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# Garbling an evaluation to retain an advantage

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# Garbling an evaluation to retain an advantage*

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**Abstract**

We study the effects of introducing interpersonal comparisons on the decisions made by career concerned experts. We consider competition between two experts who may differ in their initial reputation. We obtain that whereas full transmission of the experts' private information is an equilibrium when experts have the same initial reputation, this is not necessarily the case when they are heterogenous. In this case, we identify an incentive for the stronger expert to deliberately misreport her signal, aiming at garbling the evaluation of the principal to retain her advantage. In equilibrium, this expert may even completely contradict her signal and the other expert's decision. We discuss the implications of our results to different contexts, such as reaching consensus in a society, competition for attention, and misconception of the market's evaluation system.

**Keywords:** Interpersonal comparisons; heterogenous expertise; career concerns; probability of feedback

**JEL:** C72; D82; D83

## 1 Introduction

It's human nature to compare ourselves to others. Sometimes unconsciously, human beings tend to evaluate our own social and personal achievements based on how we stack up against others. We do it on a daily basis and across multiple dimensions, from success and intelligence to wealth and attractiveness.

Though a regular and well established phenomenon, we do not know much about how interpersonal comparisons affect our decisions in relevant spheres of our life. One example is the effect of social comparisons on the common human aspiration of being perceived as well informed and good at one's job. This paper aims to contribute to this research question. More precisely, we are interested in understanding the effect that interpersonal comparisons have on the incentives of agents with private

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information and a career concern for *expertise* to transmit their information.[1] This is a relevant question, as success and reputation for expertise are one of the most prominent dimensions on which individuals tend to compare themselves to others.

There are at least three reasons why agents with private information (hereafter experts) might care about interpersonal comparisons. First, the market's evaluation system makes use of interpersonal comparisons. This is the case, for example, when promotion opportunities and career prospects depend on relative expertise. An example of this is Tipranks.com, where stock market analysts are ranked according to their relative performance versus one another. Second, experts compete for the attention of an evaluator and the latter has a limited endowment of time. Third, experts themselves feel the pressure to prove better than others and self-impose this competitive spirit, a quite common feature of modern Western societies. Independently of the source behind this concern, the purpose of this paper is to shed light on the mechanisms underpinning experts' transmission of information in the presence of interpersonal comparisons. More precisely, we are interested in questions such as: Should we expect all experts to provide the evaluator with the same advice? Will they differ? Will the answer depend on whether experts are homogenous or heterogeneous? Which advice will be more informative?

To analyze these questions, we propose a model with the following structure. Two heterogeneous experts face common uncertainty about the state of the world and can be imperfectly and asymmetrically informed about it. Each expert can be of two types: either wise or normal, the difference being the quality of the information they receive about the state of the world. Experts may differ in their initial expertise, i.e., the probability an expert is believed to be wise. Accordingly, we talk about the stronger expert and the weaker expert (each of them can be either wise or normal). Upon receiving information on the state, experts take simultaneous actions. We consider experts who have reputational concerns and care about interpersonal comparisons and refer to this system of evaluation as the Relative Performance Evaluation (RPE) system.[2] To isolate effects, we compare the results under the RPE system with those under the standard system or benchmark case, referred to as the Absolute Performance Evaluation (APE) system, in which experts seek to maximize their individual/absolute reputation. We identify two key variables that determine whether both evaluation systems can yield the same outcome (in terms of the experts' behavior and information transmitted) or not: the heterogeneity in experts' expertise and the probability of feedback, i.e., the probability that the principal learns the state. Our results show that when experts are homogenous, the behavior and the information revealed by the two experts are the same under the two systems. However, when experts are rather different in expertise and the probability of feedback is below a certain threshold, both systems no not longer yield the same result. In this case, we obtain that full revelation of the experts' private information is always an equilibrium under the APE system (Proposition 1); however, it is never an

[1]With expertise we refer to the ability of an agent to know an uncertain common variable, such as the state of the world. Other models of career concerns consider agents who can differ either in their ability to exert effort (Harris and Holmström (1982) and Holmström (1999)) or in their preferences for the implemented policy (Morris (2001)). See Lin (2015) for a literature review.

[2]This term was first used by Holmström (1982), who defined it for a model of effort provision in teams with career concerned agents.

equilibrium under the RPE system (Proposition 3 and Theorem 1). In the latter case, we identify an incentive for the stronger expert to misreport her signal and differentiate her advice from that of the weaker expert, aiming at garbling the evaluation of the principal to retain her advantage. For sufficiently stronger experts, this incentive may be strong enough to induce them to always contradict their signals and the other expert's advice.

To have an intuition for the result, note that by deviating and contradicting the opponent's action, the stronger expert harms more the posterior of the opponent than her posterior. This is so because whenever actions contradict, a bayesian principal puts higher weight on the action coming from the stronger expert, for her being the expert with the ex-ante better signal.[3] The weaker expert, however, cannot do better than following her signal, for fear of the stronger expert being a wise type. To the best of our knowledge, this insight is new in the literature.

Another result we derive is that the incentive of the stronger expert to contradict her signal may even increase in the quality of the signal. This is so because the ability of this expert to anticipate the weaker expert's action increases in the signal's quality.[4] Thus, a stronger enough expert (who gains a lot from retaining her initial advantage) may find it optimal to go more often against her signal, the more informative it is. This result has an interesting implication. It suggests that when interpersonal comparisons matter, an increase in "familiarity", i.e., knowledge about an opponent, may lead to higher experts' differentiation.

The results in this paper have straightforward implications for the conditions under which societies may reach consensus and dissent. They suggest that whereas the APE system fosters consensus, the RPE system is likely to drive dissent. From our personal experience, we may probably recognize situations in which informed agents, having no different biases or preferences choose to support different opinions and contradict each other, making consensus difficult to achieve and putting burdens on the principal's capacity to make the correct decision. This work develops a new rationale for this behavior that roots in experts comparing each other and the stronger expert seeking to retain an advantage.

Our results also have interesting implications for the study of competition for an evaluator's attention, something that lack of time and increased competition from globalization is making increasingly relevant in modern Western societies. Last, our results also generate insights into the drawbacks of paying attention to interpersonal comparisons when this concern originates in an internal rather than a market or external pressure; and on the optimal design of an evaluation system when the focus is either on today's or tomorrow's information.

The rest of the paper is organized as follows. In Section 2 we review the literature and in Section 3 we present the model. Section 4 contains the analyses and results: Section 4.1 studies the Absolute Performance Evaluation system, Section 4.2.1 studies the Relative Performance Evaluation system

[3]This result requires signals (of the normal-type experts) to be either of the same quality, independently of the expert's ex-ante reputation, or to be of higher quality for the stronger expert and of lower quality for the weaker expert. For simplicity, in the paper we consider that the quality of a signal is the same for any normal-type expert. However, we conjecture that the results in this paper would maintain if stronger experts received better signals. See Section 5.2.

[4]This result is obtained considering signals that are i.i.d. conditional on the state. However, we predict this result to be stronger if conditional on the state, signals were correlated. See Section 5.2.

for a representative functional form, and Section 4.2.2 studies the general case. Section 5 presents a robustness analysis and Section 6 concludes by discussing our results in terms of their effects on i) reaching consensus in society, ii) competition for attention, iii) misconception of the market's evaluation system, and iv) optimal design of an evaluation system. The proofs of the results are in the Appendix. The Online Appendix provides algebraic support for the Appendix.

## 2 Related literature

This paper contributes to the literature about career concerns for expertise and speaks directly to the analysis of reputational concerns in the presence of competing experts (see Ottaviani and Sørensen (2001, 2006*a*), Gentzkow and Shapiro (2006), Bourjade and Jullien (2011), and Andina-Díaz and García-Martínez (2020)).[5] None of these papers consider heterogeneous experts or interpersonal comparisons. We differentiate from them in these two regards.

An exception within this literature is the paper by Ottaviani and Sørensen (2006*b*), who although mainly focusing on the behavior of experts under an absolute performance evaluation system, in Section 7 they consider an extension of their model in which experts care about relative reputation. They, however, consider homogeneous experts and a state of the world that is always revealed and obtain that introducing relative reputational concerns has no effect on experts' behavior, nor it induces experts to differentiate their advice. We differ from this work by considering experts with heterogenous expertise and a probability of feedback that may be less than one. Under this set-up, we show that relative reputational concerns do induce experts to differentiate their advice.

The result that experts differentiate their advice relates our paper to the literature on forecasting contests. The seminal work by Ottaviani and Sørensen (2006*c*) showed that concerns for ranking may create an incentive for experts to differentiate their forecasts, a goal that experts could get by putting too much weight on their signals. Subsequent work by Lichtendahl et al. (2013) showed that the amount of differentiation increases in the number of forecasters, and more recently Banerjee (2021) extends the model to allow for conditional correlation in experts' signals. In line with the literature on contest games, these papers assume an exogenous payoff function describing a winner-takes-all contest game, in which the prize is proportional to the number of succeeding forecasters.[6] This assumption has two important implications. First, it means the market commits ex-ante to a particular reward scheme, i.e, it does not necessarily use all information available to evaluate experts. Second, it introduces an incentive for *all* experts to differentiate their advice, in an attempt to reduce the number of experts with whom to share the prize. Hence, even if experts are identical (as considered in these works), in equilibrium there is differentiation. In contrast to this, we analyze a reputational

[5] In a different class of literature, Crawford and Sobel (1982), Krishna and Morgan (2001), Battaglini (2002), and Kartik and van Weelden (2019*a*,*b*) consider competition among partisan (rather than professional) experts. Bourjade and Jullien (2011) introduce reputational concerns about the quality of expertise in a model of partisan experts.

[6] The assumption of an exogenous payoff function is common in the literature on contests and tournaments. See Lazear (1981), Lazear and Rosen (1981), Green and Stokey (1983), Nalebuff and Stiglitz (1983), Moldovanu and Sela (2001, 2006), Moldovanu et al. (2007), and Kräkel (2008).

model where experts' payoffs are endogenously derived and the principal uses all information available to him. This distinction is indeed relevant for the results, as it shapes the nature of differentiation, from being a mechanism that softens competition for the prize (hence all experts can profit from) to being a mechanism to garble an evaluation and take advantage of initial asymmetries (hence experts can asymmetrically profit from). The argument behind our results is then very different from the one in forecasting contests. This is particularly clear in our Proposition 2, which shows that when experts are identical, our model does not produce differentiation.

The result of experts' differentiation also has a flavor of the reputational herding and anti-herding literature. This literature talks about the incentives of career concern experts to go for (or against) an established opinion, as a way of improving an expert's reputation. Of course (anti-)herding models require the existence of an established opinion–the so-called "popular belief"–for this incentive to emerge. This popular belief may simply come from the consideration of an unbalanced prior, for example about the state of the world. This is the case in models of herding such as Heidhues and Lagerlöf (2003), Cummins and Nyman (2005), Ottaviani and Sørensen (2001, 2006*a*,*b*), and Gentzkow and Shapiro (2006); and in models of anti-herding such as Levy (2004) and Panova (2010). Another common situation is that the popular belief refers to an established opinion that was first taken in the game, which requires a sequential structure. In this regard, see Scharfstein and Stein (1990) for a model of herding, and Effinger and Polborn (2001) and Avery and Chevalier (1999) for models of anti-herding.[7] In contrast to this literature, the results in our paper are derived under the assumption that all the states of the world are equally likely and competition is simultaneous. This guarantees that herding/anti-herding effects are not behind our results, as there is neither an unbalanced prior about the state nor a first decision to follow or contradict.

Last, for the mechanism in our paper to arise, two ideas are crucial. First, experts must be different in their initial expertise. To the best of our knowledge, there is no work in the literature that considers career concern experts with heterogenous expertise. Second, by the time the evaluator assigns reputations, the state of the world might not be revealed, i.e., experts are uncertain about whether the principal will learn the consequences of their actions or not. The literature on career concerns is divided into considering that the state is revealed or not. Ottaviani and Sørensen (2001, 2006*a*,*b*), and Levy (2004) assume that the state of the world is always revealed, whereas Scharfstein and Stein (1990), Prendergast and Stole (1996) and Avery and Chevalier (1999) assume that the state is never observed. Closer to our work in this respect, Canes-Wrone et al. (2001), Prat (2005), Levy (2007), Li and Madarász (2008), Fox and Van Weelden (2012), and Andina-Díaz and García-Martínez (2020, 2021) allow the probability of feedback to vary and identify conditions under which transparency may have a perverse effect. In our case, however, transparency always disciplines, as in Gentzkow and

[7]Herding effects have usually been associated with models in which expert/s do not know their ability (Scharfstein and Stein (1990), Ottaviani and Sørensen (2001, 2006*a*)), whereas anti-herding effects have usually been related to models in which the expert/s know their ability (Avery and Chevalier (1999), Levy (2004)). There are, however, exceptions. For example, Ottaviani and Sørensen (2006*b*) and Gentzkow and Shapiro (2006) identify herding effects in models in which experts know their type, and Effinger and Polborn (2001) present a model in which anti-herding occurs even with experts that do not know their type.

Shapiro (2006).

# 3 The model

We consider a model between two experts $i \in \{1,2\}$ (she) with career concerns and one principal (he). There is a binary state of the world $\omega \in \{L, R\}$ and a binary set of actions $a_i \in \{\hat{l}, \hat{r}\}$. We assume that the two states are equally likely.

Experts make simultaneous decisions on the actions to take. Prior to taking an action, expert $i$ receives a private signal $s_i \in \{l, r\}$ on the state of the world. We denote by $\gamma$ the quality of a signal, with $\gamma = P(l \mid L) = P(r \mid R)$, and assume that the distribution of the quality of a signal depends on the type of the expert, which can be either wise type ($W$) or normal type ($N$). Let $t_i$ be the type of an expert, with $t_i \in \{W, N\}$ and $i \in \{1,2\}$. We assume that a wise-type expert always receives a signal that perfectly reveals the state of the world (it has quality 1); whereas a normal-type expert receives an imperfect but informative signal of quality $\gamma \in (\frac{1}{2}, 1)$. Types of experts are i.i.d. and signals are i.i.d. conditional on the state. Note that $\gamma$ can be arbitrarily close to 1, i.e., normal-type experts can receive signals of arbitrarily excellent quality. The type of an expert is her private information. The other players (expert $j$ and the principal) have a common prior about the probability that expert $i$ is a wise type. Let $\alpha_i \in (0,1)$ be this common prior probability; then $1 - \alpha_i$ is the prior probability that expert $i$ is normal type. We assume $\alpha_1 \geq \alpha_2$, i.e., it is common knowledge that ex-ante, expert 1 has a higher (or equal) probability of being wise type than expert 2. Hereafter, we refer to expert 1 as the *stronger* expert and to expert 2 as the *weaker* expert.

We define the strategy of an expert as a mapping that associates with every possible type and signal of the expert a probability distribution over the space of actions. For the sake of simplicity, we denote by $\sigma_t^i(s)$ the probability that expert $i$ of type $t$ takes the action $a$ that corresponds to her signal $s$. Thus, $\sigma_t^i(l) = P_t^i(\hat{l} \mid l)$ and $\sigma_t^i(r) = P_t^i(\hat{r} \mid r)$, for $i \in \{1,2\}$ and $t \in \{W, N\}$. Then, $1 - \sigma_t^i(l) = P_t^i(\hat{r} \mid l)$ and $1 - \sigma_t^i(r) = P_t^i(\hat{l} \mid r)$ is the probability that expert $i$ of type $t$ takes the action $a$ that does not correspond to her signal $s$.

Let $\mu > 0$ denote the probability that before forming a belief about the type of the experts, the principal receives ex-post verification of the state of the world. We refer to $\mu$ as the *probability of feedback*. We denote by $X \in \{L, R, \varnothing\}$ the feedback received by the principal, with $X = \varnothing$ indicating that there is no feedback and $X = L$ $(R)$ indicating that the principal learns that the state is $L$ $(R)$. The principal observes the vector of actions $(a_1, a_2)$ and feedback $X$ and, based on this information, updates his beliefs about each of the experts' types. Let $\hat{\alpha}_i(a_i, a_j, X)$ denote the principal's posterior probability that expert $i$ is type $W$, given $(a_i, a_j)$ and $X$, with $i, j \in \{1,2\}$ and $i \neq j$.

Experts have concerns for expertise and each chooses the action to take seeking to maximize her reputation for looking wise, i.e., for being perceived as type $W$. We consider experts that care about interpersonal comparisons and aim at maximizing their (relative) reputation for looking wise. We refer to this system of evaluation as the *Relative Performance Evaluation* (RPE) system, and consider that the payoff function of expert $i$, $\Pi_i^R$, is:

$$\Pi_i^R(a_i, a_j, X) = f(\hat{\alpha}_i(a_i, a_j, X), \hat{\alpha}_j(a_j, a_i, X)), \quad (1)$$

with $f(\hat{\alpha}_i, \hat{\alpha}_j) : [0,1]^2 \to \mathbb{R}_+$ being $C^1$ with $f'_{\hat{\alpha}_i} > 0$ and $f'_{\hat{\alpha}_j} < 0$.[8] Our analysis proceeds in two steps. In Section 4.2.1, we analyze a representative functional form of $f(\hat{\alpha}_i, \hat{\alpha}_j)$, described by equation (3) below. Then, in Section 4.2.2, we analyze the general case, described by equation (1).

The RPE system illustrates situations in which either the principal or the experts themselves evaluate an expert's performance based on the comparison with the other expert. When it is the expert who evaluates herself this way, she does it through the eyes of the principal, using the principal's posterior that he assigns to each expert being a wise type. Note that under the RPE system, expert $i$ may increase her payoff by either increasing her posterior $\hat{\alpha}_i$ or by decreasing the posterior of the opponent $\hat{\alpha}_j$, as the distance away from the opponent's posterior matters. This suggests that under the RPE system, an expert might prefer to be perceived as an expert with a small posterior rather than a high posterior if by accepting a lower posterior she harms more the posterior of the other expert. As discussed later in the text, these considerations introduce an asymmetry into the game, as the two experts might be asymmetrically able to harm the opponent. This asymmetry will turn crucial to the results.

# 4 Results

Prior to presenting the results, we introduce the equilibrium concept and some definitions and conditions that we use in the analysis.

Our equilibrium concept is Perfect Bayesian Equilibrium. We say that $(\sigma_W^i(l)^*, \sigma_W^i(r)^*; \sigma_N^i(l)^*, \sigma_N^i(r)^*)$ is an *equilibrium strategy* of expert $i$ if given the equilibrium strategy of expert $j$ and the players' consistent beliefs, $\sigma_t^i(l)^*$ maximizes the expected payoff of expert $i$ of type $t$ after observing signal $l$, and $\sigma_t^i(r)^*$ does it after signal $r$. We denote an equilibrium strategy by $\{(\sigma_W^i(l)^*, \sigma_W^i(r)^*; \sigma_N^i(l)^*, \sigma_N^i(r)^*)\}_{i\in\{1,2\}}$.

For a given $i \in \{1,2\}$ and $t \in \{W,N\}$, we say that the strategy of expert $i$ of type $t$ is *honest* when $(\sigma_t^i(l)^*, \sigma_t^i(r)^*) = (1,1)$, i.e., the expert takes the action that corresponds to her signal with probability one. When the two types of the two experts use an honest strategy, we say that the equilibrium is honest. Additionally, for a given $i \in \{1,2\}$ and $t \in \{W,N\}$, we say that the strategy of expert $i$ of type $t$ is *symmetric* when $\sigma_t^i(l) = \sigma_t^i(r) = \sigma_t^i$, i.e., the expert takes the action that corresponds to her signal with the same probability across the two information sets, $s = l$ and $s = r$. When the two types of the two experts use symmetric strategies, we say that the equilibrium is symmetric. Finally, we say that an equilibrium is *sincere* if $\sigma_t^i(s) = 1$ whenever $p_t^i(\omega|s) > \gamma$, with $p_t^i(\omega|s)$ being the probability that expert $i$ of type $t$ assigns to state $\omega$ after receiving signal $s$, for all $i \in \{1,2\}$ and $t \in \{W,N\}$.

The analysis that follows considers two conditions or simplifications. First, it restricts attention to symmetric strategies. Note that in our set-up, considering symmetric strategies is a natural assumption, as the two information sets that correspond to the two possible states of the world are symmetric: both

[8] A function $f$ is said to be of class $C^1$ at $[0,1]^2$ if its 1-partial derivatives exist at all points of $[0,1]^2$ and are continuous.

states are equally likely, signals are equally informative across states, and the probability of feedback is fixed and invariant across actions and/or states.[9]

Second, it requires the equilibria to be sincere. Note that this requirement is vacuous on the normal-type experts, as her posterior about the state of the world being either $L$ or $R$ is always $\gamma$. Sincerity, however, is not vacuous on the wise-types, who are required to choose $a = s$ with probability one, since $p^i_W(s|s) > \gamma$. This is in line with Fox and Van Weelden (2012) and Fu and Li (2014), who impose conditions similar in spirit to this one. It is however important to notice that the restriction on sincere equilibria has no substantial effects on our results, though it greatly simplifies the analysis. This is shown in Section 5.1, where we relax this assumption and show that the main insight of the paper, namely stronger experts may have an incentive to contradict their signal, also holds when we consider strategic wise-type experts.

Finally, note that the sincerity condition allows us to focus our attention on the behavior of normal-type experts, hereafter simply referred to as *experts*.

## 4.1 Benchmark: The Absolute Performance Evaluation system

As a benchmark, we analyze the behavior of experts that aim at maximizing their (absolute) reputation for looking wise. In this case, we say we are under the *Absolute Performance Evaluation* (APE) system, which is the standard system in the literature on career concerns. Under the APE system, experts choose the action to take seeking to maximize the payoff function:

$$\Pi^A_i(a_i, a_j, X) = g(\hat{\alpha}_i(a_i, a_j, X)), \tag{2}$$

with $g(\hat{\alpha}_i) : [0, 1] \to \mathbb{R}_+$ being increasing in $\hat{\alpha}_i$. This payoff function exclusively depends on the expert's posterior, $\hat{\alpha}_i$, which nevertheless depends on the actions of the two experts. This is clear when $X = \emptyset$, in which case action $a_j$ may contain information about the state; hence, it may be informative about expert $i$'s expertise. The analysis of the benchmark case yields the following result.

**Proposition 1.** *Consider $\alpha_1 \geq \alpha_2$ and the payoff function in (2). The equilibrium is unique and it is described by the two experts using the honest strategy, i.e., $(\sigma^{1*}_N, \sigma^{2*}_N) = (1, 1)$ for all $\mu > 0$.*

This proposition shows that whether or not experts are initially homogenous, the APE system has a unique equilibrium. In this equilibrium, the two experts follow their signals, for any probability of feedback $\mu > 0$. To have an intuition for the result, note that when experts are evaluated in absolute terms–so that all that matters is to make accurate predictions about the state of the world, as wise experts make–the best an expert can do is to follow her informative signal, as it maximizes the probability of taking the action that matches the state. This result extends the standard positive effect of reputation (e.g. Kreps et al. (1982)) to the consideration of heterogenous experts, showing

[9]Considering the two information sets to be symmetric is a simplifying assumption that however allows us to better identify the sources behind our novel results. Literature has already shown that introducing asymmetries affects the results. See Ottaviani and Sørensen (2001) for a model of asymmetric states, Prat (2005) for a model with asymmetric informative signals, and Andina-Díaz and García-Martínez (2020) for a model of asymmetric feedback.

that even if experts are heterogenous in their expertise, in the equilibrium of the APE system they will never misreport their signals.

## 4.2 The Relative Performance Evaluation system

The analysis of the *Relative Performance Evaluation* (RPE) system proceeds in two steps. First, we consider a representative payoff function and derive the results for this case. Then, we analyze the general case.

### 4.2.1 A representative payoff function

We start by considering the following representative payoff function for the experts:

$$\Pi_i^R(a_i, a_j, X) = \frac{\hat{\alpha}_i(a_i, a_j, X)}{\hat{\alpha}_i(a_i, a_j, X) + \hat{\alpha}_j(a_j, a_i, X)}. \tag{3}$$

The use of this particular functional form presents some advantages. First, it is highly tractable, which allows us to analyze the game in detail and obtain clear-cut predictions. Second, it takes values in the interval zero-one and is homogeneous of degree zero, thus the payoff is not sensitive to changes in the unit of measure of reputations.[10] Third, it finds support in the contest theory literature, where it corresponds to the ratio-form introduced by Tullock (1980) for the contest success function.[11] Additionally, it admits at least two interpretations: On the one hand, it represents the reputational market share of an expert, in line with the concept of a firm's market share. On the other hand, it represents the probability that an expert gets promotion as the probability that she wins a lottery with $\hat{\alpha}_i + \hat{\alpha}_j$ tickets when she has $\hat{\alpha}_i$ tickets.

Our first result analyzes the case of homogenous experts.

**Proposition 2.** *Consider $\alpha_1 = \alpha_2$ and the payoff function in (3). The equilibrium is unique and it is described by the two experts using the honest strategy, i.e., $(\sigma_N^{1*}, \sigma_N^{2*}) = (1, 1)$ for all $\mu > 0$.*

Two notes on this result. First, it shows that when experts have the same initial reputation, the RPE system described by (3) produces the same result as the benchmark system, in which experts do not care about interpersonal comparisons. To have an intuition for this result, note that even though experts are now evaluated in relative terms, since they are identical (and there is no other asymmetry), there is no possibility of taking advantage of any asymmetry. In this case, an expert that aims to be perceived as wise cannot do better than following her informative signal, as it maximizes the probability of taking the action that matches the state. Second, even thought the result might look minor, it is indeed important, for it pin downs our contribution to the literature. In particular, it proves that the mechanism driving experts' differentiation in our paper is different from the one posited by the literature (see Ottaviani and Sørensen (2006*c*), Lichtendahl et al. (2013), and Banerjee (2021)).

[10]Two notes. First, a function $f(\boldsymbol{x}) : \mathbb{R}^2 \to \mathbb{R}$ is homogeneous of degree zero if $f(\boldsymbol{x}) = f(\lambda \boldsymbol{x})\ \forall \lambda \neq 0$. Second, for the indeterminate case of $(\hat{\alpha}_i, \hat{\alpha}_i) = (0, 0)$, we assume expression (3) takes value 0.

[11]The ratio-form states that the winning probability for a contestant equals the contestant's effort over the sum of all contestants' efforts.

The reason is that these papers obtain experts' dissent with identical experts (see our discussion in Section 2), something that can never occur in our case.

Next, we consider heterogenous experts, i.e, $\alpha_1 > \alpha_2$. We obtain the following result, with the expressions of the thresholds $\mu_1$, $\mu_2$, and $\bar{\alpha}$, and the equilibrium probability, $x$, being defined in the proof.[12]

**Proposition 3.** *Consider $\alpha_1 > \alpha_2$ and the payoff function in (3). There exists $\mu_1$ and $\mu_2$, with $\mu_1 < \mu_2$ and $\mu_2 \in (0, 1)$, such that in the unique equilibrium:*

- *If $\mu > \mu_2$, then $(\sigma_N^{1*}, \sigma_N^{2*}) = (1, 1)$.*
- *If $\mu_1 < \mu < \mu_2$, then $(\sigma_N^{1*}, \sigma_N^{2*}) = (x, 1)$, with $x \in (0, 1)$.*
- *If $\mu < \mu_1$, then $(\sigma_N^{1*}, \sigma_N^{2*}) = (0, 1)$, where $\mu_1 > 0$ if and only if $\alpha_1 > \bar{\alpha}$, with $\bar{\alpha} \in (\alpha_2, 1)$.*

Proposition 3 identifies different scenarios according to the probability of feedback $\mu$. A common feature in all the scenarios is that the weaker expert always follows her signal. More interesting is the behavior of the stronger expert. We observe that except for the case in which the probability of feedback is sufficiently high (i.e., $\mu > \mu_2$), the RPE introduces an incentive for the stronger expert to misreport and contradict her signal, with this incentive increasing the lower the probability of feedback. In the limit, when $\mu < \mu_1$, which requires a stronger enough expert, we obtain that this expert always contradicts her signal.

To understand the incentive of the stronger expert to contradict her signal, note that when the probability of feedback is sufficiently low, an expert's action is (most likely) judged against the other expert's action.[13] In this case, taking the same action as the opponent does not imply a substantial positive effect on the stronger expert's posterior. However, by taking different actions this expert can gain a lot. The reason is that when actions contradict each other, the (bayesian) principal puts higher weight on the action taken by the stronger expert than on the one coming from the weaker expert, for the former being more likely a wise type, i.e., a type with a perfect signal. It implies a more favorable ratio of posteriors for the stronger expert, which outweighs her ratio of posteriors for following the signal. Hence, in equilibrium, the stronger expert misreports the signal. The weaker expert, however, cannot do better than sticking to her signal, for fear of the stronger expert being a wise type who perfectly informs about the state of the world.

This discussion sheds light on the mechanism behind experts' differentiation in our model, pointing out the ability of the stronger expert to exploit and take advantage of an initial asymmetry as the driving force. This mechanism requires three key ingredients, pinned down in Propositions 1-3. First,

[12]The expressions of thresholds $\mu_1$, $\mu_2$, and $\bar{\alpha}$ are given by expressions 8, 6, and 7 in the Appendix. The equilibrium probability $x$ is the unique solution of equation $\Delta_{r,N}^{1,R} = 0$, where $\Delta_{r,N}^{1,R}$ is the expected gain to the normal-type expert 1 from taking action $\hat{r}$ rather than $\hat{l}$ after signal $r$ under the RPE system. See expression (4) in the Appendix. From Lemma 1, $x$ is also the unique solution of equation $\Delta_{l,N}^{1,R} = 0$. The probability $x$ is a function of the parameters of the model $\alpha_1$, $\alpha_2$, $\gamma$, and $\mu$.

[13]Quite straightforward, when $X = \emptyset$, the posterior of an expert depends on the action taken by the other expert. When $X \neq \emptyset$, this is not the case, as $X$ is sufficient. See beliefs (9)-(15) in the Online Appendix.

we need experts to be heterogenous; otherwise, there is no initial advantage to exploit (see Proposition 2). Second, we need the probability of feedback not to be very high; otherwise, contradicting a signal becomes very risky. Third, we also need some class of interpersonal comparisons that allow experts to benefit from an opponent's loss of reputation; otherwise, contradicting a signal to contradict the opponent might not be optimal (see Proposition 1).

The next corollary presents a comparative static analysis of the different equilibrium regions.

**Corollary 1.** *Thresholds $\mu_2$ and $\mu_1$ satisfy $\frac{\partial \mu_2}{\partial \alpha_1} > 0$, $\frac{\partial \mu_1}{\partial \alpha_1} > 0$, and $\frac{\partial \mu_2}{\partial \gamma} > 0$. Additionally, there exist $\hat{\alpha} \in (\bar{\alpha}, 1)$ and $\hat{\gamma} \in (\frac{1}{2}, 1)$ such that if $\alpha_1 > \hat{\alpha}$ and $\gamma < \hat{\gamma}$, then $\frac{\partial \mu_1}{\partial \gamma} > 0$; otherwise, $\frac{\partial \mu_1}{\partial \gamma} < 0$.*

Figure 1 below presents a graphical description of the results of Corollary 1, where top panels present a comparative static analysis with respect to parameter $\alpha_1$, and bottom panels do it for parameter $\gamma$. We represent in blue the equilibrium with $(\sigma_t^{1*}, \sigma_t^{2*}) = (1,1)$ $\forall t \in \{W, N\}$, referred to as the *honest equilibrium*; in brown the equilibrium with $(\sigma_W^{1*}, \sigma_W^{2*}; \sigma_N^{1*}, \sigma_N^{2*}) = (1,1;x,1)$, with $x \in (0,1)$, referred to as the *mixed equilibrium*; and in purple the equilibrium with $(\sigma_W^{1*}, \sigma_W^{2*}; \sigma_N^{1*}, \sigma_N^{2*}) = (1,1;0,1)$, refereed to as the *mirror equilibrium*.

Figure 1 about here

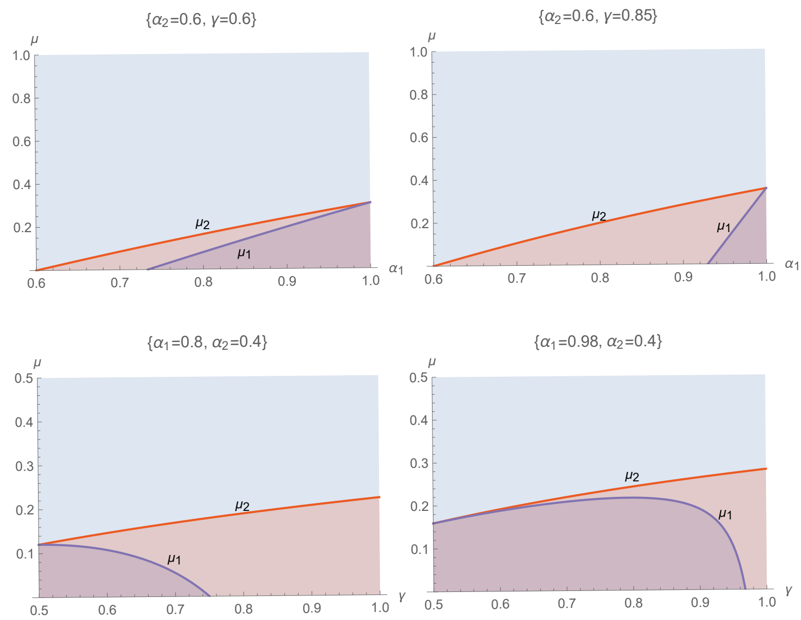


Figure 1: Top panels represent the effect of a change in $\alpha_1$ on the regions where the honest (blue), the mixed (brown), and the mirror equilibrium (purple) exist. Threshold $\bar{\alpha}$ corresponds to $\mu_1(\alpha_1) = 0$. The top-left panel considers $\alpha_2 = 0.6$ and $\gamma = 0.6$ and the top-right panel considers $\alpha_2 = 0.6$ and $\gamma = 0.85$. The bottom panels represent the effect of a change in $\gamma$ on the regions where the honest (blue), the mixed (brown), and the mirror equilibrium (purple) exist. The bottom-left panel considers $\alpha_1 = 0.8$ and $\alpha_2 = 0.4$, and the bottom-right panel considers $\alpha_1 = 0.98$ and $\alpha_2 = 0.4$.

Some relevant comments are the following. First, an increase in $\alpha_1$ increases both $\mu_2$ and $\mu_1$, which means that the higher the reputation of the stronger expert is, the smaller the region of $\mu$ where this expert plays the honest strategy, and the higher the region where she plays the mirror strategy.[14] Second, $\mu_2 \to 0$ when $\alpha_1 \to \alpha_2$ (see the proof of Proposition 3 for proof of this result), which means that the more similar experts are in their initial expertise, the higher the region of $\mu$ where the stronger expert reveals her signal. In the limit, the two experts are always honest (Proposition 2).

Third and last, $\mu_2$ increases in $\gamma$, which means that the region of $\mu$ where the stronger expert plays the honest strategy decreases as the signal's quality increases. In other words, the stronger expert deviates more frequently from her signal, the better the signal's quality. Though apparently counterintuitive at first sight (a higher $\gamma$ conveys better information about the state of the world, hence a higher deviation cost from the honest strategy), the crucial idea is that an increase in $\gamma$ also conveys more accurate information about the weaker expert's action. Corollary 1 shows that this second effect is strong enough to dominate the first one, resulting in the stronger expert contradicting her signal more often, the higher its quality.[15]

### 4.2.2 General case

This section presents the results for the general payoff function $f(\hat{\alpha}_i, \hat{\alpha}_j)$, as given in (1). We focus our attention on the most relevant case of $\mu$ being sufficiently low, for which Proposition 3 shows that the main result appears. In this section, we show that if the payoff function $f(\hat{\alpha}_i, \hat{\alpha}_j)$ satisfies the *sensitivity condition* (that we introduce next) and the stronger expert is sufficiently strong, the equilibrium of the game is unique and it exhibits the same garbling features than in the previous section.

**Definition 1.** *A function $f(x, y) : [0, 1]^2 \to \mathbb{R}_+$ that is $C^1$ in $[0, 1]^2$ satisfies the sensitivity condition whenever:*

1. $|f'_x(x, y)| \leq \left|f'_y(x, y)\right|$ *if* $x > y$,
2. $|f'_x(x, y)| \geq \left|f'_y(x, y)\right|$ *if* $x < y$.

Since the payoff function $\Pi_i^R$ described in (1) satisfies $f'_{\hat{\alpha}_i} > 0$ and $f'_{\hat{\alpha}_j} < 0$, the sensitivity condition requires that whenever $\hat{\alpha}_i > \hat{\alpha}_j$, the increase in $\Pi_i^R$ due to an infinitesimal increase in $\hat{\alpha}_i$, is smaller than the decrease in $\Pi_i^R$ due to the same infinitesimal increase in $\hat{\alpha}_j$. It is straightforward to check that many payoff functions, such as $f(\hat{\alpha}_i, \hat{\alpha}_j) = \frac{\hat{\alpha}_i}{\hat{\alpha}_i + \hat{\alpha}_j}$, $f(\hat{\alpha}_i, \hat{\alpha}_j) = \frac{\hat{\alpha}_i}{\hat{\alpha}_j}$, $f(\hat{\alpha}_i, \hat{\alpha}_j) = \hat{\alpha}_i - \hat{\alpha}_j$, and any monotonic transformation of these functions, satisfy the sensitivity condition (note that for $f(\hat{\alpha}_i, \hat{\alpha}_j) = \hat{\alpha}_i - \hat{\alpha}_j$ and its monotonic transformations, the condition holds with equality). To any function satisfying this condition (among which it is the payoff function in (3)), we obtain the following result:

[14] We also observe that $\mu_1 \to \mu_2$ when $\alpha_1 \to 1$ (see the last part of the proof of Proposition 3 for proof of this result), which implies that the higher the initial reputation of the stronger expert, the smaller the region where she uses a mixed strategy. In the limit, she either sticks to her signal or contradicts it.

[15] Regarding the effect of $\gamma$ on $\mu_1$, we observe it is not always monotonic: whereas the left-hand side panel represents a situation in which $\frac{\partial \mu_1}{\partial \gamma} < 0$ always, the right-hand side panel represents a situation in which first $\frac{\partial \mu_1}{\partial \gamma} > 0$ and then $\frac{\partial \mu_1}{\partial \gamma} < 0$. According to Corollary 1, in the left-hand side panel we have $\alpha_1 < \hat{\alpha}$ and in the right-hand side panel we have $\alpha_1 > \hat{\alpha}$. A final comment is that $\mu_1 \to \mu_2$ when $\gamma \to 1/2$ (see also the proof of Proposition 3 for proof of this result), which implies that the smaller $\gamma$, the smaller the region where the mixed equilibrium exists. In the limit, the stronger expert either sticks or contradicts her signal.

**Theorem 1.** *Consider $\alpha_1 > \alpha_2$ and any payoff function in (1) that satisfies the sensitivity condition. There exists $\tilde{\mu} \in (0,1)$ and $\tilde{\alpha} \in (0,1)$, such that $(\sigma_N^{1*}, \sigma_N^{2*}) = (0,1)$ is the unique equilibrium for any $\mu < \tilde{\mu}$ and $\alpha_1 > \tilde{\alpha}$.*

Theorem 1 shows that for a sufficiently low probability of feedback and a sufficiently stronger expert, the RPE system shapes the nature of the game for the two experts, producing very different incentives to them: an incentive for the stronger expert to differentiate her action from that of the weaker expert (as in strategic substitutes games), and an incentive for the weaker expert to take the same action than the stronger expert (as in strategic complements games). As a result, in the unique equilibrium of the game, $(\sigma_N^{1*}, \sigma_N^{2*}) = (0,1)$.

To understand this insight, it helps to analyze the sensitivity condition, which implies that the stronger expert, i.e., expert 1, gains more by reducing the posterior probability $\hat{\alpha}_2$ than by increasing $\hat{\alpha}_1$, as long as $\hat{\alpha}_1 > \hat{\alpha}_2$.[16] The opposite holds for the weaker expert. These conditions yield an incentive for the stronger expert to contradict the opponent as, by contradicting her, she harms the posterior of the weaker expert more than her posterior. Regarding the weaker expert, the sensitivity condition requires she gains more by increasing her posterior than by reducing the posterior of the opponent. It induces the weaker expert to follow her signal, as the honest strategy maximizes the expert's posterior.

We conclude with a remark about contest games. Contest games are games in which contestants make a task aiming at gaining one or more *exogenous prizes* with some probability (see Corchón and Serena (2018) for a survey). In terms of our set-up, a simple winner-takes-all contest game will have our experts competing for an exogenous fixed prize, with the prize assigned to the expert that ends up with the higher posterior; the other expert receiving nothing. The reader may recognize this game as an example of a relative performance evaluation system.[17] Unlike us, this contest game has an equilibrium in which heterogeneous experts reveal their information.[18] The source for the difference is that in this contest game, the expert with the higher posterior gets the prize, no matter how far her posterior is over the other expert's posterior. In other words, the payoff function in this winner-takes-all contest game does not satisfy the sensitivity condition.

# 5 Robustness

In this section we show the robustness of our results to variations in our set-up, considering now strategic-wise types, correlated signals, and signals of different quality.

[16] Lemma 8 in the Appendix shows that if the initial reputation of expert 1, $\alpha_1$, is higher than threshold $\tilde{\alpha}$, then posteriors satisfy $\hat{\alpha}_1 > \hat{\alpha}_2$.

[17] This is right, in the sense that the probability an expert wins the prize increases in her posterior and decreases in the posterior of the opponent.

[18] To see it, note that if $\alpha_1 > \alpha_2$ and experts play the honest strategy $(\sigma_N^{1*}, \sigma_N^{2*}) = (1,1)$, the posterior of the stronger expert will always be above the posterior of the weaker expert, with the latter having no chances to defeat the former.

## 5.1 Strategic-wise types

We start by considering strategic-wise types. Technically, it means we do not longer require the equilibria to be sincere. We perform the analysis for the representative payoff function given by (3).

**Proposition 4.** *Both in the APE system, described by equation (2), and the RPE system, as described by equation (3), we have:*

- *Suppose $\sigma_N^{i*} > 0$ for all $i \in \{1,2\}$. Then, under both APE and RPE, the honest strategy $(\sigma_W^{1*}, \sigma_W^{2*}) = (1,1)$ is the unique equilibrium strategy of the wise-type experts.*
- *Suppose $\sigma_N^{i*} = 0$ for at least one $i \in \{1,2\}$. Then, under APE the honest strategy $(\sigma_W^{1*}, \sigma_W^{2*}) = (1,1)$ is an equilibrium strategy of the wise-type experts. Under RPE, it is not always ($\sigma_W^1 = 1$ may not be the best response).*

Proposition 4 fully characterizes the behavior of the wise-type experts in the APE system, showing that the honest strategy is always an equilibrium strategy in the benchmark case. It further states that if $\sigma_N^{i*} > 0$ for all $i \in \{1,2\}$, $(\sigma_W^{1*}, \sigma_W^{2*}) = (1,1)$ is the unique equilibrium strategy. This result, together with Proposition 1, implies that in the APE system, the honest equilibrium is the unique equilibrium of the game. Regarding the RPE system, it shows that whenever $\sigma_N^{i*} > 0$ for all $i \in \{1,2\}$, the wise-type experts also find it optimal to play the honest strategy. There are two comments on this. First, this result is compatible with a situation where the stronger-normal-type expert garbles the evaluation, choosing $\sigma_N^{1*} \in (0,1)$. It implies that the main insight of the paper–in equilibrium, garbling occurs–is robust to the consideration of strategic wise-type experts. The Corollary below formally states this idea, in comparison to the APE system. Second, it excludes the case in which $\sigma_N^{i*} = 0$ for at least one $i \in \{1,2\}$, e.g. third case of Proposition 3 that requires $\alpha_1 > \hat{\alpha}$ and $\mu < \mu_1$. Briefly, in this case, we obtain that the stronger-wise-type expert has an incentive to misreport her signal. This result has a flavor of Corollary 1–showing that $\mu_2$ increases in $\alpha_1$–and suggests that for sufficiently stronger experts, the incentive of the stronger expert to contradict the weaker expert's action can be sufficiently strong as to induce her (perfectly informed) wise-type to contradict her signal.

**Corollary 2.** *Consider $\alpha_1 > \alpha_2$ and let all types be strategic. If $\mu \in (\mu_1, \mu_2)$, with $\mu_1$ and $\mu_2$ as defined in Proposition 3, then $(\sigma_W^{1*}, \sigma_W^{2*}; \sigma_N^{1*}, \sigma_N^{2*}) = (1,1;1,1)$ is the unique equilibrium of the APE system, and $(\sigma_W^{1*}, \sigma_W^{2*}; \sigma_N^{1*}, \sigma_N^{2*}) = (1,1;x,1)$, with $x \in (0,1)$ as defined in Proposition 3, is the unique equilibrium of the RPE system.*

## 5.2 Correlated signals and signals of different quality

In this section, we provide an informal discussion about the robustness of our results to the consideration of i) correlated signals and ii) signals of different quality.

Regarding the first idea, note that our analysis considers that signals are i.i.d. conditional on the state. This is a standard assumption in the literature (Ottaviani and Sørensen (2001, 2006*a*,*b*,*c*)), and it greatly simplifies the analysis. Despite this limitation, we consider that the main result of the paper holds and may even reinforce if, conditional on the state, signals were correlated instead. The reason is quite straightforward and has to do with the fact that, with correlated signals, the stronger expert would even have more accurate information about the weaker expert's action. In line with the result in Corollary 1–showing that contradiction increases in $\gamma$–we speculate that, with correlated signals, the incentive of the stronger expert to contradict her signal would not decrease.

Regarding the second idea, note that we consider that the two normal-type experts receive signals of the same quality $\gamma \in (1/2, 1)$. Though a natural and simplifying assumption, we might consider instead that stronger-normal types receive signals of better quality than weaker-normal types. We conjecture that the main result in the paper would maintain under this alternative specification. The reason is that with signals of different quality, the principal will even have more incentives to follow the stronger expert, for her being more likely to be wise, and her receiving better signals when being normal.

# 6 Discussion

We consider a model of career concerns with heterogenous experts, who care about interpersonal comparisons. We compare our results under this scenario with those under the benchmark case, where experts are evaluated in absolute terms. We draw results and establish conditions under which introducing social comparisons make a difference, identifying the source of the difference. To conclude, we make a comparison of the two systems, the absolute and the relative performance evaluation system, and discuss them in terms of their effects on i) reaching consensus in society, ii) competition for attention, iii) misconception of the market's evaluation system and iv) optimal design of an evaluation system.

***Experts' consensus and dissent***

Casual evidence suggests that, on many occasions, experts disagree on the action to take. Existing arguments explain experts' disagreement using differences in preferences, access to different information, or a desire to reduce the number of experts with whom to share a prize. The results in this paper propose a new rationalize to explain this behavior that roots in experts comparing each other, and the stronger expert seeking to retain an advantage.

To formalize ideas, let us say there is experts' consensus when both experts take the same action with a probability higher than one-half; there is dissent otherwise. Since the signal about the state is informative, there is experts' consensus in an honest equilibrium, and there is dissent in a mirror equilibrium. To see this, note that in an honest equilibrium, the probability that experts' actions coincide is $\gamma^2 + (1-\gamma)^2 > 1/2$, whereas it is $2\gamma(1-\gamma) < 1/2$ in the mirror equilibrium. Having this idea in mind, a comparison of the results under the APE and RPE system suggests that a committee composed of homogenous experts will reach a consensus, irrespective of the evaluation system. It will also be the case if experts are heterogenous in expertise and social comparisons are not at work. In contrast to this, if experts are heterogenous and they care about interpersonal comparisons, our take-home message is that the outcome is likely to be experts' dissent.

***Competition for attention***

Lack of time, an increasingly relevant variable in modern Western societies, is pushing speakers more and more towards using strategies to attract the attention of an increasingly busy audience. Thus, understanding the effects of competition for attention on the behavior of career-concerned experts is a relevant issue. The results in this paper directly speak to this research question.

To formalize ideas, notice that as long as the endowment of time of an evaluator is finite, competition for the evaluator's attention defines a zero-sum game. Notice also that our payoff function in (3) defines a zero-sum game, as $f_i(\hat{\boldsymbol{\alpha}}) + f_j(\hat{\boldsymbol{\alpha}}) = 1$. In this sense, our results in this case can be directly applied to the analysis of competition for attention. Quite straightforward, they suggest that competition for attention, far from increasing information transmission, may have pernicious effects, namely misreported signals and contradicting messages. In this line, we believe that polarized speeches in social networks, where competition for attention can be extremely fierce, might be partially explained by our results.

***Misconception of the market evaluation system***

The reader may probably recognize situations in which agents who are not being evaluated by the market in relative terms, feel an internal pressure to prove better than others. The results in this paper also speak to these situations.

A relevant idea for this discussion is that an expert who cares about interpersonal comparisons may be willing to give up a higher posterior and accept instead a lower posterior if, by accepting a lower posterior, she harms more the posterior of the opponent than her posterior. Straightforward, by accepting a lower posterior, the expert does not maximize her probability of being perceived as a wise type. This idea suggests that when interpersonal comparisons are self-imposed by experts and not by the market, (stronger) experts may be making completely erroneous decisions. Then, the take-home message is that career-concerned experts should be careful about paying attention to others as if misconceiving the market's evaluation system, their decisions may weaken rather than boost their reputation.

***Optimal design of an evaluation system***

Last, notice that the paper plays with two sources of uncertainty, uncertainty about experts (adverse selection) and uncertainty about messages (moral hazard). Notice also that the two evaluation systems we consider have different effects on these two sources of uncertainty. While the APE system induces experts to reveal their signals, which yields better information as it softens the moral hazard problem; the RPE system induces the stronger expert to contradict her signal, which ex-post–if the state is realized–facilitates sorting, as it helps separate the normal from the wise type. These different effects point to different optimal designs of an evaluation system, depending on whether we are more interested in extracting information today or extracting it tomorrow. In fact, note that the APE system is better for *disciplining* and, in this sense, is a better system if we are interested in receiving good information today. In contrast, the RPE system is better for *sorting* and then, might be a better evaluation system if we are interested in tomorrow's information.

# A Appendix

## A.1 Part I: Definitions

Let $z \in \{A, R\}$ describe the performance evaluation system, with $A$ standing for the APE system and $R$ for the RPE system. We denote by $EU_t^{i,z}(a_i \mid s_i)$ the expected payoff to expert $i \in \{1, 2\}$ of type $t \in \{W, N\}$ when she takes action $a_i \in \{\hat{l}_i, \hat{r}_i\}$ and observes signal $s_i \in \{l_i, r_i\}$, under system $z \in \{A, R\}$. We denote by $\Delta_{s,t}^{i,z}$ the expected gain to expert $i$ of type $t$ from taking action $\hat{r}_i$ rather than $\hat{l}_i$ after signal $s$, under system $z$. Under symmetric strategies, we have:

$$\Delta_{r,t}^{i,z}(\sigma_W^1, \sigma_W^2; \sigma_N^1, \sigma_N^2) = EU_t^{i,z}(\hat{r}_i \mid r_i) - EU_t^{i,z}(\hat{l}_i \mid r_i) \tag{4}$$

$$\Delta_{l,t}^{i,z}(\sigma_W^1, \sigma_W^2; \sigma_N^1, \sigma_N^2) = EU_t^{i,z}(\hat{r}_i \mid l_i) - EU_t^{i,z}(\hat{l}_i \mid l_i) \tag{5}$$

The reader is referred to the Online Appendix for a thorough derivation of beliefs and expected payoffs.

We use functions (4) and (5) to define the equilibrium. Assuming sincere equilibria, i.e., $(\sigma_W^1, \sigma_W^2) = (1, 1)$, the definitions and analysis that follow restrict attention to the normal-type experts.[19] We describe an equilibrium profile $\sigma_N^* = (\sigma_N^{1*}, \sigma_N^{2*})$ as $(\sigma_N^{i*}, (\sigma_N^*)_{-i})$, for $i \in \{1, 2\}$. Then, in a Perfect Bayesian equilibrium, the equilibrium strategy of player $i \in \{1, 2\}$ is:

1. $\sigma_N^{i*} = 0$ if, for all $\sigma_N^i \in [0, 1]$, $\Delta_{r,N}^{i,z}(\sigma_N^i, (\sigma_N^*)_{-i}) < 0$ and $\Delta_{l,N}^{i,z}(\sigma_N^i, (\sigma_N^*)_{-i}) > 0$ (with weak inequalities, $\leq 0$ and $\geq 0$ respectively, when $\sigma_N^i = 0$).

2. $\sigma_N^{i*} = 1$ if, for all $\sigma_N^i \in [0, 1]$, $\Delta_{r,N}^{i,z}(\sigma_N^i, (\sigma_N^*)_{-i}) > 0$ and $\Delta_{l,N}^{i,z}(\sigma_N^i, (\sigma_N^*)_{-i}) < 0$ (with weak inequalities, $\geq 0$ and $\leq 0$ respectively, when $\sigma_N^i = 1$).

3. $0 < \sigma_N^{i*} < 1$ if $\Delta_{r,N}^{i,z}(\sigma_N^{1*}, \sigma_N^{2*}) = \Delta_{l,N}^{i,z}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$.

## A.2 Part II: Proofs

The first result is instrumental. It allows us to restrict the analysis to one of the two information sets–in terms of signals. We usually consider the information set $r$.

**Lemma 1.** *Under symmetric strategies,* $\Delta_{r,N}^{i,z} = -\Delta_{l,N}^{i,z}$ *for all* $z \in \{A, R\}$ *and* $i \in \{1, 2\}$.

**Proof**

Note that, under symmetric strategies, an expert is honest with the same probability after either signal $s_i \in \{l_i, r_i\}$. For the normal type, it implies $EU_N^{i,z}(\hat{l}_i \mid l_i) = EU_N^{i,z}(\hat{r}_i \mid r_i)$ and $EU_N^{i,z}(\hat{r}_i \mid l_i) = EU_N^{i,z}(\hat{l}_i \mid r_i)$. Additionally, since $\Delta_{r,N}^{i,z} = EU_N^{i,z}(\hat{r}_i \mid r_i) - EU_N^{i,z}(\hat{l}_i \mid r_i)$ and $\Delta_{l,N}^{i,z} = EU_N^{i,z}(\hat{r}_i \mid$

[19] Proposition 4 relaxes this restriction.

$l_i) - EU_N^{i,z}(\hat{l}_i \mid l_i)$, see (4) and (5), then $\Delta_{r,N}^{i,z} = -\Delta_{l,N}^{i,z}$. ■

**Proof of Proposition 1**

By Lemma 1, $\Delta_{r,N}^{i,A} = -\Delta_{l,N}^{i,A}$. Then, it suffices to prove $\Delta_{r,N}^{i,A} > 0$ for any $\sigma_N^i$ and $\sigma_N^j$, with $i, j \in \{1, 2\}$. It implies expert $i$ that observes signal $r$ ($l$) is strictly better off (worse off) by sending $\hat{r}$ than $\hat{l}$. It proves that in equilibrium expert $i \in \{1, 2\}$ is honest and shows the uniqueness of the equilibrium.

To prove $\Delta_{r,N}^{i,A} > 0$, we use the expression (18) in the Online Appendix. Expression (18) is a linear function in $\mu$; hence, it suffices to prove $\Delta_{r,N}^{i,A}|_{\mu=0} \geq 0$ and $\Delta_{r,N}^{i,A}|_{\mu=1} > 0$. Both conditions hold. See the Online Appendix for details. ■

**Proof of Proposition 2**

The proof is a limit case of the result in Proposition 3. It follows directly from the fact that when $\alpha_1 = \alpha_2$, threshold $\mu_2$ is equal to 0. See expression (6). ■

**Proof of Proposition 3**

The proof consists of several steps and uses instrumental Lemmas 2-6. See the Online Appendix for these Lemmas.

First, by Lemma 1, $\Delta_{r,N}^{i,R} = -\Delta_{l,N}^{i,R}$. For convenience, in the proof we analyze expression $\Delta_{r,N}^{1,R}$ for expert 1, and both $\Delta_{r,N}^{2,R}$ and $\Delta_{l,N}^{2,R}$ for expert 2.

Second, we provide an exhaustive list of all the equilibria configurations and the conditions for these equilibria in the next table:

| | Type of equilibrium | | Condition for equilibrium | |
|---|---|---|---|---|
| 1. | $\sigma_N^{1*} = 0$ | $\sigma_N^{2*} = 0$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) \leq 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) \geq 0$ |
| 2. | $\sigma_N^{1*} = 0$ | $\sigma_N^{2*} = 1$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) \leq 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) \leq 0$ |
| 3. | $\sigma_N^{1*} = 0$ | $0 < \sigma_N^{2*} < 1$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) \leq 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$ |
| 4. | $\sigma_N^{1*} = 1$ | $\sigma_N^{2*} = 0$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) \geq 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) \geq 0$ |
| 5. | $\sigma_N^{1*} = 1$ | $\sigma_N^{2*} = 1$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) \geq 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) \leq 0$ |
| 6. | $\sigma_N^{1*} = 1$ | $0 < \sigma_N^{2*} < 1$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) \geq 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$ |
| 7. | $0 < \sigma_N^{1*} < 1$ | $\sigma_N^{2*} = 0$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) \geq 0$ |
| 8. | $0 < \sigma_N^{1*} < 1$ | $\sigma_N^{2*} = 1$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) \leq 0$ |
| 9. | $0 < \sigma_N^{1*} < 1$ | $0 < \sigma_N^{2*} < 1$ | $\Delta_{r,N}^{1,R}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$ | $\Delta_{l,N}^{2,R}(\sigma_N^{1*}, \sigma_N^{2*}) = 0$ |

Third, we use Lemmas 2-3 to prove that none of the following configurations: 1, 3, 4, 6, 7, and 9, are possible. Lemma 2 shows that $\sigma_N^{1*} = 1$ and $\sigma_N^{2*} < 1$ cannot occur simultaneously; as $\Delta_{r,N}^{2,R} > 0$ for all $\sigma_N^1 \in [0, 1]$. This result rules out configurations 4 and 6. Lemma 3 shows $\Delta_{r,N}^{1,R} > \Delta_{l,N}^{2,R}$. This result rules out configurations 1, 3, 7, and 9. Then, in equilibrium, only configurations 2, 5, and 8 can hold. It implies expert 2 is always honest in equilibrium, i.e., $\sigma_N^{2*} = 1$.

Fourth, we analyze the behavior of expert 1. The analysis proceeds as follows:

i) We show that $\sigma_N^{1*} = 1$ is the unique equilibrium strategy of expert 1 if and only if $\mu > \mu_2$. To prove this result, we use Lemmas 4-5. Lemma 4 shows $\frac{\partial \Delta_{r,N}^{1,R}}{\partial \sigma_N^1} < 0$ and Lemma 5 shows $\Delta_{r,N}^{1,R}\Big|_{\sigma_N^1=1} > 0$ if and only if $\mu > \mu_2$, with

$$\mu_2 = \frac{\alpha_1\alpha_2(\alpha_1-\alpha_2)(2\alpha_2(\gamma-1)-2\gamma+1)}{(1-\alpha_2)\big(\alpha_1^2(\alpha_2(2\alpha_2-1)(\gamma-1)^2-\gamma)+\alpha_1\alpha_2((\gamma-2)\gamma-3\alpha_2(\gamma-1)^2)+\alpha_2^2(\gamma-1)\gamma\big)}. \tag{6}$$

From here, $\Delta_{r,N}^{1,R} > 0$ for all $\sigma_N^1 \in [0,1]$ if and only if $\mu > \mu_2$; hence $\sigma_N^{1*} = 1$ if and only if $\mu > \mu_2$.

ii) We analyse the case $\mu < \mu_2$. We use Lemma 6, which consists of two points. The first point shows that $\Delta_{r,N}^{1,R}\Big|_{\sigma_N^1=0} < 0 \iff \alpha_1 > \bar{\alpha}$ and $\mu < \mu_1$, with

$$\bar{\alpha} = \frac{\alpha_2(1-\gamma) + 2\gamma - 1}{\gamma}, \tag{7}$$

and

$$\mu_1 = \frac{\alpha_1\alpha_2(2\alpha_2(\gamma-1)-2\gamma+1)(\gamma(\alpha_1+\alpha_2-2)-\alpha_2+1)}{(1-\alpha_2)(\gamma-1)\big(\alpha_1^2(\gamma-\alpha_2(\gamma(\alpha_2+\gamma+1)-1))+\alpha_1\alpha_2(\alpha_2((\gamma-1)\gamma+1)+\gamma^2+\gamma)-\alpha_2^2(\gamma-1)\gamma\big)}, \tag{8}$$

with $\mu_1 < \mu_2$ (see the Online Appendix).

Since, by Lemma 4, $\Delta_{r,N}^{1,R}$ is decreasing in $\sigma_N^1$, the first point of Lemma 6 implies that if $\alpha_1 > \bar{\alpha}$ and $\mu < \mu_1$, then $\Delta_{r,N}^{1,R} < 0$ for all $\sigma_N^1 \in [0,1]$. Hence, the unique equilibrium strategy of expert 1 is $\sigma_N^{1*} = 0$ in this case.

The second point of Lemma 6 shows that $\Delta_{r,N}^{1,R}\Big|_{\sigma_N^1=0} > 0$ if and only if either $\alpha_1 < \bar{\alpha}$ or both $\alpha_1 > \bar{\alpha}$ and $\mu > \mu_1$ hold. It implies that if $\mu_1 < \mu < \mu_2$, then the decreasing function $\Delta_{r,N}^{1,R}$ is positive at $\sigma_N^1 = 0$ and negative at $\sigma_N^1 = 1$, which implies $\Delta_{r,N}^{1,R} = 0$ has a unique solution $x \in (0,1)$. This probability $x$ defines the unique equilibrium strategy, i.e., $\sigma_N^{1*} = x$. ■

**Proof of Corollary 1**

It follows from the sign of the derivatives of expressions (6) and (8). See the Online Appendix for the details. ■

**Proof of Theorem 1**

By Lemma 1, $\Delta_{r,N}^{i,R} = -\Delta_{l,N}^{i,R}$. Hence, hereafter we focus on $\Delta_{r,N}^{i,R}$, for $i,j \in \{1,2\}$.

To prove Theorem 1, we first consider $\mu = 0$ and show that if $\alpha_1$ is greater than a certain threshold $\tilde{\alpha} < 1$, we have $\Delta_{r,N}^{2,R} > 0$ and $\Delta_{r,N}^{1,R} < 0$.

Second, we apply a continuity argument and argue that by the continuity of $\Delta_{r,N}^{i,R}$ in $\mu$ (note $\Delta_{r,N}^{i,R}$ is linear $\mu$, see expression (18) in the Online Appendix), there exists $\tilde{\mu} > 0$ such that $\Delta_{r,N}^{2,R} > 0$ and $\Delta_{r,N}^{1,R} < 0$ for any $\mu < \tilde{\mu}$ and $\alpha_1 > \tilde{\alpha}$. It implies $(\sigma_N^{1*}, \sigma_N^{2*}) = (0,1)$ is the unique equilibrium strategy in this case.

Next, we sketch the first part of the proof, i.e., we show that if $\mu = 0$ and $\alpha_1 > \tilde{\alpha}$, then $\Delta_{r,N}^{2,R} > 0$ and $\Delta_{r,N}^{1,R} < 0$. For detailed proof, see the Online Appendix. We analyze expression (4) and obtain two main results:

1. $\Delta_{r,N}^{2,R} > 0$ for any $(\sigma_N^1, \sigma_N^2) \in [0,1]^2$, if $\alpha_1 > \tilde{\alpha}$ and $\mu = 0$.

2. $\Delta_{r,N}^{1,R} < 0$ for any $\sigma_N^1 \in [0,1]$, if $\sigma_N^{*2} = 1$, $\alpha_1 > \tilde{\alpha}$ and $\mu = 0$.

Proposition 5 in the Online Appendix proves the first result, which characterizes the conditions under which the weak expert is always honest, i.e., $\sigma_N^{*2} = 1$. To prove this result, we simplify function $\Delta_{r,N}^{2,R}$, given by the detailed version of expression (4)–expression (18) in the Online Appendix–and obtain

$$\Delta_{r,N}^{2,R} > 0 \Leftrightarrow f(\hat{\alpha}_2(\hat{r}_2, \hat{r}_1, \varnothing), \hat{\alpha}_1(\hat{r}_1, \hat{r}_2, \varnothing)) - f(\hat{\alpha}_2(\hat{l}_2, \hat{r}_1, \varnothing), \hat{\alpha}_1(\hat{r}_1, \hat{l}_2, \varnothing)) > 0.$$

Then, we apply the sensitivity condition and the directional derivative of the function $f$ to show that function $f$ is decreasing from the point $(\hat{\alpha}_2(\hat{r}_2, \hat{r}_1, \varnothing), \hat{\alpha}_1(\hat{r}_1, \hat{r}_2, \varnothing))$ to the point $(\hat{\alpha}_2(\hat{l}_2, \hat{r}_1, \varnothing), \hat{\alpha}_1(\hat{r}_1, \hat{l}_2, \varnothing))$. It implies $\Delta_{r,N}^{2,R} > 0$.

The second result is proved in Proposition 6 in the Online Appendix. It characterizes the conditions under which the strong expert always contradicts her signal, i.e., $\sigma_N^{*1} = 0$. The proof of this result is analogous to the proof of Proposition 5. ■

**Proof of Proposition 4**

The explicit expressions of the expected payoffs and probabilities are detailed in the Online Appendix.

It is straightforward to see that Lemma 1 also applies in this case. Then, $\Delta_{r,W}^{i,z} = -\Delta_{l,W}^{i,z}$, which implies it is sufficient to analyze one of the two expressions. The proof consists of the following steps.

First, for $s \in \{r, l\}$, a comparison of $\Delta_{s,N}^{i,z}$ and $\Delta_{s,W}^{i,z}$ shows $\Delta_{r,W}^{i,z} > \Delta_{r,N}^{i,z}$ and $\Delta_{l,W}^{i,z} < \Delta_{l,N}^{i,z}$. These inequalities imply that both under the APE system and the RPE system, wise-type experts are always more honest than normal-type experts.

Second, we prove the first point of Proposition 4. To this aim, let us assume $\sigma_N^i > 0$ for all normal-type experts $i \in \{1, 2\}$. It implies both $\Delta_{r,N}^{i,z} \geq 0$ and $\Delta_{l,N}^{i,z} \leq 0$. By the inequalities above, $\Delta_{r,W}^{i,z} > 0$ and $\Delta_{l,W}^{i,z} < 0$; hence, necessarily, $\sigma_W^{i*} = 1$.

Third, we prove the second point of Proposition 4. To this aim, assume $\sigma_N^i = 0$ for at least one normal-type expert $i \in \{1, 2\}$. It can be shown that, in the APE system, $\Delta_{r,W}^{i,A} > 0$ if $\sigma_W^i = 1$ for $i \in \{1, 2\}$ and $\sigma_N^j \geq 0$ for all $i, j \in \{1, 2\}$. It implies $\sigma_W^{i*} = 1$ for $i \in \{1, 2\}$. See the Online Appendix for the details. Finally, in the RPE system, a similar argument shows that $\Delta_{r,W}^{1,R}$ is not always positive when it is evaluated at $\sigma_W^i = 1$, $\sigma_N^i = 0$ and $\sigma_N^j \geq 0$, for $i, j \in \{1, 2\}$, $i \neq j$, and $\mu$ not too much high. Hence, $\sigma_W^1 = 1$ is not always the best response. ■

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