresses men: "[I]n order to promote altruism—whether it is for charities, refugees, or in other economic and political contexts—it is essential to appeal to a person's empathy for specific recipients." We do not believe that affirmative action policies require such psychological interventions which must be tuned to appeal to women and men separately. Instead, we suggest focusing on the economic institutions that govern the productive behavior of individuals with systematically differing empathic abilities[29]: In particular, investing in human resources analytics tools to improve the precision of measuring effort supplies via performance targets can turn merit pay systems into the preferred alternative. Such systems are less sensitive regarding behavioral responses of employees who are actually characterized by cherished social competencies.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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ENDNOTES

[1] The contribution by Abernethy et al. (2022) constitutes the notable exception: it theoretically and empirically investigates the effects of different incentive designs using the principal-agent framework. Agents with other-regarding preferences appreciate the "work climate" in an organization which results from their allocating effort over either supportive or detrimental activities.

[2] We focus on altruistic effects and ignore the possibility of envy. Following Yamagishi et al. (2013), individuals show such pro-social behavior consistently across different game scenarios.

[3] We exclude cases where individuals might only possess one of these abilities: For instance, autists show a deficiency of cognitive empathy, while psychopaths are able to *mentalize* about the other but remain emotionally unaffected (Blair, 2005; Decety et al., 2013; Preckel et al., 2018).

[4] An example of such "situation selection" (Zaki, 2014, p. 1613) would be crossing the street to avoid running into a homeless person because this would cause negative emotions such as guilt or sadness. Hodges et al. (2007) refer to this behavior as "exposure control."

[5] Zaki (2014, p. 1608). See also Heyes (2018) and Cuff et al. (2016).

[6] The density function $h(\theta) = \alpha m \theta^{-(m+1)} \exp\{-\alpha z^{-m}\} I_{[\theta>0]}$ characterizes the general inverse exponential distribution. The parameters α and m have opposite effects on shifting the probability mass. We choose the standard form of the distribution to keep the analysis simple and more easily tractable (Jia, 2008; Jia et al., 2013).

[7] Using $ln(z_i)$ to measure performances restores the linear structure of the Lazear-Rosen tournament model. In this case, the error term would have to follow an extreme value (Gumbel) distribution to support our model structure (Fu & Lu, 2012; McFadden, 1973; Yellott, 1977).

[8] For example, Friebel et al. (2017) describe the introduction of such a KPI-based incentive design for both managers and employees of retail chain and discuss its effects on measured performances.

[9] See Tullock (2001).

[10] One benefit of using a contest model is that it can actually be easily generalized to groups of N contestants and even asymmetric contests. Recalling the assumptions regarding the performance measures z_i and their distributional properties, the Tullock contest success function for employee i is given by $Q_i(e_i, e_{-i}) = e_i / \sum_{j=1}^{N} e_j$ in this case. Similarly, it is possible to derive the probability to be ranked lth, where $l = 1, 2, \ldots N$ (Fu & Lu, 2012).

[11] Since S is common knowledge, even employees who do not realize their empathic abilities are aware of the possibility that their colleague might respond empathically.

[12] Following the *motivated account* model of Zaki (2014), individuals avoid costs and approach benefits of empathic behavior. We model an "empathy benefit" in case the colleague receives the bonus. Instead, one could include an "empathy cost" in case that the colleague fails to receive the bonus. For instance, it could be that an individual experiences sadness (guilt) if the colleague misses the KPI (loses the contest). Both modeling approaches are analytically identical.

[13] See Croson and Gneezy (2009). Miller and Ubeda (2012) study gender differences regarding context-sensitivity in economic decision-making.

[14] More generally, Sent and van Staveren (2018) meta-analysis cannot confirm significant and sizable gender differences in regard to risk-attitudes, over-confidence, trust, and altruism. The study warns that the existing literature does not sufficiently consider the effects of context, socialization, and cross-cultural differences when interpreting results of experimental research to provide policy recommendations.

[15] Lavy (2013) finds no gender effect on schoolteachers' performances when incentives are newly introduced and take the form of rank-order competition.

[16] Evidence from professional sports is actually mixed. Contradicting earlier findings by Paserman (2010), Cohen-Zada et al. (2017) show that men perform worse than women if stakes in tennis tournaments are high. The authors warn that this effect may be due to the single-sex environment.

[17] For better readability, but without loss of generality, we will, from now on, refer to a non-empathic individual as "he" and to an empathic individual as "she."

[18] Kranich (2022) finds a similar effect when investigating equilibria in charitable giving games.

[19] See, for example, Brandts et al. (2015) and, with specific focus on women underestimating their probability of winning in contests against men, Bordalo et al. (2016).

[20] Gender differences in risk attitudes are small, though (Filippin & Crosetto, 2016).

[21] Using an all-women sample, Bartling et al. (2009) conclude that risk aversion, lack of confidence, and a preference for egalitarian outcomes (specifically, aversion to being ahead) explain why individuals shy away from competition.

[22] Also note that, according to Flory et al. (2018), personality traits change over time; specifically, the gender gap in regard to competitiveness shrinks and then vanishes as the individual ages.

[23] Such self-deceiving behavior overrides other personality traits (Bénabou & Tirole, 2016; Di Tella et al., 2015; Lin et al., 2016) and reputation concerns (Andreoni et al., 2017; Exley, 2018; Klinowski, 2015; Lazear et al., 2012).

[24] See, for example, the benchmark case in Demougin and Fabel (2019).

[25] Using the same logic (but assuming altruistic utility losses if the vis-à-vis realizes damages rather than, as we do, gains if the opponent succeeds), Zaki (2014) argues that empathic individuals should not become professional ice hockey players because the possibility to injure an opponent inflicts additional pain on them.

[26] Blau and Kahn (2017) add that the pay gap is particularly wide at the top of the income distribution.

[27] Welch and Byrne (2003, p. 4) state the 20/70/10 distribution rule, which forces supervisors to differentiate the 20% top employees, from the 70% average performers and the 10% bottom ones. This rule is often applied, although companies may also use different percentiles (Moon, Scullen, & Latham, 2016).

[28] We include the case where contestant 2 may be entirely egoistic, that is, $m_2 = 0$.

[29] Niederle (2017) reaches the same conclusion.

[30] A detailed analysis and discussion for $p \in [0,1]$ is available upon request.

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How to cite this article: Fabel, O., Mauser, S., & Zhang, Y. (2023). Performance contests and merit pay with empathic employees. *Managerial and Decision Economics*, 1–20. https://doi.org/10.1002/mde.4003

APPENDIX A: PROOF OF PROPOSITION 2

We confine the analysis to cases where there are two distinctly different types in the population and assume that $p \in (0,1)$.[30] Notice that, inserting from (10) and (11) into (12), rearranging terms yields

$$\frac{p\tilde{e}^{MN}}{(1-m)}+\frac{(1-p)\tilde{e}^{MM}}{(1-m)}=p\tilde{e}^{MN}+(1-p)\tilde{e}^{MM}=(1-m)\tilde{e}^{N}. \tag{A1}$$

We proceed by proving the proposition by contradiction. Hence, suppose that $\tilde{e}^{MM} \geq \tilde{e}^{N}$. Due to $0<m<1$, (A1) implies $\tilde{e}^{MN}<\tilde{e}^{N}$ in this case and it must be true that

$$0=\frac{\tilde{e}^{N}}{\left(\tilde{e}^{MN}+\tilde{e}^{N}\right)^{2}}(1-m)\Delta-c>\frac{(1-m)\Delta}{4\tilde{e}^{N}}-c, \tag{A2}$$

where the LHS of (A2) simply restates the incentive-compatibility constraint (11). Rearranging this constraint yields $c>\frac{(1-m)\Delta}{4\tilde{e}^{N}}$. Therefore,

$$\tilde{e}^{N}>\frac{(1-m)\Delta}{4c}=\tilde{e}^{MM}. \tag{A3}$$

The RHS of (A3) now restates the incentive-compatibility constraint (10). It follows that (A3) contradicts the initial assumption that $\tilde{e}^{MM} \geq \tilde{e}^{N}$. Consequently, $\tilde{e}^{MM}<\tilde{e}^{N}$ must be true.

Now, suppose that $\tilde{e}^{MN} \geq \tilde{e}^{N}$. This assumption implies

$$\frac{\tilde{e}^{N}}{\left(\tilde{e}^{N}+\tilde{e}^{N}\right)^{2}}(1-m)\Delta-c \geq \frac{\tilde{e}^{N}}{\left(\tilde{e}^{MN}+\tilde{e}^{N}\right)^{2}}(1-m)\Delta-c=0, \tag{A4}$$

where the RHS of the inequality restates the incentive-compatibility constraint (11) again. It follows that

$$\frac{\tilde{e}^{N}}{4\left(\tilde{e}^{N}\right)^{2}}(1-m)\Delta \geq c \tag{A5}$$

and

$$\frac{(1-m)\Delta}{4c} \geq \tilde{e}^{N} \tag{A6}$$

The LHS of (A6) defines $\tilde{e}^{MM}$. However, (A3) yields $\tilde{e}^{MM}<\tilde{e}^{N}$. By further contradiction, it therefore follows that $\tilde{e}^{MN}<\tilde{e}^{N}$.

Lastly, given $\tilde{e}^{MN}<\tilde{e}^{N}$,

$$\frac{1}{4\tilde{e}^{MN}}=\frac{\tilde{e}^{MN}}{\left(\tilde{e}^{MN}+\tilde{e}^{MN}\right)^{2}}>\frac{\tilde{e}^{N}}{\left(\tilde{e}^{MN}+\tilde{e}^{N}\right)^{2}} \tag{A7}$$

Jointly, (A7) and the incentive-compatibility constraint (11) then imply

$$\begin{aligned} \tilde{e}^{MN} &= \tilde{e}^{MN} \frac{\tilde{e}^{N}}{\left(\tilde{e}^{MN}+\tilde{e}^{N}\right)^{2}} \frac{(1-m)\Delta}{c}, \\ \tilde{e}^{MN} &< \tilde{e}^{MN} \frac{1}{4\tilde{e}^{MN}} \frac{(1-m)\Delta}{c}, \\ \tilde{e}^{MN} &< \frac{(1-m)\Delta}{4c} = \tilde{e}^{MM}, \end{aligned} \tag{A8}$$

which finalizes the proof of Proposition 2.

APPENDIX B: PROOF OF PROPOSITION 3

As expected in a static one-period contest model, the fixed pay w does not appear in any of the employees' first-order Conditions (10)–(12). Thus, it does not affect contest behavior. Expected profit maximization therefore implies $\check{w} = 0$.

Recall that the proposition focuses on an equilibrium where contestants are drawn from a population of individuals with identical empathic abilities $(\{p,m\})$, and therefore, $\tilde{e}_1^X = \tilde{e}_2^X = \tilde{e}^X$ with $X \in \{MM, MN, N\}$. Then, (10) immediately yields

$$\frac{(1-m)\Delta}{4c} = e^{MM}. \tag{B1}$$

Next, (11) can be rearranged to

$$\sqrt{\frac{\Delta(1-\mathrm{m})e^{N}}{c}} = e^{MN} + e^{N} \tag{B2}$$

and (12) yields

$$\frac{\Delta}{c}\left[pe^{MN}e^{N} + \frac{(1-p)}{4}\left(e^{MN}+e^{N}\right)^{2}\right] = e^{N}\left(e^{MN}+e^{N}\right)^{2}. \tag{B3}$$

Inserting from (B2) into (B3), we obtain

$$e^{N}[1-\mathrm{m}+\mathrm{p}] - p\sqrt{\frac{\Delta(1-m)}{c}}\sqrt{e^{N}} - \frac{(1-p)\Delta(1-m)}{4c} = 0. \tag{B4}$$

Equation (B4) possesses two roots:

$$e^{N} = \frac{(1-m)\Delta}{4c} \cdot \frac{\left(p \pm \sqrt{1-m(1-p)}\right)^{2}}{(1-m+p)^{2}}. \tag{B5}$$

For ease of notation, we define

$$\varphi_1 := \frac{\left(p + \sqrt{1-m(1-p)}\right)^{2}}{(1-m+p)^{2}}; \varphi_2 := \frac{\left(p - \sqrt{1-m(1-p)}\right)^{2}}{(1-m+p)^{2}}. \tag{B6}$$

The terms in the square root in the expressions of (B6) are always positive and there is no need to consider complex solutions.

Lastly, using (B5) to insert for e_2^N into (B2), we obtain

$$\mathrm{e}^{MN} = \frac{(1-m)\Delta}{4c} \cdot \frac{2(1-m)\left(p \pm \sqrt{1-m(1-p)}\right) + p^{2} - 1 + m(1-p)}{(1-m+p)^{2}}. \tag{B7}$$

Once more, for ease of notation, let

$$\begin{aligned}\phi_1 &:= \frac{2(1-m)\left(p+\sqrt{1-m(1-p)}\right)+p^2-1+m(1-p)}{(1-m+p)^2},\\ \phi_2 &:= \frac{2(1-m)\left(p-\sqrt{1-m(1-p)}\right)+p^2-1+m(1-p)}{(1-m+p)^2}.\end{aligned} \tag{B8}$$

Investigating the two possible solutions, ϕ_2 can be verified to be negative for all (p,m) and ϕ_1 is positive for all p and $0<m<\frac{3+p}{4}$. Since the effort levels cannot be negative, this restriction on m cannot be omitted.

Thus, letting $\Phi(p,m)=\phi_1$ and $\Psi(p,m)=\varphi_1$, we obtain (19)–(23) in Proposition 3. (18) follows from insertion into (17) for $E\pi^C=0$ and setting $\check{w}=0$.

Q.E.D.

APPENDIX C: PROOF OF PROPOSITION 4

To prove Proposition 4, we enter into the analysis of asymmetric contest settings. Thus, without loss of generality, let $m_1>m_2$. According to (10), it must be true in equilibrium that

$$\frac{\tilde{e}_1^{MM}}{(1-m_1)}=\frac{\tilde{e}_2^{MM}}{(1-m_2)}, \tag{C1}$$

which proves the statement (i) in part (a) of the proposition.

In order to analyze changes in m_2, define

$$F_1:=\frac{\tilde{e}_2^{MM}}{\left(\tilde{e}_2^{MM}+\tilde{e}_1^{MM}\right)^2}(1-m_1)\Delta-c=0; F_2:=\frac{\tilde{e}_1^{MM}}{\left(\tilde{e}_1^{MM}+\tilde{e}_2^{MM}\right)^2}(1-m_2)\Delta-c=0 \tag{C2}$$

Applying the implicit function theorem, we obtain

$$\begin{pmatrix}\frac{\partial F_1}{\partial \tilde{e}_1^{MM}} & \frac{\partial F_1}{\partial \tilde{e}_2^{MM}}\\ \frac{\partial F_2}{\partial \tilde{e}_1^{MM}} & \frac{\partial F_2}{\partial \tilde{e}_2^{MM}}\end{pmatrix}\begin{pmatrix}\frac{\partial \tilde{e}_1^{MM}}{\partial m_2}\\ \frac{\partial \tilde{e}_2^{MM}}{\partial m_2}\end{pmatrix}=-\begin{pmatrix}\frac{\partial F_1}{\partial m_2}\\ \frac{\partial F_2}{\partial m_2}\end{pmatrix}. \tag{C3}$$

In the following, we denote the 2×2 Jacobian matrix on the LHS of (C3) by J_1. The determinant of J_1 must be non-zero. The second-order conditions

$$\frac{\partial F_i}{\partial \tilde{e}_i^{MM}}=\frac{-2\tilde{e}_j^{MM}}{\left(\tilde{e}_i^{MM}+\tilde{e}_j^{MM}\right)^3}(1-m_i)\Delta<0,\ i=1,2 \text{ and } j\neq i \tag{C4}$$

can be verified to be satisfied so that the first-order conditions necessarily characterize maxima. With $\frac{\partial F_1}{\partial \tilde{e}_2^{MM}}<0$ and $\frac{\partial F_2}{\partial \tilde{e}_1^{MM}}>0$, it follows that $det\,J_1>0$. Further, we obtain $\frac{\partial F_1}{\partial m_2}=0$ and $\frac{\partial F_2}{\partial m_2}<0$. Solving (C3) for $\left(\frac{\partial \tilde{e}_1^{MM}}{\partial m_2},\frac{\partial \tilde{e}_2^{MM}}{\partial m_2}\right)^T$, we therefore find that

$$\begin{pmatrix}\frac{\partial \tilde{e}_1^{MM}}{\partial m_2}\\ \frac{\partial \tilde{e}_2^{MM}}{\partial m_2}\end{pmatrix}=-\frac{1}{detJ_1}\begin{pmatrix}\frac{\partial F_2}{\partial \tilde{e}_2^{MM}} & -\frac{\partial F_1}{\partial \tilde{e}_2^{MM}}\\ -\frac{\partial F_2}{\partial \tilde{e}_1^{MM}} & \frac{\partial F_1}{\partial \tilde{e}_1^{MM}}\end{pmatrix}\begin{pmatrix}\frac{\partial F_1}{\partial m_2}\\ \frac{\partial F_2}{\partial m_2}\end{pmatrix} \tag{C5}$$

implies $\frac{\partial \tilde{e}_1^{MM}}{\partial m_2} > 0$ and $\frac{\partial \tilde{e}_2^{MM}}{\partial m_2} < 0$ which proves statement ii) of part a) of Proposition 4.

Next, suppose individual 1 has altruistic preferences, $m_1 > 0$, and individual 2 does not, that is, $m_2 = 0$. Again, comparative statics can be used to investigate effort effects associated with varying m_1. For this purpose, define

$$F_1 := \frac{\tilde{e}_2^N}{\left(\tilde{e}_2^N + \tilde{e}_1^{MN}\right)^2}(1-m_1)\Delta - c = 0; F_2 := \left[p\frac{\tilde{e}_1^{MN}}{\left(\tilde{e}_1^{MN} + \tilde{e}_2^N\right)^2} + (1-p)\frac{\tilde{e}_1^N}{\left(\tilde{e}_1^N + \tilde{e}_2^N\right)^2}\right]\Delta - c = 0. \tag{C6}$$

Now, we solve the system

$$\begin{pmatrix} \frac{\partial \tilde{e}_1^{MN}}{\partial m_1} \\ \frac{\partial \tilde{e}_2^N}{\partial m_1} \end{pmatrix} = -\frac{1}{detJ_2}\begin{pmatrix} \frac{\partial F_2}{\partial \tilde{e}_2^N} & -\frac{\partial F_1}{\partial \tilde{e}_2^N} \\ -\frac{\partial F_2}{\partial \tilde{e}_1^{MN}} & \frac{\partial F_1}{\partial \tilde{e}_1^{MN}} \end{pmatrix}\begin{pmatrix} \frac{\partial F_1}{\partial m_1} \\ \frac{\partial F_2}{\partial m_1} \end{pmatrix}, \tag{C7}$$

where the 2×2 matrix in the RHS of (C7) is the inverse of the respective Jacobian J_2. The second-order conditions are satisfied, that is, $\frac{\partial F_1}{\partial \tilde{e}_1^{MN}} < 0$ and $\frac{\partial F_2}{\partial \tilde{e}_2^N} < 0$. With $\frac{\partial F_1}{\partial \tilde{e}_2^N} < 0$ and $\frac{\partial F_2}{\partial \tilde{e}_1^{MN}} > 0$, we obtain $detJ_2 > 0$ which assures the existence of J_2^{-1}. Further, we obtain $\frac{\partial F_1}{\partial m_1} < 0$ and $\frac{\partial F_2}{\partial m_1} = 0$. Hence, solving (C7) yields $\frac{\partial \tilde{e}_1^{MN}}{\partial m_1} < 0$ and $\frac{\partial \tilde{e}_2^N}{\partial m_1} < 0$ as stated in (iii) of part (a) of Proposition 4.

Lastly, suppose again that individual 1 has altruistic preferences, $m_1 > 0$, and individual 2 does not, that is, $m_2 = 0$. Then, define

$$F_1 := \frac{\tilde{e}_2^N}{\left(\tilde{e}_2^N + \tilde{e}_1^{MN}\right)^2}(1-m_1)\Delta - c = 0; F_2 := \left[p_1\frac{\tilde{e}_1^{MN}}{\left(\tilde{e}_1^{MN} + \tilde{e}_2^N\right)^2} + (1-p_1)\frac{\tilde{e}_1^N}{\left(\tilde{e}_1^N + \tilde{e}_2^N\right)^2}\right]\Delta - c = 0. \tag{C8}$$

As above, the respective Jacobian matrix is given by J_2. Therefore, we solve the system

$$\begin{pmatrix} \frac{\partial \tilde{e}_1^{MN}}{\partial p_1} \\ \frac{\partial \tilde{e}_2^N}{\partial p_1} \end{pmatrix} = -\frac{1}{detJ_2}\begin{pmatrix} \frac{\partial F_2}{\partial \tilde{e}_2^N} & -\frac{\partial F_1}{\partial \tilde{e}_2^N} \\ -\frac{\partial F_2}{\partial \tilde{e}_1^{MN}} & \frac{\partial F_1}{\partial \tilde{e}_1^{MN}} \end{pmatrix}\begin{pmatrix} \frac{\partial F_1}{\partial p_1} \\ \frac{\partial F_2}{\partial p_1} \end{pmatrix}, \tag{C9}$$

where $\frac{\partial F_1}{\partial p_1} = 0$ and $\frac{\partial F_2}{\partial p_1} < 0$, and obtain $\frac{\partial \tilde{e}_1^{MN}}{\partial p_1} > 0$ and $\frac{\partial \tilde{e}_2^N}{\partial p_1} < 0$. This proves part b) of Proposition 4.

Q.E.D.