

Article

Omer Dekel* and Amos Schurr

Cognitive Biases in Government Procurement – An Experimental Study

Abstract: Competitive bidding (CB) is the dominant governmental contracting mechanism by which hundreds of billions of dollars are allocated annually. We claim that when bid evaluators assess the qualitative components of competing bids while being exposed to the bid prices, a systematic bias occurs that gives an unjust advantage to the lower bidder. We term this the Lower-Bid Bias. It is then shown that this bias can be neutralized by splitting the evaluation process into two stages, whereby bid price is revealed only after the evaluation process has culminated (two-stage CB). This is demonstrated through the findings of a survey and three controlled experiments, the first to be conducted with procurement officials. We also explain why this bias is undesirable and suggest a mandatory rule, requiring two-stage CB for any competitive public procurement based on evaluation criteria other than price. Further applications of the experiments' findings are also discussed.

Keywords: behavioral economics, public procurement, cognitive bias

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1 Introduction

In any given country, the government is always the biggest single purchaser, both in expenditure and in number of acquisitions.¹ In most Western countries,

¹ To illustrate, according to the Federal Procurement Data System, in 2012 alone, the U.S. federal government procured approximately \$536 billion worth of goods, services, and infrastructure. Of this, \$334.5 billion was expended through competitive procedures (Federal

*Corresponding author: Omer Dekel, Faculty of Law, College of Law and Business, Ramat Gan, Israel, E-mail: omerdekel@clb.ac.il

Amos Schurr, Guilford Glazer Faculty of Business and Management, Ben-Gurion University of the Negev, Beer Sheva, Israel, E-mail: samos@post.bgu.ac.il

a significant portion of the government procurement is conducted through competitive procedures.² Hundreds of billions of dollars, then, are spent annually in tens of millions of competitive acquisitions of a tremendous variety. These range from the procurement of simple off-the-shelf products (e.g., office supplies) and services (e.g., cleaning or door-keeping) to procuring complex products and services (such as IT systems, military projects, or infrastructure works) of huge economic value (like mega-construction projects or sizable weapons transactions).

In many cases, especially when complex or large transactions are involved, the competitive procurement process is not based on bid price alone, but on an intricate set of evaluation criteria. In such instances, the Competitive Bidding (CB) records specify a variety of evaluation criteria (including price), where each is assigned a relative weight that represents its relative importance. The bid evaluator, known as the “Contracting Officer” (CO) (48 C.F.R. §1.602-2, 2.101), is thus required to evaluate and rate any of the attributes of the competing bids in accordance with these criteria, the winner being the bidder with the highest overall score. This procedure is usually termed a “Request for Proposals” (RFP) (48 C.F.R. §15.203(a)(4)), which is distinct from the “Invitation For Bids” (IFB) procedure, where competition is based on price alone (48 C.F.R. §14.101(e), §14.408-1(a)). U.S. federal law requires the Contracting Officer to “*evaluate competitive proposals and then assess their relative qualities solely on the factors and subfactors specified in the solicitation*” (48 C.F.R. §15.305(a); §13.106-2(a)(2)). Deviation from this provision is considered a violation of the CB rules and the law. It also contravenes the CB designer’s intention as well as the bidders’ expectations that the outcome will be determined strictly according to the CB specifications. Even though the courts show reluctance in intervening in the bid evaluation process and allow COs wide discretion in implementing the

Procurement Data System – Next Generation (last updated December 2013), <https://www.fpds.gov/Reports/manage/jsp/myReportsController.jsp>). Millions of additional competitive procedures, worth billions of dollars, are conducted each year by administrative agencies and state and local governments.

² For the regulation of the U.S. federal government acquisition system, see the Federal Acquisition Regulation (FAR) (48 C.F.R. § 1 (2003)). For the European Community public procurement regulations, see Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts, 2004 O.J. (L 134) 114-240. For the regulation of public procurement by the World Trade Organization (WTO), see the Agreement on Government Procurement (April 15, 1994), *available at* http://www.wto.org/english/docs_e/legal_e/gpr-94_01_e.htm. Similar regulations exist in the State of Israel, where the experiments used for the current research were conducted. See the Public Tenders Act, 1992 (Israel).

evaluation criteria indicated in the solicitation,³ any deviation from these criteria has been explicitly overturned.⁴

In line with the traditional legal and economic thinking on rational choice, the conventional economic model of government procurement expects government officials to implement an optimal procurement mechanism that will generate the maximum revenue for the government (Cramton, 1995; McAfee and McMillan, 1996; Kwerel and Rosston, 2000; Klemperer, 2002; Milgrom, 2004), and bidders are expected to maximize the benefits they can extract from any given transaction. In recent years, however, behavioral studies have shown that human judgment does not always adhere to the rational model. Rather, decision makers are often susceptible to cognitive biases that deter them from evaluating options in a rational way and lead them to systematic biases and mistakes (see, for example, Tversky and Kahneman, 1986; Tversky and Thaler, 1990; Kahneman, 2011). These findings are not unique to laypeople and are applicable to professional decision makers as well (Tversky and Kahneman, 1983; Shanteau, 1988; Wistrich et al., 2005; Rachlinski et al., 2006; Guthrie et al., 2009; Danziger et al., 2011).

In this article, we document for the first time the presence of such a cognitive bias in the governmental contracting arena and propose a simple remedy to contend with it. Specifically, we argue that as a result of bid evaluators' awareness of the bid price when assessing the competing bids' qualitative components, they deviate from the CB determinations in favor of the lower bidder. We term this the "Lower-Bid Bias". It is then shown that this bias can be easily eliminated through what we term "two-stage competitive bidding,"⁵ whereby the bid price is submitted in a separate envelope that is opened only upon the culmination of the evaluation process. The lower-bid bias is demonstrated through our findings from three controlled experiments and a survey, the first to be conducted with actual public officials specializing in public procurement.

³ TRW Environmental Safety Systems, Inc. v. United States, 18 Cl. Ct. 33, 43 (1989) Glenn Def. Marine Asia, PTE Ltd. v. United States, 720 F.3d 901, 907–908 (Fed. Cir. 2013).

⁴ Banknote Corp. of Am. v. United States, 56 Fed. Cl. 377, 386 (2003) ("It is hornbook law that agencies must evaluate proposals and make awards based on the criteria stated in the solicitation."); 360Training.com, Inc. v. United States, 106 Fed. Cl. 177, 184 (2012). ("... if the agency's evaluation of proposals significantly differs from the evaluation process disclosed in the solicitation, the agency's decision can be found to lack a rational basis.")

⁵ A distinction must be made between "two-stage competitive bidding" and "two-step sealed bidding" (48 C.F.R. § 14.5 (2003)). In the latter, the submitted bids do not include the proposed price. Only once the bids have been reviewed, are the bidders whose bids were found to be suitable in the first stage asked to submit price proposals. For more details, see Section 5 below.

We point to three reasons for the undesirability of the lower-bid bias. The first reason is that it amounts to a retroactive alteration of the CB evaluation criteria, in violation of the CB designer's original intention. Second, the bias represents a breach of both the law and the CB rules. The third reason is that the lower-bid bias might encourage bidders to disregard the solicitation specifications by placing greater weight on price than warranted under the CB designer's original intention. Accordingly, we propose implementing a mandatory two-stage evaluation process for governmental Requests for Proposals, to eliminate that bias (Jolls and Sunstein, 2006).

We conclude the article by discussing possible applications of our findings in two other areas of law and decision-making contexts. First, we assert that our conclusions can serve to justify the legal rule prohibiting employers from requesting and inquiring about the medical history of work applicants at the first stage of the recruiting process. Second, we explain how our findings could impact other decision-making procedures, such as those used in grant applications.

Indeed, several studies in various fields have demonstrated that inadmissible information can distort decision makers' judgment and support withholding that information from the decision maker in certain circumstances (Taylor and Yildirim, 2011). For example, Goldin and Rouse (2000) showed the successful neutralization of sex-biased hiring by American orchestras through a "blind" auditioning procedure. Blank (1991) found that papers written by authors from near-top-ranked universities (ranked 6–50) and from non-academic U.S. institutions have a better chance of acceptance in informed review than in blind review. It has been shown that using prior convictions to impeach a defendant may lead to bias against him or her and might increase the risk of false conviction (Hans and Doob, 1976; Blume, 2008; Eisenberg and Hans, 2009). Ample research has found that mock juries almost consistently fail to ignore inadmissible information if it seems relevant to the case (for a comprehensive review, see Wistrich et al., 2005:1270–1276), and Wistrich et al. (2005) have demonstrated that with few exception, judges are not much better than layperson jurors in this respect (pp. 1325–1327). The above situations would all benefit from the same solution: concealing the potentially distorting information from the decision maker.

Our context, however, is more complex and difficult to resolve. Unlike the above examples, in public procurement, a complete filtering-out of the potentially distorting information (the bid price) is not even an option, since this information is not only *allowed* to be considered but is actually *required* to be considered. Therefore, the dilemma here is thus not *whether* to disclose the problematic information but, rather, *when* and *how* to disclose it.

The article proceeds as follows: Section 2 begins by conventionally presenting the psychological foundation of our argument that bid evaluators' exposure to the bid price creates a lower-bid bias. Section 3 presents and analyzes the results of a survey and three experiments we conducted with public officials specializing in public procurement, which support our argument. In Section 4 we explain the negative aspects of the lower-bid bias and why it should be debiased. Our proposal for a debiasing mechanism is outlined in Section 5. Finally, Section 6 discusses broader ramifications of our research, followed by a summary of our discussion in Section 7.

2 Psychological processes underlying the lower-bid bias

Numerous studies in psychology and behavioral economics offer different possible accounts for the lower-bid bias. One such possible account relates to the *context of evaluation*, which, among other things, holds that people's preferences are sensitive to the procedure of evaluation and to the way that different evaluated attributes relate to one another (Hsee and Zhang, 2010). Under this account, the scoring of the qualitative components of the bids, when the bid price is known, can be expected to produce a different evaluation from when price is concealed until a later stage. Another factor that might lead to the lower-bid bias is *confirmation bias*, whereby bid evaluators recognize the lower bid as the desired one, which causes them to arrive at an evaluation that supports that perception. The third factor that could be responsible for the lower-bid bias is the *halo effect*, where the "halo" of the lower bid price shines a positive light on the bid's other attributes. The psychological research raises good reason to assume that any of these three effects can be a contributory factor to the lower-bid bias.

2.1 Context of evaluation

One of the basic principles of rational choice theory is procedure invariance. Under this principle, preferences must not be influenced by the way in which they are solicited. For example, bids could be evaluated through a single-stage evaluation procedure, in which their qualitative components are evaluated jointly with the price. They could also be evaluated through a two-stage procedure, whereby the qualitative components are evaluated before the bid price is

revealed. “Invariance” means that such divergence in the evaluation procedure should not alter the CB results. However, in contrast with this principle, research on decision making has revealed that procedure invariance does not always hold. A substantial body of psychological research suggests that even a small change in the evaluation procedure may have a substantial effect on individuals’ preferences. Preference has been found to be a constructed, context-dependent process, largely influenced by the framing of a problem, by the method in which preferences are elicited, and by the context in which a decision is made (see for example Lichtenstein and Slovic, 1971; Tversky and Kahneman, 1986; Tversky et al., 1990; Tversky and Thaler, 1990; Shafir, 1993; Hsee, 1996; Bazerman et al., 1999; Hsee et al., 1999; Nowlis et al., 2002; Simonson, 2008; Hsee and Zhang, 2010).

The research presented in this paper similarly sought to uncover a bias related to the *context* of evaluation: namely, the question of whether submitted bids are evaluated in a single-stage or in a two-stage evaluation procedure affects their evaluation as a whole and may alter the competition results. Specifically, we claim that evaluating the qualitative components of the bids in tandem with the bid price, which is the procedure in single-stage CB, produces a bias in favor of the lower bid. However, splitting the evaluation procedure into two stages, by concealing the bid price from the evaluator until after the qualitative components have been assessed, as in two-stage CB, will eliminate this bias. Psychological research points to two factors that potentially contribute for the lower-bid bias.

One contributing factor can be related to the *evaluability hypothesis*, according to which people tend to place greater weight on attributes that are easy to evaluate and to be compared and relatively less weight on attributes that are difficult to evaluate and to be compared with each other (Hsee, 1996; Hsee and Zhang, 2010). In our context, price is clearer to discern than quality, and differences in price are more observable, comparable, and better understood than differences in quality. Accordingly, differences in price between competing bids are easier to evaluate than differences between their qualitative attributes, such as experience, seniority, financial turnover, or past performance of the bidders. For example, it is difficult to evaluate and internalize the actual significance of the difference between 5 and 7 years of experience among competing bidders. In contrast, it is much easier to evaluate the difference between \$100 and \$120 bids. Under the *evaluability hypothesis*, it is plausible that the difference in the *ease of evaluation* between the bids’ qualitative attributes and price causes bid evaluators to pay less attention, and therefore attribute less weight, to the former and more attention and weight to the later. This results in a bias in favor of the lower bidder.

Some support for the hypothesis that awareness of price biases the bid evaluation process in favor of the lower bidder can be drawn from Nowlis and Simonson's research (1997) on consumer behavior. They showed that when consumers are asked to choose between different commercial products, they give greater attention and weight to precise and easy-to-compare attributes (like price) than to ambiguous and hard-to-compare attributes (like brand name, country of manufacture, experience, seniority, financial turnover, and past performance). This phenomenon results in an advantage for the cheaper product in a comparison context. However, this advantage diminishes when each product is evaluated separately on its own. These findings seem to be in line with our claim that when bid evaluators evaluate the bids' qualitative elements alongside price, they focus on differences in price (easy to compare), whereas disparities in quality (hard to compare) are less noticed and, consequently, under-valued.

The second contributing factor is related to the nature of the CB as a mechanism designed for purchasing, which is intuitively and contiguously connected with expenses, cost, and price. Research on *prominence* and *task compatibility* principles (Tversky et al., 1988) suggests that decision makers are likely to weigh more heavily aspects that are related to the core of their task. Accordingly, it is reasonable to assume that in evaluating the bids' qualitative components jointly with their price, price will loom larger than quality and will consequently be ascribed greater weight than it warranted. Withholding the bid price until the end of the evaluation process, however, can be expected to eliminate this tendency. Here, then, is further possible support for the contention that the evaluation context can impact the CB outcome.

2.2 Confirmation bias

The lower-bid bias is consistent with two other well-known psychological phenomena. The first is the *confirmation bias*: namely, people's tendency to accord greater weight to information, evidence, or arguments that support the result that they seek in any event or, conversely, to give insufficient weight to information or evidence that negates or weakens that outcome, sometimes to the point of completely discounting that evidence (for a comprehensive review, see Nickerson, 1998). This bias presents not only in situations in which the decision maker has an interest in obtaining a particular result (a motivated bias) but also in situations in which no such interest exists, but the decision maker has already formulated an opinion on the matter (unmotivated bias) (Ross et al., 1975).

Naturally, confirmation bias can also have ramifications in the legal sphere. For example, it leads criminal investigators and prosecutors to overestimate

evidence that supports their hypothesis regarding a suspect's guilt and underestimate evidence that contradicts it (Ask and Granhag, 2007; O'Brian, 2009; Rassin et al., 2010; Earland and Rassin, 2012). As a result of confirmation bias, jury members (Carlson and Russo, 2001) as well as judges (Rachlinski, 2012) tend to interpret new evidence in a way that supports their prior beliefs as to the guilt or innocence of the accused.

In the context of the CB process, we contend that in their pursuit of a good bargain for the government and of efficient use of public funds, bid evaluators may identify the lowest bid as the desirable one. The desire for the lower bid to win the CB is then translated, whether consciously or subconsciously, into a preference for that bid, through the over-valuation of its other attributes.

2.3 Halo effect

The lower-bid bias can also be attributed to the *halo effect*. This refers to decision makers' tendency to focus on the most prominent attribute of the subject they are evaluating (be it a person, object, or bid), with their impression of this attribute affecting their assessment of its other attributes. The first to observe the halo effect was Thorndike (1920), who showed that people tend to ascribe success, happiness, and higher social status to people with an attractive external appearance. The halo effect was thereafter found to be present with regard to other subjects of evaluation as well (Backwith and Lehmann, 1975; Nisbett and Wilson, 1977; Felton et al., 2004; Smith et al., 2010). In the CB context, the halo effect can work either way: an attractive price can make the qualitative parts of a bid appear more attractive in the evaluator's eyes, or conversely, the superiority of qualitative parts of a bid can cause a higher price to look more attractive than it really is. However, since price is an attribute the scoring of which is not subject to any discretion, the halo of the qualitative element is less likely to affect the assessment of the price, while the halo of an attractive price may have a positive impact on the assessment of the bids' qualitative attributes.

Contrary to our hypothesis, research in the field of consumer marketing shows that consumers tend to infer high quality from the high price of products (Akshay and Monroe, 1989; Brucks et al., 2000; Shiv et al., 2005), suggesting that a high price is expected to have a positive impact on the perception of the qualitative elements of a product (or a bid). However, we argue that government officials treat public procurement in a different way than private entities treat their own consumption. In sum, then, since price is easier to evaluate than quality and because procurement is price-oriented, we suggest that when bid

evaluators are exposed to the bid price while evaluating its qualitative components, a lower-bid bias tends to emerge. Compounding this effect is the confirmation bias, where the desire to find a good bargain makes the lower bid more attractive and, therefore, more favorable. Finally, halo effect may also cause bid evaluators to perceive the qualitative elements of a lower bid more favorably than is warranted.

3 The study

In order to determine whether awareness of the bid price leads bid evaluators to a biased evaluation, we conducted a study consisting of a survey and three controlled experiments with Israeli public officials who are involved in government procurement on a daily basis. The subjects were all employees of public entities subject to a mandatory CB process, such as government offices, administrative agencies, and government-owned companies.

The Israeli legal regime governing public procurement in general, and bid evaluation and comparison in particular, closely resembles that of the United States. Thus, as in the United States (48 C.F.R. §15.305(a)), Israeli bid evaluators are restricted to the CB evaluation criteria specified in the CB records when scoring the bids, and the bid receiving the highest score is the winner. However, in Israel, decisions are made by a Contracting Committee, composed of three to five members authorized by law, rather than by a Contracting Officer.

3.1 A survey of public officials and frequent bidders on the impact of bid price awareness on bid evaluation

We first tested our hypothesis by way of a survey of public officials engaged in public procurement and bidders who frequently participate in public procurements. The survey sought to uncover the respondents' views on how awareness of the bid price impacts the bid evaluator and the evaluation process.

The survey was conducted with two different groups of respondents: (1) 91 employees of various Israeli public entities, whose jobs entail involvement in procurement procedures, either as members of contracting committees (analogous to contracting officers in the United States) or as assistants to those committees (the counterparts to contracting officer representatives and technical evaluation panels); and (2) 96 employees of corporations that are frequent bidders in public CBs. The survey was conducted during a series of professional

training courses. It comprised 20 questions relating to a variety of issues regarding the procurement process, with one question (Q. 17) referring to the effect of the knowledge of bid price on the bid evaluation. This latter item asked respondents to indicate their position regarding the following statement, on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree):

Contracting committee members should not be exposed to the bid prices until after the bid evaluation process has been completed, so that knowledge of the bid price does not affect their judgment.

Most respondents indicated agreement with this statement ($M = 3.71$, S.D. = 1.33). However, the frequent bidders expressed stronger support for concealing the bid price from bid evaluators than did the officials ($M = 3.93$, S.D. = 1.25 and $M = 3.49$, S.D. = 1.37, $t(176) = 2.22$, $p < 0.05$, respectively).

3.2 Experiment 2a: the actual effect of knowing the bid price on the CB outcome – eight evaluation criteria

The survey results served as the background for the next stage of our study: an experiment designed to determine whether a bid evaluator's awareness of the bid price influences her assessment of the non-price qualitative elements of the bids.

3.2.1 Method

The experiment participants were 36 Israeli public officials who are either members of contracting committees or serve as assistants to those committees. The experiment was conducted in the framework of a 7-week professional training course that met for a 6-hour session once a week, sponsored by the Israeli Ministry of Finance. Employing a within-subjects design, the first part of the experiment was conducted at the first session of the course, and the second part was conducted 4 weeks later at the beginning of the fifth session, before the topic of "bids' evaluation" was discussed in class.

Participants were presented with a case of a CB for the provision of school transportation services, conducted by a municipality, in which two bids had been submitted. Participants were given a table detailing eight qualitative criteria to be considered in choosing the CB winner (geographical location, references, number of buses available to the bidder, model of the buses used by the bidder, ISO certification, bidding companies' years of operation, and the amount of training hours completed by each company's bus drivers). The table

presented the maximum score that could be given for each criterion, as well as the information each of the two bidders provided regarding these criteria. Participants were asked to score the bids on all eight evaluation criteria, with the maximum combined score allotted for these components being a total of 400 points of the overall 1,000 points. The remaining 600 points were allotted to the price component.

In the first part of the experiment, the case was set up as a two-stage CB: the participants were asked to evaluate the qualitative components of the bids without knowing their prices. In the second part, the same case was presented to the participants, but the bid price was included along with the qualitative information, as well as the points that each bid had received for its price – i.e., a single-stage CB scenario. To prevent the participants' recollection of their previous responses, the order of the two bids within the table was switched, and the order in which the qualitative components were presented was altered randomly. In order to determine the impact of their exposure to the bid price, the participants were asked to provide identification on the experiment form filled out at both stages of the experiment (see Appendix A for the experiment form). After completing the experiment, participants were asked to respond to a questionnaire about their views on the impact of knowing the bid price on their own evaluations, on those of their colleagues, and on contracting committee members in general.

3.2.2 Results

The first two bars in Figure 1 and Table 1 summarize the experiment's main findings (for detailed results, see Table A1 in Appendix A). As can be seen, it

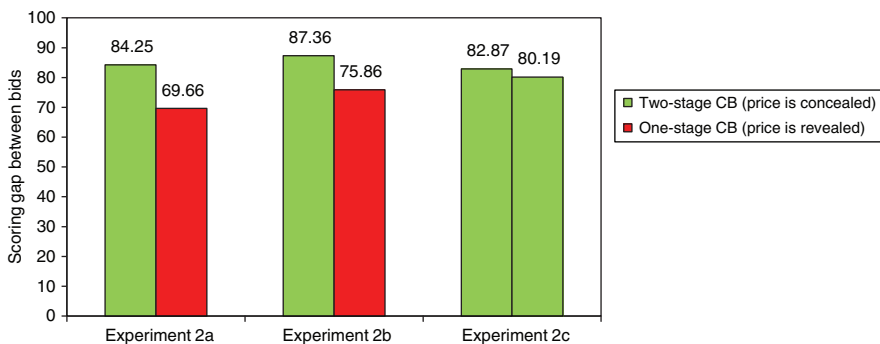


Figure 1: Summary of the main results of the three experiments

Table 1: Mean qualitative score (and standard deviation (in parentheses)) for the competing bids in a two-stage/single-stage CB – Experiment 2a

	Two-stage CB (<i>n</i> = 36)	Single-stage CB (<i>n</i> = 36)	Variance resulting from shift to single-stage CB
Mean score of qualitative components of the <i>lower</i> bid (out of a possible 400 points)	273.61 (43.00)	297.42 (36.08)	An additional 23.81 points for the lower bid
Mean score of qualitative components of the <i>higher</i> bid (out of a possible 400 points)	357.86 (30.04)	367.08 (22.32)	An additional 9.22 points for the higher bid
Difference in scores (before weighting of bid price)	84.25 points in favor of the higher bid	69.66 points in favor of the higher bid	Difference in scores reduced by 14.59 points (17.31%)
Number of participants (out of 36) choosing the lower bid as the winner	6/36 (16.67%)	13/36 (36.11%)	Chances of the lower bid winning the CB increased dramatically

emerges that when participants assessed the qualitative components of the two bids without being aware of the proposed prices, the mean evaluation of the higher-priced, qualitatively superior bid, was higher than that of the lower-priced, qualitatively inferior bid, by 84.24 points ($M = 357.86$, S.D. = 30.04, versus $M = 273.61$, S.D. = 43.00, respectively).

However, when participants assessed the bids' qualitative components while knowing their prices, this gap was significantly decreased. The mean qualitative evaluation of the higher-priced bid was then 367.08 (S.D. = 22.32), whereas the mean qualitative evaluation of the lower-priced bid was 297.42 (S.D. = 36.08). This amounted to a mean difference of only 69.66 points in favor of the more expensive and qualitatively superior bid before factoring in bid price. After factoring in the bid price, which gave the lower bid a 50-point advantage, the difference between the bids decreased from 34.25 points in favor of the qualitatively superior bid, to only 19.66 points.

A repeated measures ANOVA testing the difference between the two-stage CB and the single-stage CB in terms of the average qualitative bid scores confirmed that the above observations were significant. Most importantly, and in line with our prediction, there was significant interaction between type of procedure (single-stage versus two-stage) and the gap between the evaluations of each bid ($F(1, 35) = 5.909$, $p < 0.05$, partial $\eta^2 = 0.144$). Orthogonal to our research question, the analysis also revealed a significant effect of procedure ($F(1, 35) = 11.19$, $p < 0.01$, partial $\eta^2 = 0.242$).

The same trend also emerged in the analysis of the participants' specific choices. All 36 participants gave a higher score to the qualitative part of the more expensive and qualitatively superior bid than to the qualitative part of the lower-priced, qualitatively inferior bid. However, in the two-stage procedure, the difference in the qualitative scores between the two bids was less than 50 points in 6 cases out of 36 (16.67%). Thus, once the bid price was factored in, the lower bid emerged as the CB winner in these six cases. However, in the single-stage procedure, the lower-priced bid was the winner in 13 of the 36 cases (36.11%), more than double than in the two-stage procedure.

Taken together, these results indicate that the bid evaluators' knowledge of the bid price led to: (1) a significant reduction in the difference between the qualitative scores awarded to each bid, from a difference of 84.25 points to a difference of only 69.66 points, representing a decrease of about 17% and (2) a considerable increase in the number of cases in which the lower bid won the CB, from 6 cases to 13 out of a total of 36, amounting to an increase of 19.44% in the likelihood of winning the CB.

Complementary Questionnaire at the Conclusion of the Experiment: At the end of the second round of the experiment, the participants were asked to complete the following questionnaire, using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree):

1. Do you think that knowing the bid prices affected your evaluation of the bids?
2. Do you think that knowing the bid prices affected your fellow classmates in their bid evaluations?
3. Do you think that in general, contracting committee members are affected by knowledge of bid price when evaluating bids?
4. As a CB bidder, would you prefer your bid to be evaluated by an evaluator who is aware of the bid price or that the bid price remain undisclosed and be revealed only upon the culmination of the evaluation process?

Participants indicated that their exposure to the bid prices had only a relatively minimal effect on their own evaluations ($M = 2.31$, $S.D. = 1.37$), which contrasted with the actual experiment results. Participants also tended to think that exposure to bid price had a far greater impact on the other participants and on bid evaluators in general ($M = 3.31$, $S.D. = 0.93$, and $M = 3.80$, $S.D. = 0.99$, respectively). This inconsistency is not surprising given the "bias blind spot": people's tendency to treat themselves as less vulnerable to cognitive biases than the average person and as less vulnerable to biases than they really are (Pronin and Kugler, 2007). Furthermore, participants also indicated a belief that

bidders would prefer a two-stage CB process to a single-stage process ($M = 3.71$, $S.D. = 1.44$). The questionnaire results lead to the conclusion that although bid evaluators appear to be aware that exposure to bid prices is likely to bias evaluators' judgment, they are unable to neutralize this effect.

3.3 Experiment 2b: the actual effect of knowing the bid price on the CB outcome – five evaluation criteria

3.3.1 Method

Experiment 2b was designed to corroborate the findings of Experiment 2a. Its participants were 29 Israeli public officials who are either contracting committee members or assistants to such committees and who were participating in a 3-week professional training course that met once a week for a 6-hour session. The same experimental design was used as in Experiment 2a, but with three alterations: (1) the CB procedure included five evaluation criteria rather than eight; (2) the bids were evaluated over a shorter time period (2 weeks) than in the first experiment, since the course ran for only 3 weeks; and (3) the participants were not asked to fill out a questionnaire at the end of the experiment (see Appendix B for the experiment form).

3.3.2 Results

The two center bars in Figure 1 and Table 2 summarize the main findings of the experiment. In line with the findings of Experiment 2a, when participants assessed the qualitative components of the two bids without knowledge of the bid price, the mean evaluation of the higher-priced, qualitatively superior bid was greater by 87.36 points than the mean evaluation of the lower-priced, qualitatively inferior bid ($M = 370.93$, $S.D. = 21.99$, versus $M = 283.57$, $S.D. = 34.41$, respectively). After factoring in the bid price, the difference between the bids' score was 37.36 points, giving the lower bid a 50-point advantage.

However, when the participants assessed the bids' qualitative components while informed of the bid price, the difference decreased significantly: the mean qualitative evaluation of the higher-priced bid was 371.38 ($S.D. = 25.27$), whereas the mean qualitative evaluation of the lower-priced bid was 295.52 ($S.D. = 47.62$). In other words, a mean difference of 75.86 points emerged in favor of the more expensive bid before factoring in the bid price, which dropped to only

Table 2: Mean qualitative score (and standard deviation (in parentheses)) for the competing bids in a two-stage/single-stage CB – Experiment 2b

	Two-stage CB (<i>n</i> = 29)	Single-stage CB (<i>n</i> = 29)	Variance resulting from shift to single-stage CB
Mean score of qualitative components of the <i>lower</i> bid (out of a possible 400 points)	283.57 (34.41)	295.52 (47.62)	An additional 11.95 points for the lower bid
Mean score of qualitative components of the <i>higher</i> bid (out of a possible 400 points)	370.93 (21.99)	371.38 (25.27)	An additional 0.45 points for the higher bid
Difference in scores (before weighting of bid price)	87.36 points in favor of the higher bid	75.86 points in favor of the higher bid	Difference in scores reduced by 11.50 points (13.16%)
Number of participants (out of 29) choosing the lower bid as the winner	5/29 (17.24%)	10/29 (34.48%)	Chances of the lower bid winning the CB increased dramatically

25.86 points after the bid price was factored in (see Table B1 in Appendix B for the detailed results).

A repeated measures ANOVA testing the difference between the two-stage CB procedure and the single-stage procedure in terms of the average qualitative bid scores confirmed the significance of the above observations. Most importantly, and again as expected, this analysis revealed significant interaction between the type of procedure (single-stage versus two-stage) and the gap between the bids' scores ($F(1, 28) = 4.782$, $p < 0.05$, partial $\eta^2 = 0.146$). Orthogonal to our research question, the analysis did not reveal a significant effect of procedure ($F(1, 28) = 1.253$, $p = 0.272$, partial $\eta^2 = 0.043$).

This course was also apparent in the analysis of the participants' specific choices. In the two-stage procedure, 5 of the 29 participants (17.24%) chose the lower-priced bid as the CB winner (without being aware of this result, since the price was concealed). However, in the single-stage procedure, where price was known from the outset, 10 of the 29 participants (34.48%) chose the lower-priced bid as the winner – a 17.24% increase.

Taken together, the results corroborate that the bid evaluators' knowledge of bid price produced: (1) a significant narrowing of the difference in the scoring of the two bids, from a gap of 87.36 points to a gap of only 75.86 points, which amounts to a decrease of about 13% and (2) a massive increase in the chances of the lower bidder winning the CB, from a 17.24% chance to one of 34.48% – an increase of 17.24%.

3.4 Experiment 2c: testing the effect of time and learning on the CB qualitative scoring

The results of Experiments 2a and 2b indicated that moving from a two-stage CB to a single-stage CB significantly reduced the gap between the bids' qualitative scores. Although these findings were in line with our hypothesis regarding the lower-bid bias, one may argue that they may also have been the result of the time that lapsed between the experiments' two runs, or of a "learning effect" – caused by the knowledge participants gained at the training course where the experiments were conducted. Experiment 2c was designed to test these alternative reasons.

3.4.1 Method

The experiment participants were again 22 Israeli public officials who were either contracting committee members or assistants to such committees, and who were participating in a three-session professional training course that met every 3 weeks for 6-hour sessions. The same experimental design was used as in Experiment 2a, except that the participants in both runs evaluated the qualitative parts of the bids without being aware of the bid price (the first form was identical to the form presented in Appendix A as the "first version", while the latter was identical to the "second version", excluding the price line). The first run was conducted at the beginning of the first session, while the second run was conducted in the middle of the second one, 3 weeks later.

Our hypothesis was that in contrast to Experiments 2a and 2b, since this time the bid price was concealed in both runs, the gap between the two bids' qualitative scores would not be changed significantly between the runs.

3.4.2 Results

The last two bars in Figure 1 and Table 3 summarize the main findings of the experiment. As can be seen, when participants assessed the qualitative evaluation criteria of the two bids in the first stage of the experiment, the gap between their mean qualitative scores was 82.87 points ($M = 360.64$, $S.D. = 26.78$, versus $M = 277.77$, $S.D. = 42.35$). This gap remained very much the same in the second stage of the experiment, conducted 3 weeks later. This time the difference between the two bids' qualitative scores was 80.19 points ($M = 349.10$, $S.D. = 48.74$, versus $M = 268.91$, $S.D. = 62.09$).

Table 3: Mean qualitative score (and standard deviation (in parentheses)) for the competing bids Experiment 2c

	Mean score of qualitative components of the inferior bid (out of a possible 400 points)	Mean score of qualitative components of the superior bid (out of a possible 400 points)	Difference in scores
1st run	277.77 (42.35)	360.64 (26.78)	82.87 points in favor of the better bid.
2nd run	268.91 (62.09)	349.10 (48.74)	80.19 points in favor of the better bid.

To test whether the gap between the two bids remained the same across time, we entered participants' evaluations into a repeated measures ANOVA model. The results of the analysis revealed a significant effect of bid type ($F(1, 21) = 124.07$, $p < 0.001$, partial $\eta^2 = 0.85$) indicating that participants differentiated between the bids. Importantly, there was a non-significant effect of time of evaluation ($F(1, 21) = 1.69$, $p = 0.21$, partial $\eta^2 = 0.08$) and a non-significant interaction between the timing of the evaluation and the bids' qualitative score ($F(1, 21) = 0.12$, $p = 0.731$, partial $\eta^2 = 0.01$). These findings confirm our hypothesis that the reduction in the gap between the competing bids, demonstrated in Experiments 2a and 2b, was not a result of time or learning effect.

Figure 1 shows how the move from a two-stage CB with bid price concealed (green bars) to a single-stage CB with bid price disclosed (red bars), resulted in a reduction of the gap between the bids' scoring, in favor of the lower bidder (Experiments 2a and 2b). In Experiment 2c, participants responded to a two-stage CB case in both runs, showing that the results of the previous experiments were not a consequence of a "learning effect".

3.5 Discussion

The survey and the three experiments were constructed to test our hypothesis that bid evaluators' knowledge of the bid price, when evaluating the qualitative components of bids, biases the evaluation process in favor of the lower bidder. The survey results confirmed that evaluators and frequent bidders tend to believe that knowing the bid price probably affects the evaluation of the bids' qualitative components, suggesting that bid price should be revealed only upon completion of the qualitative evaluation process. The results of the experiments, in turn, showed that evaluating competing bids in one-stage CB (where the bid

price is known from the outset), as compared to two-stage CB (where the bid price is concealed at the outset), produces a clear advantage for the lower bidder, which, in a considerable amount of the cases, shifts the balance in the latter's favor. This also confirms our suggestion that procurement officials treat prices in a way that differs from the way that private consumers do.

Comparison of results from the three experiments reveals that the effect of the move from the first round of the experiment (price concealed) to the second round (price revealed) on the bids' qualitative score was slightly different. Thus, in Experiment 1, even though, in accordance with our hypothesis, the gap between the two competing bids decreased significantly, the qualitative scoring of the more expensive bid rose by 9.22 points (2.5%). This phenomenon was not repeated in Experiment 2, in which the qualitative score of the more expensive bid increased in the move from a two-stage CB to a single-stage CB by a negligible amount of only 0.45 points. In Experiment 3, an opposite phenomenon was observed: even though, according to the research hypothesis, the gap between the competing bids remained almost the same, the qualitative score of the two bids fell by an average of 10.2 points. A possible explanation for this is that bid evaluators concentrate on the gap between competing bids and in the distribution of the points between them, and not on their overall score, which is of no significance in terms of the CB outcome. As in any competitive process, including the CB process, the crucial factor in the competition is the gap between competitors rather than the grade each competitor is awarded individually. Therefore, although this is an interesting finding, it has no practical importance in our case. It is worth noting that the lower-bid bias that was apparent in our study probably has a greater impact in reality than in the controlled experimental setting. We consider that this is for three main reasons: First, bid evaluators' motivation to secure what they identify as a desired bargain and ensure efficient use of public funds (Kunda, 1990). Unlike participants in a controlled experiment, who are indifferent to the CB outcome, in the real world, bid evaluators accord great significance to the CB results and have a strong tendency to prefer the bid they perceive to be more attractive. This motivation can be expected to amplify the lower-bid bias that arose in our study (see Lord et al., 1979; Kunda, 1987; Edwards and Smith, 1996). Second, for practical reasons, the experiments that we conducted required a comparison between two bids only. However, actual procurement processes often involve numerous bids. Understandably, a large number of competing bids makes comparison between the qualitative attributes of the bids more difficult, making the easily compared elements (the bid price) even more salient. Third, although a few weeks elapsed between the two parts of the experiments and the change of the data order made memorizing previous answers difficult, some subjects may have remembered some of their previous assessments.

Naturally, this might have narrowed the gap between the single- and the two-stage assessments. In reality, such a result is not expected to occur. The two main conclusions that can be derived from our study are actually the flip sides of the same coin: one, bid evaluator awareness of the bid price does, indeed, lead to a lower-bid bias; and two, concealing bid price until after the review process has been completed can neutralize this bias. At this juncture, two questions arise. First, is the lower-bid bias in fact undesirable? And second, if it is undesirable, can it be neutralized by a legal rule?

4 Is the lower-bid bias undesirable?

Is the lower-bid bias truly a bias? Arguably, the fact that a bidder can perform the same service or supply the same product at a lower price than another bidder can be a legitimate signal regarding the bidder's quality, since this probably reflects good management practices, positive returns to scale, pricing power with suppliers, and so forth. Moreover, the fact that such features are not easily discerned and scaled could justify, perhaps even make desirable, the consideration of the bid price by evaluators when assessing and scoring the qualitative components of the bids.

While this argument seems persuasive at first glance, its flaws become apparent upon closer examination. While bid price may, indeed, incorporate certain qualitative attributes of the relevant bidder, this should be manifested in the weight ascribed to price at the outset. Thus, if a CB designer believes that in certain circumstances, the bid price is indicative of not just mere "price" but also of certain aspects of quality, this should be expressed by according greater weight to the price criterion in the solicitation documents themselves. Bid evaluators should, accordingly, assume that the relative weighting of price and quality in the solicitation documents represents the CB designer's intention as well as her view of the acquisition as a whole. In other words, the weight attached to price as a criterion is reflective of both pure cost considerations as well as qualitative considerations, to the extent that the CB designer deemed desirable. There is no reason to assume that CB designers systematically fail at their job and, thereby, legitimate bid evaluators' consistent "correction" of any seeming errors through the bid scoring process.

In this context, it is important to understand that, in practice, the lower-bid bias is analogous to retroactively increasing the weight originally accorded to the price criterion while decreasing the weight accorded to the qualitative criteria. The results of our two experiments can serve as a persuasive illustration of this effect. In the first experiment, the move from a two-stage CB procedure to

a single-stage procedure narrowed the gap between the bids' qualitative mean scores by 14.59 points (from 84.25 points to 69.66 points). As a result, the number of cases in which the lower-priced, qualitatively inferior bid, won the CB more than doubled (from 6 cases to 13 cases out of 36). In the second experiment, a reduction by only 11.5 points of the difference between the bids' qualitative mean scores led to an exact doubling of the number of cases in which the lower bid won the CB (from 5 cases, out of 29, to 10). As can be seen, the lower-bid bias narrowed the gap between the bids' qualitative scores, which intensified the impact of the difference in prices on the CB outcome and, thereby, gave an advantage to the lower bidder. This outcome is tantamount to a shift in weight from the qualitative criteria to the price criterion. The more the lower-bid bias narrows the gap between the bids' qualitative scores, the more weight shifts from the qualitative criteria to the cost criterion.

This shifting of weight has several undesired ramifications. First, from the bidders perspective, the lower-bid bias encourages bidders to formulate their bids in a manner that does not conform with the weighting of cost and quality as presented in the solicitation documents, but, rather, to place greater emphasis on cost at the expense of higher quality. This is due to their expectation that such a strategy may improve their chances of winning the competition. To illustrate, say the stated distribution in the solicitation allocates 60% to the price criterion and 40% to quality. As a result of the lower-bid bias, this will be translated by sophisticated bidders into 70% for price and only 30% for quality. This is an undesirable result because it induces bidders to deviate from the CB designer's original intention and forces them to guess at the exact impact of the lower-bid bias, with a high risk of error. Second, as explained above, there is no plausible justification for bid evaluators' systematic deviation from the CB designer's original plan. Indeed, CB designers may cope with the tendency of bid evaluators to give too much weight to the bid price (due to the lower bid bias) by according less weight to the price criterion from the outset (say, 60% instead of 70%). However, this solution is also inadvisable since it requires the CB designer to guess at the exact effect of the lower bid bias though armed with no effective tools to do so. Third, deviation from the CB evaluation scheme is simply illegal: "*Agencies do not have the discretion to announce in the solicitation that they will use one evaluation plan, and then follow another; once offerors are informed of the criteria against which their proposals will be evaluated, the agency must adhere to those criteria or inform all offerors of any significant changes made in the evaluation scheme*".⁶ and "*if the agency's evaluation of proposals*

⁶ *Latecoere Int'l, Inc. v. United States Dep't of the Navy*, 19 F.3d 1342, 1359 (11th Cir. Fla. 1994). See also *Dubinsky v. United States*, 43 Fed. Cl. 243 (Fed. Cl. 1999).

significantly differs from the evaluation process disclosed in the solicitation, the agency's decision can be found to lack a rational basis".⁷ These three negative aspects of the lower-bid bias point to the importance of implementing a regulatory mechanism that will neutralize the lower-bid bias.

5 Debiasing through law: a mandatory two-stage competitive bidding

We contend that the lower-bid bias can be effectively neutralized through a rule that requires that any competitive government procurement based on evaluation criteria other than price (mainly Requests for Proposals) be conducted through a two-stage procedure. To recap, under a two-stage mechanism, the bid price is submitted along with the other components of the bid, but in a separate sealed envelope that is opened only upon the completion of the bid reviewing process. We propose that single-stage CB should be used only in exceptional circumstances.

It is interesting to note that a two-stage CB mechanism is not even mentioned in the federal or state legislation that regulates government procurement. However, the Federal Acquisition Regulations do refer to a closely resembling process, "Two-Step Sealed Bidding" (FAR § 14.5), which is a voluntary procedure in which the bids include only technical features. Only after these technical components have been reviewed, those bidders who have passed this stage are invited to submit their bid price (48 C.F.R. §14.5). This procedure is reserved mainly for cases involving complex technical issues and is designed to enable the purchaser to formulate its exact requirements over the course of the procurement process. In the state sphere, only Virginia appears to have some form of two-stage CB, referred to as "Combined Two-Step Sealed Bidding." This procedure is not included in the Code of Virginia, and the state government uses it on a purely voluntary basis.⁸

We propose a two-stage mechanism for contending with the lower-bid bias that is innovative both in its method and its mandatory nature and that, we assert, offers two main advantages. First, as indicated by our experiments, two-stage CB assures unbiased and more accurate evaluation of bids' qualitative components. Second, in serving to neutralize the lower-bid bias, the two-stage procedure can reinforce CB's outward appearance as a fair, reliable, and objective bid review and evaluation mechanism. This was also confirmed by the

⁷ 360Training.com, Inc. v. United States, 106 Fed. Cl. 177, 184 (2012). See also L-3 Communs. Eotech, Inc. v. United States, 83 Fed. Cl. 643, 654 (2008).

⁸ Available at <http://www.eva.virginia.gov/library/files/APSPM/Chapter6.pdf>.

results of the survey we conducted, which indicated that bidders prefer two-stage CBs. Reliability is of great importance in this context, since it enhances participation in the competitive procurement process and serves to moderate losing bidders' natural suspicion regarding decisions made by government procurement authorities (a suspicion often shared by the general public and, at times, by the courts too). Moreover, the bolstered faith in bid evaluators' exercise of their discretion may reduce the likelihood of judicial intervention in their decisions, as well as legitimize allowing them broader discretion in this context. In sum, moving to a two-stage CB regime could improve the overall efficiency of the public procurement process.

One possible argument against a mandatory two-stage CB rule relates to its cost: disclosing the bid prices only after the completion of all the other stages of the evaluation process could mean a longer and costlier process than entailed by single-stage CB. Indeed, what might make single-stage CB a shorter procedure is the fact that in certain instances, the bid evaluator can get an immediate impression of which bids are likely to win the competition already upon opening the bid envelopes. In such circumstances, the bid evaluator can ignore those bids that are unlikely to win and focus solely on evaluating those with a genuine chance of winning. In contrast, a two-stage process requires a qualitative review of all the bids that have been submitted, leading to a waste of precious time in evaluating bids that have no actual chance of winning.

While this argument can, at times, have merit, it does not detract from our proposal for two central reasons. First, in many cases this argument is simply untrue: recognizing from the outset bids lacking any chance of winning is neither a trivial nor common ability. In the regular course of things, all the competing bids must be examined in the framework of single-stage CB as well. Second, even if two-stage CB does, on occasion, take longer than single-stage CB, neither the additional time nor the additional cost will be significant relative to the considerable advantages deriving from the two-stage procedure.

However, it is important to note the limitations of two-stage CB. While it is an effective means for inhibiting the lower-bid bias, it is not effective in neutralizing *any* form of potential bias that can impact the way bid evaluators exercise their discretion. Thus, for example, a bid evaluator might prefer a bidder with a stronger reputation in a particular field than its competing bidders, by disregarding or under-valuating other relevant attributes of the competing bids. Two-stage CB will not prevent this bias. However, the lower-bid bias, which, as we have demonstrated, is neutralized by the two-stage procedure, is of key importance in the decision-making process. Thus, the apparent success of two-stage CB in this context serves, we hold, as sufficient justification for its adoption as the general rule in competitive public procurement that includes evaluation criteria other than price.

6 Further applications: debiasing by splitting the decision-making process

From a broader perspective, the bidding process scenario that emerges from the results of our experiments is characterized by three core features: (1) the existence of a complex decision entailing the consideration and evaluation of several factors or attributes; (2) the existence of information that, on the one hand, is necessary to reach the right decision, but, on the other, might lead to bias when evaluated jointly with the other data; (3) concealing the biasing information from the decision maker until a later stage of the evaluation process is feasible and, apparently, does not, in itself, generate any other distortions or biases.

It emerges from our experiments' results that in such situations, a single-stage decision-making process might generate a systematic bias, whereas splitting the decision-making process into stages can prevent such a bias. Accordingly, this justifies the adoption of an obligatory multi-stage decision-making rule.

These three noted features are not, of course, unique to public procurement and can be found also in other legal and decision-making contexts. This could suggest the implementation of our insights in situations that share similar characteristics. Below, we discuss this potential briefly in reference to two well-known examples, the one from constitutional law and the other from the sphere of grant applications.

One possible context in which our findings could be implemented is employment discrimination. The existence of discrimination in the labor market based on race, gender, age, religion, and so on has been well and extensively documented and studied (see, for example, Newman, 1978; Bertrand and Mullainathan, 2004). In many contexts, complete eradication of employment discrimination is virtually impossible due to the limited effectiveness of restricting rules (Wistrich et al., 2005) and the impracticability of concealing the distortional information from the decision maker. Thus, it is usually impossible to hide the fact that a job applicant is African-American or a woman.

Yet, there are situations in which the biasing information can be concealed without impeding the decision-making process and revealed at a later stage of the decision-making process if relevant for the final decision. This could be the case with information regarding disabilities that are not outwardly apparent (like epilepsy, diabetes, a slight hearing impairment, or a history of mental illness) or information regarding personal status (such as marital status, parenthood, or sexual orientation). And indeed, section 102(d)(2)(A) of the Americans

with Disabilities Act of 1990 (ADA) (42 U.S.C. 12112) states that, with few exceptions, an “*entity shall not conduct a medical examination or make inquiries of a job applicant as to whether such applicant is an individual with a disability or as to the nature or severity of such disability.*” In addition, the Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act, as amended, 2009 (29 C.F.R. 1630) establish a two-stage process concerning employment decisions that are protected under law. In the first stage of the recruiting process, the employer is prohibited from requesting any details concerning an applicant’s medical condition or from asking the applicant to fill out any kind of medical history questionnaire. At the end of this stage, the employer must decide whether to extend a conditional offer to the applicant, which will then trigger the second stage of the process. At that point, the employer is permitted to inquire about the applicant’s medical history, so long as this is requested of all applicants (29 C.F.R. 1630.14 (b); see also 34 C.F.R. 104.14 (a); 45 C.F.R. 84.14 (a)). The aim of concealing an applicant’s medical information from the decision maker until a later stage of the recruiting process is clearly to eliminate conscious or unconscious discrimination of applicants with disabilities (Feldblum, 1991:531–533). Yet, since occasionally that information can be relevant to job functioning, it can be requested at the second stage of the applicant’s evaluation. The insights from our study, regarding the potential bias inherent to joint evaluation and the debiasing effect of shifting to two-stage evaluation, clearly support this rule mandating the splitting of the recruitment process into two segregated, sequential stages.

The second example in which our insights could have relevance is decisions regarding grant applications. Various considerations come into play in grant decisions, in order to ensure that the predetermined budget is optimally allocated. However, there is significant concern that application assessors could be biased by irrelevant attributes (such as an applicant’s gender, academic status, age, or nationality) (Bornmann and Daniel, 2006; Bornmann et al., 2007; Marsh et al., 2008). Moreover, there is a risk that even relevant information, such as the amount requested or the applicant’s reputation, could distort the application’s evaluation if it overshadows relevant factors that are more vague or harder to evaluate, such as research innovativeness or importance.

Our study findings tentatively suggest that in such situations, a multi-stage evaluation process, consisting of at least three consecutive stages, should be weighed. In the first stage, the assessor would evaluate the application’s quality with knowledge of only the details of the proposed research and without any information regarding the applicant or the requested funding. The amount being requested would be revealed only at the second stage of the evaluation process, at which point the application would be reevaluated. The applicant’s

details should be revealed only at the final stage, when the application is given a final ranking. As implied by our findings, such a method could contribute to preventing undesired biases and increasing the reliability of the evaluation process for grant applications (for another proposal, see Jayasinghe et al., 2006).

These two decision-making contexts manifest the core attributes of competitive procurement described above. They both entail complex decision making; in each, a supposedly relevant piece of information has the potential to create a bias when evaluated jointly with the other data; and finally, splitting the decision-making process seems a feasible option in both cases. This brings us to a fourth similarity: the bias could be prevented by postponing the disclosure of the potentially distorting information to a later stage of the decision-making process. Accordingly, we propose that cases of this type warrant consideration of a mandatory splitting of the decision-making process.

7 Summary and conclusions

This article has sought to demonstrate that a bid evaluator's awareness of the bid price when evaluating the qualitative components of competing bids biases the bid evaluation process by producing an unfair advantage for the lower bidder. We explained that this bias is undesirable because it amounts to a retroactive change of the weight accorded to the CB evaluation criteria, in opposition to the intention of the CB designer; it violates the law and the CB rules; and it creates unwanted incentives for the bidders. We showed that the lower-bid bias can be neutralized by splitting the decision-making process into two stages. On this background, we proposed the adoption of a mandatory rule requiring a two-stage evaluation procedure for any competitive public procurement that is not based solely on the price criterion. We also suggested that in any decision-making situation, where there is a high probability that exposure to certain information from the outset could bias the decision maker's judgment, a multi-stage decision process should be weighed.

Several questions on these matters remain to be considered and explored. For example, can the lower-bid bias be neutralized by attaching quantitative formulas to the qualitative criteria? Are experts in the specific field of acquisition less vulnerable to the lower-bid bias than public officials who are not as knowledgeable in that field? Is the lower-bid bias also present in considering the rejection or acceptance of problematic or faulty bids? Well beyond the scope of the present article, these questions merit their own comprehensive investigation and will hopefully serve as the starting point for future research.

Appendices

Appendix A: Experiment 2a form

The municipality of Ramat-Gan conducted a Request for Proposals (RFP) for the transportation of the city's schoolchildren during the 2011–2012 school year. A weight of 60% was given to the bid price and 40% was given to quality criteria. Two bids were submitted.

[**1st version:** The bid prices were submitted in separate sealed envelopes, to be opened after examination of the other parts of the bids (two-stage sealed bidding).]

[**2nd version:** “The Carrier Ltd.” submitted the lowest bid, at \$800,000, and received the full 600 points (out of 1,000) for the price criterion. The other bid, submitted by “The Transporter Ltd.,” for \$875,000, scored only 550 points for the price criterion.]

As a member of the contracting committee, you are asked to score the bids with respect to the other criteria:

Criterion ⁹	Max.	“The Carrier”	Points	“The Transporter”	Points
[2nd version only: Price]	600	\$800,000	600	\$875,000	550
Years of operation	60	8 years		12 years	
Bus model	30	Mercedes “VIP” 2011		Mercedes “Dolphin” 2010	
Recommendations	70	2 good, 1 moderate		5 good	
No. of buses owned by the bidder	60	12 buses		20 buses	
Average experience of the drivers	70	12 years		20 years	
Training hours per driver	30	35 hours		20 hours	
ISO certification	50	Not certified, but in the final stages of the certification process		Has certification	
Distance from R.G.	30	Bnei-Brak (5 km)		Ra'anana (15 km)	
Total	1,000				

⁹ The order of presentation of the evaluation criteria was randomly altered between the two rounds of the experiment, in order to prevent participants from remembering their responses in the first round of the experiment.

Table 4: Experiment 2a results: the mean scores for the bids' components at each stage

Criterion	Max. points	"The Carrier"		"The Trans."		Average points "The Trans."	
		Average points "The Carrier"		Average points "The Trans."		Average points "The Trans."	
		2-stage CB	1-stage CB	2-stage CB	1-stage CB	2-stage CB	1-stage CB
2nd version only: Price	600	\$800,000	-	600	\$875,000	-	550
Years of operation	60	8 years	43.33 (12.31)	49.72 (8.53)	12 years	55.41 (9.81)	58.47 (4.28)
Bus model	30	Mercedes "VIP" 2011	28.56 (4.07)	29.31 (2.44)	Mercedes "Dolphin" 2010	24.39 (5.12)	25.72 (4.31)
Recommendations	70	2 good, 1 moderate	37.64 (12.15)	44.58 (11.29)	5 good	67.03 (6.00)	66.81 (7.85)
No. of buses owned by the bidder	60	12 buses	36.56 (10.90)	39.28 (9.24)	20 buses	54.25 (8.00)	56.25 (9.88)
Average experience of the drivers	70	12 years	49.58 (12.56)	56.94 (12.21)	20 years	67.03 (6.12)	68.19 (5.09)
Training hours per driver	30	35 hours	28.50 (3.28)	28.42 (3.29)	20 hours	20.42 (5.53)	21.81 (3.72)
ISO certification	50	Not certified, but in the final stages of the certification process	21.94 (18.02)	20.69 (19.71)	Has certification	49.72 (1.67)	46.66 (10.95)
Distance from R.G.	30	Bnei-Brak (5 km)	27.50 (3.68)	28.75 (3.85)	Ra'anana (15 km)	19.61 (6.48)	23.17 (7.76)
Total (quality)	400		273.61 (43.00)	297.42 (36.08)		357.86 (30.04)	367.08 (22.32)
Total	1,000		873.61	897.42		907.86	917.08

Appendix B: Experiment 2b form

The preface is exactly the same as in Appendix A.

Criterion	Max. points	“The Carrier”	Points	“The Trans.”	Points
[2nd version only: Price]	600	\$800,000	600	\$875,000	550
Years of operation	75	8 years		12 years	
Recommendations	80	2 good, 1 moderate		5 good	
No. of buses owned by the bidder	70	12 buses		20 buses	
Average experience of the drivers	75	12 years		20 years	
Distance from R.G.	100	Bnei-Brak (5 km)		Ra’anana (15 km)	
Total	1,000				

Table 5: Experiment 2b results: the mean scores for the bids’ components at each stage

Criterion ¹⁰	Max. points	“The Carrier”	Average points “The Carrier”		“The Trans.”	Average points “The Trans.”	
			2-stage CB	1-stage CB		2-stage CB	1-stage CB
			2nd version only: Price	600		\$800,000	–
Recommendations	80	2 good, 1 moderate	42.96 (8.83)	47.65 (11.86)	5 good	78.79 (3.18)	78.97 (5.57)
No. of buses owned by the bidder	70	12 buses	44.41 (11.63)	47.71 (10.33)	20 buses	66.88 (8.06)	69.13 (2.70)
Average experience of the drivers	75	12 years	49.95 (13.78)	53.73 (14.59)	21 years	72.59 (5.77)	72.97 (5.09)
Distance from R.G.	100	Bnei-Brak (5 km)	91.72 (12.48)	90.86 (22.83)	Ra’anana (15 km)	79.31 (16.73)	76.38 (21.99)
Years of operation	75	8 years	56.59 (9.68)	55.57 (9.68)	12 years	73.34 (3.30)	73.93 (2.45)
Total (quality)	400		283.57 (34.41)	295.52 (47.62)		370.93 (21.99)	371.38 (25.26)
Total	1,000		883.57	895.52		920.93	921.38

¹⁰ The order of presentation of the evaluation criteria was randomly altered between the two rounds of the experiment, in order to prevent participants from remembering the answers they gave in the first round.

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