Employees' Perceived Values of Their Stock Option Holdings: How Training Affects the Cost-Value Gap

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ABSTRACT

Analyzing unique data from an equity compensation service provider, we examine how employee stock option recipients perceive the value of their own option holdings and explore an educational training program as a mechanism for changing employees' perceived values of their options. Results show most employees perceive their options as less valuable than the corresponding Black-Scholes cost. Importantly, we find that a training program which clearly articulates the economic fair value of employees' options increases both their perceived values and their confidence in related decision-making. We complement the proprietary data with an experiment that manipulates components of the educational training program. We find the same before- and after-training patterns of perceived values with our experiment participants as we find for the employee recipients, and analyze the effects of the manipulations to provide additional evidence on how training changes perceptions of option value.

Keywords: *Employee stock options (ESO), perceived value, Black-Scholes, training.*

Data availability: *Proprietary data are obtained under a confidentiality agreement with Net Worth Strategies, Inc., as indicated in the text. Contact the authors for experiment data.*

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1. Introduction

Over the past twenty years, employee stock options have become a widely-used mechanism for compensating employees, expanding beyond the CEO level to the rank-and-file (Hall and Liebman 1998; Hall and Murphy 2002; Murphy 1999). Firms use stock options because they are believed to provide a means of attracting, retaining, and motivating employees (Core and Guay 2002; Elson 2003). Yet, some practitioners are questioning the incentive benefits of stock options because of employees' potential inability to appropriately value their options (Enright and Reilly 2002; Reilly et al. 2003; Schneider 2003; Watson Wyatt Worldwide 2003). In this paper, we provide evidence on how employee stock option recipients perceive the value of their current stock option holdings and on how those perceived values are affected by the completion of a stock option education program.

Prior academic research distinguishes between the opportunity cost to firms of issuing stock options and employees' perceptions of the value of those options. Specifically, while firms incur an opportunity cost equal to the market value of an unrestricted stock option (estimable with, e.g., Black-Scholes), an undiversified and risk-averse employee is expected to perceive stock option compensation at a much lower value because of the additional trading and hedging restrictions imposed (Hall and Murphy 2002; Mollen et al. 2003). Indeed, Hall and Murphy (2002) use analytic modeling with numeric examples to show that undiversified and risk-averse employees should place lower values on stock options as compared to the firm's Black-Scholes opportunity cost; that is, that there is a "cost-value gap".

We contribute to this line of research by empirically examining the difference between firms' Black-Scholes opportunity costs and employees' perceived values for their own stock options using unique data from the proprietary records of a national provider of equity compensation planning services, Net Worth Strategies, Inc. Extant research provides only limited insight into the difference between the cost and perceived value of stock options and finds mixed results. For example, while a recent study conducted by Watson Wyatt Worldwide (2004) finds that employees do indeed discount option values

relative to Black-Scholes, others find that employees overvalue options (Larcker and Lambert 2001). The two most recent of these studies also find that mean perceived values are higher than the corresponding Black-Scholes costs in all (Hodge et al. 2006) or many (Devers et al. 2007) of their settings. However, in all of these studies, individuals evaluate partially or fully hypothetical settings. In contrast, the proprietary data we analyze consists of *actual* employees' perceptions of their *own* current stock options, which allows us to provide a better estimate of the underlying distribution of perceived values (Libby et al. 2002, 778).

We also contribute by empirically examining the extent to which a stock option education program affects the cost-value gap. A recent survey (PriceWaterhouseCoopers 2005) finds that employee communications regarding equity plans is one of the most challenging aspects of offering equity compensation (after compliance and administration). This difficulty of educating employees about stock options is echoed in field interviews conducted by Hodge et al. (2006, 34), which indicate a general reluctance to provide employees with personal finance assistance (in part because of concerns over the potential liability associated with discussing possible future stock prices). With the proprietary data, we are able to examine the effects of employees completing a stock option education program that explains how stock options operate and clearly articulates the Black-Scholes values of the employees' current options. Specifically, the proprietary data include a subsample of employees who provided their perceived values for their stock options both *before* and *after* completing the stock option education program. This allows us to directly evaluate the impact of an intervention that companies could implement to change employees' perceived values of their options. Further, we complement the proprietary data by conducting a follow-up experiment that replicates components of the education program to isolate the impact of those components on perceived values and to provide additional insights into the heuristics individuals may use to arrive at those values.

Our results provide convincing evidence of a cost-value gap before training. In the proprietary data, 76% of employee recipients' perceived values are lower than the corresponding Black-Scholes cost.

Likewise, 65% of the graduate business student participants in our experiment perceive the value of hypothetical employee stock options to be lower than the corresponding Black-Scholes cost.

We also find that completing the stock option education program leads to a significant reduction in the cost-value gap. In the proprietary data, we find a statistically significant increase in employee recipients' perceived values, with the majority (84%) of the employees who perceived a lower value than the Black-Scholes cost before training increasing their perceived values after training. We no longer find any significant evidence of a cost-value gap after completion of the stock option education program, and find some evidence that employee recipients may value their options at a premium over the Black-Scholes cost. Consistent with results from the proprietary data, analyses of our experiment also indicate a significant reduction in the cost-value gap after training.

By isolating components of the education program in our experimental manipulations, we provide additional insights into these findings. First, the effect of receiving a qualitative description of the Black-Scholes model during training is asymmetric. Experiment participants whose before-training perceived values were lower than (higher than) the corresponding Black-Scholes cost significantly increased (did not significantly change) their perceived values after receiving the qualitative description. Second, however, the effect of receiving computed option value estimates is symmetric. Experiment participants whose before-training perceived values were lower than (higher than) the corresponding Black-Scholes cost significantly increased (decreased) their perceived values after receiving the computed value estimates, leading to a significant decrease in the amount by which participants' perceived values differ from the Black-Scholes cost. Third, we find that training generally shifts individuals away from using simple valuation heuristics (e.g., intrinsic value) toward attempting to apply more sophisticated valuation techniques (e.g., Black-Scholes).

These results have notable implications for current compensation practices. Until recently, part of the appeal of stock options resulted from their favorable accounting treatment as compared to, for example, cash or restricted stock. However, the Financial Accounting Standards Board's Statement 123(R) now mandates that firms record an income statement expense for employee stock option

compensation. This change has led numerous firms to consider reevaluating the use of options in pay packages (e.g., Deloitte 2005; Wilson and Altmansberger 2003).[1] At the same time, compensation and human resource consultants are recognizing the importance of understanding the gap between the opportunity cost and employees' perceived value of stock options (see, e.g., Enright and Reilly 2002; Mercer Human Resource Consulting 2006a; Watson Wyatt Worldwide 2003), and of communicating the potential value of employees' pay packages (Mercer Human Resource Consulting 2006a). Our research informs this practical cost-benefit assessment of the use of stock options by evaluating communications (e.g., education and training programs) aimed at reducing the cost-value gap.

The remainder of this paper is organized as follows. The next section develops our hypotheses. Section 3 describes the proprietary data, the stock option education program, and our follow-up experiment. Section 4 presents the analyses and results. Section 5 concludes.

2. Background and Hypothesis Development

Employee stock options (ESOs) have become widely used by firms as a mechanism to attract, retain, and motivate employees (Core and Guay 2002; Elson 2003). The ability of ESOs to achieve these objectives, however, requires firms to restrict the trading (i.e., with vesting provisions) and hedging activities of employees who receive ESOs. These restrictions likely result in a divergence between the opportunity cost to the firm of issuing ESOs and the value placed on ESOs by undiversified and risk-

[1] There is mixed evidence of the impact of Statement 123(R) on stock option compensation (Knowledge@Wharton 2003, 2006). For example, after Microsoft announced its stock option program conversion, Intel issued a statement defending the use of options (Guth and Lublin 2003; Knowledge@Wharton 2003). Some preliminary evidence indicates that Statement 123(R) has not had a dampening effect on the number or value of stock options issued by the average publicly-traded company (Hulbert 2006), while other evidence suggests that option grants have decreased but stabilized over the last two years, at least at the CEO level (Mercer Human Resource Consulting 2006b, 2). Even if firms have reduced option grants, the majority of firms sampled in recent research still grant options, either alone or in combination with other forms of long-term incentive compensation such as restricted stock or performance shares (Brown and Lee 2006; Carter et al. 2006, Table 4; Equilar 2006; Mercer Human Resource Consulting 2006b, 2).

averse employees; that is, these restrictions result in a cost-value gap.[2] As Hall and Murphy (2002, 5) note,

> The opportunity cost of an option to a company is the amount the company could receive if it were to sell a tradable and hedge-able option to an outside investor rather than giving it to the executive. This cost often significantly exceeds the value of the option from the perspective of a risk-averse, undiversified executive who can neither sell the option nor hedge against its risk. Executives receiving options will therefore value the options below their cost to shareholders, and this differential must be weighed against the incentive benefits in determining the optimal level of stock option compensation.

The opportunity cost of an ESO can be estimated using common valuation techniques such as Black-Scholes. Notwithstanding numerous academic critiques, the Black-Scholes valuation model remains "the best known and most widely utilized method for calculating the company's cost of granting an executive stock option" (Murphy 1999, 2511).[3]

The incentive benefit of an ESO, on the other hand, is a function of employees' perceptions regarding the value of the option and, hence, is less easily measured. We know little about how ESO recipients perceive the value of their current stock option holdings. The "black box" of perceived value likely contributes to the general lack of knowledge regarding the individual and firm performance effects of ESOs (Ittner et al. 2003). Failure to understand the value employees place on ESOs may also lead to inefficient use of ESO compensation (Hall 2003, 22). Indeed, ESOs should only be granted if the cost-value gap is sufficiently small (Murphy 1999). In the following subsections, we develop our hypotheses regarding the cost-value gap.

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[2] Consistent with this reasoning and the existence of a cost-value gap, employees commonly exercise their options well before the options would expire (see, e.g., Bettis et al. 2005; Huddart 1994; Huddart and Lang 1996), though at least partially because of affective reactions to stock price trends (Heath et al. 1999). However, not all researchers agree that early exercise necessarily implies a cost-value gap (e.g., Hallock and Olsen 2006).

[3] For example, Maris et al. (2003, 672) identified the option valuation model applied by the S&P 100 firms in their 1996 fiscal year, finding that only one firm (1.4%) reported using a binomial model while the remainder (98.6%) reported using the Black-Scholes model. Culpepper and Associates, Inc. (2006) found that 87% of companies surveyed use the Black-Scholes model for purposes of expensing options. Similarly, Hall and Murphy (2002, 6) note the continuing prevalence of the Black-Scholes model in academic research, commenting that "for example, every empirical paper in the recent Journal of Financial Economics special issue on stock options (a Symposium on Executive Stock Options, July 2000) uses Black-Scholes to value executive stock options." Similar assessments are offered by Hill and Stevens (2002, 45) and Levine and Luft (2003, 10).

2.1. EMPIRICAL ESTIMATION OF THE COST-VALUE GAP

With data availability representing a substantial research obstacle (Core and Guay 2002; Devers et al. 2007), extant empirical research that examines the value employees place on ESOs is understandably limited in scope and, unfortunately, presents mixed results. For example, a web-based survey of 400 respondents conducted by Watson Wyatt Worldwide (2004) suggests that employees *undervalue* ESOs by 30%-50% relative to the Black-Scholes cost, consistent with economic theory.

In contrast, a survey of 122 *Knowledge@Wharton* readers by Larcker and Lambert (2001) reports that employees significantly *overvalue* ESOs relative to the corresponding Black-Scholes cost. They conclude that this overvaluation is based, in part, on "unrealistic expectations as to what will happen to the stock price." Similarly, Hodge et al. (2006) and Devers et al. (2007) survey executive education and MBA students and find that they, too, may systematically overvalue ESOs relative to the Black-Scholes cost. Hodge et al. (2006) suggest that "optimistic" managers extrapolate recently rising stock prices to ESO values, and that ESO overvaluation reflects firm sorting practices aimed at identifying optimistic employees. In contrast, Devers et al. (2007) attribute their findings of overvaluation to loss aversion and an endowment effect.

However, in all of these prior studies, individuals are asked to evaluate partially or fully hypothetical settings. Hypothetical settings can be used to great effect in experiments to hold background information constant while focusing analyses on the directional effects of carefully manipulated variations (e.g., as in Hodge et al. 2006 and Devers et al. 2007). As Libby et al. (2002, 798) note, however, "it is usually difficult to ensure a representative sample of independent variable values, which limits the interpretability of levels of effects and parameter estimates in most experiments." In other words, because effect *levels* (e.g., the overall magnitude of the cost-value gap) are dependent on the many specific choices in the experiment's design and materials, effect levels are more reliably estimated using a broader and more representative sample of naturally occurring values (i.e., "real-world" data).

Although we are not aware of any other studies that directly examine how actual employees value their *own* current ESO holdings, Ikaheimo et al. (2004) analyze the market trading of vested ESOs on the

Helsinki Stock Exchange. Their multivariate analyses suggest an overall discount rate of approximately 25% relative to the corresponding Black-Scholes costs. Excluding country-specific differences, their results likely represent an upper limit to employees' perceived ESO values in that, to be included in their sample, the ESOs must have been both vested and transferable. This analysis, however, falls short as an examination of employee value perceptions for their own ESOs.

Because prior evidence is mixed, we return to the predictions consistent with economic theory. Stated formally:

H1: There is a cost-value gap such that employees will perceive values for their employee stock option holdings that are *lower* than the corresponding Black-Scholes cost of those options.

2.2. THE EFFECT OF EMPLOYEE STOCK OPTION TRAINING ON THE COST-VALUE GAP

We now turn to the steps a firm can take to affect the cost-value gap and potentially improve the incentive benefits of ESOs. As noted by Hall (2000, 123), "stock options are bafflingly complex financial instruments. They tend to be poorly understood by both those who grant them and those who receive them." Reflecting this complexity, employees likely find it difficult to assess the value of their ESOs (also see Hallock and Olson 2006, 7).

Prior research suggests that learning opportunities for the decision-maker affect both the store of knowledge and the effectiveness with which that knowledge is organized and retrieved, ultimately leading to improved judgment performance (Libby and Luft 1993). Accordingly, similar to Hill and Stevens' (2002) suggestion, we posit that firms can influence the cost-value gap by implementing training programs designed to increase employee knowledge of ESOs. That is, we predict that stock option education programs that explain how ESOs operate and that clearly articulate the value of the employees' options (e.g., by illustrative examples under particular growth patterns—Larcker and Lambert (2001)) will change employees' perceived values of their ESOs.

However, the effect of incorporating additional knowledge into judgments about ESO value could be positive or negative. Perceived values could increase if, for example, employees attempt to apply the Black-Scholes model instead of using a simple intrinsic value heuristic. Alternately, perceptions could

decrease if, for example, employees begin to adjust the Black-Scholes model for trading or hedging restrictions.

The proprietary data does not allow us to directly examine the cognitive processes by which employees value their ESOs. Therefore, we make no directional prediction; rather, we predict only that perceived values, and hence the cost-value gap, will change following employee training. Stated formally:

H2: Employees' perceived values of their employee stock option holdings will *change* following the completion of an ESO training program.

To supplement the proprietary data and improve our understanding of how employees arrive at their perceived values, we conduct an experiment that replicates selected components of the training program provided in practice. We use this data to corroborate, explain, and extend findings from the proprietary data.

3. Methodology

We begin this section by describing the proprietary data for actual employee stock option recipients, along with the variables we use in hypothesis tests and supplemental analyses. We then describe our complementary experiment design and related variables.

3.1. PROPRIETARY DATA FOR EMPLOYEE STOCK OPTION RECIPIENTS

3.1.1. Sample and Data Collection. Our sample is obtained from the confidential data files of Net Worth Strategies, Inc. (NWSI), a national provider of equity compensation planning services. NWSI provides employee stock option analysis software and educational services aimed at enabling companies and individuals to maximize the value of equity compensation.

During the period September 2004 through March 2006, NWSI conducted employee stock option education programs at five client sites, hereafter Companies A through E.[4] Although NWSI collects from the companies detailed information about each employee recipients' current ESO holdings (i.e., all

[4] NWSI introduced its training product in 2003 and, per discussions with NWSI, we have received data from all education program sessions during this time period with the exception of one client company that did not consent to NWSI's release of its employees' data.

options that remain unexpired and unexercised), we only have access to aggregated values of employee recipients' holdings due to confidentiality constraints. We have also been granted only limited descriptions of the client companies and the employee recipients. The client companies are all mid- or large-cap (i.e., market capitalization of at least $2 billion), and are all non-manufacturing (most commonly, financial services). In all cases, select employees are invited and encouraged to participate in the training by top executives in their companies; invited employees are from organizational units within the client companies and are compensated in the top 10% of all employees in their company.

Figure 1 provides an overview of the steps involved in NWSI's education program and the data obtained during each step. As a mandatory part of program registration, employee recipients are asked to provide selected financial information, including confirmation of the company-provided Black-Scholes inputs (i.e., current stock price, stock price volatility, dividend yield, and risk-free rate),[5] and to complete a six-question Stock Option Survey (Appendix A). In turn, employee recipients receive an individualized "Equity Compensation Profile Report" (hereafter, Profile Report), prepared by NWSI within two weeks prior to the scheduled training (see Appendix B for relevant excerpts from the Profile Report).

The education program consists of an interactive group seminar session, approximately 60-90 minutes in length, that explains fundamentals about stock option valuation, leverage, risk, taxation, planning strategies, and considerations for exercising options, referring to employee recipients' individualized Profile Reports as the session progresses. After completing the education program, employee recipients are asked to complete a second copy of the Stock Option Survey (Appendix A) and an anonymous after-training evaluation form.

3.1.2. Variables from Proprietary Data. Variables from the proprietary data are summarized in Table 1 and discussed further below. We measure the before-training perceived value of ESOs with

[5] NWSI collects inputs for computing Black-Scholes values from a client-company representative. These values are then listed as the "default" values when the employee recipients register, and it is possible (though unlikely) that recipients changed the values from those reported by the company. Per discussions with NWSI, if an employee overrode the default values, NWSI used the employee-provided values in computations. Therefore, NWSI computations are consistent with employee recipients' expectations for the Black-Scholes inputs.

$Forfeit_{BT}$, the employee-estimated value of stock options and restricted stock forfeited if the employee decided to leave his/her company immediately, collected as part of the Stock Option Survey during the registration process (Appendix A, Question 6).[6] We measure the cost of an employee's ESOs with $Forfeit_{BS}$, the computed Black-Scholes cost of stock options and restricted stock forfeited if the employee decided to leave the company immediately (that is, the total Black-Scholes cost less any intrinsic value for vested items, which would not be forfeited).

Consistent with Hall and Murphy (2002), we measure the divergence between the cost and perceived value of ESOs as the ratio of the perceived value to the Black-Scholes cost. Thus, our dependent measure for H1 is $Ratio_{BT}$, defined as $Forfeit_{BT}$ / $Forfeit_{BS}$. H1 predicts that an employee recipient's perceived value will be lower than the Black-Scholes cost (i.e., a discount); that is, $Ratio_{BT}$ will be less than one. In contrast, a $Ratio_{BT}$ greater than one would indicate that the perceived value is greater than the Black-Scholes cost (i.e., a premium).

We track employee recipients' revised valuations after training. $Forfeit_{AT}$, is each employee's response to the same perceived value question as $Forfeit_{BT}$ but is collected after training. We then also compute $Ratio_{AT}$, and the *Change in Ratio* from before to after training ($Ratio_{AT}$ - $Ratio_{BT}$). H2 predicts that the *Change in Ratio* will significantly differ from zero.

We supplement our analyses of *Ratio* with comparable analyses of the absolute deviation of an employee recipient's perceived values from the Black-Scholes cost. We compute $AbsDev_{BT}$ as the absolute value of the difference between $Forfeit_{BT}$ and $Forfeit_{BS}$, standardized by dividing by $Forfeit_{BS}$ (that is, |$Forfeit_{BT}$ - $Forfeit_{BS}$| / $Forfeit_{BS}$). We then also compute $AbsDev_{AT}$, and the *Change in AbsDev*

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[6] Although included in the elicitation question, restricted stock primarily affects only one client company. Thirty-seven of the 43 employee recipients (86.0%) from Firm E report restricted stock ownership. A minimal number of employee recipients from the other four client companies report restricted stock ownership (5 of 171, or 2.9%). Omitting employee recipients who report restricted stock ownership from the analyses leaves the inferences from our hypothesis tests unchanged, as does omitting all responses from Firm E. As an alternative measure that asks only about ESOs (i.e, excluding restricted stock), we also consider 'sensitivity to stock returns' or 'leverage' (e.g., Core and Guay 1999). Specifically, as part of the Stock Option Survey, employee recipients were asked to estimate the percentage increase in the value of their stock option holdings if the company stock price were to increase by 20% (Appendix A, Question 4). When we compare before and after training perceptions of leverage to the NWSI-computed leverage, the inferences from our hypothesis tests are unchanged.

from before to after training ($AbsDev_{AT}$ - $AbsDev_{BT}$). As employee recipients' perceptions of ESO value move closer to the Black-Scholes cost, the *Change in AbsDev* would be negative.

In supplemental analyses, we proxy for employee recipients' knowledge of ESOs using their experience with receiving ESO grants. We measure *Years*, the number of years since the employee's earliest dated ESO grant for which any options remain unexpired and unexercised.[7]

Finally, we examine other training effects with analyses of changes in self-assessed confidence, motivation, and loyalty, collected as part of the Stock Option Survey before and after training. *Confidence* is the employee recipient's level of agreement with the statement, "I am confident I can make timely and tax efficient decisions regarding my stock options and restricted stock" (Appendix A, Question 3). *Motivation* is the employee recipient's level of agreement with the statement, "My stock options and restricted stock encourage me to work harder to contribute to the financial performance of the company" (Appendix A, Question 1). *Loyalty* is the employee recipient's level of agreement with the statement, "My stock options and restricted stock encourage me to continue my employment with the company" (Appendix A, Question 2). Agreement is assessed on five-point scales, with 1 = *strongly disagree* to 5 = *strongly agree* after reverse scoring.

Table 1, Panel A lists the number of observations by client company for both the full sample and the matched subsample of employee recipients for whom we have both before- and after-training responses for our primary dependent variable, *Ratio*. Panel B includes descriptive statistics for *Ratio* and *AbsDev* for both the full sample and the subsample. Panel C includes descriptive statistics for other employee-level variables for both the full sample and the subsample, and Panel D includes the overall means and standard deviations for company-level inputs into the Black-Scholes model.

[7] NWSI confirmed that each of the participating firms typically grants options annually. However, *Years* may underestimate employee recipients' true experience because it is based on the oldest grant which is still active (i.e., it omits prior grants that expired or were fully exercised).

3.2. EXPERIMENT

3.2.1. Sample and Data Collection. Because the proprietary data offers limited insights into *how* training changes perceived values, we conduct an experiment that replicates components of NWSI's education program. Experiment participants are 192 Master's-level business students from two large state universities who had taken a mean of 4.3 accounting courses, 2.1 finance courses, and 2.6 economics courses prior to entering their graduate programs. Our use of graduate business students as proxies for employee stock option recipients is consistent with Hodge et al. (2006) and Devers et al. (2007). We administer the experiment before the students' coursework includes coverage of option pricing models in general and ESOs in particular so that participants' recent formal training is likely similar to that of employee recipients in the proprietary data.

We use a 2 x 3 (between-subjects) x 2 (within-subjects) experimental design. Between subjects, we manipulate whether or not experiment participants receive the detailed qualitative description of the Black-Scholes model included in the Profile Report (see Appendix B for the Profile Report and Appendix C, Panel A for the manipulation); we call these conditions *present* and *absent* in analyses. We also manipulate the explicit option values provided to participants at three levels (Appendix C, Panel B): no values (*none*), both the current intrinsic and Black-Scholes values (*current*), or the current values plus a table of both intrinsic and Black-Scholes values for several hypothetical stock prices (*current+table*). Within subjects (Appendix C, Panel C), we ask participants to consider a hypothetical ESO grant that would be forfeited if they left the company, and to provide their perceived values for this grant before (*before training*) and again after training (*after training*).

The experiment was administered using four envelopes of paper-and-pencil materials. Researchers were present to insure that participants sequentially proceeded through the envelopes, did not return to previously-completed parts of the task, and did not use electronic devices to compute option values using pricing models. As participants reported to the experiment site, they were randomly assigned to experimental conditions. Experiment participants received cash compensation of $15, and took approximately 45 minutes to complete the task.

Envelopes A and B contain the main body of the experiment. In Envelope A, participants read a brief definition of an ESO and were asked to assume the role of an ESO recipient. They were then given details of a hypothetical ESO grant and were asked to estimate the forfeit value of that grant (*before training*). In Envelope B, participants read through the training materials, which were manipulated between-subjects as described above. After reading the materials, participants were asked to again estimate the forfeit value of the same hypothetical grant (*after training*).

Envelopes C and D contain post-task questions. In Envelope C, participants complete two additional after-training valuations to gauge the carryover effects of training to subsequent perceptions of ESO value (Appendix C, Panel D). Participants were asked to estimate the forfeit value for the same hypothetical option grant previously valued but assuming two years have passed (*updated grant)*, and for a new hypothetical option grant (*new grant*). For these questions, no explicit option values are provided, regardless of experimental condition. In Envelope D, participants answered questions about their beliefs about likely future stock prices, self-assessed ratings of the factors that were important in their ESO valuations (Appendix 3, Panel E), beliefs about how employees *should* value ESOs (Appendix 3, Panel F), self-assessed knowledge, and other demographics.

3.2.2. Variables from Experiment Data. The measured variables from the experiment are defined to be consistent with those from the proprietary data. $Forfeit_{BT}$ and $Forfeit_{AT}$ are the participants' perceived values measured before and after training, respectively. We compute the Black-Scholes cost of the hypothetical ESO, $Forfeit_{BS}$, and we measure the divergence between the cost and perceived value of the hypothetical ESO before training with $Ratio_{BT}$, computed as $Forfeit_{BT}$ / $Forfeit_{BS}$. We then also compute $Ratio_{AT}$ and *Change in Ratio*. Similarly, we compute $AbsDev_{BT}$ as the absolute value of the difference between $Forfeit_{BT}$ and $Forfeit_{BS}$, divided by $Forfeit_{BS}$, and then compute $AbsDev_{AT}$ and *Change in AbsDev*.

In supplemental analyses, we examine the heuristics that experiment participants use in arriving at their perceived values. To do so, we identify four heuristics that would result in particular perceived values: zero value, intrinsic value, Black-Scholes value, and current stock price. We then classify each

participants' valuations into one of eight *Heuristic* categories, consisting of those four heuristics and four additional categories to capture intermediate values. We then also examine whether the applied valuation heuristics are associated with participants' self-assessments (obtained in post-task questions).

4. Results

We first test our hypotheses regarding employee recipients' ESO valuations from the proprietary data. Next, we replicate the hypothesis tests with the experiment data, analyze the effects of the experimental manipulations on perceived values, and conduct analyses of applied valuation heuristics. We then reconcile our results with prior empirical research.

4.1. PROPRIETARY DATA FOR EMPLOYEE STOCK OPTION RECIPIENTS

4.1.1. Empirical Estimation of the Cost-value Gap (H1). As seen in Figure 2, the distribution for $Ratio_{BT}$ is asymmetric—heavily skewed with heavy tails—with a zero minimum $Ratio_{BT}$ but an infinite maximum value. Therefore, we begin by describing and testing the distribution of $Ratio_{BT}$, then apply non-parametric tests to estimate the central tendency.

We find strong evidence that employee recipients apply a discount relative to Black-Scholes. Overall, 162 of the 214 recipients (75.7%) perceive that the value of their stock options and restricted stock forfeited upon leaving the company is *less than* the corresponding Black-Scholes cost (Table 2, Panel A). The median $Ratio_{BT}$ of 0.376 (i.e., a discount of 62.4% compared to the Black-Scholes cost) represents a statistically significantly discount ($p < 0.001$, one-sided signed rank test of the median < 1), as well as an economically significant one. While these results vary across client companies, the majority of employee recipients in each company discount their perceived values relative to the corresponding Black-Scholes cost (ranging from 53.8% to 100.0%), with a median $Ratio_{BT}$ of less than one in all companies (and significantly so in all but two).[8]

[8] NWSI believes that prior exposure to the Profile Report contributes to the lack of significant results for these two companies. In *post hoc* analyses, NWSI identified that approximately one quarter and one half of the employee recipients in Firms B and C, respectively, had previously been introduced to some or all of the concepts presented in training (e.g., time value component of the options). Thus, although none had completed a training session, the prior *(Cont'd)*

With only five companies in the data, there is insufficient variation in the Black-Scholes model inputs to effectively assess the extent to which the ESO discount varies with those inputs (e.g., dividend rate, risk free rate, expected volatility). Thus, we are unable to assess whether the observed discount reflects a misunderstanding of the influence of these Black-Scholes inputs on value. However, we can confirm that employee recipients' perceived values, $Forfeit_{BT}$, is positively correlated with the corresponding Black-Scholes cost, $Forfeit_{BS}$ (n = 214, Spearman rank r = +0.471, p < 0.001). This positive correlation suggests that recipients' perceived values are at least partially consistent with some of the Black-Scholes model inputs.[9, 10]

4.1.2. Stock Option Training (H2). Consistent with our predictions for H2, we find that employee recipients' perceived values are significantly affected by training. For the 126 recipients for whom we have after-training data, Figure 3 shows the distribution for *Ratio* before and after training.[11]

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exposure to these concepts may foreshadow the effects of training (in this case, reducing the extent of the discount). Excluding those employee recipients with prior exposure to some or all of the concepts presented in training leaves the inferences from our hypothesis tests unchanged. Further, while unable to specifically identify the affected employee recipients, NWSI is aware that a number of recipients from Firm B were informed that they would no longer be receiving stock options. Excluding all recipients from Firm B leaves the inferences from our hypothesis tests unchanged. NWSI confirmed that these issues are unique to Firms B and C.

[9] The forfeit value elicitation question does not specify whether an employee recipient's estimate of the amount he/she would forfeit upon leaving the company should be specified on a before- or after-tax basis. However, in untabulated analyses, we generally find positive relations between recipients' self-reported tax rates and $Forfeit_{BT}$ and between the tax rates and $Ratio_{BT}$. This suggests that the lower value that recipients' perceive relative to the corresponding Black-Scholes cost is unlikely to be caused by recipients' interpreting the question on an after-tax basis.

[10] As an exhibitor at the 13th Annual Conference for The National Association of Stock Plan Professionals, NWSI conducted a series of contests, two of which asked conference attendees to estimate the value of a hypothetical employee's option and restricted stock holdings for actual, known companies. Overall, 47 of 60 participating stock plan professionals (78.3%) perceive the value of the hypothetical employee's stock options and restricted stock forfeited upon leaving the company as *less than* the Black-Scholes cost (i.e., *Ratio* < 1). The median *Ratio* of 0.634 represents a statistically significantly discount (p < 0.001, one-sided signed rank test of the median < 1). These qualitatively similar results suggest that our findings are not likely to be driven by the particular group of employees who might be interested in participating in a stock option education program. Rather, these analyses suggest that even people who make their living understanding equity compensation display a cost-value gap.

[11] Of the 214 employee recipients for whom we have pre-training data, 162 (52) perceived value as less (more) than the Black-Scholes cost. Of those recipients, we have post-training data for 95 (31). To address potential self-selection biases, we note that the drop-out rate does not vary with whether the recipient perceived value as less (41.4%) or more (40.4%) than the corresponding Black-Scholes cost before training (p = 1.0000 under Fisher's Exact Test). We also compare $Ratio_{BT}$ from the 126 recipients who completed the after-training survey (median $Ratio_{BT}$ = 0.376) to that from the 88 recipients who did not (median $Ratio_{BT}$ = 0.390), and do not find any significant difference (χ^2_1 = 0.511, p = 0.475, two-sided Kruskal-Wallis test of a difference in medians).

The median *Ratio* after training is 1.000 (i.e., approximately equal to the Black-Scholes cost), compared to 0.376 prior to training. This increase is statistically significant (median *Change in Ratio* = +0.671, $p < 0.001$ for a signed-rank test; Table 2, Panel B), and is consistent with the before-training cost-value gap being caused (at least in part) by a lack of knowledge or understanding about ESOs, which is then addressed during training.

The median *Change in Ratio* varies significantly by company (Table 2, Panel B). Reported results are largely driven by the client companies in which employee recipients displayed significant discounts before training, with generally insignificant results for the other two companies (see footnote 8).

Consistent with our results for *Ratio*, we find that the absolute deviation of employee recipients' perceived values from the corresponding Black-Scholes cost (*AbsDev*) are significantly affected by training (Table 2, Panel C). The median *AbsDev* is lower (i.e., perceived values are closer to the Black-Scholes cost) for 83 of 126 employee recipients (65.9%) for whom we have after-training data. The decrease is statistically significant overall (median *Change in AbsDev* = -0.354, $p < 0.001$ for a signed-rank test) and for all but one client company.

4.1.3. Supplemental Analyses. Before training, correlations show that our proxy for employee recipients' knowledge of ESOs, *Years,* is positively associated with $Ratio_{BT}$ (n = 214, Spearman rank r = +0.241, $p < 0.001$). This finding is also consistent with the before-training cost-value gap being caused (at least in part) by a lack of knowledge of or experience with ESOs.

During training, employee recipients' individualized Profile Reports clearly display the Black-Scholes forfeit values of their ESOs. That explicitly-stated value likely acts as an anchor (e.g., Slovic and Lichtenstein 1971; Tversky and Kahneman 1974), shifting recipients' perceived values toward the Black-Scholes cost of their ESOs. However, anchoring and adjustment is unlikely to fully explain our results because the changes we observe are not symmetric. Of the 95 employee recipients who perceive values lower than the Black-Scholes cost before training, 80 (84.2%) increase their perceived values while only 7 (7.4%) decrease their perceived values after training (eight others, 8.4%, remain unchanged). In contrast, of the 31 recipients who perceive values higher than the Black-Scholes cost before training, 21

(67.7%) decrease their perceived values while the other 10 (32.3%) increase their perceived values after training. The tendency for employee recipients who discount ESOs before training to *increase* their perceived values after training is significantly stronger than the tendency for employees who place a premium on ESOs before training to *decrease* their perceived values after training ($p < 0.001$, Fisher's Exact Test).

We also investigate changes in self-assessed confidence, motivation, and loyalty, which anchoring and adjustment would be unlikely to cause. We find strong evidence that training improves employee recipients' confidence in their financial decision-making with respect to their option holdings, *Confidence* (Table 1, Panel C). Overall, 74 (16) of 118 recipients reported increased (decreased) *Confidence* (28 others remain unchanged), with a mean and median increase of +1.0 and +1.0 on the five-point scale (both $p < 0.001$). This increase in *Confidence* varies by client company, with employees in all but one company reporting a significant increase in confidence. We also find some evidence that training improves the employee recipients' self-reported *Motivation* and *Loyalty* (Table 1, Panel C). Despite a likely ceiling effect because the majority of employee recipients agree with the statements about motivation and loyalty before training, we find a significant increase in agreement after training (for *Motivation*, mean increase = +0.2, $p = 0.042$ and median increase = +0.0, $p = 0.078$; for *Loyalty*, mean increase = +0.2, $p = 0.038$ and median increase = +0.0, $p = 0.063$). The increase in *Motivation* does not vary significantly by client company; the increase in *Loyalty* does vary significantly by client company (with one company showing a mean decrease relative to the others' mean increases).[12]

[12] For completeness, we note that an anonymous post-training evaluation form asked employee recipients to rate the improvement in their understanding of stock ownership holdings, the value of the Profile Report, the value of the interactive session, the knowledge level of the instructor, and the effectiveness of the instructor's presentation. The mean ratings of those who returned the evaluation were all significantly above the midpoint of the response scale. Interestingly, although the mean rating of the need for assistance in developing a tax-efficient decision framework was lower than the other evaluation measures, it, too, was significantly above the midpoint of the response scale. Respondents also strongly indicated a desire for updated reports, with all but one respondent indicating a desire for at least annual updates. This suggests that employee recipients perceived a benefit from the training and a likely additional future benefit from continuing education about their options.

4.2. EXPERIMENT

4.2.1. Replication of Hypotheses. Consistent with the proprietary data, experiment participants' perceptions of ESO value are not normally distributed, so we again examine medians and apply non-parametric statistics. Figure 4 shows the distribution for *Ratio* before and after training for experiment participants, and we discuss the details of each test below.

Overall, we successfully replicate the results from the proprietary data in our experiment. With respect to H1, we find strong evidence that participants apply a discount relative to the Black-Scholes cost. Of 192 experiment participants, 124 (64.6%) exhibit a cost-value gap before training. The median $Ratio_{BT}$ of 0.557 for experiment participants represents a statistically significantly discount ($p < 0.003$, one-sided signed rank test of the median < 1).[13, 14]

With respect to H2, we find that experiment participants' perceptions of ESO value are significantly affected by training. The median $Ratio_{AT}$ for experiment participants is 1.000 (i.e., median perceived value is approximately equal to the Black-Scholes cost). The increase from the median $Ratio_{BT}$ of 0.557 (i.e., a discount of 44.3% compared to the Black-Scholes cost) is statistically significant (median *Change in Ratio* = +0.000, p = 0.088, one-sided signed-rank test). Consistent with these results for *Ratio*, we find that the absolute deviation of participants' perceived values from the corresponding Black-Scholes cost (*AbsDev*) is significantly affected by training. The median decrease of -0.053 appears

[13] Recall that participants' before-training perceived values are collected prior to any of our between-subject experimental manipulations. Therefore, we confirm that, as expected, the before-training proportion of participants perceiving a discount versus a premium does not significantly differ across between-subject conditions (Fisher's exact test, p = 0.488), nor does the median $Ratio_{BT}$ (Kruskal-Wallis test of medians, p = 0.240).

[14] Experiment participants include 78 MBAs from School A, 69 MBAs from School B, and 45 non-MBAs (e.g., masters of accounting or finance) from School B. Supplemental analyses (not tabulated) indicate no significant school (A vs. B) effects before training. However, there is a significant program (MBA vs. non-MBA) effect, with non-MBA students from both schools perceiving lower before-training values than MBA students (p=0.057 for the median $Ratio_{BT}$; p=0.033 for the proportion of participants who perceived a discount before training). This finding partially reconciles our overall discounting result to prior research that documents an average (but not necessarily median) premium among MBA experiment participants. Participants with a concentration in finance also tend to estimate lower values (not significant in the overall sample, but marginally significant within MBAs: p=0.138 for the median $Ratio_{BT}$, and p=0.087 for the proportion of participants who perceived a discount before training).

smaller than for the employee recipients in the proprietary data, but it remains statistically significant ($p < 0.001$, signed-rank test).

4.2.2. Effects of Experimental Manipulations on Changes in the Cost-Value Gap. We now turn to the effects of our experimental manipulations on the before-to-after training change in perceived value. Our dependent measure is the *Change in Ratio* as in H2; we analyze percentile ranks to minimize the influence of extreme observations.

We expect that receiving a qualitative description of the Black-Scholes model during training will increase *Ratio* for participants who discount ESOs before training but may decrease *Ratio* for participants who place a premium on ESOs before training. The model description delineates a credible method for valuing options and highlights potential sources of over- or undervaluation that participants may not have considered when arriving at their before-training perceived values. Following this reasoning, receiving the model description should decrease *AbsDev* for all participants.

We also expect that receiving explicit option values during training will increase *Ratio* for participants who discount ESOs before training but will decrease *Ratio* for participants who place a premium on ESOs before training. The Black-Scholes option values will likely act as an anchor. Following this reasoning, receiving the explicit option values should decrease *AbsDev* for all participants. However, there may also be a difference between merely receiving the current option values (*current*) and receiving a table of potential intrinsic and Black-Scholes values for a series of hypothetical stock prices (*current+table*). By introducing multiple stock prices, participants may be encouraged to think about the impact of future stock price increases, inducing optimism about future ESO values.

Table 3 provides descriptive information for the experiment data by before-training perceptions of value and experimental condition. The ranked values of *Change in Ratio* by before-training perceptions of value and experimental condition are illustrated in Figure 5.

Table 4 presents results of the planned contrasts, focusing on the *Change in Ratio* from before to after training (column labeled *after training*). Results indicate that the effect of receiving a qualitative description of the Black-Scholes model during training is asymmetric. As expected, the qualitative

description significantly increases *Ratio* and decreases *AbsDev* for participants who discount ESOs before training (for *Ratio*, contrast estimate = 8.2, $p < 0.05$; for *AbsDev*, contrast estimate = -10.4, $p < 0.05$). However, the qualitative description had no significant effect on perceptions of participants who place a premium on ESOs before training (for *Ratio*, contrast estimate = 6.6, $p > 0.10$; for *AbsDev*, contrast estimate = 7.9, $p > 0.10$). This asymmetry may help explain why employee recipients (in the proprietary data) who discount ESOs before training have a stronger tendency to *increase* their perceived values after training than those who place a premium on ESOs before training to *decrease* their perceived values.

Results also indicate that, as expected, receiving explicit option values significantly increases *Ratio* and decreases *AbsDev* for participants who discount ESOs before training (for *Ratio*, contrast estimate = 15.0, $p < 0.01$; for *AbsDev*, contrast estimate = -20.0, $p < 0.01$), while receiving explicit option values significantly decreases *Ratio* and decreases *AbsDev* for participants who place a premium on ESOs before training (for *Ratio*, contrast estimate = -14.5, $p < 0.05$; for *AbsDev*, contrast estimate = -14.4, $p < 0.05$). Finally, although the contrasts are in the expected direction, we do not find any significant incremental effect of receiving a table of values for hypothetical stock prices (*current+table*) beyond receiving only the current option values (*current*) (all $p > 0.10$). As a result, anchoring appears to play a more significant role in our experiment than it does in the proprietary data. This is perhaps not surprising, as we do not replicate many qualitative aspects of the training (e.g., interactive seminar, greater discussion of types of options, discussion of tax implications).[15]

4.2.3. Training Carryover Effects on Subsequent ESO Valuations. The remaining columns of Table 4 present results of planned contrasts for the changes in perceived values from before training to two subsequent ESO valuations. Recall that post-task questions asked participants to estimate the forfeit value for the same hypothetical option grant previously valued but assuming two years have passed

[15] Unlike results from the proprietary data, we find no significant changes in participants' reported confidence from before to after training, either overall or by experimental condition. This may suggest that aspects of the NWSI education program that are not captured in our experiment (e.g., interactive seminar, greater discussion of types of options, discussion of tax implications) contribute to some of the proprietary data confidence changes. Alternately, this may suggest that our confidence measure (confidence in value estimate) captures another construct than does NWSI's measure (confidence in ability to make timely and tax efficient decisions about ESOs).

(*updated grant)*, and for a new hypothetical option grant (*new grant*); for these ESOs, no explicit option values were provided, regardless of experimental condition.

Overall, we find that experiment participants partially revert to their before-training perceived values relative to the Black-Scholes cost. The median *Ratio* for their subsequent valuations of the *updated* and *new grants* are 0.779 and 0.871 (signed-rank one-sided p=0.001 and 0.048; not tabulated), respectively. However, both are larger than the *Ratio* of 0.557 observed before training, and we find significant increases in *Ratio* from before training to the subsequent valuations, with a median *Change in Ratio* of +0.151 and +0.080 (both p = 0.001, one-sided signed-rank test) for the *updated* and *new grant*, respectively. Results in Table 4 suggest that, while some of the training effects on *Ratio* may carryover, these effects persist somewhat inconsistently across the two subsequent valuations. In contrast, the carryover effects for *AbsDev* are stronger, but only for participants who initially viewed ESOs at a discount before training; for participants who place a premium on ESOs before training, we observe no significant carryover effects for *AbsDev*.

In general, these results indicate that training effects can have some carryover to subsequent perceptions of ESO value. However, carryover effects are not strong, despite the fact that experiment participants are asked to value relatively simple hypothetical grants almost immediately after training. This suggests that in practice, firms could benefit by frequent repetition of training and/or communications about options (see footnote 12). These findings also weakly suggest that firms could more easily influence the perceived values of employees who would otherwise discount ESOs than the perceived values for those who would otherwise place a premium on ESOs.

4.2.4. Valuation Heuristics. We provide exploratory analyses about the valuation heuristics used by experiment participants before and after training. We focus on the four *Heuristics* categories that capture particular perceived values: zero value, intrinsic value, Black-Scholes value, and current stock price.

In the first columns of Table 5, Panel A, we report the before-training use of heuristics. We confirm that, as expected, the heuristics participants use in their before-training perceived values do not

differ across between-subject experimental conditions (χ^2, p = 0.828). Before training, 122 of 192 participants (63.6%) fall into one of the four intuitive categories described above, with the modal classification being intrinsic value (28.6%). The majority of participants (110 of 192, or 57.3%) use a heuristic that results in a value perception of less than an approximate Black-Scholes value, consistent with H1.

The remaining columns of Table 5, Panel A corroborate results for H2 by reporting changes in the use of heuristics from before to after training. We confirm that the after-training application of heuristics varies by experimental condition (χ^2, p = 0.025). After training, the proportion of participants falling into one of the four intuitive categories remains similar (113 of 192, or 58.8%), but the modal classification is now an approximate Black-Scholes value (40.1%).

The shaded diagonal in Table 5, Panel A, indicates a tendency for participants to retain the same heuristic classification after training (with only 113 of 192 participants, or 58.9%, changing classifications). However, when change occurs, it tends to be to an approximate Black-Scholes value (with 56 participants doing so, or 49.6% of changes). Of those who apply an approximate Black-Scholes value heuristic before training, 34.4% change heuristics after training, with no relation to experimental condition (p=0.918, Fisher's Exact Test). However, for participants who initially apply another valuation heuristic, 63.8% change heuristics after training, with a significant relation to experimental condition (p=0.066, Fisher's Exact Test). Table 5, Panel B reports the frequency and percentage of participants in each heuristic classification for each ESO valuation question (before, after, and subsequent to training), and we see a similar pattern.

Table 6 provides corroborating evidence of the heuristics applied by participants. In additional post-task questions, participants allocated 100 points among potential valuation components (e.g., current stock price, volatility, etc.) based on how much those components influenced their valuation perceptions (Appendix C, Panel E). Panel A shows that participants who use the zero-value heuristic appear to do so because the ESOs are not vested (i.e., the highest mean points are allocated to vesting date). Participants

who use the intrinsic-value heuristic pay the most attention to both the current stock price and the exercise price, whereas participants who apply an approximate Black-Scholes value allocate attention more broadly. Finally, participants who use the stock price heuristic pay the most attention to the current stock price. These patterns are repeated in participants' rated agreement with potential valuation decision rules (Table 6, Panel B; see Appendix C, Panel F for post-task questions).

Finally, Table 6, Panel C, presents participants' mean rated task efforts and investment knowledge. Participants who use the stock price heuristic tend to report being less familiar with the task; less knowledgeable about option pricing models, options in general, and investments in general; and less confident in their perceived values. However, while participants who use the zero-value heuristic understandably report finding the task less difficult, they also report being *more* familiar with the valuation task; *more* knowledgeable about option pricing models, options in general, and investments in general; and, *more* confident in their perceived values than other participants.

4.3. RECONCILIATION TO PRIOR EMPIRICAL EVIDENCE

The median $Ratio_{BT}$ of 0.376 for employee recipients and 0.557 for experiment participants denote discounts relative to the Black-Scholes cost of 62.4% and 44.3%, respectively. These $Ratio_{BT}$ values are consistent with Hall and Murphy's (2002, Table 1) numeric examples, which range from 0.02 to 0.72 (with the majority of the examples contained between 0.30 and 0.70). They are also consistent with Meulbroek's (2001, 6) *Ratio* estimates using the Sharpe ratio to adjust for undiversified risk (i.e., 0.53 for undiversified managers of Internet firms and 0.70 for undiversified managers of a NYSE firms). The median $Ratio_{BT}$ values we document are also below the upper bound of 0.75 for *Ratio* (i.e., minimum 25% discount) suggested by Ikaheimo et al.'s (2004) analysis of vested ESOs trading on the Helsinki Stock Exchange.

In contrast, the prior experimental research of Hodge et al. (2006) and Devers et al. (2007) often find perceived ESO values to be higher than the Black-Scholes cost. We argue that our findings likely differ for three reasons.

First, participants in Hodge et al. (2006) were MBA students and participants in a business-school continuing education class; participants in Devers et al. (2007) were MBA students. These participants likely had recent exposure to formal education on options in general and/or ESOs in particular. In contrast, it is unlikely that the employee recipients in the proprietary data have had such recent formal training, and many may not have had any formal financial training. To reduce the likelihood that our experiment participants' recent training would exceed that of employee recipients in the proprietary data, we administered our experiment before our participants' coursework included detailed coverage of options in general and ESOs in particular.

Second, Hodge et al. (2006) provide their participants with definitions of options, restricted stock, and inputs into the Black-Scholes model (including a graphical depiction of stock price volatility); Devers et al. (2007, 8) indicate that their participants "were first provided with a primer on how stock options operate." Thus, individuals in these two studies were likely already in a variation of an "after training" setting when they provided their perceptions of ESO value. In contrast, neither the employee recipients nor experiment participants in our study received extensive explanations of options before they provided their initial perceived values (see further discussion in footnote 8).

Third, Hodge et al. (2006) attribute their findings of a premium to participants' optimism regarding future stock price performance. We believe that their design choice to provide their participants with a Black-Scholes benchmark in their experimental materials mimics, in their artificial setting, the real-world effects of providing employees with the intrinsic and Black-Scholes values for their own ESOs during the employee stock option education program. Thus, Hodge et al.'s (2006) observed valuation premium imply that their participants consciously decided to demand more than that benchmark for their hypothetical ESOs. If ESO recipients believe a premium is appropriate (e.g., because of optimism) but initially underestimate ESO values because they do not have easy access to a valuation benchmark, then their net perceived values may still be lower than the corresponding Black-Scholes cost, as in our before-training data. Perhaps training and the availability of a salient benchmark reduces the noise in perceived values to allow the optimism premium to then be observed.

We present evidence on this issue by analyzing *Ratio* as a function of experiment participants' optimism. We measure optimism with experiment participants' expectations for the hypothetical company's stock price in five years (a post-task question, with higher values indicating greater participant optimism). We find no significant rank correlation between optimism and participants' before-training perceived values ($p = 0.272$) or the change in their perceptions after training ($p = 0.250$). However, we find a significant positive rank correlation after training ($p = 0.008$), which also carries over to the subsequent option valuations ($p = 0.014$ and 0.002 for the *updated* and *new grant*, respectively). This is consistent with training helping to reduce the noise in participants' perceived values such that the impact of optimism can then be observed.[16, 17]

5. Conclusion and Directions for Future Research

Using unique data from the proprietary records of a national provider of equity compensation planning services, we examine the difference between the Black-Scholes opportunity cost and employees' perceived values of their own stock option holdings. In contrast to prior studies (e.g., Devers et al. 2007; Hodge et al. 2006; Larcker and Lambert 2001; Watson Wyatt Worldwide 2004) in which individuals evaluate partially or fully hypothetical settings, our data consist of actual employees' perceptions of their own current ESOs, which allows us to provide a more reliable assessment of the values employees place on their ESOs. We supplement this investigation with an experiment in which we replicate results from the proprietary data and manipulate components of the stock option education program provided in practice.

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[16] We confirm that our experimental manipulations do not themselves induce optimism by verifying that participants' expectations for the future stock price are not predicted by experimental condition (*omnibus* $F_{5, 186} = 0.68$, $p = 0.641$). Inferences from the planned training-effect contrasts are unchanged when we control for participants' expectations for the future stock price.

[17] After-training, employee recipients in the proprietary data show some tendency to apply a valuation premium relative to the Black-Scholes cost. Specifically, after training, both the median $Ratio_{AT}$ of 1.000 and mean $Ratio_{AT}$ of 1.481 are significantly greater than one ($p = 0.014$ for a two-sided signed rank test of the median and $p= 0.002$ for two-sided Student t test of the mean). This finding is not driven by outlying observations, with a significant mean premium when the data are winsorized at the extreme 1% and 5% of observations (both $p < 0.01$ two-sided). However, our experiment participants do not appear to replicate this tendency, with the median *Ratio* significantly less than one both after training and for subsequent valuations (all $p < 0.10$ two-sided) and the mean *Ratio* generally insignificantly different even when winsorized at the extreme 1% or 5% of observations.

We find a significant difference between employee recipients' perceived values of their ESOs and the corresponding Black-Scholes costs, with 76% of recipients' perceived values *lower than* the corresponding Black-Scholes costs. Consistent with this finding, 65% of graduate business student participants in our experiment perceive the value of a hypothetical ESO to be lower than its corresponding Black-Scholes cost.

Perhaps of greatest practical significance, we examine the effects of completing a stock option education program that explains how stock options operate and clearly articulates the Black-Scholes values of the recipients' current ESOs. For a matched subsample of employee recipients in the proprietary data, we find a statistically significant increase in perceived ESO values after training, with the majority (84%) of the employee recipients who perceived a lower value than the Black-Scholes cost before training increasing their perceived values after training. We no longer find significant evidence that employee recipients discount their perceived values relative to the Black-Scholes cost, suggesting that investments in employee training can significantly decrease the cost-value gap and increase the incentive benefit of ESOs. We replicate these after-training findings in our experiment: participants' perceived values significantly increase after a training program that replicates components of the training provided in practice.

Further, with our experiment, we find that receiving a detailed qualitative description of the Black-Scholes model during training increases perceived values for participants who initially discount ESOs before training, but has no effect on perceived values for participants who place a premium on ESOs before training. In contrast, the effect of receiving explicitly stated current intrinsic and Black-Scholes option values is symmetric, increasing perceived values for participants who discount the ESOs before training and decreasing perceived values for those who place a premium on the ESOs before training. Training appears to move participants away from the use of simple valuation heuristics (e.g., intrinsic value, stock price) toward at least attempting to use more sophisticated valuation methods (e.g., Black-Scholes).

The results presented in this paper provide convincing evidence that employee stock option recipients tend to exhibit a cost-value gap before training, and that a training program can alter employee perceptions of the value of their ESOs. In this paper, we remain generally agnostic as to the appropriate

method of ESO valuation. We find it interesting to note that, from the perspective of much of the prior research (which has argued that employees should value their ESOs at an amount lower than the Black-Scholes value due to trading and hedging restrictions), the before-training results could represent "rational" perceptions, while the training effects may mislead employees into making "irrational" changes to those perceptions. Conversely, other researchers have argued that employee stock options are such complex instruments that it is difficult for employees to recognize sources of value; from this perspective, the before-training results likely arise from a lack of understanding and knowledge, while the training effects may help employees to learn more about how to value their ESOs. With our analyses of participants' applied valuation heuristics, we tend to find the later perspective more plausible, but we leave it to future research to discern how to educate employees to reach optimal ESO valuations.

Of course, this paper has several other limitations that present opportunities for future research. First, economics theory (e.g., Hall and Murphy 2002) posit that characteristics of the employees who receive ESOs (e.g., risk aversion) can affect perceived values. However, the proprietary data we analyze in this paper did not include adequate measures for these characteristics, so we are unable to fully reconcile our results to economic theory. Second, because of confidentiality constraints, we have only limited information about the employees and companies in the proprietary data, and are restricted to the brief descriptions that are already included in the paper. We acknowledge that our understanding of perceived values would be enhanced by an investigation of the effects of particular individual (e.g., risk preferences, knowledge) and firm (e.g., industry, stock price trends) characteristics. Third, our experiment necessarily excludes many components of the real-world stock option education program (e.g., interactive seminar, greater discussion of types of options, discussion of tax implications). A useful next step in this research stream could be to explore the effects of these additional components on employees' ESO valuations.

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Table 1
Descriptive Statistics for Proprietary Data

Panel A – Sample Sizes by Company

Firm	Training Participants	Obs with $Forfeit_{BT}$[a]	Obs with $Forfeit_{BT}$ and $_{AT}$[a]
A	75	74	53
B	26	26	15
C	35	35	15
D	36	36	27
E	67	43	16
Total	239	214	126

Panel B – Descriptive Statistics for Variables Measuring Perceived and Black-Scholes Values

	Observations with Perceived Value Before Training (N=214)								Observations with Perceived Value Both Before and After Training (N=126)							
Variable	N	MEAN	STD	MIN	Q1	Median	Q3	MAX	N	MEAN	STD	MIN	Q1	Median	Q3	MAX
$Forfeit_{BS}$[b]	214	138,933	244,408	3,451	32,037	63,745	130,147	1,605,499	126	119,569	172,266	3,451	33,045	65,248	124,212	1,053,846
$Forfeit_{BT}$[a]	214	88,079	205,125	0	7,000	25,000	75,000	2,000,000	126	87,096	168,007	0	8,000	30,000	75,000	1,000,000
$Ratio_{BT}$[c]	214	1.596	11.721	0.000	0.125	0.376	0.981	171.399	126	2.233	15.245	0.000	0.125	0.376	0.982	171.399
$AbsDev_{BT}$[d]	214	1.644	11.620	0.016	0.457	0.752	0.961	170.399	126	2.262	15.125	0.018	0.530	0.763	0.999	170.399
$Forfeit_{AT}$[a]									126	183,155	334,670	0	22,788	74,894	150,000	2,152,584
$Ratio_{AT}$[c]									126	1.481	1.738	0.000	0.940	1.000	1.717	15.388
$AbsDev_{AT}$[d]									126	0.789	1.620	0.000	0.007	0.268	1.000	14.388
Change in Forfeit[a]									126	96,059	289,112	-969,500	0	40,500	90,314	2,102,584
Change in Ratio[c]									126	-0.752	14.985	-166.172	0.000	0.671	0.988	15.263
Change in AbsDev[d]									126	-1.473	14.893	-166.172	-0.719	-0.354	0.116	13.513

Panel C – Descriptive Statistics for Other Employee-Level Variables

	Observations with Perceived Value Before Training (N=214)								Observations with Perceived Value Both Before and After Training (N=126)							
Variable	N	MEAN	STD	MIN	Q1	Median	Q3	MAX	N	MEAN	STD	MIN	Q1	Median	Q3	MAX
$Confidence_{BT}$[e]	210	3.0	1.1	1.0	2.0	3.0	4.0	5.0	124	3.0	1.2	1.0	2.0	3.0	4.0	5.0
$Confidence_{AT}$[e]									120	4.0	1.0	1.0	3.0	4.0	5.0	5.0
Change in Confidence[e]									118	0.9	1.3	-2.0	0.0	1.0	2.0	4.0
$Motivation_{BT}$[f]	210	4.0	1.1	1.0	4.0	4.0	5.0	5.0	124	4.1	1.1	1.0	4.0	4.0	5.0	5.0
$Motivation_{AT}$[f]									120	4.4	0.8	1.0	4.0	5.0	5.0	5.0
Change in Motivation[f]									118	0.2	1.3	-3.0	0.0	0.0	1.0	4.0
$Loyalty_{BT}$[g]	210	4.0	1.2	1.0	4.0	4.0	5.0	5.0	124	4.1	1.2	1.0	4.0	4.0	5.0	5.0
$Loyalty_{AT}$[g]									120	4.4	0.8	1.0	4.0	5.0	5.0	5.0
Change in Loyalty[g]									118	0.2	1.3	-3.0	0.0	0.0	0.0	4.0
DiversifiedInvestments[h]	214	403,431	493,941	0	45,000	250,000	527,000	3,000,000	126	419,208	523,452	0	65,000	250,000	600,000	3,000,000
WealthGoal[i]	214	2,518,802	1,574,539	3,000	2,000,000	2,000,000	2,658,000	17,000,000	126	2,461,142	1,758,660	100,000	2,000,000	2,000,000	2,658,000	17,000,000
$Concentration_{BT}$[j]	214	0.244	0.242	0.000	0.050	0.150	0.330	1.000	126	0.280	0.263	0.000	0.080	0.200	0.500	1.000
Years[k]	214	5.7	2.7	1.0	3.0	6.0	8.0	10.0	126	6.0	2.8	1.0	4.0	6.0	8.0	10.0
SharesOwned[l]	214	76,299	226,555	0	0	8,450	47,313	2,700,000	126	94,492	279,508	0	0	12,845	68,000	2,700,000
BlackScholes[m]	214	242,208	496,242	3,451	42,798	84,864	194,193	3,532,427	126	225,195	352,513	3,451	47,934	87,623	221,723	2,152,584
ITM[n]	214	146,514	333,848	0	13,419	38,851	101,828	2,255,988	126	147,583	286,943	0	14,794	45,412	133,672	2,202,576
PctOptionsVested[o]	214	0.518	0.364	0.000	0.127	0.607	0.840	1.000	126	0.498	0.353	0.000	0.130	0.563	0.806	1.000
PctOptionsITM[p]	214	0.698	0.327	0.000	0.405	0.842	1.000	1.000	126	0.715	0.307	0.000	0.535	0.842	0.986	1.000

Panel D – Descriptive Statistics for Company-Level Variables[q]

Variable	N	MEAN	STD
StockPrice[r]	214	36.16	13.43
Volatility[s]	214	0.293	0.032
Dividend[t]	214	0.006	0.010
RiskFreeRate[u]	214	0.038	0.004

NOTES

[a] $Forfeit_{BT}$ and $Forfeit_{AT}$ are the employee recipient's fill-in-the-blank response before training (BT) or after training (AT) to the following question on the Stock Option Survey (Appendix A): "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?" *Change in Forfeit* is computed as $Forfeit_{AT} - Forfeit_{BT}$.

[b] $Forfeit_{BS}$ is the NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer.

[c] $Ratio_{BT}$ and $Ratio_{AT}$ are computed as $Forfeit_{BT} / Forfeit_{BS}$ and $Forfeit_{AT} / Forfeit_{BS}$, respectively. *Change in Ratio* is computed as $Ratio_{AT} - Ratio_{BT}$.

[d] $AbsDev_{BT}$ and $AbsDev_{AT}$ are computed as $|(Forfeit_{BT} - Forfeit_{BS}) / Forfeit_{BS}|$ and $|(Forfeit_{AT} - Forfeit_{BS}) / Forfeit_{BS}|$, respectively. These computations are equivalent to $|Ratio - 1|$. *Change in AbsDev* is computed as $AbsDev_{AT} - AbsDev_{BT}$.

[e] $Confidence_{BT}$ and $Confidence_{AT}$ are the employee recipient's rated agreement on a 5-point Likert scale (1=strongly disagree and 5=strongly agree after reverse scoring) before training (BT) or after training (AT) with the following statement on the Stock Option Survey (Appendix A): "I am confident I can make timely and tax efficient decisions regarding my stock options and restricted stock." *Change in Confidence* is computed as $Confidence_{AT} - Confidence_{BT}$.

[f] *Motivation*$_{BT}$ and *Motivation*$_{AT}$ are the employee recipient's rated agreement on a 5-point Likert scale (1=strongly disagree and 5=strongly agree after reverse scoring) before training (BT) or after training (AT) with the following statement on the Stock Option Survey (Appendix A): "My stock options and restricted stock encourage me to work harder to contribute to the financial performance of the company." *Change in Motivation* is computed as *Motivation*$_{AT}$ − *Motivation*$_{BT}$.

[g] *Loyalty*$_{BT}$ and *Loyalty*$_{AT}$ are the employee recipient's rated agreement on a 5-point Likert scale (1=strongly disagree and 5=strongly agree after reverse scoring) before training (BT) or after training (AT) with the following statement on the Stock Option Survey (Appendix A): "My stock options and restricted stock encourage me to continue my employment with the company." *Change in Loyalty* is computed as *Loyalty*$_{AT}$ − *Loyalty*$_{BT}$.

[h] *DiversifiedInvestments* is the employee recipient's fill-in-the-blank response to the following statement in training registration: "Please estimate the before-tax value of assets outside of company stock, options, and restricted stock. Do not include any company stock or options or the value of the personal residence."

[i] *WealthGoal* is the employee recipient's fill-in-the-blank response to the following statement in training registration: "Please estimate the amount of money needed today to meet future financial needs."

[j] *Concentration*$_{BT}$ is the employee recipient's fill-in-the-blank response before training (BT) to the following question on the Stock Option Survey (Appendix A): "Of my total investment assets, my total stock option holdings and company stocks are about what percentage?"

[k] *Years* is the number of years the employee recipient has received option grants, based on the earliest active grant in the stock option grant summary information provided by each client company.

[l] *SharesOwned* is the value of owned shares, based on the current stock price (Panel D) multiplied by the employee recipient's response to the following statement in training registration: "Please provide the number of vested company shares (do not include options as shares); these may have come from prior exercises, vestings or purchases on the open market."

[m] *BlackScholes* is the total Black-Scholes value of the employee recipient's options holdings, based on stock option grant summary information provided by each client company and the Black-Scholes model inputs assumptions (Panel D).

[n] *ITM* is the total intrinsic (in-the-money) value of the employee recipient's options holdings, based on stock option grant summary information provided by each client company and the current stock price (Panel D).

[o] *PctOptionsVested* is the percentage of the total number of options held by the employee recipient that are vested.

[p] *PctOptionsITM* is the percentage of the total number of options held by the employee recipient that are in-the-money.

[q] These variables are initially collected from a client company representative. Values are listed as the "default" values when employee recipients enter their personal information during training registration, and it is possible (though unlikely) that recipients changed the defaults. Per discussions with NWSI, if a recipient overrode the default values, NWSI used the recipient-provided values in their computations.

[r] *StockPrice* is the share price of company stock.

[s] *Volatility* is the estimated volatility of company stock.

[t] *Dividend* is the expected annual per-share dividends on company stock, in dollars.

[u] *RiskFreeRate* is the estimated risk-free rate of return.

Table 2
Results of Tests Using Proprietary Data

Panel A: Value-Cost Ratio (*Ratio*[a]) for Employee Stock Option Recipients (H1)

	$Ratio_{BT}$		Recipients' Value < Cost ($Ratio_{BT}$ < 1)	
Firm	Median	p[b]	Count	Percent
A	0.511	0.005	52 of 74	70.3
B	0.761	0.407	14 of 26	53.8
C	0.653	0.235	22 of 35	62.9
D	0.114	<0.001	31 of 36	86.1
E	0.235	<0.001	43 of 43	100.0
Combined	0.376	<0.001	162 of 214	75.7

Panel B: Change in the Value-Cost Ratio (*Ratio*[a]) After Training (H2)

	Change in Ratio ($Ratio_{AT}$-$Ratio_{BT}$)		Increase in Ratio (Change in Ratio > 0)	
Firm	Median	p[b]	Count	Percent
A	0.985	<0.001	46 of 53	86.8
B	0.000	0.761	7 of 15	46.7
C	-0.117	0.217	6 of 15	40.0
D	0.701	0.008	18 of 27	66.7
E	0.349	0.002	13 of 16	81.3
Combined	0.671	<0.001	90 of 126	71.4

Panel C: Change in the Absolute Deviation of Employee Stock Option Recipients' Perceived Values from the Black-Scholes Values (*AbsDev*[c]) After Training

	Change in Deviation ($AbsDev_{AT}$-$AbsDev_{BT}$)		Decrease in Deviation (Change in AbsDev < 0)	
Firm	Median	p[b]	Count	Percent
A	-0.002	0.197	27 of 53	50.9
B	-0.363	0.068	11 of 15	73.3
C	-0.729	0.011	11 of 15	73.3
D	-0.759	<0.001	21 of 27	77.8
E	-0.342	0.003	13 of 16	81.3
Combined	-0.354	0.001	83 of 126	65.9

NOTES:

[a] Computed as the employee recipient's fill-in-the-blank response before training (BT) or after training (AT) to the following question from the Stock Option Survey (Appendix A), "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?", divided by the NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer.

[b] In Panel A, p is the one-sided p-value for a signed-rank test of the median $Ratio_{BT} < 1$. In Panels B and C, p is the two-sided p-value for a signed-rank test of the median *Change in Ratio* = 0 for Panel B and median *Change in AbsDev* = 0 for Panel C.

[c] Computed as the absolute value of the difference between the employee recipient's fill-in-the-blank response before training (BT) or after training (AT) to the following question from the Stock Option Survey (Appendix A), "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?" and the NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer, divided by the NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer**.** This computation is equivalent to |*Ratio* – 1|.

Table 3
Descriptive Statistics for Experiment Data
by Participants' Before-Training Perceptions of Value and Experiment Condition

Before-Training Perceived Values	Black-Scholes Model Description[a]	Option Values Provided[b]	N	Mean Percent Rank for *Change in Ratio*[c]	Mean Percent Rank for *Change in AbsDev*[d]
Discount (i.e., $Ratio_{BT}$[c] <1)	Present	None	21	53.6	58.5
		Current	24	66.7	40.1
		Current+Table	17	68.5	35.7
	Absent	None	19	44.1	68.1
		Current	20	58.8	49.4
		Current+Table	23	61.5	48.1
Premium (i.e., $Ratio_{BT}$[c] >1)	Present	None	11	51.2	71.6
		Current	9	27.3	50.2
		Current+Table	15	28.4	40.3
	Absent	None	13	32.8	47.8
		Current	12	18.4	34.7
		Current+Table	8	35.9	56.0

NOTES:

[a] Experiment participants are either provided (*present*) or not provided (*absent*) with a detailed description of the Black-Scholes model. See Appendix C, Panel A for details.

[b] Experiment participants are either provided with no option values (*none*), both the current intrinsic and Black-Scholes values (*current*), or both the current values plus a table of both intrinsic and Black-Scholes values for several hypothetical stock prices (*current+table*). See Appendix C, Panel B for details.

[c] Computed as the experiment participant's fill-in-the-blank response before training (BT; Appendix C, Panel C, Question 1) or after training (AT; Appendix C, Panel C, Question 2) to the following question, "If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting?", divided by the Black-Scholes (BS) value of the options that would be forfeited.

[d] Computed as the absolute value of the difference between the experiment participant's fill-in-the-blank response before training (BT; Appendix C, Panel C, Question 1) or after training (AT; Appendix C, Panel C, Question 2) to the following question, "If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting?" and the Black-Scholes (BS) value of the options that would be forfeited, divided by the Black-Scholes (BS) value of the options that would be forfeited**.** This computation is equivalent to $|Ratio - 1|$.

Table 4
Planned Contrasts for Experimental Manipulations
by Experiment Participants' Before-Training Perceived Values

	Change in Ratio[c] Rank Contrast Estimates[e, f]				*Change in AbsDev*[d] Rank Contrast Estimates[e, f]			
		After	Subsequent Grants			After	Subsequent Grants	
Contrast[e]	Expected Sign	Training (N=192)	Updated (N=191)	New (N=185)	Expected Sign	Training (N=192)	Updated (N=191)	New (N=185)
Before-Training Discount (i.e., $Ratio_{BT}$[c] < 1)								
B-S model description[a] (present vs. absent)	+	8.2 **	4.9	11.3 **	–	-10.4 **	-5.5	-9.4 **
Option values provided[b] (any vs. none)	+	15.0 ***	7.0 *	3.5	–	-20.0 ***	-12.3 **	-10.4 **
Current+table (vs. current)	+	2.2	-1.9	-3.0	–	-2.8	1.9	-3.8
Current (vs. none)	+	13.9 ***	8.0 *	5.0	–	-18.6 ***	-13.3 **	-8.5 *
Current+table (vs. none)	+	16.1 ***	6.0	2.0	–	-21.4 ***	-11.3 **	-12.4 **
Before-Training Premium (i.e., $Ratio_{BT}$[c] > 1)								
B-S model description[a] (present vs. absent)	–	6.6	0.5	6.2	–	7.9	10.9	4.0
Option values provided[b] (any vs. none)	–	-14.5 **	-12.5 **	-9.6 *	–	-14.4 **	-6.9	-5.6
Current+table (vs. current)	+	9.3	9.0	-9.5	+	5.7	0.8	-6.0
Current (vs. none)	–	-19.1 ***	-17.0 **	-4.9	–	-17.3 **	-7.3	-2.6
Current+table (vs. none)	–	-9.8 *	-8.0	-14.4**	–	-11.6 *	-6.5	-8.6

NOTES:

[a] Experiment participants are either provided (*present*) or not provided (*absent*) with a detailed description of the Black-Scholes model. See Appendix C, Panel A for details.

[b] Experiment participants are either provided with no option values (*none*), both the current intrinsic and Black-Scholes values (*current*), or both the current values plus a table of both intrinsic and Black-Scholes values for several hypothetical stock prices (*current+table*). See Appendix C, Panel B for details.

[c] Computed as the experiment participant's fill-in-the-blank responses to questions asking for the amount of option value that would be forfeited if he/she left the hypothetical employer today, divided by the Black-Scholes (BS) value of those options. Changes are computed relative to before-training responses. See note e for more information.

[d] Computed as the absolute value of the difference between the experiment participant's fill-in-the-blank responses to questions asking for the amount of option value that would be forfeited if he/she left the hypothetical employer today and the Black-Scholes (BS) value of those options, divided by the Black-Scholes (BS) value of those options. This computation is equivalent to $|Ratio - 1|$. Changes are computed relative to before-training responses. See note e for more information.

[e] Participants provided forfeit value estimates four times: for the original grant *before training* and *after training*, for the original grant assuming two years have passed (*updated grant*), and for a *new grant*. See Appendix C, Panels C and D for grant details.

[f] Ranks are percentile ranks, and *, **, and *** indicates one-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 5
Heuristics Used to Estimate Option Value

Panel A: Before- and After-Training Heuristic Classifications[a, b]

			After-Training Heuristic															
			Negative Value		0=ZeroValue		1		2=Intrinsic		3		4=ApproxBS		5		6=StockPrice		7	
Before-Training Heuristic	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent
0=ZeroValue ($0)	12	6.3	0	0.0	7	3.6	2	1.0	1	0.5	0	0.0	2	1.0	0	0.0	0	0.0	0	0.0
1	34	17.7	0	0.0	0	0.0	20	10.4	2	1.0	3	1.6	6	3.1	2	1.0	0	0.0	1	0.5
2=Intrinsic ($10,000)	55	28.6	1	0.5	0	0.0	8	4.2	15	7.8	2	1.0	25	13.0	2	1.0	1	0.5	1	0.5
3	9	4.7	0	0.0	0	0.0	1	0.5	1	0.5	2	1.0	5	2.6	0	0.0	0	0.0	0	0.0
4=ApproxBS ($15,000-$20,000)	32	16.7	0	0.0	0	0.0	2	1.0	2	1.0	1	0.5	21	10.9	3	1.6	2	1.0	1	0.5
5	9	4.7	0	0.0	0	0.0	2	1.0	0	0.0	0	0.0	2	1.0	3	1.6	1	0.5	1	0.5
6=StockPrice ($30,000)	23	12.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	10	5.2	2	1.0	3	1.6	7	3.6
7	18	9.4	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	6	3.1	3	1.6	0	0.0	8	4.2
Total	192	100.0	1	0.5	7	3.6	36	18.8	22	11.5	8	4.2	77	40.1	15	7.8	7	3.6	19	9.9

Panel B: Percentage of Experiment Participants Using Heuristics For Each Perceived Value Question[a]

	Before Training		**After Training**		**Subsequent Grants**			
					Updated		**New**	
Heuristic[c]	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Negative value			1	0.5				
0=ZeroValue ($0)	12	6.3	7	3.6	5	2.6	6	3.2
1	34	17.7	36	18.8	39	20.4	26	14.1
2=Intrinsic	55	28.6	22	11.5	40	20.9	25	13.5
3	9	4.7	8	4.2	14	7.3	33	17.8
4=ApproxBS	32	16.7	77	40.1	34	17.8	27	14.6
5	9	4.7	15	7.8	29	15.2	38	20.5
6=StockPrice	23	12.0	7	3.6	13	6.8	4	2.2
7	18	9.4	19	9.9	17	8.9	26	14.1
Total	192	100.0	192	100.0	191	100.0	185	100.0

NOTES:

[a] Experiment participants provided fill-in-the-blank responses to questions about the total amount of option value forfeited if they left the firm today. *Before* and *after training* questions asked for estimates of forfeit value for an option grant (Appendix C, Panel C). *Updated* and *new grant* questions assess carryover effects of training to subsequent perceptions of ESO value (Appendix C, Panel D). Specifically, *updated grant* asked for an estimate of forfeit value for the original option grant assuming two years have passed, and *new grant* asked for an estimate of forfeit value for a new grant. Responses to each question were then categorized to create *Heuristic*. We identify four heuristics that would result in particular perceived values: zero value, intrinsic value, Black-Scholes value, and current stock price. We then classify each participants' valuations into one of eight *Heuristic* categories, consisting of those four heuristics and four additional categories to capture intermediate values, as shown in the table. An additional category was created *ex post* for the single participant whose *after training* response was negative.

[b] Shaded diagonal represents the number and percent of experiment participants who used the same heuristic for both *before training* and *after training* estimates of option value.

[c] The dollar ranges for each category varies across questions. The intrinsic value is either $10,000 (*before training*, *after training*, and *new grant*) or $15,000 (*updated grant*). The Black-Scholes value is $17,951 for the original grant (*before training* and *after training*), so we include values from $15,000 to $20,000 as approximate Black-Scholes estimates; the Black-Scholes values for the *updated* and *new grants* are $21,178 and $20,197, respectively, so we include values from $17,500 to $22,500 as approximate Black-Scholes estimates. The stock price is either $30,000 (*before training* and *after training*) or $35,000 (*updated* and *new grants*). Dollar ranges for the intermediate categories are adjusted accordingly.

Table 6
Analysis of Post-Task Questions

Panel A: Point Allocations to Potential Factors Influencing Perceived Option Value[a]

		Mean point allocations to potential valuation components (average across subsequent post-task valuation questions)										
After-Training Heuristic[b]	N	Stock Price Today	Future Stock Price	Exerercise Price	Volatility	Grant Date	Vesting Date	Expiration Date	Interest Rate	Ability to Diversify	Existing Holdings of Firm Stock	Investment Risk Tolerance
Negative value (<$0)	1	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0=ZeroValue ($0)	7	3.4	6.3	3.4	15.0	1.4	60.2	6.6	1.4	0.0	0.0	2.5
1	36	24.7	12.9	16.7	8.3	5.8	10.5	4.6	5.6	3.5	4.8	2.8
2=Intrinsic ($10,000)	22	37.6	7.7	23.8	5.0	3.0	6.7	3.0	1.6	2.3	6.6	2.7
3	8	22.2	17.8	16.9	7.8	3.1	8.8	5.0	8.4	1.6	3.4	5.0
4=ApproxBS ($15,000-$20,000)	77	25.9	10.1	22.9	10.1	4.7	9.3	5.7	6.6	1.1	2.0	1.7
5	15	23.0	10.3	17.4	9.8	7.3	11.3	7.2	7.7	0.5	2.9	2.5
6=StockPrice ($30,000)	7	31.8	12.4	10.5	7.8	4.2	5.0	11.4	5.0	0.1	6.5	5.2
7	19	27.2	12.8	16.5	9.4	5.2	7.0	4.9	10.1	2.2	2.7	2.5
Overall	192	26.3	10.8	19.5	9.0	4.7	10.8	5.4	6.1	1.7	3.3	2.4

Panel B: Rated Agreement with Statements on How Employees Should Determine ESO Values[c]

		Mean rated agreement with possible decision rules (0=Disagree, 10=Agree)								
After-Training Heuristic[b]	N	Zero - no value until exercised	Zero - no value until vested	Stock price today	Expected future stock price	Intrinsic value today	Future intrinsic value	Future intrinsic + time value	B-S using current stock price	B-S using future stock price
Negative value (<$0)	1	5.0	5.0	8.0	8.0	6.0	6.0	6.0	8.0	8.0
0=ZeroValue ($0)	7	6.3	9.9	3.0	5.3	4.4	5.9	6.1	3.1	3.0
1	36	4.4	5.2	6.3	6.6	5.9	5.9	7.0	5.6	6.4
2=Intrinsic ($10,000)	22	4.2	4.3	5.8	5.6	6.6	5.6	5.9	5.0	4.7
3	8	5.0	2.6	6.6	6.3	6.4	6.8	7.8	6.4	6.1
4=ApproxBS ($15,000-$20,000)	77	3.3	4.4	4.0	4.4	5.0	5.8	6.7	6.2	6.2
5	15	3.3	5.3	5.7	6.9	5.1	6.8	7.5	6.8	6.7
6=StockPrice ($30,000)	7	5.1	5.1	6.7	9.0	7.3	7.0	7.7	6.6	7.0
7	19	4.9	4.4	5.3	6.4	4.9	6.5	6.8	5.5	6.1
Overall	192	4.1	4.8	5.1	5.6	5.5	6.0	6.8	5.9	6.0

Panel C: Rated Effort, Knowledge and Confidence

After-Training Heuristic[b]	N	Mean rated task efforts (0=Low, 10=High): Difficulty making estimates	Familiarity with estimates	How hard worked	Mean rated knowledge (0=Low, 10=High): Option pricing models	Options in general	Investments in general	Confidence in after-training value estimate (0=Low, 10-High)
Negative value (<$0)	1	3.0	2.0	2.0	3.0	5.0	5.0	5.0
0=ZeroValue ($0)	7	4.3	5.4	4.7	5.0	5.7	6.3	6.3
1	36	7.5	3.2	5.7	2.6	5.2	5.4	4.1
2=Intrinsic ($10,000)	22	5.9	3.4	5.7	3.0	5.0	5.0	5.4
3	8	7.9	4.1	5.6	3.0	5.6	5.4	5.3
4=ApproxBS ($15,000-$20,000)	77	6.9	3.6	5.5	3.2	5.4	5.6	5.4
5	15	7.5	3.2	5.7	3.1	4.5	4.9	4.8
6=StockPrice ($30,000)	7	5.9	3.7	5.0	2.0	3.4	4.0	4.0
7	19	7.5	2.1	5.3	2.1	3.9	4.8	3.0
Overall	192	6.9	3.4	5.5	2.9	5.0	5.3	4.9

NOTES:

[a] After training, experiment participants were asked to allocate 100 points across 11 factors based on the degree to which each factor influenced their estimates of option value (see Appendix C, Panel E). Participants completed the point allocation task twice – once for each of the subsequent post-task valuation questions (i.e., *updated grant* and *new grant*). Values provided are the mean point allocations across the two questions.

[b] Experiment participants provided fill-in-the-blank responses for an after training estimate of forfeit value for an option grant (*after training*; see Appendix C, Panel C for details). Responses were then categorized to create *Heuristic* by identifying four heuristics that would result in particular perceived values (zero value, intrinsic value, Black-Scholes value, and current stock price), and then classifying each participants' valuation into one of eight categories, consisting of those four heuristics and four additional categories to capture intermediate values, as shown in the table. An additional category was created *ex post* for the single participant whose *after training* response was negative.

[c] After training, experiment participants were asked to rate their agreement with nine statements about how employees *should* determine the value of their options. See Appendix C, Panel F for details.

Figure 1
NWSI Client Training Process

The figure below illustrates the steps in NWSI's training process (in bold), what data is collected during each step, and the number of observations in the NWSI data from each step (in italics). The last four steps of the process occur within about a two-week time period.

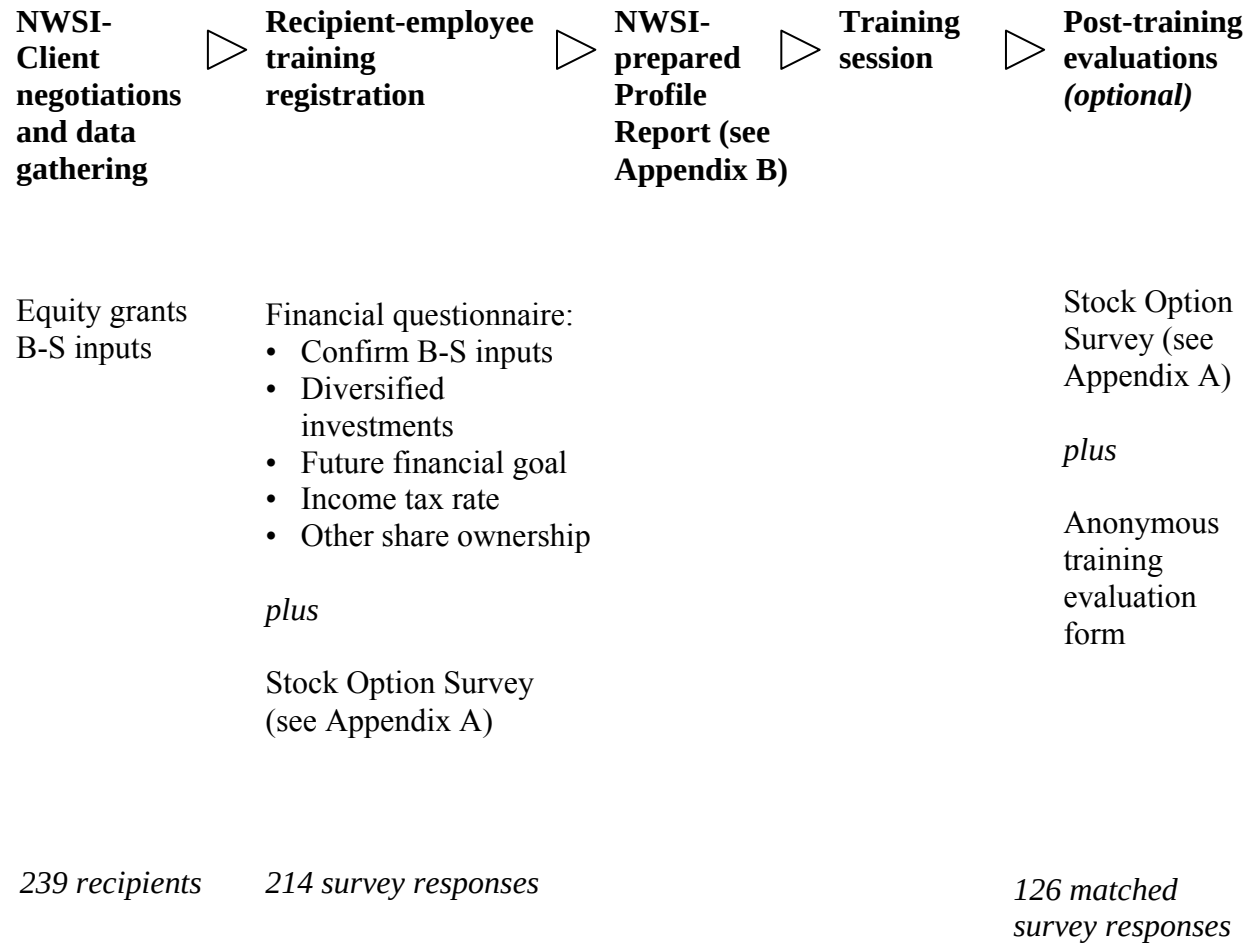
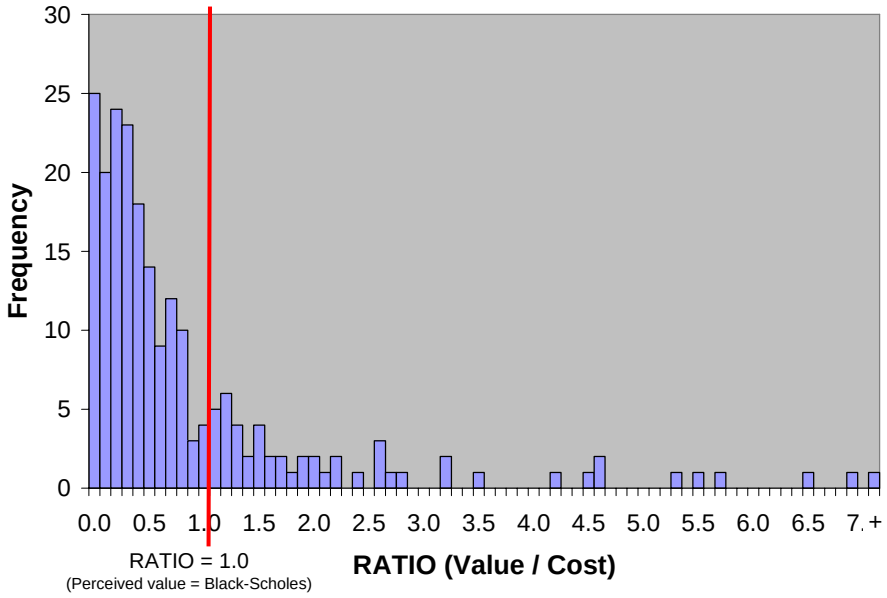


Figure 2
H1 Results: Value-Cost Ratio ($Ratio_{BT}$[a]) for Employee Stock Option Recipients

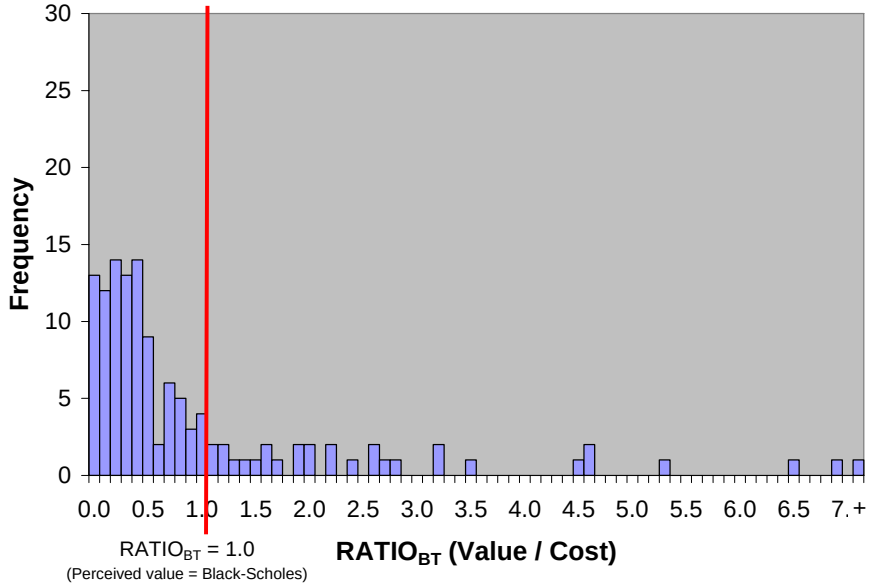


NOTES:

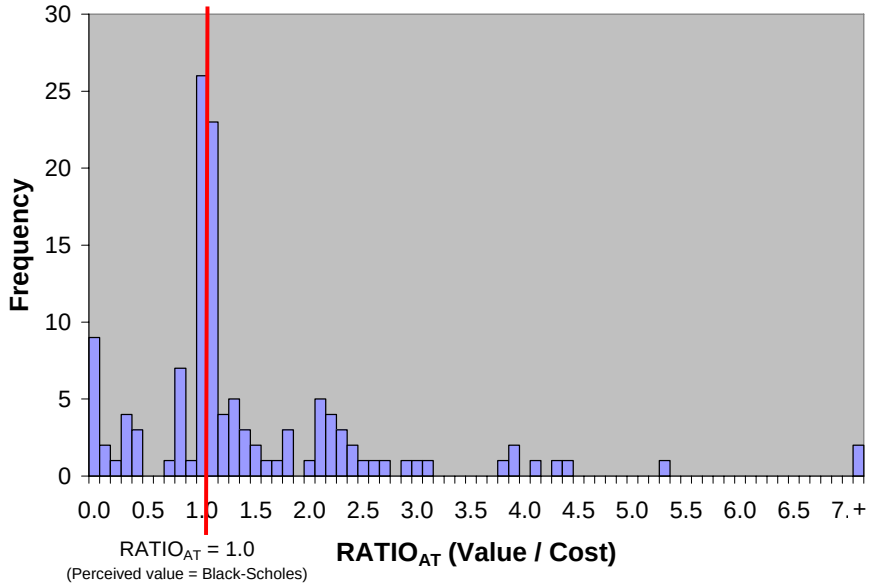
[a] Computed as the employee recipient's fill-in-the-blank response before training (BT) to the following question from the Stock Option Survey (Appendix A), "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?", divided by the NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer.

Figure 3
H2 Results: Matched Before and After Training Value-Cost Ratios (*Ratio*[a])
for Employee Stock Option Recipients

Panel A: Before Training (*Ratio*$_{BT}$[a])



Panel B: After Training (*Ratio*$_{AT}$[a])

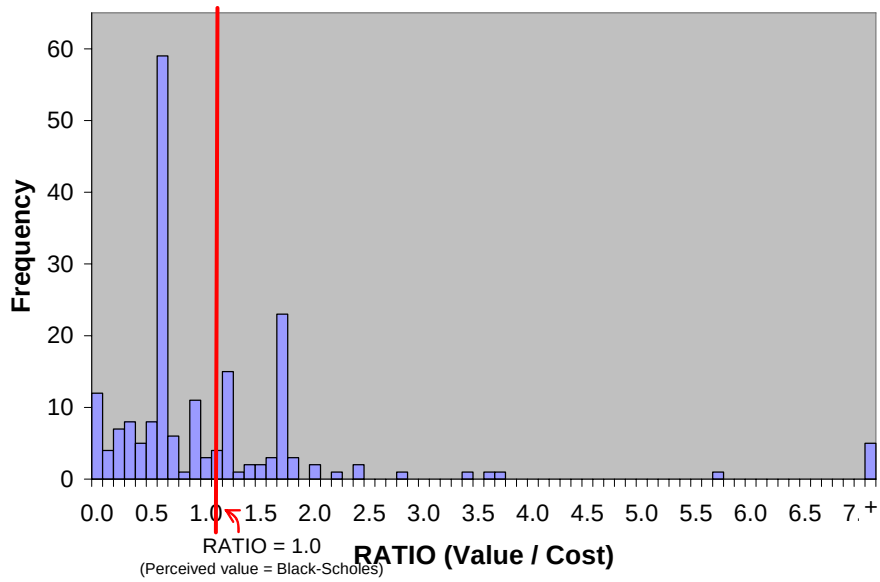


NOTES:

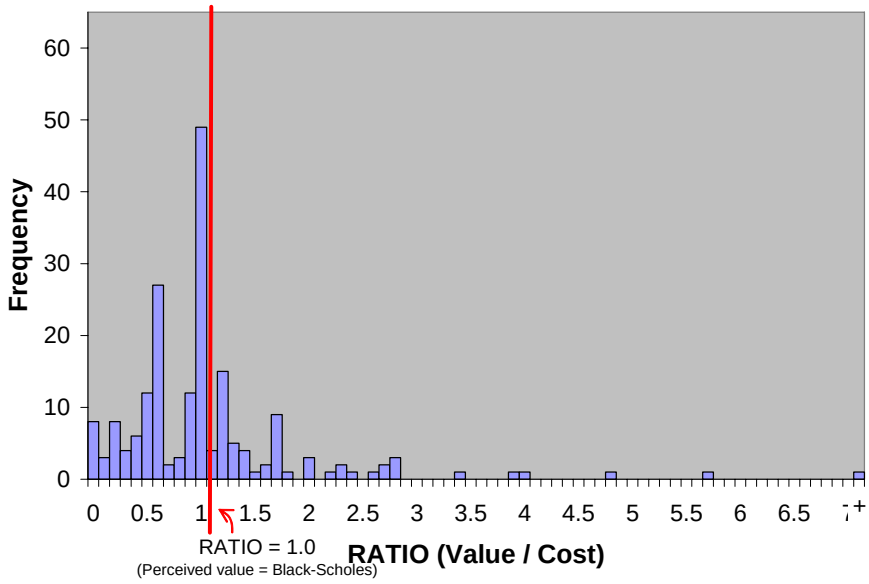
[a] Computed as the employee recipient's fill-in-the-blank response before training (BT) or after training (AT) to the following question from the Stock Option Survey (Appendix A), "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?", divided by the NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer.

Figure 4
H1 and H2 Results: Before and After Training Value-Cost Ratios (*Ratio*[a])
for Experiment Participants

Panel A: Before Training (*Ratio*$_{BT}$[a])



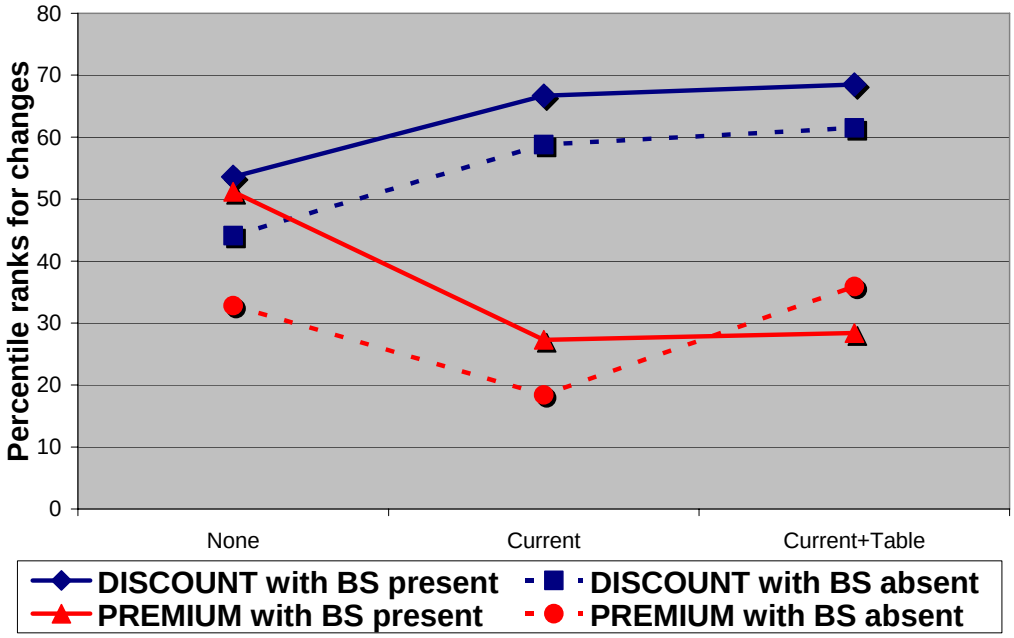
Panel B: After Training (*Ratio*$_{AT}$[a])



NOTES:

[a] Computed as the experiment participant's fill-in-the-blank response before training (BT; Appendix C, Panel C, Question 1) or after training (AT; Appendix C, Panel C, Question 2) to the following question, "If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting?", divided by the Black-Scholes (BS) value of the options that would be forfeited.

Figure 5
Mean Percent Rank for Change in Value-Cost Ratio (*Ratio*[a])
by Participants' Before-Training Perceptions of Value and Experiment Condition[b]



NOTES:

[a] Computed as the experiment participant's fill-in-the-blank response before training (BT; Appendix C, Panel C, Question 1) or after training (AT; Appendix C, Panel C, Question 2) to the following question, "If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting?", divided by the Black-Scholes (BS) value of the options that would be forfeited. Before-training perceived values are classified based on $Ratio_{BT} < 1$ (*discount*) and $Ratio_{BT} > 1$ (*premium*).

[b] Between subjects, experiment participants are either provided (*BS present*) or not provided (*BS absent*) with a detailed description of the Black-Scholes model; see Appendix C, Panel A for details. Also between subjects, experiment participants are either provided with no option values (*none*), both the current intrinsic and Black-Scholes values (*current*), or both the current values plus a table of both intrinsic and Black-Scholes values for several hypothetical stock prices (*current+table*); see Appendix C, Panel B for details.

APPENDIX A
Stock Option Survey Administered by NWSI

Responses to the following survey questions were required of all NWSI training program registrants prior to the start of the training. The survey was also completed on a voluntary basis immediately following the training program.

	Strongly Agree				Strongly Disagree
1. My stock options and restricted stock encourage me to work harder to contribute to the financial performance of the company.	1	2	3	4	5
2. My stock options and restricted stock encourage me to continue my employment with the company.	1	2	3	4	5
3 I am confident I can make timely and tax efficient decisions regarding my stock options and restricted stock.	1	2	3	4	5
4 If my company stock price were to increase 20%, the value of my option holdings would increase about what percentage?					%
5 Of my total investment assets, my total stock option holdings and company stocks are about what percentage?					%
6 If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?					$

APPENDIX B
Excerpts From Sample NWSI Equity Compensation Profile Report

The NWSI Equity Compensation Profile Report (Profile) includes five sections; we include excerpts from Sections I and III here since they are relevant to our analysis. Section I summarizes the employee's current option holdings, based on four valuation methods: 1) In-the-money (or intrinsic) value, 2) Cash-out (after-tax) value, 3) Black-Scholes value and its related time value, and 4) Forfeit Value. Section III summarizes the concept of leverage in general and how the concept applies to the employee's equity holdings in particular.

I. ESO Portfolio Value for EMPLOYEE NAME as of DATE

This section summarizes your current option holdings in **EMPLOYER** and is divided into 3 sections, each of which look at the current value of your stock option portfolio in a slightly different way. The three valuation methods are: 1) In-the-money value, 2) Cash-out value, and 3) Black-Scholes value and its related time value.

In-The-Money Value of All Options

The table below shows the gross value (before tax) you would realize from exercising and selling your options, or the difference between the current "fair market value" (FMV) per share (the current stock price) and your exercise price times the number of options. This amount is called the "in-the-money" (ITM) value or "intrinsic" value. The table shows this value for both vested and unvested options. You cannot realize the value from your unvested options until they vest.

FMV	$20.00			Vested		Unvested		Total	
Grant ID	Option Type	Expiration Date	Strike Price	# of Options	ITM Value	# of Options	ITM Value	# of Options	ITM
1 ISO 97	ISO	01/01/07	$13.00	40,000	280,000	0	0	40,000	280,000
2 ISO 98	ISO	01/01/08	$15.00	25,000	125,000	0	0	25,000	125,000
3 NQ 00	NQSO	01/01/10	$41.80	40,000	0	0	0	40,000	0
4 NQ 02	NQSO	01/01/12	$19.65	30,000	10,500	20,000	7,000	50,000	17,500
5 NQ 04	NQSO	01/01/14	$20.11	0	0	40,000	0	40,000	0
Grand Total				135,000	415,500	60,000	7,000	195,000	422,500

Cash-Out Value of Vested Options

The table below estimates what you can realize from your vested options at the given FMV. The "Potential Tax" column is computed by applying your estimated marginal income tax rate of **35.0%** shown in Appendix A. Your "cash-out" value for each vested grant is determined by subtracting your potential tax burden from your ITM value. The cash-out value for any vested Incentive Stock Options (ISOs) is computed as if they are sold at the time of exercise.

FMV	$20.00	Vested					
Grant ID	Option Type	Expiration Date	Strike Price	# of Options	ITM Value	Potential Tax	Cash out Value, Vested
1 ISO 97	ISO	01/01/07	$13.00	40,000	280,000	98,000	182,000
2 ISO 98	ISO	01/01/08	$15.00	25,000	125,000	43,750	81,250
3 NQ 00	NQSO	01/01/10	$41.80	40,000	0	0	0
4 NQ 02	NQSO	01/01/12	$19.65	30,000	10,500	3,675	6,825
5 NQ 04	NQSO	01/01/14	$20.11	0	0	0	0
Grand Total				135,000	415,500	145,425	270,075

Black-Scholes / Time Value of All Options
In this section of the report, we explore a unique value of your Employee Stock Options (ESOs). Conceptually, this value represents the amount a willing seller would be able to sell their options to a willing buyer. Of course, your ESOs cannot be sold. However, the concept of unique value still applies and more importantly, can be used to help you make better decisions about when to consider exercising any given ESO. The unique value we are talking about is the Time Value of your options.

The concept of Time Value is best illustrated when we consider an "under-water" option (i.e., the strike price is greater than the stock's current fair market value). For example, is an option on a stock worth $8 that has a strike price of $10 but doesn't expire for 7 years worthless? Most would agree it is not worthless because of the possibility that some time between now and the expiration of the option, the stock's price will rise above the $10 strike price, yielding in-the-money value that can be realized. In the context of ESOs, it is this opportunity that we are measuring with the Time Value (TV).

The TV of your options is shown in the following chart. We have estimated it using the most widely used formula for determining the price of market traded stock options, the Black-Scholes Model. The output of this model is known as the Black-Scholes Value (BSV) of an option. BSV is the "theoretical" full-value of the option and is calculated as follows:

Black-Scholes Value = In-The-Money Value + Time Value

By computing the Black-Scholes Value of your options, we are able to estimate the Time Value of each of your options with the following calculation:

Time Value = Black-Scholes Value - In-The-Money Value

There are four key assumptions that must be made in order to calculate the Black-Scholes Value and the Time Value of your options:

The expiration date: An option with a long time to expiration is more valuable than one with a short time. This is because there is a longer time for the stock price to increase and for your capital to be invested elsewhere. **Therefore, the greater the time until expiration, the greater the Time Value of the option**.

The strike price: The relationship between the strike price (the price at which you can exercise the option) and the price of the stock determines the amount of upside leverage remaining in the option. The concept of leverage is discussed in more detail in Section II of this report but, in general, the greater the

difference between the strike price and the fair market value of the stock (the in-the-money value), the less upside leverage will remain. **Therefore, the greater the in-the-money-value, the greater the Black-Scholes Value but the *lower* the Time Value.** The TV decreases as your option's in-the-money value increases. This reflects the rising value you are putting at risk by continuing to hold the in-the-money value.

The volatility of the stock: Volatility measures the range above and below the average by which a stock's price fluctuates. An option with relatively high volatility is a stock with a wide range of probable (one standard deviation) stock prices at any given moment. An option on a stock whose price is highly volatile (fluctuates substantially) will have a greater BSV than an option with low volatility. This reflects the increased potential upside AND downside risks associated with the stock's price. **Therefore, a higher volatility assumption will result in a higher BSV and TV of the option**.

The risk-free rate of return: An option provides the holder with the right to own stock at a certain price without having to purchase the stock. Therefore, an option's value is enhanced not only by the opportunity to participate in the appreciation of the stock, but also the ability to use the capital that would otherwise be invested in the stock for some other purpose. The risk-free rate input to the Black-Scholes formula is used to value these benefits. **The higher the risk-free rate of return, the higher the BSV and TV of the option**.

To summarize:

- The Time Value decreases as the expiration date approaches.
- The Time Value decreases as the in-the-money amount increases.
- The Time Value is higher for stocks with higher volatility.
- The Time Value is higher when the risk free rate of return is higher.

Time Value is an important metric in determining when to exercise options. This is because, as the TV decreases, so does the value of holding the option. In-the-money options with a low TV may be good candidates for diversification. The table below calculates the Black-Scholes Values and associated Time Values for your stock options.

Volatility: 40.0%
Annual Dividend (per share): $0.00
Risk Free Rate: 3.5%

FMV	$20.00			Vested		Unvested		Total	
Grant ID	Option Type	Expiration Date	Strike Price	Time value	BSV	Time Value	BSV	Time value	BSV
1 ISO 97	ISO	01/01/07	$13.00	63,200	343,200	0	0	63,200	343,200
2 ISO 98	ISO	01/01/08	$15.00	81,778	206,778	0	0	81,778	206,778
3 NQ 00	NQSO	01/01/10	$41.80	137,286	137,286	0	0	137,286	137,286
4 NQ 02	NQSO	01/01/12	$19.65	274,675	285,175	183,117	190,117	457,792	475,292
5 NQ 04	NQSO	01/01/14	$20.11	0	0	424,134	424,134	424,134	424,134
Grand Total				556,939	972,439	607,250	614,250	1,164,190	1,586,690

Forfeit Value™ of All Options
You are making an important investment of your time and career in the company. By the same token, the company is making an investment in you. The company believes it is important to you and the shareholders that a common language be used for understanding the full value of your equity compensation. The first piece of this is to understand the Forfeit Value™ of your employee stock options. Your Forfeit Value™ is the sum of the remaining Time Value in your vested holdings and the total Black-Scholes Value of your unvested holdings. The sum of these two (your Forfeit Value™) represents the current estimated value you would potentially forfeit if you were to leave the company.

Your FORFEIT VALUE™ is: **$1,171,190**

III. Investment Risk/Reward for EMPLOYEE NAME as of DATE

An important dynamic for you to understand about your equity compensation is the leveraged nature of an option. This leverage will make the values reviewed in Section I of this report, inherently more volatile than the value of your employer's stock.

The following table shows your stock option ITM value (vested and unvested), the value of your held and restricted shares and the total value of all of these for hypothetical stock prices that are illustrated in 20% increments above and below the current fair market value (FMV). The row without an increment shows the current FMV. The *Incremental Change* is the percent that each value calculation is above or below the prior level. This quantifies the risk/reward leverage inherent in your company stock and option portfolio.

Leverage Table

		Based on Current Portfolio of Vested and Unvested Stock and Options					
Potential Stock Price	Incremental Change	Option ITM Value	Incremental Change	Share & RSP Value	Incremental Change	Option, Share & RSP Value	Incremental Change
$8.19	-20.0%	$0	0.0%	$131,000	-20.0%	$131,000	-20.0%
$10.24	-20.0%	$0	0.0%	$164,000	-20.0%	$164,000	-20.0%
$12.80	-20.0%	$0	-100.0%	$205,000	-20.0%	$205,000	-20.0%
$16.00	-20.0%	$145,000	-65.7%	$256,000	-20.0%	$401,000	-45.9%
$20.00		$422,500		$320,000		$742,500	
$24.00	20.0%	$1,038,100	145.7%	$384,000	20.0%	$1,422,000	91.6%
$28.80	20.0%	$1,782,100	71.7%	$460,000	20.0%	$2,242,000	57.6%
$34.56	20.0%	$2,674,900	50.1%	$552,000	20.0%	$3,196,000	42.5%
$41.47	20.0%	$3,745,950	40.0%	$662,432	20.0%	$4,407,000	37.8%
$49.77	20.0%	$5,351,250	42.9%	$794,486	20.0%	$6,145,000	28.2%

Depending on the details of your options, a 20% change in your company's stock price can result in a significantly higher percentage gain or loss in your option portfolio. This is due to the leverage in the options. Also worth noting is the fact that, generally speaking, as the FMV of the stock rises further above the strike prices of your various option holdings, the relative percentage change of the option portfolio grows increasingly similar to the percentage change in the stock value. This trend represents the declining leverage of the option portfolio as the cost of exercising becomes a smaller percentage of the value of the stock.

APPENDIX C
Experimental Manipulations and Selected Post-Task Questions

Panel A: Between-Subjects Manipulation of Black-Scholes Model Description

***ABSENT* EXPERIMENTAL CONDITION –** Training materials did not include any descriptive information about the Black-Scholes model.

***PRESENT* EXPERIMENTAL CONDITION –** Training materials included the following description of the Black-Scholes model, which mimics the descriptions in the NWSI Profile Report (see Appendix B) and training sessions:

Valuing Employee Stock Options

The fair value of a stock option is the amount for which the option could be sold to a willing buyer. Recall, however, that ESOs cannot be publicly traded. Nevertheless, the concept of fair value can still be applied to ESO.

The total fair value of your options can be estimated using an option valuation model. The most widely used formula for doing this is called the Black-Scholes Model.

The fair value of a stock option as valued by the Black-Scholes Model has two components, the "In-The-Money Value" and the "Time Value."

The In-The-Money Value of your stock option is the difference between the current stock price of your firm's stock and the exercise price of the stock option. If the exercise price is less than the current stock price, the stock option is "in-the-money"; if the exercise price is greater than the current stock price, the stock option is "under-water."

The concept of Time Value is best illustrated when we consider an under-water option (i.e., the exercise price is greater than the stock's current fair market value). For example, is an option on a stock worth $8 that has a exercise price of $10 but doesn't expire for 7 years worthless? Most would agree it is not worthless because of the possibility that some time between now and the expiration of the option, the stock's price will rise above the $10 exercise price, yielding In-The-Money value that can be realized. In the context of ESOs, it is this opportunity that we are measuring with the Time Value.

Black-Scholes Value is the "theoretical" full-value of the option and is calculated as follows:

Black-Scholes Value = In-The-Money Value + Time Value

There are four key assumptions that must be made in order to calculate the Black-Scholes Value (including the Time Value) of your options:

The expiration date: An option with a long time to expiration is more valuable than one with a short time. This is because there is a longer time for the stock price to increase and for your capital to be invested elsewhere. **Therefore, the greater the time until expiration, the greater the Time Value of the option**.

The exercise price: The relationship between the exercise price (the price at which you can exercise the option) and the price of the stock determines the amount of upside leverage remaining in the option. In general, the greater the difference between the exercise price and the fair market value of the stock (the

In-The-Money value), the less upside leverage will remain. **Therefore, the greater the In-The-Money-value, the greater the Black-Scholes Value but the *lower* the Time Value.** The Time Value decreases as your option's In-The-Money value increases. This reflects the rising value you are putting at risk by continuing to hold the In-The-Money value.

The volatility of the stock: Volatility measures the range above and below the average by which a stock's price fluctuates. An option with relatively high volatility is a stock with a wide range of probable (one standard deviation) stock prices at any given moment. An option on a stock whose price is highly volatile (fluctuates substantially) will have a greater Black-Scholes Value than an option with low volatility. This reflects the increased potential upside AND downside risks associated with the stock's price. **Therefore, a higher volatility assumption will result in a higher Black-Scholes Value and Time Value of the option**.

The risk-free rate of return: An option provides the holder with the right to own stock at a certain price without having to purchase the stock. Therefore, an option's value is enhanced not only by the opportunity to participate in the appreciation of the stock, but also the ability to use the capital that would otherwise be invested in the stock for some other purpose. The risk-free rate input to the Black-Scholes formula is used to value these benefits. **The higher the risk-free rate of return, the higher the Black-Scholes Value and Time Value of the option**.

To summarize:

- The Time Value decreases as the expiration date approaches.
- The Time Value decreases as the In-The-Money amount increases.
- The Time Value is higher for stocks with higher volatility.
- The Time Value is higher when the risk free rate of return is higher.

Panel B: Between-Subjects Manipulation of Option Values Provided

***NONE* EXPERIMENTAL CONDITION –** Training materials included no statements about the intrinsic and Black-Scholes values of the option grant.

***CURRENT* EXPERIMENTAL CONDITION –** Training materials included the following statement about option values:

> The current In-The-Money Value (based on the difference between the current stock price and the options' exercise price) of your first grant of 1,000 ESOs is $10,000.
>
> The total current Black-Scholes Value of your first grant of 1,000 ESOs is $17,951.

***CURRENT+TABLE* EXPERIMENTAL CONDITION –** Training materials included the following statement about and table of option values:

> The current In-The-Money Value (based on the difference between the current stock price and the options' exercise price) of your first grant of 1,000 ESOs is $10,000.
>
> The total current Black-Scholes Value of your first grant of 1,000 ESOs is $17,951.
>
> Below is a table that provides the In-The-Money values and estimated Black-Scholes values of your first grant of 1,000 ESOs for hypothetical stock prices in 20% increments above and below the current stock price. The shaded row reflects values at the current stock price:

Potential Future Stock Price	Incremental Change in Stock Price	In-The-Money Value	Incremental Change in In-The-Money Value	Black-Scholes Value	Incremental Change in Black-Scholes Value
$12.29	-20.00%	$0	0.00%	$3,768	-35.27%
$15.36	-20.00%	$0	0.00%	$5,820	-33.19%
$19.20	-20.00%	$0	-100.00%	$8,711	-31.23%
$24.00	-20.00%	$4,000	-60.00%	$12,667	-29.44%
$30.00	–	$10,000	–	$17,951	–
$36.00	20.00%	$16,000	60.00%	$23,468	30.74%
$43.20	20.00%	$23,200	45.00%	$30,277	29.01%
$51.84	20.00%	$31,840	37.24%	$38,612	27.53%
$62.21	20.00%	$42,208	32.56%	$48,751	26.26%
$74.65	20.00%	$54,650	29.48%	$61,023	25.17%

Panel C: Within-Subjects Questions About Perceptions of Option Value

QUESTION 1 – ORIGINAL GRANT, PERCEPTION OF VALUE BEFORE TRAINING

Please use the information provided below about your ESO grant to answer the questions that follow.

ESO Grant #1	
Number of options:	1,000
Grant date:	1 year ago
Vesting date:	4 years from today
Expiration date:	9 years from today
Stock price today:	$30 per share
Exercise price:	$20 per share
Risk-free interest rate:	4 percent
Stock price volatility:	30 percent

If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting? (Please ignore possible income tax implications.)

$_____

QUESTION 2 – ORIGINAL GRANT, PERCEPTION OF VALUE AFTER TRAINING

Previously, you were asked to value your first grant of 1,000 ESOs. Please value those options again. The details of your first ESO grant are repeated below.

ESO Grant #1	
Number of options:	1,000
Grant date:	1 year ago
Vesting date:	4 years from today
Expiration date:	9 years from today
Stock price today:	$30 per share
Exercise price:	$20 per share
Risk-free interest rate:	4 percent
Stock price volatility:	30 percent

If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting? (Please ignore possible income tax implications.)

$_____

Panel D: Post-Task Questions About Subsequent Perceptions of Option Value

QUESTION 3 – UPDATED ORIGINAL GRANT, SUBSEQUENT PERCEPTION OF VALUE

Assume **two (2) years** have passed. The stock price is now $35.

Please use the updated information about your ESO grant provided below to answer the questions that follow.

Updated ESO Grant #1	
Number of options:	1,000
Grant date:	3 years ago
Vesting date:	2 years from today
Expiration date:	7 years from today
Stock price today:	$35 per share
Exercise price:	$20 per share
Risk-free interest rate:	4 percent
Stock price volatility:	30 percent

If you were to leave the firm today, you would have to leave behind your first grant of 1,000 ESOs. About what total amount of value would you be forfeiting? (Please ignore possible income tax implications.)

$_____

QUESTION 4 – NEW GRANT, SUBSEQUENT PERCEPTION OF VALUE

Assume that, in the intervening two years, you have also received a **new grant** of 1,000 ESOs. This **second** grant is in addition to the first grant previously described. Please use the additional information about your **second** ESO grant provided below to answer the questions that follow.

ESO Grant #2	
Number of options:	1,000
Grant date:	1 year ago
Vesting date:	4 years from today
Expiration date:	9 years from today
Stock price today:	$35 per share
Exercise price:	$25 per share
Risk-free interest rate:	4 percent
Stock price volatility:	30 percent

If you were to leave the firm today, you would have to leave behind your second grant of 1,000 ESOs. About what total amount of value would you be forfeiting? (Please ignore possible income tax implications.)

$_____

Panel E: Post-Task Questions About Factors Affecting Option Valuation Decisions

Participants were asked to complete two versions of this table: one for the updated grant (i.e., the original grant assuming two years have passed—Panel D, Question 3), and one for a new grant (Panel D, Question 4). Only the first table is reproduced below.

Please consider how you arrived at the value estimates for **updated ESO Grant #1** in Envelope 3. Allocate 100 points across the following factors based on the degree to you believe each factor influenced your estimates. Enter zero for any item that you believe did not influence your estimates. The details of updated ESO Grant #1 are repeated below.

Number of options:	1,000
Grant date:	3 years ago
Vesting date:	2 years from today
Expiration date:	7 years from today
Stock price today:	$35 per share
Exercise price:	$20 per share
Risk-free interest rate:	4 percent
Stock price volatility:	30 percent

	Point Allocation
1. Stock price today	_____
2. Future stock price at time when options are expected to be exercised	_____
3. Exercise price	_____
4. Stock price volatility	_____
5. Grant date of the options	_____
6. Vesting date of the options	_____
7. Expiration date of the options	_____
8. Risk-free interest rate	_____
9. Ability (or lack of ability) to diversify your investment holdings	_____
10. Existing holdings of your firm's stock	_____
11. Tolerance (or lack of tolerance) for risk in your investment portfolio	_____

Total points allocated must add to: 100

Panel F: Post-Task Questions About How Employees Should Value Options

Please indicate your level of agreement with each of the following statements about how employees ***should*** determine ESO values by circling your response from 0 (Strongly Disagree) to 10 (Strongly Agree).

An employee should consider the value of his or her ESO to be:

	Strongly Disagree					*Neither Agree nor Disagree*					*Strongly Agree*
(a) zero — options have no value until exercised.	0	1	2	3	4	5	6	7	8	9	10
(b) zero — options have no value until vested.	0	1	2	3	4	5	6	7	8	9	10
(c) the stock price today.	0	1	2	3	4	5	6	7	8	9	10
(d) the expected future stock price.	0	1	2	3	4	5	6	7	8	9	10
(e) the stock price today less the exercise price.	0	1	2	3	4	5	6	7	8	9	10
(f) the expected future stock price less the exercise price.	0	1	2	3	4	5	6	7	8	9	10
(g) the expected future stock prices less the exercise price, plus an additional time value component.	0	1	2	3	4	5	6	7	8	9	10
(h) the current Black-Scholes value.	0	1	2	3	4	5	6	7	8	9	10
(i) the Black-Scholes value using the expected future stock price.	0	1	2	3	4	5	6	7	8	9	10