An Experimental Study of Selling Expert Advice

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Abstract

This study explores the interaction between a product expert, who offers to sell a product ranking, and an incompletely informed consumer. The consumer considers acquiring the expert's product ranking not only because the expert has superior information about the quality of the products the consumer is considering and knows the consumer's utility function, but also because the expert can directly influence consumer utility of a product by the product's rank. There are multiple equilibria in this setting with strategic information transmission: ones in which the expert ranks products in a manner that is consistent with the consumer's pre-ranking utilities, which depend exclusively on the products themselves, and ones in which the expert does not. We design a laboratory experiment to investigate which equilibrium an expert and consumer play. Across the three treatments we examine, which vary by the consumer's possible pre-ranking utilities, we find evidence that product experts are likely to select a ranking methodology that involves considerable uncertainty about the final product ranking, even though doing so involves ranking products in a manner that is inconsistent with consumer pre-ranking utilities.

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1 Introduction

Consumers prior to making purchase decisions frequently seek expert advice, which sometimes takes the form of product rankings. Familiar scenarios include students acquiring college and university ranking publications (e.g., *U.S. News & World Report Best Colleges Guidebook* and *The Wall Street Journal/Times Higher Education College Rankings*), car buyers acquiring auto rankings (e.g., *Kelley Blue Book New Car Buyer's Guide* and *Consumer Reports New Car Buying Guide*), and home cooks acquiring kitchen product rankings (e.g., *Cook's Illustrated*). A less familiar case is consumers acquiring a retailer's product ranking (e.g., TireRack.com's tire rankings).

These publications are experts because they measure, or collect information about, product attributes and they have information about consumer utility regarding those product attributes (e.g., the weights in their utility functions they attach to the various product attributes). In an extreme, an expert is completely informed about product attributes and knows the utility function, which maps product attributes and the ranking into product utilities, of the consumer seeking advice. Consumers are novices because while they may know their utility functions, they are incompletely informed about the qualities of the product attributes. Therefore, a completely informed expert has the opportunity to offer a consumer good advice in the sense of ranking products in a manner that reflects her product utilities.

Many rankings publishers are for-profit institutions, including some of the above, and the objective of a for-profit publisher is not necessarily to offer good advice to consumers by ranking products in a manner that is consistent with consumer utility of the products being considered, but rather it is to maximize sales of its ranking (or sales of detailed product information linked to the ranking), sales of its general publication, or sales of advertising associated with the ranking platform. We ask the question whether a completely-informed for-profit expert would rank products in a manner that is inconsistent with consumer utility of the products she is considering.

Popular press writers suggest that in the university ranking arena the answer to this question is no. Commercial college and university ranking publications receive frequent criticism about the methodologies they use to develop their rankings. In fact, the sentiment about university rankings in general and *U.S. News & World Report* in particular is so strong that an entire Wikipedia page is devoted solely to the criticism of college and university rankings.[1] One common criticism about such university rankings is that they tinker with their methods from year to year. Tierney (2013) in The Atlantic writes:

> U.S. News is always tinkering with the metrics they use, so meaningful comparisons from one year to the next are hard to make. Critics also allege that this is as much a marketing move as an attempt to improve the quality of the rankings: changes in the metrics yield slight changes in the rank orders, which induces people to buy the latest rankings to see what's changed.[2]

As Tierney (2013) suggests, these changes may have more to do with the marketing of these publications than with improving the quality of the ranking.

In the context of student decision making about universities to attend, Dearden, Grewal and Lilien (2019, forthcoming) evaluate whether a for-profit expert ranks universities (i.e., products) in a manner that is consistent with student (i.e., consumer) utilities. In doing so,

[1] http://en.wikipedia.org/wiki/Criticism_of_college_and_university_rankings_(North_America); accessed October 2018.

[2] https://www.theatlantic.com/education/archive/2013/09/your-annual-reminder-to-ignore-the-em-us-news-world-report-em-college-rankings/279103/; accessed October 2018.

they partition student utility into two components: the utility of the quality of a university's attributes (which are set by the university); and the utility of the university's rank (which is extrinsic to the university and determined by the expert). Their analysis demonstrates that the effect of a university' rank on a student's utility (e.g., a prestige effect of a university ranking) creates the incentive for a for-profit ranking publication to add uncertainty to its ranking methodology beyond that created by, when using the student's utility of university attributes to aggregate university attribute scores into overall scores, the randomness of university attribute scores. If the students evaluating universities are concerned with only the rank, and not with the quality of attributes, of the universities they attend, and therefore not with the information about university attributes provided (probabilistically) by the ranking, then the expert selects a ranking methodology where each possible ranking of the universities is equally likely a uniform distribution over all possible rankings. However, if the students are concerned with only the quality of the attributes and accordingly with the information provided (probabilistically) by the ranking, and the university's rank does not affect their utilities of attending, then the expert ranks universities in a manner that is consistent with the student's utilities of the university attributes by using the students' utility function (which maps university attributes into utilities) as a ranking methodology.

The Dearden, Grewal and Lilien (2019, forthcoming) model has multiple equilibria in which the expert's ranking methodology, and the degree to which the expert adds uncertainty to the ranking outcome, varies across the equilibria. They examine only the equilibrium methodology that maximizes the expert's profit. Due to the influence of the expert's ranking on the students' utilities, this ranking that maximizes profit may not rank universities in a manner that is consistent with student utility. Hence, the question remains about whether an expert and student (more generally, consumer) play this equilibrium. On one hand, the expert selects this methodology because it provides consumers with the incentive to acquire the ranking. On the other hand, when the ranking influences the consumer's utility, then ranking may boost the utility of a product that, according to product attributes, is not the consumers' favorite. In this sense, the expert harms the consumers. If the expert is concerned about the consumers, then he may shy away from using the methodology that maximizes his profit.

In this paper, we experimentally investigate the key insight of Dearden, Grewal and Lilien (2019, forthcoming) by addressing two research questions. First, we explore under what circumstances the theoretical prediction that a product expert ranks products in a manner that is inconsistent with consumer utility of product attributes. Second, we examine whether the expert's willingness to use a ranking methodology that may not rank products according to consumer utility of product attributes varies with the extent to which the expert in maximizing profit must harm the consumer.

The results of our experiment suggest that product experts have a strong tendency to rank products in a manner that is inconsistent with a consumer's pre-ranking utilities of the products being considered. The expert does so to incent the consumer to acquire the expert's advice. Furthermore, by varying the possible pre-ranking utilities of the product across three treatments of our experiment, we find that the expert's selected product ranking methodology in the three treatments changes in a way that suggests competing incentives of the expert in selecting a ranking methodology.

The remainder of the paper proceeds as follows. Section 2 provides an overview of our analysis and surveys the related studies. Section 3 presents our experimental game of selling expert advice, followed by the experimental design in Section 4. We then report our experimental findings in Section 5, and summarize possible discussions in Section 6. Finally, Section 7 concludes.

2 Overview and Literature

To provide an overview of the strategic issues involved in an expert selling advice, in this section we develop consumer utility in a way that is relevant to the construction of our model, present related literature, and introduce a popular ranking methodology and how it relates to our model.

2.1 Consumer Utility

A product ranking not only affects a consumer's expected utility of selecting a product through the information it provides about the product, but also it influences the consumer's utility of consuming a product by the prestige or future economic value it may create for a product according to the product's position in the ranking.

Considering the prestige or economic effect of an expert's product ranking, a product's rank interacts in a consumer's utility function with the consumption of that product. With a bit of detail, the utility of consuming a product could be modeled a function of the quality of the product's attributes (which are designed by a product's manufacturer) and its rank in an expert's product ranking. In our model with one expert and one consumer, we refer to the consumer's utility of a product's attributes as the *pre-ranking utility* and the combined utility of these attributes and the product's rank in the expert's ranking as the *post-ranking utility*. The post-ranking utility less the pre-ranking utility is the *ranking utility*.

In our model, the quality of product attributes set by the product-selling firms is not modeled here; this pre-ranking utility is therefore exogenously given in our game. By contrast, the interaction between product expert's ranking and a consumer's utility – the ranking utility – is endogenously determined by the position the expert places the product in its ranking; the ranking utility is decreasing in the product's ranking position (with number 1 being the top-rank).

This added utility associated with a product's rank comes from the expert's power to create prestige or economic value for highly-ranked products. We interpret this power in two ways. First, a good product rank could provide consumers with future payoffs. Take the automobile market as one example. If a car is top-ranked in a popular auto ranking, its owner can resell it at a higher price. In another example, job recruiters may use a university's rank as salient information about quality of university graduates. If so, the best firms may visit the top-ranked universities, which benefits the students who attend them. That is, students and recruiters use a university ranking as a coordination device. Those potential returns result from the reputation generated by the product ranking. Second, a high ranking may contain a psychological benefit to consumers who feel better when the selected product is highly recommended. This is analogous to persuasive advertising that could influence consumers' preferences. In the context of university rankings, the ranking value is a prestige effect in

Dearden, Grewal and Lilien (2019, forthcoming), meaning an increase in consumer utility when the products they choose improve their ranks. We adopt the same idea here.

Luca and Smith (2013) demonstrate that the actual college and university ranks in *U.S. News & World Report*, controlling for school attributes, influence application decisions. Using the Chetty, Looney and Kroft (2009) definition of the salience of information as the simplicity of calculating the information, Luca and Smith (2013) suggest that this influence of the *U.S. News & World Report* ranking on student decisions is due to the salience of the information provided by a simple rank-order of colleges and universities. We contend that this effect of university ranks on student decisions could be due to this popular ranking's prestige conferred on colleges and universities, in which a student's utility of attending a college or university is decreasing in its position in the ranking (position 1 is best).

A product ranking has the opportunity to inform consumers about the attributes of the products being considered because either a consumer updates the distribution of product attributes values using Bayes' rule based on ranks (because higher-ranked products tend to have higher-quality attributes) or a consumer uses product ranks as salient information about the quality of th product's attributes. The case of Bayesian updating may apply to important purchases that significantly affect utility. A consumer may pay attention to an array of product attributes and, if the consumer acquires a ranking, she may carefully update expected attribute scores based on product ranks. The salience case may apply to smaller purchases of unfamiliar products. If a consumer views a ranking, she may not be as careful in contemplating attribute scores, and rather she may use the ranking as salient information about product quality (Chetty, Looney and Kroft, 2009). Whether a consumer rationally updates probabilistic beliefs about the quality of a product's attributes based on its rank or uses its rank as salient information about this quality, a product ranking affects a consumer's expected expected utilities of the considered products.

As product rankings are likely to be consumed in a manner similar to advertising (or any marketing communication), the literature on advertising is relevant. Product rankings provide information about products, and create ranking value for highly-ranked ones, similar to how advertisements provide information and create status or prestige. Those two perspectives, information and prestige, parallel those that dominate research in advertising, the first of which views advertising as an information source while the second views advertising as a persuasion tool (Bagwell, 2007). Hence, from an information perspective, similar to advertising in general, rankings inform consumers about product attributes (Butters, 1977; Nelson, 1974; Stigler, 1961). From a persuasion perspective, rankings influence the utilities of the consumers who select products (Ackerberg, 2001; Becker and Murphy, 1993; Galbraith, 1976).

2.2 The Expert's Ranking Methodology

In our model with one expert and one consumer, the expert's decision whether to offer good advice to the consumer by ranking products according to the consumer's pre-ranking product utilities involves its selection of the methodology it uses to rank products.

One popular ranking process – one used by all of the above institutions – to rank products is an attribute-and-aggregate process in which an expert identifies product attributes of importance, for each product measures its attribute scores or collects attribute score data, chooses weights for the attributes, for each product multiplies the weights and the attribute scores, and determines the aggregated scores. The publication then rank-orders products based on these aggregated scores to form a ranking of products. Each of the above steps in the ranking process can affect whether the expert ranks products in a manner that is consistent with the consumer's utilities of product attributes. Whether the expert does so is the focus of our research.

Our research simplifies the attribute-and-aggregate ranking process. The expert in our model knows the consumer's utility function. Within the process we examine, the expert's ranking methodology is a mapping from the consumer's pre-ranking utilities of the products being considered to ranks. To be consistent with practice in which rankings publications offer only overviews of their methodologies, we assume that the expert does not report its methodology to the consumer. After having selected its ranking methodology, the expert learns the consumer's pre-ranking utilities and ranks products according to its selected methodology. The consumer then decides whether to acquire the expert's ranking, either by expending the time cost required to do so or paying the monetary cost. If the consumer acquires the product ranking, then she learns the products' ranks prior to her product selection. If she does not acquire the ranking, then she learns the ranks only after she has selected a product. However, whether or not she acquires the ranking, it affects her utility of consuming her selected product.

2.3 Strategic Information Transmission

Our model involves strategic information transmission in which an expert (sender) sends a message in the form of an ordinal product ranking to a consumer (receiver). Unlike the canonical problem (see Crawford and Sobel, 1982; Argenziano, Severinov and Squintani, 2016) in our model: (i) the expert's message is an argument in the consumer's utility function, (ii) the expert is unconcerned with product selected by the consumer, and (iii) the consumer decides whether to acquire the expert's ranking. Furthermore in our model (iv) the expert selects a ranking methodology when he and the consumer hold the same prior probabilistic beliefs about the attributes of the products being ranked (and therefore the consumer's pre-ranking utilities of the products). The expert commits to using the methodology, which in terms of the strategic information transmission models is a message function from the space of possible pre-ranking product values to the set of possible ordinal product rankings. Also unlike the canonical model, our model (v) involves commitment because the expert selects the ranking methodology prior to learning the pre-ranking values, but ranks the products after having learned them.

A growing number of experiments have been conducted on strategic information transmission (see Crawford (1998) and Blume, Lai and Lim (2017) for surveys of experimental studies). Among those experimental studies, our research is similar to the setting with imperfect incentive alignment where Blume, Lai and Lim (2017) document that systematic over-communication is commonly evidenced in experiments with a single sender and a single receiver (e.g. Cai and Wang, 2006).[3] However, Blume, Lai and Lim (2017) argue that the

[3]The fully revealing equilibrium occurs more often in multiple-sender multidimensional cheap talk that is

evidence of equilibrium selection is limited.

This paper also relates to a special case of strategic information transmission named "persuasion," which is studied by Kamenica and Gentzkow (2011), Gentzkow and Kamenica (2014), and Hörner and Skrzypacz (2016). In these models, a sender strategically discloses his information to the receiver, aiming to influence the receiver's action. The studies characterize sender's decision whether to disclose complete information or only partial information (e.g. Rayo and Segal, 2010; Ostrovsky and Schwarz, 2010).[4]

This paper contributes to the literature of expert product rankings in the following ways. First, it constructs a simple model to describe the strategic environment of an expert selling advice, which has implications that might be applied to many product markets. Second, we emphasize the expert's strategic behavior when he has the power to influence consumer utility, possible through affecting market values of the recommended products. This case in which the sender's (expert's) message (ranking) is an argument in the receiver's (consumer's) utility function adds a new angle to the literature on strategic information transmission.

2.4 Optimal Ranking Methodology and Randomness

Just as an expert may change its methodology from year to year in a dynamic setting, in our static model, the expert may select a methodology that introduces uncertainty into its product ranking. In our model, the expert generates the consumer's interest in his ranking by creating uncertainty about the top-ranked product (of the two in our model) and ultimately

investigated by Lai, Lim and Wang (2015).

[4]When reviewing theoretical and empirical studies on quality disclosure, Dranove and Jin (2010) argue that even third-party certification can provide inaccurate and biased information due to either the data generating process or conflict of interest.

about the product that receives the expert's ranking value boost.

Dearden, Grewal and Lilien (2019, forthcoming) identify the ranking value created by the expert, and not the information provided by the expert, as the source of the expert adding uncertainty to its product ranking. Simply put, if the consumer learns the product ranking, then she selects the top-ranked product. However, if the consumer does not acquire the product ranking to learn the products' ranks, then she may make the *ex post* mistake of not selecting the top-ranked product. In adding uncertainty to the product ranking, the expert increases the probability that a consumer who does not acquire the ranking makes the mistake of not selecting the top-ranked product.

Similar to the way a product expert can create value for highly-ranked products, an influential fashion magazine can create prestige for the people who wear the items it singles as being stylish. As Kuksov and Wang (2013) suggest, fashion editors are "the single most important influencer of fashion" (p. 53). The authors note that since fashion editors carry great weight in determining fashion hits, they are key players in generating a fundamental property of the fashion marketplace, namely the seemingly random nature of the determination of a season's "it" (Kuksov and Wang, 2013). Fashion editors include that randomness to appeal to fashion-conscious consumers who are interested in wearing the "it" products, whether for their intrinsic pleasure or for the benefits associated with signaling their fashion senses.

In offering product recommendations, deception is a possible issue. One interesting point about the Kuksov and Wang (2013) analysis is that a fashion magazine influences consumer utility by its selection of "it" items without deceiving consumer because the designation does not indicate that the top product is better than the others. In designing our experiment, because an expert's product ranking methodology to motivate the consumer to acquire his product ranking might involve deception and lying, we want to measure the effect of the expert's influence on the consumer's utility – the ranking value – without muddying this influence by having the possibility of deception. In Section 6, we use the Sobel (2018) definition of deception in models of strategic information transmission to contend that our model does not involve deception.

3 The Experimental Game: Selling Product Advice

3.1 The Strategic Environment

There are two players, a product expert (he) and a consumer (she), and two products, A and B. The expert sells product advice to the consumer in the form of a report ranking Products A and B. The consumer, who is imperfectly informed about the values of the products, decides whether to acquire the expert's ranking report and which product to purchase.[5]

The value of a product to the consumer comprises two components, a *pre-ranking value* and a *ranking value*. The pre-ranking value, v, refers to the value the consumer attaches to the product based on its quality and price, variables that are set by the product-selling firm not modeled here; this component of the value is therefore exogenously given in our game. By contrast, the ranking value of a product is endogenously determined by the expert; the consumer attaches an additional value, γ, to the product that is ranked first by the expert.

[5]Because the utilities in our experiment are monetary rewards, we refer to utility as value.

The pre-ranking value of Product A, $\bar{v}_A > 0$, is commonly known. The consumer is uncertain about the pre-ranking value of Product B, v_B, which takes one of two values, 0 and $\bar{v}_B > 0$. The expert learns the realized value of v_B, but he makes his only move in the game – commits to a ranking methodology – before observing the realization. The common prior is that $v_B = \bar{v}_B$ with probability $0 < p < 1$. The ranking value γ is also a common knowledge.

A *ranking methodology* is a mapping, $r : \{0, \bar{v}_B\} \to \{A, B\}$; it specifies for each possible value of v_B a *ranking report* for the consumer, where report A (B) indicates that Product A (B) is ranked first. Alternatively, the reports can be interpreted as non-binding recommendations to the consumer on which product to purchase.

We restrict attention to two ranking methodologies, an uninformative and an informative. The uninformative methodology, r_A, always ranks Product A first, i.e., $r_A(0) = r_A(\bar{v}_B) = A$, thus providing no information regarding the uncertain pre-ranking value of Product B. On the other hand, the informative methodology, $r_{A||B}$, which fully reveals the two possible pre-ranking values of Product B, generates ranking reports in the following manner:

$$r_{A||B}(v_B) = \begin{cases} A & \text{if } v_B = 0, \\ \\ B & \text{if } v_B = \bar{v}_B. \end{cases}$$

The set of pure strategies of the expert is $\{r_A, r_{A||B}\}$.[6] After choosing a pure strategy, which is

[6]In this study, we assume the expert might have incentive to misreport the ranking only when the difference between two products is not too big. This assumption is realistic since the expert may consider his reputation. We maintain this by assuming that the expert always ranks product A first if $v_B = 0$, assuring that a really bad product B will not be ranked first.

tantamount to committing to a ranking methodology, the expert observes the realized value of υ_B and offers a ranking report according to the adopted methodology. The use of a mixed strategy, for which we denote by $q_{r_{A||B}} \in [0,1]$ the probability that the expert chooses $r_{A||B}$, is appropriately interpreted.

The consumer never observes the expert's strategy choice (the adopted ranking methodology). The consumer observes the output of the methodology – the ranking report – before selecting a product if and only if she acquires it at a cost $c > 0$. After making such an acquisition decision and seeing the ranking report, if any, the consumer chooses between Products A and B. A pure strategy of the consumer consists of two components: i) a report-acquisition decision $\alpha \in \{0,1\}$, where 1 indicates acquiring the ranking report and 0 otherwise, and ii) a product-purchasing rule $\rho : \{\varnothing, A, B\} \to \{A, B\}$, where $\varnothing$ represents not seeing any report after acquisition decision $\alpha = 0$. For simplicity, we assume that the consumer does not pay for either product.

The expert earns a payoff of $\pi > 0$ if the consumer acquires his ranking report. The expert's choice of ranking methodology does not affect his payoff, and he takes no interest in the product choice of the consumer.[7] The consumer's payoff is the sum of the pre-ranking value and any ranking value of her chosen product, minus any report-acquisition cost. A consumer who chooses product $K \in \{A, B\}$ with pre-ranking value υ_K, makes report-acquisition decision $\alpha \in \{0,1\}$, and faces an expert offering ranking report $r(\upsilon_B)$ receives a payoff of

$$u(K, \upsilon_K, \alpha, r(\upsilon_B)) = \upsilon_K + \gamma \mathbb{I}_{r(\upsilon_B)}(K) - \alpha c,$$

[7]We assume that the expert earns 0 if the consumer does not acquire the ranking report. Notice that the expert's revenue is unaffected by which ranking methodology is used or whether the ranking orders products according to the consumer's pre-ranking values.

where $\mathbb{I}_{r(\upsilon_B)}(K)$ is an indicator function taking the value 1 if $K = r(\upsilon_B)$, i.e., Product K is ranked first given the expert's ranking methodology and the realized pre-ranking value of Product B, and 0 otherwise. Note that the consumer receives the ranking value γ for choosing the first-ranked product even if she does not acquire the ranking report ($\alpha = 0$).

The timing of the game is as follows. The expert privately chooses a ranking methodology. The pre-ranking value of Product B is realized and privately observed by the expert, who then issues a ranking report based on the adopted methodology. The consumer decides whether to acquire and see the report, after which she chooses a product.

Before proceeding to the equilibrium analysis, we further comment on the properties of the ranking methodologies. In addition to the dichotomy of informative versus uninformative, the methodologies can also be characterized as whether it is *consumer-optimal*. A consumer-optimal methodology *always* ranks higher the product based on the consumer's pre-ranking utilities. Only one of the ranking methodologies is consumer-optimal; and the one that is so depends on the parameter values.

If $\bar{\upsilon}_A \geqslant \bar{\upsilon}_B$, Product A is more valuable to the consumer irrespective of the realized pre-ranking value of Product B. Even though the informative $r_{A||B}$ resolves the uncertainty surrounding Product B, it is not consumer-optimal because it sometimes ranks Product B higher. On the other hand, r_A, though not informative, is consumer-optimal. If $\bar{\upsilon}_A < \bar{\upsilon}_B$, informativeness coincides with consumer-optimality: $r_{A||B}$ would be a consumer-optimal methodology while r_A would not be.

Informativeness and consumer-optimality are properties of the ranking methodologies related to the consumer's pre-ranking value. The ranking value of the first-ranked product also confers a *persuasive* property to the methodologies analogous to the effect of persuasive advertising, in which the provider not only offers information but can also directly influence the consumer's preferences. Our equilibrium analysis, as well as the experimental design, exploits the interplay of these three properties of the game.[8]

3.2 Equilibrium Analysis

We analyze the perfect Bayesian equilibria of the game, in which the expert best responds to the consumer, the consumer best responds to her beliefs, and beliefs are formed via Bayes' rule whenever possible. Note that the consumer has two types of belief: we denote by $\mu_{r_{A||B}}$ her *strategy belief* that the expert has chosen $r_{A||B}$ and $\mu_{\bar{v}_B}$ her *product belief* that the pre-ranking value of Product B is $\bar{v}_B$.[9]

We begin by characterizing the consumer's product-purchasing rule (all proofs are relegated to Appendix A.1):

Lemma 1. *For any given mixed strategy of the expert $q_{r_{A||B}} \in [0, 1]$,*

1. *it is a best response for the consumer who has not acquired the ranking report ($\alpha = 0$) to purchase Product A ($\rho(\varnothing) = A$) if $p\bar{v}_B \leqslant \bar{v}_A + (1 - 2p)\gamma$; and*

[8]Notice that the ranking value is independent of whether the expert's ranking reflects the pre-ranking values. That is, no matter which product is ranked first, the consumer obtains the same utility from the top ranking. This is reasonable from two viewpoints. First, at the point in time when a consumer makes a purchase decision, she evaluates the product values and not the source of the value, whether it is pre-ranking value or ranking value. Therefore, at this point, she is unconcerned with whether the expert had ranked products according to pre-ranking values. Second, sometimes a consumer cannot exactly tell whether the ranking reflects pre-ranking values, even after a transaction. In particular, some experience goods like cars are too complicated to detect whether the ranking reflects pre-ranking values, in part because those products have many attributes.

[9]Although the expert's choice of ranking methodology and the consumer's report-acquisition decision are strategically simultaneous, a perfect Bayesian equilibrium explicitly specifies the consumer's strategy beliefs, in addition to her product beliefs.

2. it is a best response for the consumer who has acquired the ranking report ($\alpha = 1$) to purchase the first-ranked product ($\rho(K) = K$, $K = A, B$) if $\gamma \geqslant \max\{p\bar{\upsilon}_B - \bar{\upsilon}_A, \bar{\upsilon}_A - \bar{\upsilon}_B\}$.

Without seeing any report, the consumer's strategy belief $\mu_{r_{A||B}}$, which is relevant for the expected ranking value, coincides with the expert's strategy $q_{r_{A||B}}$, and her product belief $\mu_{\bar{\upsilon}_B}$, which is relevant for the expected pre-ranking value of Product B, coincides with the prior p. Her expected payoffs from Products A and B are respectively lower and higher *via the ranking value* when the probability that the expert chooses methodology $r_{A||B}$ is higher. For Product A to be more attractable under a frequent adoption of $r_{A||B}$, its pre-ranking value needs to be sufficiently high and/or that of Product B needs to be sufficiently low. Part 1 of Lemma 1 provides an upper bound for the expected pre-ranking value of Product B, $p\bar{\upsilon}_B$, below which the consumer prefers Product A even if the expert always chooses methodology $r_{A||B}$.

When the consumer sees the ranking report, there is no uncertainty surrounding the ranking value; the only belief that is relevant to her product choice is the product belief. Since the report that ranks Product A first is an output of both methodologies, the consumer's updated product belief after seeing such a report, $\mu_{\bar{\upsilon}_B} = \frac{p - pq_{r_{A||B}}}{1 - pq_{r_{A||B}}}$, depends on the expert's strategy and the prior over Product B. Note that the higher is the probability that the expert chooses $r_{A||B}$, the lower is the expected pre-ranking value of Product B. The ranking value from choosing the first-ranked Product A then needs to be sufficiently high for Product A to be preferred. Part 2 of Lemma 1 provides a lower bound, $p\bar{\upsilon}_B - \bar{\upsilon}_A$, for the ranking value, γ, for this to be the case even if the expert always chooses methodology $r_{A||B}$.

Unlike the above case, since the report that ranks Product B first is generated only under

$r_{A||B}$, and only for pre-ranking value $\bar{v}_B$, the consumer's updated product belief is degenerate at $\mu_{\bar{v}_B} = 1$. The condition for the first-ranked Product B to be preferred is accordingly simpler, which is just that the ranking value is no less than $\bar{v}_A - \bar{v}_B$.

We next analyze the consumer's preferences with respect to the acquisition of the report, assuming that she chooses Product A without the report and the first-ranked product after seeing the report, the case that drives our experimental design:

Lemma 2. *Under product-purchasing rule $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$, the consumer is indifferent between acquiring the report ($\alpha = 1$) and not acquiring ($\alpha = 0$) if the expert's mixed strategy $q_{r_{A||B}} = \frac{c}{p(\bar{v}_B + \gamma - \bar{v}_A)}$; for $q_{r_{A||B}}$ higher (lower) than this threshold, the consumer strictly prefers $\alpha = 1$ ($\alpha = 0$).*

The intuition of Lemma 2 can be seen by the equivalent condition that the consumer prefers to acquire the report if $c \leqslant pq_{r_{A||B}}(\bar{v}_B + \gamma - \bar{v}_A)$. When the consumer would purchase Product A without seeing any report, acquiring the report makes a difference only when the report is B, which occurs when the pre-ranking value of Product B is $\bar{v}_B$ and the expert chooses $r_{A||B}$. By acquiring the report in this case, the consumer purchases the first-ranked Product B instead of Product A, receiving $\bar{v}_B + \gamma$ rather than $\bar{v}_A$. To justify paying for the report before learning what it is, the difference must present a probable benefit ($p > 0$ as is assumed and $\bar{v}_B + \gamma > \bar{v}_A$), the expert must choose $r_{A||B}$ at least some of the time ($q_{r_{A||B}} > 0$), and the resulting expected benefit must be no less than the cost $c > 0$.

We proceed to characterize the equilibria of the game, continuing to focus on the case where the consumer adopts the product-purchasing rule $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$, which is guaranteed to be a best response of the consumer under the parameter conditions in Lemma 1:[10]

Proposition 1. *Suppose that* $p\bar{v}_B \leqslant \bar{v}_A + (1-2p)\gamma$ *and* $\gamma \geqslant \max\{p\bar{v}_B - \bar{v}_A, \bar{v}_A - \bar{v}_B\}$ *and let* $\bar{q} = \frac{c}{p(\bar{v}_B+\gamma-\bar{v}_A)}$. *For* $0 < c \leqslant p(\bar{v}_B + \gamma - \bar{v}_A)$, *there exist three sets of perfect Bayesian equilibria:*

(a) the expert chooses $r_{A||B}$ *with probability* $q_{r_{A||B}} \in [0, \bar{q}]$, *and the consumer does not acquire the ranking report (*$\alpha = 0$*);*

(b) the expert chooses $r_{A||B}$ *with probability* $q_{r_{A||B}} \in [\bar{q}, 1]$, *and the consumer acquires the ranking report (*$\alpha = 1$*);*

(c) the expert chooses $r_{A||B}$ *with probability* $q_{r_{A||B}} = \bar{q}$, *and the consumer randomizes between* $\alpha = 0$ *and* $\alpha = 1$ *with any probability.*

In all these equilibria, the consumer adopts the product-purchasing rule $\rho(\varnothing) = \rho(A) = A$ *and* $\rho(B) = B$.

Recall that the expert only cares about selling the report to earn $\pi > 0$. He is indifferent to the choice of ranking methodology (and the consumer's product choice) so long as the consumer acquires the report. Accordingly, the expert is always willing to randomize between the two methodologies, and the randomization probabilities are chosen in equilibrium to support either a fixed or a randomized acquisition decision of the consumer. On the other hand, when the consumer is indifferent between acquiring the report or not, any randomization on the part of the consumer constitutes an equilibrium – the consumer does not need to randomize in

[10] Additional characterizations for product-purchasing rule $\rho(A) = A$ and $\rho(\varnothing) = \rho(B) = B$ can be found in Appendix A.2.

specific ways to generate indifference for the expert, who is already indifferent. Note that the characterized equilibria include two pure-strategy equilibria. We call the equilibrium in which the expert always chooses r_A [under Proposition 1(a)] the *uninformative-ranking equilibrium* and that in which he always chooses $r_{A||B}$ [under Proposition 1(b)] the *informative-ranking equilibrium*.

Proposition 1 provides several insights about the interaction between the expert and the consumer. First, to make the ranking report attractive so that the consumer acquires it, the ranking value has to be sufficiently high while the cost of the report sufficiently low. This may explain why profit-making ranking reports typically exist for expensive goods or important decisions, such as automobiles and colleges, while the rankings of other small goods either do not exist or are provided by non-profit institutes such as *Consumer Reports*.

Second, the expert can manage to induce the consumer to acquire the report by counter-intuitively choosing a methodology that makes the consumer worse off. Consider the pure-strategy equilibrium in which the expert always chooses $r_{A||B}$ and suppose that $\bar{v}_A > \bar{v}_B$. When Product A is always better than Product B, acquiring the report or not the consumer prefers methodology r_A: when acquiring, the consumer receives a payoff of $\bar{v}_A + \gamma - c$ from choosing the always first-ranked Product A under r_A and with probability p trades the higher $\bar{v}_A$ for the lower $\bar{v}_B$ in order to obtain γ when Product B is ranked first under $r_{A||B}$; when not acquiring, by choosing Product A she receives $\bar{v}_A + \gamma$ under r_A and with probability p receives γ less when Product B is ranked first under $r_{A||B}$.

While relative to r_A the adoption of $r_{A||B}$ harms the consumer, with the parameter values assumed in Proposition 1 it harms her more when she does not acquire the report, in which case she loses $p\gamma$, than when she acquires the report, in which case she loses $p(\bar{v}_A - \bar{v}_B)$. The consumer, however, is offered an opportunity to avoid the incremental harm $p(\bar{v}_B + \gamma - \bar{v}_A)$ by paying for the ranking report which costs less than the incremental harm. In a sense, the expert strategically creates a very unfavorable situation for the consumer if she does not acquire the report and offers a less unfavorable situation with a mutually beneficial price.

The last insight concerns the informativeness and consumer-optimality of the ranking methodologies. The discussion above shows that the consumer may be better off under the uninformative methodology r_A. However, since she makes the same product choice under r_A with or without the report, acquiring the report does not bring any marginal benefit yet it is costly. The consumer is only willing to pay for the report when there is sufficiently high probability that it is generated by the informative $r_{A||B}$. This is the case even when r_A is consumer-optimal and $r_{A||B}$ is not (as when $\bar{v}_A > \bar{v}_B$): the consumer report-acquisition decision hinges on whether the underlying methodology is informative, not whether it is consumer-optimal (i.e., ranks products according to the consumer's pre-ranking values).

4 Experimental Design

4.1 Treatments

The theoretical analysis in Section 3 guides the design of our treatments. There are six parameters in our game, $\bar{v}_A$, $\bar{v}_B$, γ, p, c, and π. In choosing the treatment values for these parameters, we are guided by three considerations: (i) to satisfy the parameter conditions in Proposition 1 so that the characterized equilibria exist and serve as the theoretical benchmarks for evaluating observed behavior; (ii) to generate treatment variations so that the otherwise same equilibria have different implications regarding informativeness and consumer-optimality; and (iii) to provide salience within the confine of the first two considerations by making the payoff differences from different strategies reasonably large.

The outcome of these considerations is the following choices of parameters, which give us three treatments. We assign values for five parameters that are fixed across all three treatments: $\bar{v}_A = 100$, $\gamma = 250$, $p = 0.6$, $c = 70$, and $\pi = 5c = 350$. For treatment variations, we vary the value of $\bar{v}_B$ at 120, 80, and 60. We call the resulting treatments, *SUPERIOR-B*, *AVERAGE-B*, and *INFERIOR-B*. Table 1 summarizes the three treatments and presents the players' expected payoffs at the strategically simultaneous stage where the expert chooses the ranking methodology and the consumer makes the report-acquisition decision. The consumer's expected payoffs are calculated based on the equilibrium product-purchasing rule $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$.

The games induced in the three treatments have the same set of pure-strategy equilibria, while their mixed-strategy equilibria differ only by the randomization probabilities of the expert. For each treatment, the bold pairs of payoff numbers correspond to the two pure-strategy equilibria. Note that only in treatment *SUPERIOR-B* does the pure-strategy equilibrium in which the expert sells the report with $r_{A||B}$ rank products according to the consumer's pre-ranking values of the products (because $\bar{v}_B > \bar{v}_A$).

If we interpret choosing a consumer-sub-optimal methodology as a form of harm to the consumer, there is a sense that the expert in selecting $r_{A||B}$ harms the consumer more in *INFERIOR-B* than in *AVERAGE-B* and does not harm the consumer at all in *SUPERIOR-*

Table 1: Experimental Treatments

		Consumer $\alpha = 0$	Consumer $\alpha = 1$
Expert	r_A	**0, 350**	350, 280
	$r_{A\|\|B}$	0, 200	**350, 292**

Treatment *SUPERIOR-B*: $\bar{v}_B = 120$

		Consumer $\alpha = 0$	Consumer $\alpha = 1$
Expert	r_A	**0, 350**	350, 280
	$r_{A\|\|B}$	0, 200	**350, 268**

Treatment *AVERAGE-B*: $\bar{v}_B = 80$

		Consumer $\alpha = 0$	Consumer $\alpha = 1$
Expert	r_A	**0, 350**	350, 280
	$r_{A\|\|B}$	0, 200	**350, 256**

Treatment *INFERIOR-B*: $\bar{v}_B = 60$

Note: r_A and $r_{A||B}$ are two ranking-methodology choices of the expert. $\alpha = 0$ and $\alpha = 1$ represent the respective cases where the consumer does not acquire and acquire the ranking report. In each cell, the first number is the expert's payoff and the second number the consumer's expected payoff for the given (r, α), based on the product-purchasing rule $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$. The bold pairs of numbers correspond to the pure-strategy equilibria of the game. In all three treatments, the parameters of the game take the values $\bar{v}_A = 100$, $\gamma = 250$, $p = 0.6$, $c = 70$.

B. Such a monotonicity in the extent of consumer harm corresponds with the increases in the consumer's expected payoffs from $(r, \alpha) = (r_{A||B}, 1)$ across the treatments, from 256 in *INFERIOR-B* to 268 in *AVERAGE-B* to 292 in *SUPERIOR-B*. Note that all the other expected payoff numbers are constant across the treatments; despite the existence of essentially the same sets of equilibria in all treatments, these distinctive changes in the consumer's expected payoffs provide us with a clean comparative statics.

Finally, note that in all treatments the expert and the consumer have conflicting preferences over the two pure-strategy equilibria. While the expert prefers the equilibrium in which he sells the report by choosing $r_{A||B}$, the consumer prefers the equilibrium in which she does not acquire the report generated by r_A. In their respective preferred equilibria, both the expert and the consumer earn the same (expected) payoffs of 350.

4.2 Procedures

Our experiment is conducted using oTree (Chen, Schonger and Wickens, 2016) at the Financial Services Laboratory of Lehigh University. A total of 200 subjects participate in the three treatments using a between-subject design. Subjects have no prior experience with the experiment and are recruited from the undergraduate and graduate population of the university.

Table 2 reports a summary of participation for three treatments. Four sessions are conducted for each treatment. On average, 17 subjects participate in a session, with half of them randomly assigned to the role of an expert and the other half to the role of a consumer. Roles remain fixed throughout a session. Experts and consumers in a session are *randomly matched* in each round to form groups of two to play 40 rounds of the game.

Upon arrival, subjects are instructed to sit at separate computer terminals with partitions. Each receives a copy of the experimental instructions. The instructions are read aloud using slide illustrations as an aid. A comprehension quiz and a practice round follow.

Subjects are told that there are two products, A and B. While the value of Product A is fixed at 100, that of Product B is random and varies between 0 and, using treatment *AVERAGE-B* as an example, 80, where there is a 60% chance that the computer selects 80.

The expert makes only one decision in each round, choosing between Ranking Method 1 (r_A) and Ranking Method 2 ($r_{A||B}$). The consumer makes two decisions, first choosing whether to acquire the expert's ranking report and then deciding which product to choose. If the consumer chooses to acquire the report, before her product choice is made she will see a report that is generated according to the randomly selected value of Product B and the ranking method chosen by the expert. The ranking report is framed as "Product K is ranked first." If the consumer chooses not to acquire the report, she will proceed directly to choose a product. A report will still be generated in this case to determine the ranking value.

Rewards in each round are determined based on, for the expert, the consumer's report-acquisition decision and, for the consumer, the generated report, her report-acquisition decision, and her product choice, all according to the parameters of the treatment. A more elaborate reward table than those in Table 1 is presented on each subject's screen throughout the experiment.[11]

A round is concluded by the provision of a feedback, which summarizes what has happened in the round, including the expert's chosen ranking method, the selected value of Product B, the generated ranking report, the consumer's product choice, and the subject's reward for the round. A history of the happenings in all previous rounds is also available to subjects.

We randomly select three rounds for payments. The average reward a subject earns in the three selected rounds is converted into US Dollars at a fixed and known exchange rate of US$1 per 20 reward points. A show-up fee of US$5 is also provided. Subjects on average earn US$14.88 by participating in a session that lasts about an hour.

[11] Refer to Appendix B for a sample of instructions.

5 Findings

5.1 Pure-Strategy Equilibrium Plays

For the parameters adopted in our three treatments, there are two pure-strategy equilibria, what we call the informative-ranking and uninformative-ranking equilibria, and a continuum of mixed-strategy equilibria. We begin our analysis by examining the frequencies of plays of the two pure-strategy equilibria.

Finding 1. *In all three treatments, the frequencies of plays of either the informative-ranking or the uninformative-ranking equilibria are significantly higher than those that would occur under completely random behavior. There are no significant differences in the frequencies of these equilibrium plays between the three treatments.*

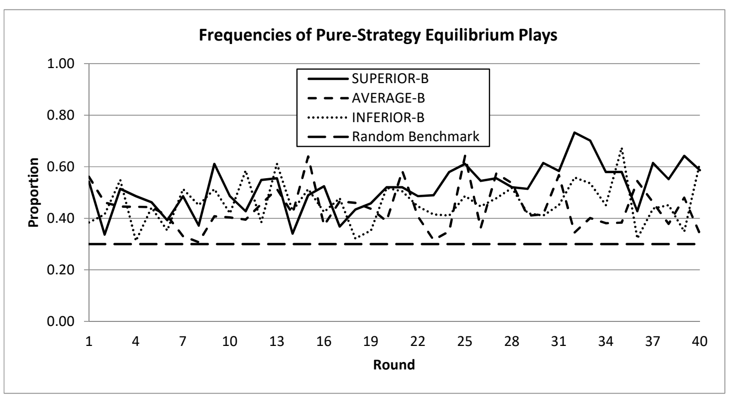

Figure 1: Pure-Strategy Equilibrium Plays

In the presence of multiple equilibria, subjects need to coordinate over which equilibrium to play, if at all. Our first finding provides evidence that subjects' behavior is purposefully shaped by the equilibrium incentives. Figure 1 presents the frequencies of plays of the two pure-strategy equilibria over rounds. In an instance of play of the game, there are 10 possible combinations of choices made by the expert and consumer. Among them, three combinations are consistent with the pure-strategy equilibria, one with the uninformative-ranking equilibrium and two with the informative-ranking equilibrium. The frequency of plays of any one of these equilibria, aggregated across all sessions and all rounds of the three treatments, is 47.32%, significantly higher than the 30% benchmark when the equilibria are played as a result of completely random choices ($p < 0.001$, Wilcoxon signed-rank test).[12]

The frequency of equilibrium plays is higher in *SUPERIOR-B* (51.98%) than in *AVERAGE-B* (44.10%) and *INFERIOR-B* (45.87%), although the differences between the three treatments are not statistically significant (two-sided $p \geqslant 0.3429$ for any pairwise comparison, Mann-Whitney tests).[13]

We next examine the frequency of each of the two pure-strategy equilibria conditional on equilibrium behavior. We perform two comparisons, a within-treatment comparison and a between-treatment comparison.

Finding 2. *Conditional on equilibrium plays,*

(a) the frequency of the informative-ranking equilibrium is significantly higher than that of the uninformative-ranking equilibrium in SUPERIOR-B and INFERIOR-B, while there is no significant difference between the two frequencies in AVERAGE-B; and

(b) the frequency of the informative-ranking equilibrium in SUPERIOR-B is higher than those in AVERAGE-B and INFERIOR-B, but only the difference with AVERAGE-B

[12] Figure 1 indicates that there is no systematic convergency in the frequencies of equilibrium plays. We accordingly use all-round data for statistical tests. Unless otherwise indicated, the reported p values are from one-sided tests.

[13] A Kruskal-Wallis test further confirms that the three frequencies have no statistical differences from one another ($p = 0.5367$).

is statistically significant.

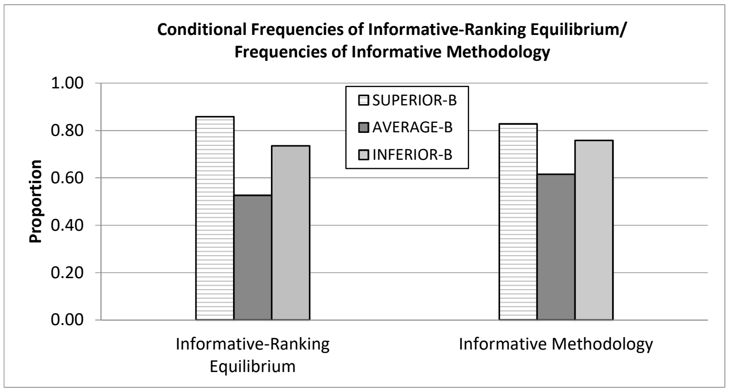

Figure 2: Informative-Ranking Equilibria and Informative Methodology

Finding 2(a) reports three within-treatment comparisons. The first set of bars in Figure 2 presents the conditional frequencies of the informative-ranking equilibrium. Among the equilibrium plays observed in *SUPERIOR-B* and *INFERIOR-B*, the informative-ranking equilibrium, which is played respectively 85.86% and 73.55% of the time, is the equilibrium that is observed more often with statistical significance ($p = 0.0625$, Wilcoxon signed-rank tests).[14] On the other hand, the informative-ranking and the uninformative-ranking equilibria are played almost as often as each other in *AVERAGE-B*, with no significant difference between their conditional frequencies, which are respectively 52.65% and 47.35% (two-sided $p = 0.625$, Wilcoxon signed-rank test).

The between-treatment comparisons reported in Finding 2(b) are apparent from the figures above. The informative-ranking equilibrium is played most often in *SUPERIOR-B*, followed by *INFERIOR-B* and then *AVERAGE-B*. Statistically, the higher frequency in *SUPERIOR-B* over that in *AVERAGE-B* is significant ($p = 0.0286$, Mann-Whitney test),

[14] $p = 0.0625$ is the lowest possible p value from the Wilcoxon signed-rank test with four independent observations.

while the difference between *SUPERIOR-B* and *INFERIOR-B* is not ($p = 0.1227$, Mann-Whitney test). The higher frequency in *INFERIOR-B* over that in *AVERAGE-B* is likewise not significant ($p = 0.1$, Mann-Whitney test).

The frequencies reported above present a non-monotonic comparative statics. Recall that the only difference in the parameters of the three treatments is $\bar{v}_B$, the high realization of the pre-ranking value of Product B. The value assumed by $\bar{v}_B$ decreases monotonically from 120 in *SUPERIOR-B* to 80 in *AVERAGE-B* to 60 in *INFERIOR-B*. The conditional frequency of the informative-ranking equilibrium, however, decreases from 85.86% in *SUPERIOR-B* to 52.65% in *AVERAGE-B* and then increases again to 73.55% in *INFERIOR-B*. We proceed to examine the observed behavior of the expert-subjects and the consumer-subjects that comprise these non-monotonic frequencies of strategic outcomes.

5.2 Experts' and Consumers' Behavior

We begin our analysis of subjects' behavior by examining the ranking methodology choices of the experts. We again perform a within-treatment and a between-treatment comparisons.

Finding 3. *For the experts' choices of ranking methodology,*

(a) the frequency of the informative methodology is higher than that of the uninformative methodology in all three treatments, with statistical significance in SUPERIOR-B and INFERIOR-B; and

(b) the frequency of the informative methodology in SUPERIOR-B is higher than those in AVERAGE-B and INFERIOR-B, but only the difference with AVERAGE-B is statistically significant.

The second set of bars in Figure 2 presents the frequencies of the informative methodology $r_{A||B}$. The same non-monotonicity across treatments noted in the frequencies of the informative-ranking equilibrium is also observed in the experts' choices of the informative methodology. The experts choose $r_{A||B}$ 82.79% of the time in *SUPERIOR-B*, 61.48% of the time in *AVERAGE-B*, and 75.77% of the time in *INFERIOR-B*. Except for *AVERAGE-B*, these frequencies are significantly higher than the complementary frequencies of uninformative methodology ($p = 0.0625$ for *SUPERIOR-B* and *INFERIOR-B* and $p = 0.1875$ for *AVERAGE-B*, Wilcoxon signed-rank tests). For between-treatment comparisons, the higher frequency in *SUPERIOR-B* over that in *AVERAGE-B* is statistically significant ($p = 0.0571$, Mann-Whitney test), while the differences in the other two pairwise comparisons are not ($p \geqslant 0.1714$, Mann-Whitney tests).

The experts' strategies put an "upper bound" on what can be achieved as equilibrium outcomes. The cross-treatment non-monotonicity in the frequencies of the experts' ranking methodologies appears to be the main driving force for the similar non-monotonicity in the frequencies of the pure-strategy equilibria. To evaluate the extent of how consumers' behavior also contributes to shape the observed equilibrium outcomes, we proceed to examine the choices made by the consumers.

Our equilibrium characterization of the expert's choice of ranking methodology and the consumer's report-acquisition decision is based on consumer's adoption of the product-purchasing rule $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$, which is a best response given the parameter values of our treatments. We examine the consumers' report-acquisition decisions as well as the extent to which their plays are consistent with this rule.

Finding 4. *The consumers in AVERAGE-B acquire the ranking report significantly less often than they do not acquire, while there are no significant differences between acquiring and not acquiring in SUPERIOR-B and INFERIOR-B. For product choices,*

(a) conditional on not acquiring the report, the frequency of Product A is significantly higher than that of Product B in all three treatments; and

(b) conditional on acquiring the report, the consumers in all three treatments virtually always choose the first-ranked products.

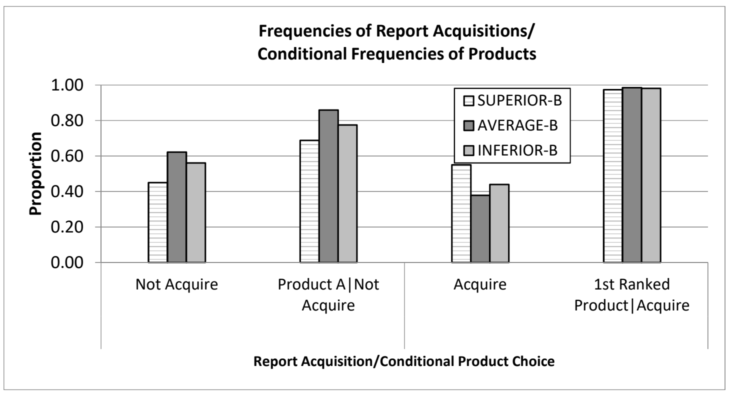

Figure 3: Consumers' Report Acquisitions and Product Choices

Figure 3 presents the frequencies of consumers' report-acquisition decisions and conditional product choices. Except in *AVERAGE-B*, consumers choose to acquire the ranking report roughly half of the time, with 55.01% in *SUPERIOR-B* and 43.94% in *INFERIOR-B*, which makes the frequencies of acquiring and not acquiring not significantly different from each other (two-sided $p \geqslant 0.375$, Wilcoxon signed-rank tests). The consumers in *AVERAGE-B*, however, chooses not to acquire the report 62.14% of the time, significantly more often than acquiring ($p = 0.0625$, Wilcoxon signed-rank test).

We also observe in *AVERAGE-B* the highest frequency of Product A conditional on not acquiring the report, which is recorded at 85.88%. This is followed by 77.55% in *INFERIOR-B* and then 68.33% in *SUPERIOR-B*. All these frequencies are significantly higher than the corresponding conditional frequencies of Product B ($p = 0.0625$, Wilcoxon signed-rank test). Conditional on acquiring the report, consumers choose the first-ranked products with frequencies above 97% in all three treatments.

The above analysis suggests that in *AVERAGE-B* consumers' report-acquisition decisions and product choices combine with experts' choices of ranking methodology to drive less frequent plays of the informative-ranking equilibrium (and more frequent plays of the uninformative-ranking equilibrium). In relative terms, the contribution of consumers' behavior to the observed equilibrium outcomes is less pronounced in the other two treatments, where the equilibrium outcomes are more strongly driven by the experts' choices of methodology. In section 6, we discuss what behavioral factors in addition to equilibrium incentives may contribute to these non-monotonic findings across the three treatments.

5.3 Dynamic Analysis

We adopt a panel setting to examine the individual behavior through 40 rounds in the experiment. For participant i in round t, we define dummy variables $Acquire_{it} = 1$ if the consumer acquires the ranking report, and $Informative_{it} = 1$ if the expert selects an informative ranking methodology $r_{A||B}$. The dynamic reactions are estimated separately by:

$$Acquire_{it} = \alpha_1 + \beta_1 \ \mathbf{L}.\mathbf{Informative} + \gamma_1 \ \mathbf{L}.\mathbf{Acquire} + \delta_1 \ \mathbf{X} + u_{it} \tag{1}$$

$$Informative_{it} = \alpha_2 + \beta_2 \ \mathbf{L}.\mathbf{Acquire} + \gamma_2 \ \mathbf{L}.\mathbf{Informative} + \delta_2 \ \mathbf{X} + \epsilon_{it} \tag{2}$$

where, $\mathbf{L}.\mathbf{Informative}$ and $\mathbf{L}.\mathbf{Acquire}$ are vectors with lag values of $Informative_{it}$ and $Acquire_{it}$ respectively, and $\mathbf{X}$ a vector including fixed effects of treatments and sessions.

We employ a random effect panel Logit regression to estimate above two models, with results presented in Table 3 and 4.

Finding 5. *For individual subjects through 40 rounds,*

(a) consumers are likely to change behavior responding to the experience from the previous rounds; and

(b) experts behave more consistently.

Table 3 presents the dynamic estimation of consumers' report-acquisition behavior. We find that consumers' report-acquisition behavior is significantly related to her paired experts' behavior in previous rounds. If a consumer was paired with an expert who selected ranking methodology $r_{A||B}$ in previous round, she is more likely to acquire the ranking report in current round, which suggests that the consumer adjusts her behavior responsively based on her experience. This finding is insightful and provides another explanation why we do not see a lot consumers acquiring the ranking. That is, if consumers saw ranking methodology r_A in the previous round, they have incentive to skip the ranking, which could make them better off under the condition of ranking methodology r_A.

On the other side, experts do not play responsively, which is shown by the regression results in Table 4. We do not see a statistically significant relation between the expert's behavior and the behavior of the paired consumer in the previous rounds. Instead, experts tend to have a self-consistent behavior: they are significantly more likely to make the same decision as they did in previous rounds. This result again demonstrates our main finding that experts could figure out an optimal strategy and resist during most of the time.

5.4 Experience-Weighted Attraction Learning

There is a growing literature on learning in laboratory experiments, with the concern that players usually need to learn to play equilibrium strategies in games where they do not have much experience playing. In this section, we present an econometric analysis of learning with two goals: (1) to examine whether players in our ranking games learn to play equilibrium strategies, and (2) to explain in more detail why not so many consumers choose to acquire the ranking report. We adopt the experience-weighted attraction (EWA) learning model developed by Camerer and Ho (1999), which integrates reinforcement and belief-based learning models.[15]

The EWA learning models a normal form game with N players and J strategies for each player. Let $s_i^j(t)$ be player i's strategy j in period t and $s_i(t)$ player i's chosen strategy in period t. Player i's payoff of choosing strategy j in period t is $\pi_i(s_i^j, s_{-i}(t))$. The core of EWA learning is two updated variables, experience weight $N(t)$ and attractions $A_i^j(t)$ with given initial values of $N(0)$ and $A_i^j(0)$ that represent pregame experience. Specifically, the experience weight is updated according to

$$N(t) = \phi(1-k)N(t-1) + 1 \tag{3}$$

where $\phi \in [0,1]$ discounts past experience and $k \in [0,1]$ denotes the updating speed of an

[15]Studies like Salmon (2001), Hopkins (2002) and Camerer (2003) reviewed different learning models.

experience weight. The attraction of strategy j for player i is updated according to

$$A_i^j(t) = \frac{\phi N(t-1)A_i^j(t-1) + [\delta + (1-\delta)I(s_i^j, s_i(t))]\pi_i(s_i^j, s_{-i}(t))}{N(t)} \tag{4}$$

where the indicator function $I(s_i^j, s_i(t))$ is equal to one if $s_i^j = s_i(t)$, and $\delta \in [0, 1]$ represents the weight put on foregone payoffs.

Based on attractions, the probability of player i choosing strategy j in period $t + 1$ is computed by the following logistic function:

$$P_i^j(t+1) = \frac{exp(\lambda A_i^j(t))}{exp(\sum_{k=1}^{J} \lambda A_i^k(t))} \tag{5}$$

where $\lambda \in [0, +\infty]$ reflects the response sensitivity for mapping attractions into choice probabilities.

There are four key parameters in the EWA learning model: λ, ϕ, δ, k, of which each captures a behavioral principle of learning. It is a reinforcement learning when $\delta = 0$ and $k = 1$, while a belief based learning when $\delta = 1$ and $k = 0$. We estimate these parameters using the method of maximum likelihood with the log-likelihood function given by:

$$LL(\lambda, \phi, \delta, k) = \sum_{t=1}^{T}\sum_{i=1}^{N} \ln[\sum_{j=1}^{J} I(s_i^j, s_i(t))P_i^j(t-1)] \tag{6}$$

where we assume initial value of $N(0) = 1$ following previous studies,[16] and compute initial attractions $A_i^j(0)$ by the first-period data as described in Ho, Wang and Camerer (2007).

We examine the EWA learning process for consumers and experts separately in each treatment, and report the estimates for parameters λ, ϕ, δ, k in Table 5 and 6.

[16]Camerer (2003) suggests that this assumption has no substantial effects on the learning process.

Overall, the estimates for λ, δ and k reveal the difference in learning between consumers and experts. Although both players have low decay of previous attractions (given by high ϕ), consumers are more likely to play according to belief based learning with positive δ and lower k, while experts are more likely to play according to reinforcement learning with insignificant δ and higher k.

Specifically, consumers are more sensitive to updated attractions when making decisions of whether to acquire the ranking (given by big λ), significantly care about the foregone payoffs (given by δ), and put higher weight on recent experience (given by lower k). This explains why not so many consumers choose to acquire ranking with high probabilities, since they pay attention to the hypothetical payoffs if they do not acquire the ranking, which increases the attraction of not acquiring.

In contrast, experts are less sensitive to updated attractions when choosing ranking methodologies and do not care about foregone payoffs. This is reasonable as experts are indifferent between two ranking methodologies. Comparing three treatments, experts in treatment *AVERAGE-B* seem to play differently by putting higher weights on recent experience, while in other treatments, experts consider each past period equally. This may help to explain why relatively fewer experts choose informative ranking methodology in treatment *AVERAGE-B*.

6 Discussion

We discuss three issues in this section: (i) the non-monotonic result that the expert is more likely to select the informative ranking methodology $r_{A||B}$ in *SUPERIOR-B* (when this ranking methodology is consumer optimal) and *INFERIOR-B* (when this methodology is the furthest from being consumer optimal) and less likely in *AVERAGE-B* (when this ranking methodology is consumer-sub-optimal, albeit closer to being consumer-optimal); (2) the consumer acquires the ranking report with a relatively low probability in *AVERAGE-B* and *INFERIOR-B*; and (3) whether lying or deception is relevant in our experiment.

6.1 Experts' Decision: Social Preferences vs Economic Incentives

Many studies have shown that people have social preferences. Bowles and Polania-Reyes (2012) define social preferences as motives such as altruism, reciprocity, intrinsic pleasure in helping others, inequity aversion, ethical commitments, and other motives that induce people to help others more than would an own-material-payoff maximizing individual. For instance, Engel (2011) conducts a meta study of 131 dictator game experiments with 616 treatments and finds solid evidence that the majority of dictators are generous, even though giving behavior varies across different social groups. In a survey of the extensive literature of measuring social preferences in experimental games, Levitt and List (2007) summarize various factors beyond monetary motivations that could influence subjects' behavior in the lab. Although we attempt to avoid the influence of most factors, it is impossible to completely eliminate the subjects' social preferences.

In our model, of the two ranking methodologies r_A and $r_{A||B}$ available to the product expert, if the expert selects r_A with sufficiently high probability, then the consumer does not acquire the expert's ranking. Alternatively, if the expert selects $r_{A||B}$ with sufficiently high probability, then the consumer does. Therefore, to motivate the consumer to acquire his ranking, the expert has an economic incentive to select $r_{A||B}$ with sufficiently high probability. However, social preferences might also influence the expert. Specifically, in all treatments an expert might select r_A because the consumer's greatest payoff is from the action profile in which the expert selects this ranking methodology and the consumer does not acquire the ranking (and selects product A). Therefore, an expert who is concerned about a consumer might select r_A.

Evaluating the consumer's and expert's payoffs across our three treatments, the only payoff that changes is consumer's from the expert selecting $r_{A||B}$ and the consumer acquiring the ranking. Therefore, in comparing the results of our experiment across the three treatments, we should focus on the consumer's payoff from this action profile. In Table 1, we see that this payoff is 292 in *SUPERIOR-B*, 268 in *AVERAGE-B*, and 256 in *INFERIOR-B*. Note that the consumer's payoff from this action profile changes across these treatments because $\bar{v}_B$ changes.

Comparing these treatments, the expert needs to provide the smallest economic incentive for the consumer to acquire the ranking by selecting $r_{A||B}$ in treatment *SUPERIOR-B* and the greatest incentive in treatment *INFERIOR-B*. With regard to social preferences, an expert who has concern for the consumer's utility might be most likely to select $r_{A||B}$ in treatment *SUPERIOR-B* and least likely to select this ranking methodology in treatment *INFERIOR-*

B.

In sum, social preferences and economic incentives perform opposite trends from treatment *SUPERIOR-B* to treatment *INFERIOR-B*. Therefore, we cannot determine in each case the net effect of the economic incentives versus the social preferences effect. As a result, we could observe the non-monotonicity of the experts' selected ranking methodology, as displayed in Figure 2, moving from the *SUPERIOR-B* to the *AVERAGE-B* to the *INFERIOR-B* treatment.

6.2 Consumers' Decision

A consumer in our experiment makes two decisions, whether to acquire the expert's product ranking and which product to select. Each of these decisions involves uncertainty about the expert's selected ranking methodology and about the value of product B. If the expert acquires the product ranking, then using Bayes rule, she can update her probabilistic belief about the value of product B. Some concerns might influence whether she applies Bayes rule correctly and whether she calculates expected payoffs correctly.

The first concern is cognitive cost that may discourage decision makers when information is overloaded (e.g. Chetty, Looney and Kroft, 2009; Kuksov and Villas-Boas, 2010; Ghose, Ipeirotis and Li, 2014). In our experimental results, we find that a certain number of consumers in all 40 rounds never acquire the product ranking report. They might, by doing so, be skipping the first decision and making their decision process easier by selecting only a product.

In addition, theories about salience contend that when dealing with uncertainty, decision makers may focus on in all 40 rounds partial information (e.g. Chetty, Looney and Kroft, 2009; Bordalo, Gennaioli and Shleifer, 2012). Therefore, salience may affect the consumer in treatments 2 and 3 where the pre-ranking value of product B is always lower than that of product A. If the consumer pays too much attention to this value rather than to the ranking value, she may think product A will give her a higher expected payoff.

Finally, the social preferences may also work on the consumer. For instance, if the consumer realizes that the expert is more likely to choose the ranking methodology $r_{A||B}$, which reduces the consumer's expected payoff compared to r_A, she may have incentive to fight back by refusing to acquire the ranking report. In particular, when refusing to acquire the ranking report, the expert would lose much more than the consumer.

6.3 Lying and Deception

In the context of our experiment, considering factors that could affect the expert's selection of $r_{A||B}$ in treatments *AVERAGE-B* and *INFERIOR-B*, we should evaluate the possibility that the expert might be deceiving, or lying to, the consumer. In our model, *ex ante* the expert and the consumer know that the pre-ranking value of product A is 100, and both are uncertain about the value of product B. Consider treatment *INFERIOR-B* in which the expert and consumer believe that the consumer's pre-ranking value of B could be either $\bar{v}_B = 60$ or 0. Despite being uncertain about the value of product B, both the expert and consumer therefore know that the pre-ranking value of product A is greater than either pre-ranking value of product B. Prior to ranking the products, but after selecting a ranking methodology, the expert learns the pre-ranking value of product B, whether it is 0 or 60.

Applying the Sobel (2018) definition of deception in settings with strategic information transmission to our model, an expert's ranking methodology (i.e., message function) is *not deceptive* if for each possible product ranking that results from using the methodology, the consumer who acquires the ranking accurately updates probabilistic beliefs about pre-ranking product values (so that her probabilistic beliefs are identical to the expert's). In our scenario, the ranking methodology $r_{A||B}$, despite possibly ranking product B first, is not deceptive.

In addition, our instructions for the experiment state that when using $r_{A||B}$, the expert is ranking products according to $\bar{v}_B$. Therefore, because the expert is not deceiving the consumer and is not lying to the consumer by using $r_{A||B}$ in treatments *AVERAGE-B* and *INFERIOR-B*, we believe that possible deception or even lying is not driving our results.[17]

However, we should note that by creating a ranking value in the consumer's utility of a product, in our two-product model, the expert's ranking boosts the value of the product he ranks first. Therefore, if the expert uses $r_{A||B}$ and ranks product B first, the expert boosts the consumer's value of product B. The expert does so despite the fact that the consumer's pre-ranking value of product B is less than her pre-ranking value of A.

If we consider an expert's new-car automobile ranking in which his creation of a ranking value is due to his influence on the eventual used-car market, then in a sense the expert is deceiving future used-car buyers. To do so, these used-car buyers must use the expert's ranking as salient information about pre-ranking value. (Otherwise, these used-car buyers would correctly update beliefs about pre-ranking value using Bayes rule.) In this scenario,

[17]There is an ongoing debate in current studies about whether people have preferences for truth-telling, or equivalently an aversion to lying. For instance, Abeler, Nosenzo and Raymond (2016) conclude that people lie less than we expect; while Sánchez-Pagés and Vorsatz (2007) and Gneezy, Kajackaite and Sobel (2018) find evidence that lying occurs more often when the behavior involving a lie is not observed.

the consumers in our experiment while benefiting from the expert's ranking value are not deceived by the expert's use of $r_{A||B}$.

In reality, the publisher of a product ranking has the opportunity to influence a consumer's choice of whether to acquire the ranking through ranking value or through deceiving the consumer. Our goal in the design of our experiment was to create an environment in which the expert by using $r_{A||B}$ influences the consumer's utility and therefore decision whether to acquire the ranking, without deceiving the consumer. That is, we wanted to isolate the effect of the expert's influence on the consumer's utility from the possible deception of the consumer.

7 Concluding Remarks

In our experimental analysis, we find evidence that product experts are likely to select a ranking methodology that involves considerable uncertainty about the final product ranking. In two of our three treatments, this methodology involves ranking products in a manner that is inconsistent with the consumers' pre-ranking values of the products being considered.

Dearden, Grewal and Lilien (2019, forthcoming) demonstrate in a theoretical model that a critical factor in this result is that a product's rank affects consumer utility. A consumer who acquires an expert's ranking learns the ranking value of each product being considered; and a consumer who does not acquire the ranking does not learn these ranking values. It is the consumer's uncertainty associated with the ranking values that drives the expert to select a ranking methodology that adds randomness to the ranking outcome, thereby motivating the consumer to learn these values by viewing an expert's ranking. The added uncertainty comes at the expense of ranking products in a manner consistent with a consumer's pre-ranking values.

The expert-consumer game that is the basis of our experiment is riddled with multiple equilibria. In one the expert selects a ranking methodology which involves no uncertainty about the product ranking and accordingly the consumer does not acquire the ranking. In another, the expert selects a ranking methodology which involves considerable uncertainty about the product ranking and accordingly the consumer acquires the ranking. In this game with multiple equilibria, we find the tendency in our experimental setting for product experts and consumers to play the equilibrium in which the expert selects a ranking methodology that does not necessarily rank products according to the consumer's pre-ranking utilities and which involves considerable uncertainty about the expert's ranking. This result indicates that product experts, for the purpose of motivating consumers to acquire their rankings, are willing to select ranking methodologies that are not best for consumers.

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Tables

Table 2: Average Payment in Each Session

Treatment	Session	Number of Subjects	Average Payment
SUPERIOR-B	11	16	15.93
SUPERIOR-B	12	16	15.36
SUPERIOR-B	13	18	12.75
SUPERIOR-B	14	14	18.34
AVERAGE-B	21	20	15.22
AVERAGE-B	22	16	13.26
AVERAGE-B	23	16	15.29
AVERAGE-B	24	22	13.78
INFERIOR-B	31	14	14.53
INFERIOR-B	32	16	15.13
INFERIOR-B	33	16	14.61
INFERIOR-B	34	16	15.38
Mean		17	14.88

Table 3: Dynamic Analysis of Consumers' Behavior

	(1) VDL1	(2) VDL2	(3) VDL3
Acquire			
L.Informative	0.3490**	0.3697**	0.3893**
	(0.1204)	(0.1215)	(0.1265)
L2.Informative		0.1497	0.1602
		(0.1115)	(0.1188)
L3.Informative			0.0834
			(0.1266)
L.Acquire	0.0397	0.0066	−0.0611
	(0.2010)	(0.1816)	(0.1807)
L2.Acquire		0.5259**	0.4769**
		(0.1686)	(0.1648)
L3.Acquire			0.3760*
			(0.1836)
N	3900	3800	3700

Clustered standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Dynamic Analysis of Experts' Behavior

	(1) RDL1	(2) RDL2	(3) RDL3
Informative			
L.Acquire	0.1850	0.2242*	0.1887
	(0.0984)	(0.0984)	(0.0999)
L2.Acquire		0.0876	0.0600
		(0.0983)	(0.1001)
L3.Acquire			0.0496
			(0.1090)
L.Informative	1.2344***	1.1039***	1.1074***
	(0.2039)	(0.1730)	(0.1781)
L2.Informative		0.5692***	0.4942**
		(0.1597)	(0.1581)
L3.Informative			0.3304*
			(0.1508)
N	3900	3800	3700

Clustered standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Estimates of EWA Learning Model for Consumers

	(1) *SUPERIOR-B*	(2) *AVERAGE-B*	(3) *INFERIOR-B*
λ	1.3896***	1.1896***	0.9939***
	(0.2186)	(0.2003)	(0.1809)
ϕ	0.9263***	0.9030***	0.9434***
	(0.0186)	(0.0184)	(0.0190)
δ	0.2902***	0.1550*	0.1235*
	(0.0555)	(0.0817)	(0.0785)
k	0.0317	0.0307	0.0522*
	(0.0216)	(0.0254)	(0.0278)
N	1280	1480	1240

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Estimates of EWA Learning Model for Experts

	(1) *SUPERIOR-B*	(2) *AVERAGE-B*	(3) *INFERIOR-B*
λ	0.4361	0.5736	0.3823
	(0.2580)	(1.1606)	(0.8409)
ϕ	0.8582***	0.8570***	0.9009***
	(0.0239)	(0.0178)	(0.0192)
δ	0.4629	0.1269	0.4862
	(0.3257)	(1.8068)	(1.1328)
k	1.0000***	0.4911	1.0000***
	(0.0006)	(0.3268)	(0.0005)
N	1280	1480	1240

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix A. Proofs and Additional Characterizations

A.1 Proofs

Proof of Lemma 1. For Part 1, it is straightforward that when $\alpha = 0$, $\mu_{r_{A||B}} = q_{r_{A||B}}$ and $\mu_{\bar{v}_B} = p$. Given these beliefs, the consumer's expected payoffs from purchasing Products A and B are, respectively, $\bar{v}_A + [q_{r_{A||B}}(1-p) + (1-q_{r_{A||B}})]\gamma$ and $p(\bar{v}_B + q_{r_{A||B}}\gamma)$. If $p\bar{v}_B \leqslant \bar{v}_A + (1-2p)\gamma$, it is a best response for the consumer to purchase Product A for all $q_{r_{A||B}} \in [0,1]$.

For Part 2, consider first the case where the consumer sees that Product A is ranked first. Bayes' rule implies that $\mu_{\bar{v}_B} = \frac{p - pq_{r_{A||B}}}{1-pq_{r_{A||B}}}$. Given this belief, the consumer's expected payoffs from purchasing Products A and B are, respectively, $\bar{v}_A + \gamma - c$ and $\left(\frac{p-pq_{r_{A||B}}}{1-pq_{r_{A||B}}}\right)\bar{v}_B - c$. If $\bar{v}_A + \gamma \geqslant p\bar{v}_B$, it is a best response for the consumer to purchase Product A for all $q_{r_{A||B}} \in [0,1]$. Consider next the case where the consumer sees that Product B is ranked first. Bayes' rule implies that $\mu_{\bar{v}_B} = 1$ for $q_{r_{A||B}} > 0$. For $q_{r_{A||B}} = 0$, we assign an off-path product belief that $\mu_{\bar{v}_B} = 1$. Given these beliefs, the consumer's expected payoffs from purchasing Products A and B are, respectively, $\bar{v}_A - c$ and $\bar{v}_B + \gamma - c$. If $\bar{v}_B + \gamma \geqslant \bar{v}_A$, it is a best response for the consumer to purchase Product B for all $q_{r_{A||B}} \in [0,1]$. Combining $\bar{v}_A + \gamma \geqslant p\bar{v}_B$ and $\bar{v}_B + \gamma \geqslant \bar{v}_A$ gives $\gamma \geqslant \max\{p\bar{v}_B - \bar{v}_A, \bar{v}_A - \bar{v}_B\}$.

$\square$

Proof of Lemma 2. It is straightforward to verify that, given that $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$, the consumer's expected payoff from choosing $\alpha = 1$ minus that from choosing $\alpha = 0$, $\{q_{r_{A||B}}[p\bar{v}_B + (1-p)\bar{v}_A] + (1-q_{r_{A||B}})v_A + \gamma - c]\} - \{\bar{v}_A + [q_{r_{A||B}}(1-p) + (1-q_{r_{A||B}})]\gamma\} \gtreqless 0$ if and only if $q_{r_{A||B}} \gtreqless \frac{c}{p(\bar{v}_B + \gamma - \bar{v}_A)}$.

$\square$

Proof of Proposition 1. We construct the equilibria. Consider first the parameter values such that $\gamma \geqslant \max\{p\bar{v}_B - \bar{v}_A, \bar{v}_A - \bar{v}_B\}$ and $p\bar{v}_B \leqslant \bar{v}_A + (1-2p)\gamma$. Suppose that $q_{r_{A||B}} = 1$. According to Lemma 1, it is a best response for the consumer to adopt $\rho(\varnothing) = \rho(A) = A$ and $\rho(B) = B$. It is easy to show that $\bar{v}_A + \gamma > p\bar{v}_B$. Together with $\bar{v}_A + \gamma > \bar{v}_A + \gamma - c$, we have ($r_A$, (Not Acquire, A)) as one equilibrium. Given Lemma 2, we have (r_A, (Acquire, First)) as another equilibrium.

$\square$

A.2 Additional Equilibrium Characterizations

The intuition for Part 2 is similar except that now acquiring the report makes a difference only when the report is A, which occurs when the pre-ranking value of Product B is 0 or when it is $\bar{\upsilon}_B$ and the expert chooses r_A. By acquiring the report in these cases, the consumer purchases the first-ranked Product A instead of Product B, receiving $\bar{\upsilon}_A + \gamma$ rather than, in the first case, 0 or, in the second case, $\bar{\upsilon}_B$. The requirement that the cost of the report is no larger than the expected benefit gives rise to the condition in the lemma.

The consumer prefers to acquire the ranking report ($\alpha = 1$) if and only if

1. $c \leqslant p q_{r_{A||B}}(\bar{\upsilon}_B + \gamma - \bar{\upsilon}_A)$ under product-purchasing rule ; or
2. $c \leqslant (1-p)(\bar{\upsilon}_A+\gamma)+p(1-q_{r_{A||B}})(\bar{\upsilon}_A+\gamma-\bar{\upsilon}_B)$ under product-purchasing rule $\rho(A) = A$ and $\rho(\varnothing) = \rho(B) = B$.

Consider $\rho(A) = A$ and $\rho(\varnothing) = \rho(B) = B$ for Part 2. Given $q_{r_{A||B}} \in [0, 1]$, the consumer's expected payoff from choosing $\alpha = 0$, $p(\bar{\upsilon}_B + q_{r_{A||B}}\gamma)$, is no larger than that from choosing $\alpha = 1$, $q_{r_{A||B}}[p\bar{\upsilon}_B + (1-p)\bar{\upsilon}_A] + (1 - q_{r_{A||B}})\upsilon_A + \gamma - c$, if and only if $c \leqslant (1-p)(\bar{\upsilon}_A + \gamma) + p(1 - q_{r_{A||B}})(\bar{\upsilon}_A + \gamma - \bar{\upsilon}_B)$.

Appendix B. Experimental Instructions for Treatment ***AVERAGE-B***

INSTRUCTIONS

Welcome to this experiment, which studies decision making between two individuals. The experiment will last approximately 1 hour. There will be 40 rounds of decisions. Please read these instructions carefully. The cash payment you receive at the end of the experiment depends on your decisions.

Your Role and Decision Group

There are 20 participants in today's session. 10 participants will be randomly assigned the role of **Product Expert**, and the other 10 the role of **Consumer**. Your role will remain fixed throughout the experiment. In each and every round, one Product Expert is matched with one Consumer. Participants will be randomly rematched after each round. You will not learn the identity of the participant you are matched with in any round, nor will that participant learn your identity.

Your Decision in Each Round

Overview. There are two products, A and B. They differ by the values to the Consumer. The value of Product A is fixed at 100.

The value of Product B is either 0 or 80. In each and every round, the computer will randomly select one of these two values for Product B according to the following:

(a) The chance that 0 will be selected is 40%.

(b) The chance that 80 will be selected is 60%.

The Product Expert makes one decision: how to rank the two products. The Consumer makes two decisions: whether to purchase to view the Product Expert's ranking report and which product to choose.

Product Expert's Decision: Choosing a Ranking Method. In each and every round, you choose a **ranking method**. There are two choices:

(a) Method 1: Rank Product A first regardless of the value of Product B.

(b) Method 2:

   (i) Rank Product A first if the value of Product B is selected to be 0.

   (ii) Rank Product B first if the value of Product B is selected to be 80.

Your decision therefore comes down to which product to rank first in the case that the value of Product B is selected to be 80.

You choose a ranking method before the computer selects the value for Product B, i.e., you don't know the selected value of Product B when you choose. Your task for the round is completed after you make the choice.

Depending on the selected value of Product B, a **ranking report** is generated according to your chosen ranking method. If the Consumer chooses to purchase to view your ranking report, the generated report, either "Product A is ranked 1st" or "Product B is ranked 1st," will be revealed to the Consumer.

Note that during the round the Consumer will never see the selected value of Product B. Note also that even if the Consumer chooses not to purchase your ranking report, the product ranking will still affect him/her. This will be further explained below.

Consumer's Decisions: Whether to Purchase the Ranking Report and Choosing a Product. In each and every round, your first decision is whether to purchase to view the ranking report (Purchase or Pass). You need to pay for the report if you choose "Purchase," which will be further explained below.

Irrespective of your first decision, you will make a second decision on which product, A or B, to choose. While you will receive the value of the product you choose, both products are free—you don't need to pay for it.

If you purchase the ranking report, you will make your product choice after seeing the generated report (you will only see the ranking report, not the ranking method that generates it). If you pass, you will make your product choice right after you choose "Pass." In either case, you will make your product choice without seeing directly the selected value of Product B. Your task for the round is completed after you make your product choice.

Your Reward in Each Round

Your reward in each round is expressed in "experimental currency unit" (ECU). How your earned ECU converts into cash payment will be explained below.

Product Expert's Reward. You will receive the amount the Consumer pays for the report, 70 ECU, multiplied by 5. Thus, if the Consumer chooses to purchase your ranking report, you will receive a total of 350 ECU for the round.

Table A.1 summarizes your potential reward in a round as a Product Expert, which depends on the Consumer's choice of *Purchase* or *Pass*.

Consumer's Decision on Purchasing Ranking Report	
Purchase	*Pass*
350	0

Table A.1: Product Expert's Potential Reward in ECU

Consumer's Reward. Your reward in a round consists of three parts:

(a) You will receive the value of the product you choose:
   (i) 100 ECU if you have chosen Product A; and
   (ii) either 0 or 80 ECU if you have chosen Product B, depending on the value randomly selected by the computer according to the 40%–60% chance.

(b) You will receive an extra reward of 250 ECU if you have chosen the first ranked product (regardless of whether you purchase the ranking report or not).

(c) You will pay a cost of 70 ECU if you choose to purchase the ranking report.

Table A.2 on the next page summarizes your potential reward in a round as a Consumer, which depends on

(a) your decision on purchasing the ranking report (*Purchase* or *Pass*);

(b) your product choice (A or B);

(c) the Product Expert's ranking method (*Method 1* or *Method 2*);

(d) chance (the randomly selected value of Product B); and

(e) the interaction between (c) and (d) which determines the generated report (*"Product A is Ranked 1st"* or *"Product B is Ranked 1st"*).

	Product Expert's Choice of Ranking Method and the Generated Report		
	Method 1	*Method 2*	
	"Product A is Ranked 1st" (always generated and seen by you)	*"Product A is Ranked 1st" (generated with 40% chance and seen by you)*	*"Product B is Ranked 1st" (generated with 60% chance and seen by you)*
Purchase & A	280	280	30
Purchase & B	−70 with 40% chance 10 with 60% chance	−70	260
Your Decisions	*Method 1*	*Method 2*	
	"Product A is Ranked 1st" (always generated and NOT seen by you)	*"Product A is Ranked 1st" (generated with 40% chance and NOT seen by you)*	*"Product B is Ranked 1st" (generated with 60% chance and NOT seen by you)*
Pass & A	350	350	100
Pass & B	0 with 40% chance 80 with 60% chance	0	330

Table A.2: Consumer's Potential Reward in ECU

Information Feedback

At the end of each round, you will be provided with a summary of what happened in the round, including the Product Expert's ranking method, the selected value of Product B, the generated ranking report, the Consumer's decision on purchasing the ranking report, the Consumer's product choice, and your reward in the current round. A history of all previous rounds will also be provided.

Your Cash Payment

The experimenter randomly selects 3 rounds out of the 40 rounds to calculate your cash payment. So it is in your best interest to take each round equally seriously. The average of the ECU you earn in the 3 selected rounds will be converted into U.S. dollar at an exchange rate of 20 ECU for 1 USD. You will also separately receive a "show-up fee" of 5 USD.

Quiz and Practice

To ensure your understanding of the instructions, we will provide you with a quiz below. After the quiz, you will participate in a practice round. The practice round is part of the instructions and is not relevant to your earnings. Its objective is to get you familiar with the computer interface and the flow of the decisions in each round.

Once the practice round is over, the computer will ask you to "Click 'Next' to start the official rounds."