Archival and Experimental Evidence on Employees' Subjective Valuations of Stock Options

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Abstract

Complementing proprietary archival data with an experiment, we examine employees' subjective valuations of their employee stock options and explore a stock option education program as a mechanism for influencing those valuations. We argue that the conflicting evidence on employee subjective valuations in prior studies can be attributed in part to knowledge differences. Our archival and experimental results show most employees value their options lower than the corresponding Black-Scholes cost. We find that a stock option education program that provides descriptive information about the Black-Scholes option pricing model and quantitative information about option values using that model increases not only employees' subjective valuations but also their self-reported loyalty and motivation. We complement our primary results with analyses of the cross-sectional determinants of subjective valuations, the differential effects on valuations of different components of the education program, and the heuristics used to formulate subjective valuations.

Keywords: *Employee stock options (ESO), subjective valuation, Black-Scholes, education.*

Data availability: *Proprietary archival 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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I. 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 as a means of attracting, retaining, and motivating employees (Core and Guay 2002; Elson 2003). Yet, some practitioners question whether firms are able to realize these benefits because of the complexities employees face when valuing this form of compensation (Enright and Reilly 2002; Reilly et al. 2003; Schneider 2003; Watson Wyatt Worldwide 2003). In this paper, we provide archival and experimental evidence on employee stock option recipients' subjective valuations of their stock option holdings—that is, employees' self-reported assessments of the value of their options. We further examine the cross-sectional determinants of these subjective valuations, and how they are influenced by a stock option education program.

Extant research provides mixed evidence regarding subjective valuations of employee stock options and limited insight regarding the potential reasons for that mixed evidence. Analytic research predicts that employees' subjective valuations will be below the firms' opportunity costs of instead issuing the options to capital markets (Lambert et al. 1991; Hall and Murphy 2002). Although this is consistent with evidence reported by Watson Wyatt Worldwide (2004) and with some of the research inferring valuation from early exercise of options (Armstrong 2007; Armstrong et al. 2007), other studies find that employees' subjective valuations are often higher than firms' opportunity costs (Lambert and Larcker 2001; Hallock and Olsen 2006; Hodge et al. 2006; Devers et al. 2007).

We expect that differences in employees' knowledge of options likely contribute to the

mixed evidence regarding employees' subjective valuations found in prior studies. In this paper, we analyze a unique archival data set from a national provider of equity compensation planning services, together with complementary experiment data. With both data sources, we obtain subjective valuations both before and after completion of a stock option education program, and measure the "valuation-cost gap" by comparing subjective valuations to the corresponding Black-Scholes estimate (a proxy for the firm's opportunity cost consistent with prior studies).

Our results provide evidence that, before completion of the education program, the majority of employees value their options lower than firms' opportunity costs. In the archival data, 76% of employee recipients' subjective valuations are lower than the corresponding Black-Scholes cost. Cross-sectional analysis indicates that valuations before training are driven more by employees' wealth diversity (or lack thereof) and whether the options are vested, and less by the fundamental drivers of stock option value as captured by Black-Scholes. Likewise, 65% of the graduate business student participants in our experiment value hypothetical employee stock options lower than cost.

We also find that completing a stock option education program leads to a significant increase in subjective valuations, consistent with knowledge gained from the program. In the archival data, we find a statistically significant increase in employee recipients' subjective valuations, with 84% of the employees who value their options lower than the firm's opportunity cost before training increasing their valuations after training. We no longer find any significant evidence that employee recipients' subjective valuations are lower than the Black-Scholes cost after completion of the education program. Notably, 57% of employee recipients' subjective valuations are higher than the Black-Scholes cost after training, compared to 25% before training. Consistent with these results, analyses of our experiment also indicate a significant

increase in subjective valuations after training.

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

We contribute to academic research by documenting a plausible explanation for prior mixed evidence regarding employees' subjective valuations. Moreover, we do so by combining insights from both archival and experimental data. Hypothetical settings can be used to great effect to hold background information constant while focusing analyses on the directional effects of carefully manipulated variations, as in Hodge et al. (2006), Devers et al. (2007), or our experimental complement. However, as Libby et al. (2002, 798) note, "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 subjective valuations) 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. By examining "real-world" data—*actual* employees' subjective valuations of their *own* current stock options holdings—we can better estimate the underlying distribution of subjective valuations.

We further contribute by empirically examining the process by which a stock option education program influences employees' subjective valuations. A recent survey finds that employee communications regarding equity plans is one of the most challenging aspects of offering equity compensation, after compliance and administration (PricewaterhouseCoopers 2005). This difficulty 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). In our archival data set, employee recipients provide subjective valuations for their personal stock option holdings both *before* and *after* completing a stock option education program that describes how stock options operate and clearly quantifies the Black-Scholes proxy for the cost of the employees' current options. Our experiment replicates and separates these components of the education program (via experimental manipulations) to isolate their impact on individuals' subjective valuations. The experiment data also provides additional insights into the heuristics individuals use to arrive at their valuations.

Our results have notable implications for current compensation practices as well. 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 managing the gap between employees' subjective valuation of stock options and the firm's opportunity cost of those options (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 programs) aimed at increasing the values employees place on their options. Firms could consider emphasizing the value of options employees would forfeit upon leaving as a means of increasing retention benefits.

The remainder of this paper is organized as follows. Section II develops our hypotheses. Sections III and IV describe the archival data and results of analyses for these data, respectively. Sections V and VI describe the experiment design and results of analyses for these data, respectively. Section VII concludes.

II. 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). Conceptually, firms that grant ESOs do so, at least in part, because of an assumption that these benefits exceed the firm's opportunity cost of instead issuing similar options to the capital markets—in other words,

[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 evidence indicates that Statement 123(R) has not reduced the number or value of options issued by the average publicly-traded company (Hulbert 2006), while other evidence suggests that CEO option grants have decreased but stabilized over the last two years (Mercer Human Resource Consulting 2006b). Even if firms have reduced option grants, the majority of firms sampled in recent research still grant options (Brown and Lee 2006; Carter et al. 2007, Table 4; Culpepper and Associates, Inc. 2006, 2007; Equilar 2006; Mercer Human Resource Consulting 2007).

the firm's incentive "benefit-cost gap" is positive (see Figure 1, Firm-level constructs).

Naturally, a necessary condition for firms to reap benefits from employee stock options is that *employees* value their options and, in turn, are incentivized to change their behaviors in ways that also benefit the firm. Evidence indicates that changes in behavior are associated with the value employees place on ESOs—the higher employees' subjective valuations, the higher their motivation, job satisfaction, and commitment to their firms, and the lower their likelihood of leaving (Ledford et al. 2004; National Center for Employee Ownership 2005).[2] Thus, the incentive benefit of stock options is driven in part by the subjective value employees place on those options (see Figure 1, Employee-level Constructs and the link between "Employee's Subjective Valuation…" and "Firm's Benefits…"), with higher subjective valuations resulting in greater incentive benefit per dollar of incentive cost. Indeed, failure to understand and manage ESO subjective valuations may lead to inefficient use of ESO compensation (Hall 2003, 22).

Yet, we know little about how employee recipients subjectively value ESOs, which may contribute to the general lack of understanding regarding the individual and firm performance effects of ESOs (Ittner et al. 2003). With data availability representing a substantial research obstacle (Core and Guay 2002; Devers et al. 2007), empirical research that examines the value employees place on ESOs is limited in scope, and the existing literature presents mixed results.

One line of research suggests that employees' subjective valuations of ESOs are *below* firms' opportunity costs. To obtain benefits from ESOs, firms restrict the trading and hedging activities of employees who receive them (with, for example, vesting provisions). Because this is not the case for options issued to capital markets, economic theory argues that undiversified and risk-averse employees' subjective valuations should fall below the firm's opportunity cost, which

[2] We provide additional evidence on this association in supplemental analyses.

may lead to a negative benefit-cost gap (Lambert et al. 1991; Hall and Murphy 2002). For example, using analytic modeling, Hall and Murphy (2002, Table 1) compute numeric estimates for employee valuations that range from 2% to 72% of the firm's opportunity cost, with the majority being between 30% and 70%.[3] Consistent with this, a web-based survey of 400 respondents conducted by Watson Wyatt Worldwide (2004) finds that employees value ESOs at 50%-70% of the corresponding opportunity costs. Using publicly available data, Armstrong (2007) and Armstrong et al. (2007) infer subjective valuations of employee stock options from the option exercise patterns of employee recipients. They use these "revealed preferences" to estimate option values ranging from 55%-75% of the corresponding opportunity costs.[4]

In contrast, other research suggests that employees' value options *above* firms' opportunity costs. A survey of 122 *Knowledge@Wharton* readers by Lambert and Larcker (2001) reports that employees' subjective valuations are significantly higher than firms' opportunity costs. They conclude that this is based, in part, on "unrealistic expectations as to what will happen to the stock price." Hodge et al. (2006) and Devers et al. (2007), studying executive education and MBA students, report similar findings. Hodge et al. (2006) suggest that "optimistic" managers extrapolate recently rising stock prices to ESO values, and thus that their result reflects firm sorting practices aimed at identifying optimistic employees. Devers et al. (2007) attribute their findings to loss aversion and an endowment effect.

Although other option pricing tools are available, these prior papers all estimate the firm's

[3] Similarly, Meulbroek's (2001, 6) estimates range from 53% to 70%. Ikaheimo et al. (2006) analyze the market trading of ESOs on the Helsinki Stock Exchange and find that valuations are, on average, 85% of the corresponding Black-Scholes cost. This likely represents an upper limit because, to be included in their sample, the ESOs must have been both vested and transferable.

[4] Employees commonly exercise their ESOs well before expiration and thus do not capture the full value (see, e.g., Bettis et al. 2005; Huddart 1994; Huddart and Lang 1996), 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 divergence between perceptions of value and cost (e.g., Hallock and Olsen 2006).

opportunity cost of issuing ESOs using the Black-Scholes model.[5] In this paper, we also investigate employees' subjective valuations of ESOs and similarly apply the corresponding Black-Scholes value as our proxy for the firm's opportunity cost of issuing ESOs to measure the "valuation-cost gap" (see Figure 1, Measurement). In applying Black-Scholes as the empirical proxy for firm cost, we do not argue that the Black-Scholes model (or, for that matter, any other particular option pricing method) provides the "right" ESO value from the employee perspective. Rather, we assume that such tools provide a reasonable estimate of the level of ESO valuations above which the benefit-cost gap may become positive. We also hold constant this aspect of the research design between our and these prior studies as we investigate a potential source for some of the conflicting results within the prior studies.

Specifically, we argue that the conflicting results of the prior empirical studies may be driven in part by differences in employees' knowledge of the sources of value inherent in options and of how to quantify those sources of value. ESOs are complex financial instruments, so much so that many employees find it difficult to assess their value (Hall 2000; Hallock and Olson 2006; Hill and Stevens 2002). Hall (2000, 123) notes that "stock options are bafflingly complex financial instruments. They tend to be poorly understood by both those who grant them and those who receive them." Hallock and Olson (2006, 7) echo this sentiment:

> While there are strong theoretical reasons to believe economically rational employees will value their options at less than their [Black-Scholes value], in practice employees

[5] Notwithstanding numerous 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; see also Hall and Murphy 2002). For example, Maris et al. (2003, 672) found that 98.6% of S&P 100 firms reported using the Black-Scholes model for expensing options in their 1996 fiscal year, and Culpepper and Associates, Inc. found that 87% (2006) and 97% (2007) of companies surveyed did so. Arguably the method used to communicate with employees about ESO value may be a more appropriate benchmark. However, the limited evidence that exists suggests many firms use the Black-Scholes model for employee communications as well. For example, Culpepper and Associates found that nearly all (2006) and 80% (2007) of surveyed companies that use Black-Scholes for financial reporting also use the model for employee communications, while 22.5% of new economy firms in Ittner et al.'s (2003) sample use Black-Scholes for employee communications.

> may have great difficulty using Black-Scholes as a benchmark in their personal valuations because of the limited information employees have about the option market and option valuation theory…Without market information, it is unlikely the typical employee will be knowledgeable about option pricing theory or able to solve an option pricing problem that won a Nobel Prize in economics for Merton and Scholes.

We posit that the majority of employees will generally lack knowledge of ESOs. As such, they are likely to use simple heuristics to form their subjective valuations (e.g., that ESOs have no value until vested or exercised, or that their value is simply their current intrinsic value—that is, the current stock price less the exercise price), which in general result in subjective valuations that are below the firms' opportunity costs.

H1: Employee subjective valuations of ESOs will be *lower than* the firm's corresponding opportunity cost.

However, employees can gain knowledge of ESOs through, for example, formal education provided by their employers. Prior research documents that learning opportunities for decision-makers 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). Both Lambert and Larcker (2001) and Hill and Stevens (2002) suggest that firms can influence employees' perceptions of ESO value by implementing education programs designed to increase their knowledge of ESOs. Accordingly, we predict that stock option education programs that descriptively explain how ESOs operate and what their sources of value are, and that clearly articulate the quantitative value of the employees' options using credible valuation tools, will increase employees' subjective valuations of ESOs. As a general consequence, subjective valuations will increase (see Figure 1, Employee-level constructs).

H2: Employees' subjective valuations of their ESOs will *increase* following the completion of an ESO education program.

Prior research findings that employees value options higher than firms' opportunity costs

(Hodge et al. 2006; Devers et al. 2007) may be due, in part, to participants in these studies having had such learning opportunities prior to the time data was collected, either via formal education or via the research materials used. With respect to formal education, 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 also MBA students. To the extent these participants had recent exposure to formal education on options in general and/or ESOs in particular (which may have included not only option pricing theory but also quantitative examples of option pricing computations), they will be more knowledgeable about option valuation when participating in these studies. With respect to the research materials, 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 education" setting when they provided their subjective ESO valuations. In contrast, it is unlikely that the majority of employees have had such recent education, and many may have limited or no formal financial education of any kind. In our experiment complement, we recruit graduate business students, but we conduct our study before the students' current coursework includes formal coverage of option pricing models and ESOs.

Prior research also suggests that optimism regarding future stock price performance may partially explain findings of subjective valuations that exceed Black-Scholes cost (Lambert and Larcker 2001; Hodge et al. 2006). While not the primary focus of our study, we examine whether subjective valuations are driven by optimism in supplemental analyses of our experiment.

III. Archival Research Design

Our proprietary archival data is obtained from the confidential data files of Net Worth Strategies, Inc. (NWSI), a national provider of equity compensation planning services. NWSI provides ESO analysis software and educational services aimed at enabling companies and individuals to maximize the value of equity compensation.

Our data comes from ESO training programs conducted by NWSI from September 2004 through March 2006 at five client sites, hereafter Companies A through E.[6] Although NWSI collects from the client companies detailed information about each employee recipient's current ESO holdings (i.e., all ESOs that remain unexpired and unexercised), we only have access to aggregate values due to confidentiality constraints. We have also been granted only limited descriptions of the client companies and the employee recipients. The client companies have market capitalizations ranging from $330 million to over $15 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 generally compensated in the top 10% of all employees in their company.

Figure 2 provides an overview of the steps involved in NWSI's training program and the data obtained during each step. As a mandatory part of training pre-registration, employee recipients provide selected financial information, confirm or modify the Black-Scholes inputs (i.e., current stock price, volatility, dividend yield, and risk-free rate),[7] and complete a six-question Stock Option Survey on which employee before-training perceptions of ESO value,

[6] NWSI introduced its training product in 2003 and 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 further release of data.
[7] NWSI collects Black-Scholes inputs from a client-company representative. These values are provided as "default" values in registration, although employees can change the values from those listed. Of the 214 employee recipients in the sample, 15 changed the default values, and NWSI used the employee-provided values in computations. Therefore, NWSI computations are consistent with employee recipients' expectations for the Black-Scholes inputs.

among other measures, are captured (see Appendix A). After an employee recipient registers and within two weeks prior to the scheduled training session, NWSI prepares an *individualized* "Equity Compensation Profile Report" (hereafter, Profile Report; see Appendix B for relevant excerpts) using each employee's personal data.

The training session itself consists of an interactive group seminar, approximately 60-90 minutes in length. At the session, each employee recipient receives his/her individualized Profile Report. The instructor explains fundamentals about stock option valuation, leverage, risk, taxation, planning strategies, and considerations for exercising options, referring to employee recipients' Profile Reports as the session progresses. Lastly, employee recipients are asked to complete a second copy of the same Stock Option Survey (Appendix A) completed before training and an anonymous training evaluation form.

IV. Results for Archival Data

Variables for Archival Data

Table 1 summarizes the variables for both the full sample and a matched subsample of employee stock option recipients for whom we have both before- and after-training responses to the Stock Option Survey. Throughout, the subscripts *BT* and *AT* refer to employee recipients' ESO subjective valuations before training and after training, respectively; the subscript *BS* refers to the firm's corresponding Black-Scholes cost for those options. Table 1, Panel A lists the number of observations by client company, Panel B includes descriptive statistics for dependent variables used in hypothesis tests, Panel C includes descriptive statistics for other employee-level variables, Panel D includes the means and standard deviations for company-level inputs into the Black-Scholes model, and Panel E lists the variable definitions.

Our primary dependent measure is $Ratio_{(BT\ or\ AT)}$, which measures the divergence between

the employee recipient's subjective valuation of ESOs and the firm's opportunity cost—that is, the "valuation-cost gap" (see Figure 1, Measurement). $Ratio_{BT}$ is computed as $Forfeit_{BT}$ / $Forfeit_{BS}$, where $Forfeit_{BT}$ is the employee-reported value of stock options and restricted stock forfeited if he/she decided to leave his/her company immediately (Appendix A, Question 6), and $Forfeit_{BS}$ is the computed Black-Scholes cost of stock options and restricted stock forfeited (i.e., the total Black-Scholes cost less any intrinsic value for vested items, which would not be forfeited).[8] A $Ratio_{BT}$ of less than one indicates that employee recipients' subjective valuations are lower than the firm's cost (i.e., a discount), while a value greater than one indicates that subjective valuations are greater than cost (i.e., a premium). Similarly, we compute $Ratio_{AT}$ and then the *Change in Ratio* from before to after training ($Ratio_{AT}$ - $Ratio_{BT}$).

To supplement these analyses, we also assess how close employee recipients' subjective valuations are to the firm's 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, $|Forfeit_{BT} - Forfeit_{BS}| / Forfeit_{BS}$). The higher the value of $AbsDev_{BT}$, the further away subjective valuations are from the firm's Black-Scholes cost. Similarly, we compute $AbsDev_{AT}$ and then the *Change in AbsDev* from before to after training ($AbsDev_{AT}$ - $AbsDev_{BT}$).

Tests of Hypothesis 1 – Empirical Estimation of Before-Training Subjective Valuations

H1 predicts that employee recipients' subjective valuations before training will be lower than the firm's corresponding Black-Scholes costs (i.e., $Ratio_{BT} < 1$). As seen in Figure 3, the distribution for $Ratio_{BT}$ is asymmetric (heavily skewed with heavy tails) with a zero minimum but an unbounded maximum value. Therefore, we first describe and test the distribution of $Ratio_{BT}$, then apply non-parametric tests to estimate the central tendency.

[8] Although included in the elicitation question, restricted stock primarily affects only one client company. Our inferences are unchanged if we omit from the analysis employee recipients who report restricted stock ownership.

We find strong evidence of a negative valuation-cost gap. Overall, 162 of the 214 recipients (75.7%) value their ESOs *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 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.[9]

Consistent with the results for $Ratio_{BT}$, analyses of $AbsDev_{BT}$ show that ESO subjective valuations are significantly different than cost. The distribution for $AbsDev_{BT}$ is also asymmetric (not reported), so we apply non-parametric tests to estimate the central tendency. The median $AbsDev_{BT}$ of 0.752 represents a statistically significant deviation of subjective value from cost ($p < 0.001$, one-sided signed rank test of the median = 0; Table 2, Panel A).

We also examine the cross-sectional determinants of subjective valuations before training (and after training below) by regressing $Forfeit_{BT}$ on characteristics of the employee recipients and their ESO holdings (Table 2, Panel B): the self-reported percent of personal investment assets held in company equity ($Concentration_{BT}$), the percent of ESOs vested (*PctOptionsVested*) and in-the-money (*PctOptionsITM*), the number of years ESO grants have been received (*Years*), and the Black-Scholes forfeit value ($Forfeit_{BS}$). We use $Forfeit_{BT}$ as the dependent variable (instead of $Ratio_{BT}$) and include $Forfeit_{BS}$ as an independent variable to investigate the mapping of the Black-Scholes value into subjective valuations (i.e., the coefficient on $Forfeit_{BS}$). We also report results for this model (Model 1) extended to include the employee recipients' self-reported tax rate (*TaxRatePct*; Model 2), but by doing so we lose 25 observations due to missing data.

[9] The median $Ratio_{BT}$ is less than one in all companies but not significantly so in Companies B and C. Interviews with NWSI representatives reveal that, for these companies, some employee recipients received prior exposure to the Profile Report. This likely contributes to the lack of significant results for these two companies (i.e., the before-training exposure may foreshadow the effects of training). Further, NWSI noted that a number of recipients from Company B were informed they would no longer be receiving stock options. Excluding recipients from Company B and C has no effect on inferences from our hypothesis tests.

The models are estimated with a tobit (Tobin 1958) regression to adjust for left-censoring of the data (i.e., zero subjective valuations) and p-values are computed using robust standard errors.

We find that, before training, $Concentration_{BT}$ ($p < 0.01$ and $p < 0.05$ for Models 1 and 2, respectively) and *PctOptionsVested* ($p < 0.05$ and $p < 0.10$, respectively) are positively associated with ESO subjective valuations; *PctOptionsITM*, *Years*, and *TaxRatePct*, however, are not significantly associated with subjective valuations. The coefficient on $Forfeit_{BS}$ (0.32 and 0.35 for models 1 and 2, respectively, $p < 0.01$ in both models) indicates that, before training, a dollar of Black-Scholes value translates to approximately 35 cents of value as subjectively determined by the recipient. Overall, the explanatory power of the independent variables (i.e., Adjusted R^2) for a comparable OLS regression is 27% and 26% for Models 1 and 2, respectively.

Overall, archival results are consistent with H1. In general, employees have a tendency to value their ESOs lower than the firm's corresponding Black-Scholes opportunity cost. Valuations before training appear to be driven more by employees' wealth diversity (or lack thereof) and whether the options are vested, and less by the fundamental drivers of stock option value as captured by Black-Scholes (and whether the option is in-the-money).

Tests of Hypothesis 2 – Effects of ESO Training on Subjective Valuations

H2 predicts that employees' subjective valuations of ESOs will increase after training (i.e., the *Change in Ratio* will be positive). Consistent with H2, employee recipients' subjective valuations are significantly higher after training.

For the 126 recipients for whom we have after-training data, Figure 4 shows the distribution for $Ratio_{BT}$ and $Ratio_{AT}$.[10] The number who value their stock options and restricted

[10] Of the 214 recipients in the full sample, we have post-training data for 126. To address potential self-selection biases, we note that the drop-out rate does not vary with whether the recipient's subjective valuation was less (41.4%) or more (40.4%) than the corresponding Black-Scholes cost before training ($p = 1.0000$ under Fisher's

(Cont'd)

stock forfeited upon leaving the company *less than* the corresponding Black-Scholes cost drops from 95 (75.4%) before training to 54 (42.9%) after training, while the number who value the options *greater than* the cost increases from 31 (24.6%) before training to 72 (57.2%) after training (Table 2, Panel C).

Of the 126 employee recipients, *Ratio* increases after training for 90 (71.4%), and *AbsDev* decreases for 83 (65.9%) (Table 2, Panel D). The median $Ratio_{AT}$ is 1.000 (i.e., approximately equal to Black-Scholes cost), compared to 0.376 before training; this increase is statistically significant (median *Change in Ratio* = +0.671, $p < 0.001$ for a signed-rank test). Likewise, the median $AbsDev_{AT}$ is 0.268, compared to 0.752 before training; this decrease is statistically significant (median *Change in AbsDev* = -0.354, $p < 0.001$ for a signed-rank test). Overall, our results are consistent with H2, and indicate that the before-training valuation-cost gap of H1 is caused in part by a lack of ESO knowledge, which is addressed during training.[11]

We also find that training differentially affects the subjective valuations of employee recipients who value options at a discount versus a premium before training. Of the 95 employee recipients who valued at a discount before training, 80 (84.2%) increase their subjective valuations while only 7 (7.4%) decrease their subjective valuations after training (eight others, 8.4%, remain unchanged). In contrast, of the 31 recipients who valued at a premium before training, 21 (67.7%) decrease their subjective valuations while the other 10 (32.3%) increase their subjective valuations after training. The tendency for employee recipients who discount

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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 ($\chi^2_1 = 0.511$, $p = 0.475$, two-sided Kruskal-Wallis test of a difference in medians).

[11] After-training, employee recipients show some tendency to apply a valuation premium relative to the Black-Scholes cost (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 significant mean premiums when the data are winsorized at the extreme 1% and 5% of observations (both $p < 0.01$ two-sided).

ESOs before training to *increase* their subjective valuations after training is significantly stronger than the tendency for those who place a premium on ESOs before training to *decrease* their subjective valuations after training ($p < 0.001$, Fisher's Exact Test).

Table 2, Panel B, Models 3 and 4 examine the cross-sectional determinants of subjective valuations after training. Consistent with the before-training results (Models 1 and 2), $Concentration_{BT}$ ($p < 0.01$ for both Models 3 and 4) and *PctOptionsVested* ($p < 0.05$ for Model 4) are positively associated with ESO subjective valuations after training. In addition, *TaxRatePct* is negatively associated with ESO subjective valuations after training ($p < 0.01$). The coefficient on $Forfeit_{BS}$ (1.24 and 1.32 for Models 3 and 4, respectively, $p < 0.01$ in both models) indicates that, after training, a dollar of Black-Scholes value translates to approximately $1.30 of value as subjectively determined by the recipient. Thus, fundamental drivers of stock option value as captured by Black-Scholes have a greater impact on subjective valuations after training (before- to after-training differences are significant at $p < 0.01$). Further, the explanatory power of the independent variables increases from 27% (26%) in a comparable OLS model without (with) tax rate before training to 57% (60%) after training, providing additional evidence that concepts highlighted during training significantly affect subjective valuations.[12,13]

Supplemental Analysis – Firm Benefits from Granting ESOs

We examine whether employees' subjective valuations of ESOs are positively associated

[12] Training also increases employee recipients' confidence in their financial decision-making with respect to their option holdings. *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 and Table 1, Panel C). Mean and median increases are +0.9 and +1.0 on the five-point scale (both $p < 0.001$).

[13] The anonymous post-training evaluation form (i.e., not matched to employee recipients) 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. Respondents also strongly indicated a desire for updated reports, with all but one 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.

with their desire to remain with their firm and their motivation—the link from employee ESO valuations to firm benefits from granting ESOs proposed in the hypothesis development (Figure 1). To do so, we examine correlations between $Ratio_{BT}$ and employee recipients' self-reports of whether ESOs encourage loyalty and increased work effort. *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). *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). Agreement is assessed on five-point scales, with 1 = *strongly disagree* to 5 = *strongly agree* after reverse scoring (see Table 1, Panel C for descriptives).

As expected, we find significant positive associations between $Ratio_{BT}$ and both $Loyalty_{BT}$ and $Motivation_{BT}$ (Spearman r = 0.17 and 0.09, $p < 0.01$ and 0.10, one tailed, respectively). Further, training increases not only *Ratio*, as reported for H2, but also *Loyalty* and *Motivation*. Despite a likely ceiling effect because the majority of employee recipients agree with the statements about motivation and loyalty before training, we find significant increases in agreement after training (for *Loyalty*, mean increase = +0.2, p = 0.038 and median increase = +0.0, p = 0.063; for *Motivation*, mean increase = +0.2, p = 0.042 and median increase = +0.0, p = 0.078). Although these results do not allow us to draw conclusions about whether higher subjective valuations lead to higher retention and motivation or vice versa, they do provide evidence of a significant employee valuation-firm benefits association.

V. Experiment Research Design

Because the archival data offers limited insights into *how* employees form estimates of value and *how* training changes those value estimates, we conduct an experiment that replicates

selected components of the training program offered by NWSI. 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 their graduate programs. Our use of graduate business students as proxies for ESO recipients is consistent with Hodge et al. (2006) and Devers et al. (2007). However, as previously discussed, we conduct our experiment before the students' current coursework includes formal coverage of option pricing models and ESOs.

We use a 2 x 3 (between-subjects) x 4 (within-subjects) experimental design. Between subjects, we manipulate whether experiment participants do (*present*) or do not (*absent*) receive the detailed 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 also manipulate the explicit quantitative 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*); we use this third level to test whether optimism about future stock prices has an effect on subjective valuations. Within subjects (Appendix C, Panel C), we ask participants to consider hypothetical ESO grants that would be forfeited if they left the company, and to provide subjective valuations for these grants four times: *before training* for an original grant, and then *after training* for the original grant, for the original grant assuming two years had passed (*updated grant*), and for a *new grant*. For the *updated* and *new grants*, no explicit option values are provided regardless of experimental condition, which allows us to test whether employees extrapolate knowledge gained during training to ESOs with different terms.

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. As participants reported to the experiment site, they were randomly assigned to experimental conditions.

In Envelope A, participants read a general 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. Participants were then asked to again estimate the forfeit value of the same hypothetical grant (*after training*). In Envelope C, participants were given details of the *updated* and *new grants* and were asked to estimate their forfeit values. For these grants, no explicit option values were provided, regardless of experimental condition, and participants did not have access to the description of the Black-Scholes model or explicit option values for the original grant. In Envelope D, participants answered questions about their beliefs about likely future stock prices, factors that were important in their ESO valuations (Appendix C, Panel D), beliefs about how employees *should* value ESOs (Appendix C, Panel E), knowledge, and other demographic characteristics. Experiment participants received cash compensation of $15, and took approximately 45 minutes to complete the task.

VI. Results for Experiment Data

Variables for Experiment Data

The measured variables for the experiment are consistent with those for the archival data. $Forfeit_{(BT\ or\ AT)}$ is a participants' self-report of ESO value forfeited if he/she left the hypothetical employer today. We compute the Black-Scholes cost of the hypothetical grant, $Forfeit_{BS}$, and

measure the divergence between the cost and subjective valuation with $Ratio_{(BT\ or\ AT)}$, computed as $Forfeit_{(BT\ or\ AT)}$ / $Forfeit_{BS}$. We compute the *Change in Ratio* relative to $Ratio_{BT}$. Similarly, we compute $AbsDev_{(BT\ or\ AT)}$ as the absolute value of the difference between $Forfeit_{(BT\ or\ AT)}$ and $Forfeit_{BS}$, divided by $Forfeit_{BS}$, and then compute the *Change in AbsDev* relative to $AbsDev_{BT}$. We compute similar measures for the *updated grant* and the *new grant*, with all changes computed relative to before-training subjective valuations.

For our replication of H1 and H2, we analyze subjective valuations for all experiment participants (pooled across between-subject conditions) and report before-and-after subjective evaluations. However, as in the archival data, the effect of training on subjective valuations differs for experiment participants who valued options at a discount versus a premium before training ($F = 3.28$, $p < 0.01$, two-tailed), so we present descriptive statistics and additional analyses for these groups separately. Consistent with the archival data, experiment participants' subjective valuations of ESOs are not normally distributed, so we examine medians and apply non-parametric statistics.

Descriptive statistics for *Ratio* and *AbsDev* are in Table 3, Panel A. Figure 5 shows the distributions for *Ratio* for the full sample before training (Panel A) and after training for the original, updated, and new grants (Panels B, C, and D, respectively). Figure 6 provides a graphical representation of the median *Ratio* (Panel A) and *AbsDev* (Panel B) for all four grants by condition and by before-training discount or premium.

Replication of Hypothesis 1 – Empirical Estimation of Before-Training Subjective Valuations

We find strong evidence of a negative valuation-cost gap before training. Of 192 experiment participants, 124 (64.6%) value the ESOs *lower* than the corresponding Black-Scholes cost (Table 3, Panel A). The median $Ratio_{BT}$ of 0.557 (i.e., a discount of 44.3%)

represents a statistically significantly discount ($p < 0.003$, one-sided signed rank test of the median < 1). Consistent with these results, the median $AbsDev_{BT}$ of 0.443 is significantly different than zero ($p < 0.001$, one-sided signed rank test of the median = 0). Thus, in our experiment, we successfully replicate the results for H1 from the archival data, providing additional evidence that employees' subjective valuations of their ESOs is lower than the firm's opportunity cost when the employee has limited knowledge about options.[14, 15]

Replication of Hypothesis 2 – Effects of Stock Option Training on Subjective Valuations

With respect to H2, as in the archival data, we find a significant increase in subjective ESO valuations after training. Increases are observed for the original grant as well as the *updated* and *new* grants.

For the original grant, the median $Ratio_{AT}$ is 1.000 (Table 3, Panel A), an increase over the median $Ratio_{BT}$ of 0.557. The median *Change in Ratio* is statistically significant ($p = 0.088$, one-sided signed-rank test). Consistent with these results, the absolute deviation of value from cost is significantly affected by training (median $AbsDev_{AT} = 0.432$). The median *Change in AbsDev* of -0.053 is of a smaller magnitude than in the archival data (-0.354), but it remains statistically significant ($p < 0.001$, signed-rank test).[16]

[14] Recall that participants' before-training subjective valuations are collected prior to any of our experimental manipulations. Therefore, we confirm that the before-training proportion of participants whose subjective valuations were below versus above the Black-Scholes value 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, $p = 0.240$).

[15] 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 providing lower before-training values than MBA students ($p=0.057$ for the median $Ratio_{BT}$; $p=0.033$ for the proportion of participants who discount before training). This finding partially reconciles our result to prior research that documents a premium among MBA experiment participants (Hodge et al. 2006; Devers et al. 2007). 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 discount before training).

[16] Results for before-to-after changes in *Ratio* and *AbsDev* are similar if we exclude participants in the *absent-no values* experiment condition who in essence received no training.

For the *updated* and *new grants*, recall that no explicit option values were provided regardless of experimental condition, and participants did not have access to either the description of the Black-Scholes model or the explicit option values provided for the original grant. Thus, any training effects observed with these grants are particularly striking, as this provides evidence that experiment participants carry knowledge gained about a given ESO grant (i.e., the original grant) to grants with different terms (i.e., the *updated* and *new grants*).

The median *Ratio*s for the *updated* and *new grants* are 0.779 and 0.871, respectively (Table 3, Panel A). Both are larger than $Ratio_{BT}$ of 0.557, and the increases in *Ratio* from before training to the *updated* and *new grants* are significant (median *Change in Ratio* of +0.151 and +0.080 for the *updated* and *new grant*, respectively, both p = 0.001, one-sided signed-rank test).

The median *AbsDev* for the *updated* and *new grants* are 0.292 and 0.485, respectively (Table 3, Panel A). The median *Change in* $AbsDev_{BT}$ for the *updated* and *new grants* is negative and significant (median *Change in AbsDev* of -0.151 and -0.050, $p < 0.001$ and $p < 0.05$ for the *updated* and *new grant*, respectively, one-sided signed-rank test).

Overall, as with the archival data, results provide support for H2: training significantly increases ESO subjective valuations. Further, while experiment participants partially revert to their before-training subjective valuations for grants different from the one discussed during training, the subjective valuations for these grants remain significantly higher than before-training values. Thus, participants appear to be able to apply knowledge gained during training to ESOs with different terms.

Supplemental Analysis – Effects of Manipulations on the Valuation-Cost Gap

We now turn to the effects of our experimental manipulations on changes in subjective valuation for participants who value their options at a discount versus a premium before training

(Table 3, Panel A and Figure 6). Analyses use percentile ranks of *Change in Ratio* and *Change in AbsDev* to minimize the influence of extreme observations.

We expect that receiving either a description of the Black-Scholes model or the quantitative Black-Scholes option values for the original grant 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 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 subjective valuations. The explicit Black-Scholes values provide a quantification of how the ESO's terms translate into value in the model. Following this reasoning, we expect that both manipulations should decrease *AbsDev* (i.e., move subjective valuations closer to the Black-Scholes cost) for all participants.

While the effect of the Black-Scholes description is expected to extend to the updated and new grants, the effect of the quantitative Black-Scholes values may be lessened for the updated and new grants because the explicit values for the original grant must be extrapolated to grants with different terms. Further, 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 think about the impact of future stock price increases, inducing optimism about future ESO values.

We begin by analyzing *before* to *after training* changes for the original grant (see Table 4, Panel A for an ANOVA and Table 4, Panel B for planned contrasts). Results indicate that the effect of receiving a description of the Black-Scholes model during training is not symmetric. As expected, the 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 description had no significant effect on the valuations 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 is consistent with the differential effects of training observed in the archival data for employee recipients who valued options at a discount versus a premium before training, and with the idea that those who value options at a premium before training are already incorporating some components of ESO value into their subjective valuations while those who initially discount their options are not.

Results also indicate that, as expected, receiving quantitative 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, there is no significant incremental effect of receiving a table of ESO values for hypothetical stock prices (*current+table*) beyond receiving only the current values (*current*) (all $p > 0.10$).

We next analyze the *Change in Ratio* from before to after training for the *updated* and *new grants* (Table 5, Panels A and B, respectively). As with the original grant, we find no significant effects in the *current+table* condition beyond those in the *current* condition, so we report results for the *updated* and *new grants* collapsed across these conditions. In general, the effects of receiving the Black-Scholes model description on subjective valuations are largely the same as for the original grant—the description significantly increases subjective valuations of

experiment participants who discount their options before training, but has no effect on the valuations of those who value options at a premium before training. This again is consistent with those participants who value at a premium before training having already incorporated this information into their subjective valuations, while those who discount before training having not. The effects of receiving quantitative option values for the original grant largely extend to subjective valuations for the *updated grant* but have little effect on valuations for the *new grant*. Thus, providing a description of the Black-Scholes model during training appears to have more lasting effects on the formulation of subjective valuations than does providing quantitative Black-Scholes values.

Supplemental Analysis – Optimism

As noted in the hypothesis development, Hodge et al. (2006) attribute their findings of a premium to participants' optimism regarding future stock price performance. Their design choice to provide their participants with a Black-Scholes benchmark in their experimental materials may mimic the real-world effects of providing employees with the intrinsic and Black-Scholes values for their own ESOs during ESO training. Thus, Hodge et al.'s (2006) observed valuation premium may imply that their participants consciously decided to demand more than the Black-Scholes 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 an understanding of credible methods that can be used to value ESOs, then their net subjective valuations may still be lower than the corresponding Black-Scholes cost, as in our before-training data. We posit that training and the availability of a benchmark reduces the noise in subjective valuations 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 participants' expectations for the hypothetical company's stock price in five years (a post-task question, with higher values indicating greater optimism). We find no significant rank correlation between optimism and $Ratio_{BT}$ (p = 0.272) or the *Change in Ratio* from training (p = 0.250). However, we find a significant positive rank correlation between optimism and after-training valuations ($Ratio_{AT}$, *updated* and *new grants*, p = 0.008, 0.014 and 0.002, respectively). This is consistent with training helping to reduce noise in subjective valuations so that the impact of optimism can be observed.[17]

Supplemental Analysis –Valuation Heuristics

We examine the heuristics experiment participants use in arriving at their subjective valuations. To do so, we identify four heuristics that would result in particular intuitive subjective valuations: 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 (see Figure 5). We compare before- and after-training heuristics applied and examine whether the applied heuristics are associated with participants' self-reports of information used in their subjective valuations (obtained in post-task questions).

The first columns of Table 6, Panel A, report the before-training use of heuristics. As expected, the heuristics participants use in their before-training subjective valuations 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%) (Figure 5, Panel A). The majority of

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

participants (110 of 192, or 57.3%) use a heuristic that results in a valuation of less than an approximate Black-Scholes value, consistent with the reasoning for H1. Interestingly, 23 (12.0%) participants use the stock price heuristic, another simple valuation method but one that results in valuations that are higher than cost.

The remaining columns of Table 6, Panel A corroborate results for H2 by reporting changes in the use of heuristics after training. 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%) (Figure 5, Panel B). Thus, participants move away from the use of simpler valuation heuristics (i.e., zero value, intrinsic value, and stock price).

Table 6, Panel B reports the frequency and percentage of participants in each heuristic classification for each ESO valuation question—before training, after training, updated, and new grants. Results indicate that participants move away from the use of simple valuation heuristics (zero value, intrinsic value, and current stock price) after training, as well as from heuristics that result in subjective values lower than Black-Scholes (consistent with H2).

Table 7 provides participant-reported evidence of factors that influenced participants' subjective valuations. 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 valuations (Appendix C, Panel D). Table 7, 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 heuristic 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 7, Panel B; see Appendix C, Panel E for questions).

Finally, Table 7, 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 subjective valuations. 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 subjective valuations.

VII. Conclusion and Directions for Future Research

Complementing unique archival data from a national provider of equity compensation planning services with experimental data, we compare employees' subjective valuations of their ESOs to a Black-Scholes benchmark. Doing so allows us to not only provide an estimate of the *level* of the valuation-cost gap for actual ESO recipients both before and after they have completed an ESO education program, but it also allows us to focus on *how* education changes employees' subjective valuations. Importantly, this enables us to address conflicting evidence on the valuation-cost gap from prior studies by presenting evidence of the effects of ESO knowledge on subjective valuations (Lambert et al. 1991; Lambert and Larcker 2001; Hall and Murphy 2002; Watson Wyatt Worldwide 2004; Hodge et al. 2006; Devers et al. 2007).

With the archival data, we find a significant difference between employee recipients' subjective valuations of their ESOs and the corresponding Black-Scholes costs, with 76% of

recipients' subjective valuations *lower than* the Black-Scholes costs. Consistent with this finding, 65% of graduate business student participants in our experiment value a hypothetical ESO lower than its Black-Scholes cost.

After completion of a stock option education program that describes how ESOs operate and quantifies the Black-Scholes values of the ESOs, we find that perceptions of value increase. For a matched subsample of employee recipients in the archival data, we find a statistically significant increase in subjective valuations of ESOs after training, with the majority (84%) of the employee recipients who valued options lower than the Black-Scholes cost before training increasing their valuations after training. We no longer find significant evidence that employee recipients discount their subjective valuations relative to the Black-Scholes cost after training, suggesting that investments in employee education can significantly increase employee subjective valuations of ESO value.

We replicate these after-training findings with our experiment, in which we also examine the differential effects of components of the training program. We find that providing a description of the Black-Scholes model seems to have more lasting effects on the formulation of subsequent subjective valuations than does providing quantitative Black-Scholes option values.

The results presented in this paper provide evidence that knowledge differences can in part explain the conflicting evidence on employees' subjective valuations of ESOs in prior studies. However, our evidence also indicates that subjective valuations are affected by more than knowledge alone. Even when explicitly presented with the Black-Scholes value of ESOs, we note that the majority (approximately 2/3^{rds}) of employees in the archival data and of participants in the experiment who were provided the Black-Scholes value report subjective valuations that nevertheless *differ* from the Black-Scholes value. We provide evidence that subjective valuations

are associated with employees' concentration of wealth in company equity, vesting, tax rates, and optimism about future stock prices. Our understanding of employees' ESO subjective valuations can benefit from further research on the effects of these and other factors.

This paper has several limitations that present opportunities for future research. First, economic theory (e.g., Lambert et al. 1991; Hall and Murphy 2002) posits that characteristics of the employees who receive ESOs (e.g., risk aversion) can affect subjective valuations, but our archival data does not include adequate measures for these characteristics. Second, because of confidentiality constraints, we have only limited information about the employees and companies in the archival data, but our understanding of subjective valuations would be enhanced by investigations of the effects of a variety of individual, ESO, and firm characteristics. Third, our experiment necessarily excludes many components of the real-world stock option education program (e.g., interactive seminar, discussion of tax implications). Future research could explore the effects of these components on employees' ESO subjective valuations.

Our results also show that firms can influence employees' ESO subjective valuations through ESO education, which informs firms' cost-benefit analyses of offering this form of compensation. However, a single option pricing model (namely, Black-Scholes) was presented during training both for the client companies in the archival data and in our experiment design. Applying this particular empirical proxy for the "benefit-cost gap" holds constant this aspect of the research design between our and prior studies. While we believe results would be comparable if other credible ESO valuation tools were presented in training, this is an open question for future research. Finally, while we provide supplemental evidence that employees' ESO subjective valuations are positively associated with their self-reported motivation and loyalty, future research could profitably focus on further investigating this relationship.

References

Armstrong, C. S. 2007. The incentives of equity-based compensation and wealth. Working paper: Stanford University.

Armstrong, C. S., A. D. Jagolinzer, and D. F. Larcker. 2007. Timing of employee stock option exercises and the valuation of stock option expense. Working Paper: Stanford University.

Bettis, J., J. Bizjak, and M. Lemmon. 2005. Exercise behavior, valuation, and the incentive effects of employee stock options. *Journal of Financial Economics* 76 (2): 445-470.

Brown, L. D., and Y. Lee. 2006. The impact of SFAS 123R on changes in option-based compensation. Working paper: Georgia State University.

Carter, M., L. Lynch, and I. Tuna. 2007. The role of accounting in the design of CEO equity compensation. *The Accounting Review* 82 (2): 327-358.

Core, J., and W. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics* 28 (2): 151-184.

———. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40 (3): 613-630.

Culpepper and Associates, Inc. 2006. *Culpepper Pay Trends Survey*. Alpharetta, GA: Culpepper and Associates. Available from *http://www.culpepper.com/eBulletin/2006/MarchPayTrends.asp*.

———. 2007. *Culpepper Pay Trends Survey*. Alpharetta, GA: Culpepper and Associates. Available from *http://www.culpepper.com/eBulletin/2007/JunePayTrends.asp*.

Deloitte. 2005. *Options Take A Hit, But What Will Take Their Place?: The 2005 Deloitte Stock Compensation Survey*. New York, NY: Deloitte Development, LLC.

Devers, C., R. Wiseman, and R. Holmes. 2007. The effects of endowment and loss aversion in managerial stock option valuation. *Academy of Management Journal* 50 (1): 191-208.

Elson, C. 2003. What's wrong with executive compensation? *Harvard Business Review* 81 (1): 68-77.

Enright, B., and M. Reilly. 2002. Stock option expense. *Trends + Issues, A 3C Publication* 1 (Quarter 3).

Equilar, Inc. 2006. FAS 123R, one year in at S&P 500 companies. *Equity Compensation Trends* September. San Mateo, California: Equilar, Inc. Available at *http://www.equilar.com/newsletter/september_2006/ect_sept_2006_article2.html*.

Guth, R., and J. Lublin. 2003. Tarnished gold: Microsoft ushers out era of options. *Wall Street Journal*, July 9, A1.

Hall, B. 2000. What you need to know about stock options. *Harvard Business Review* 78(2).

———. 2003. Six challenges in designing equity-based pay. *Journal of Applied Corporate Finance* 15 (3): 21-33.

Hall, B., and J. Liebman. 1998. Are CEOs really paid like bureaucrats? *The Quarterly Journal of Economics* 113 (3): 653-691.

Hall, B., and K. Murphy. 2002. Stock options for undiversified executives. *Journal of Accounting and Economics* 33 (1): 3-42.

Hallock, K., and C. Olsen. 2006. The value of stock options to non-executive employees. Working paper: National Bureau of Economic Research.

Heath, C., S. Huddart, and M. Lang. 1999. Psychological factors and stock option exercise. *Quarterly Journal of Economics* 114: 601-628.

Hill, N., and K. Stevens. 2002. Showing employees the value of their stock options. *Strategic Finance* 83 (9): 44-47.

Hodge, F., S. Rajgopal, and T. Shevlin. 2006. How do managers value stock options and restricted stock? Working paper: University of Washington.

Huddart, S. 1994. Employee stock options. *Journal of Accounting and Economics* 18 (2): 207-230.

Huddart, S., and M. Lang. 1996. Employee stock option exercises: An empirical analysis. *Journal of Accounting and Economics* 21 (1): 5-42.

Hulbert, M. 2006. No rain on the stock options parade. *The New York Times*, July 16.

Ikäheimo, S., N. Kuosa, and V. Puttonen. 2006. 'The true and fair view' of executive stock option valuation. *European Accounting Review* 15 (3): 351-366.

Ittner, C., R. Lambert, and D. Larcker. 2003. The structure and performance consequences of equity grants to employees of new economy firms. *Journal of Accounting & Economics* 34 (1/3): 89-127.

Knowledge@Wharton. 2003. Stock options: The end of the affair? *Wharton Finance and Investment* (July 30).

———. 2006. How new accounting rules are changing the way CEOs get paid. *Wharton Finance and Investment* (May 3).

Lambert, R., D. Larcker, and R. Verrecchia. 1991. Portfolio considerations in valuing executive compensation. *Journal of Accounting Research* 29 (1): 129-149.

Lambert, R. and D. Larcker. 2001. *How employees value (often incorrectly) their stock options*. Available from *http://knowledge.wharton.upenn.edu/index.cfm?fa=viewArticle&id=363*.

Ledford, G., M. Lucy, and P. LeBlanc. 2004. The effects of stock ownership on employee attitudes and behavior: Evidence from the rewards of work studies. *Perspectives: Insights for Today's Business Leaders* 11 (4). Available from *http://www.sibson.com/publications/perspectives/Volume_11_Issue_4/e_article000211368.cfm.*

Libby, R., R. Bloomfield, and M. Nelson. 2002. Experimental research in financial accounting. *Accounting, Organizations and Society* 27 (8): 775-810.

Libby, R., and J. Luft. 1993. Determinants of judgment performance in accounting settings: Ability, knowledge, motivation, and environment. *Accounting, Organizations & Society* 18 (5): 425-450.

Maris, B., J. Maris, and T. Yang. 2003. The effect of exercise date uncertainty on employee stock option value. *Journal of Business Finance & Accounting* 30 (5/6): 669-697.

Mercer Human Resource Consulting. 2006a. *Perspective: Outlook for executive compensation governance 2006: Beyond due diligence*. Available from *http://www.mercerhr.com/referencecontent.jhtml?idContent=1211875*.

———. 2006b. *The Wall Street Journal / Mercer Human Resource Consulting 2005 CEO Compensation Survey and Trends*. New York, NY: Mercer Human Resource Consulting.

———. 2007. *The Wall Street Journal / Mercer Human Resource Consulting 2006 CEO Compensation Survey and Trends*. New York, NY: Mercer Human Resource Consulting.

Meulbroek, L. 2001. The efficiency of equity-linked compensation: Understanding the full cost of awarding executive stock options. *Financial Management* 30 (2): 5-44.

Murphy, K. 1999. Executive compensation. In *Handbook of Labor Economics*, edited by O. Ashenfelter and D. Card. Amsterdam: North-Holland. Vol. 3B: 2485-2563.

National Center for Employee Ownership. 2005. A Comprehensive Overview of Employee Ownership. Available from *http://www.nceo.org/library/overview.html*.

PricewaterhouseCoopers. 2005. *Trends in Times of Uncertainty: 2005 Global Equity Incentives Survey*. New York, NY: PricewaterhouseCoopers, LLC.

Reilly, M., B. Enright, D. Cumpston, and L. Audi. 2003. A model executive compensation process. *Trends + Issues, A 3C Publication* 2 (Quarter 1).

Schneider, C. 2003. Who rules accounting? *CFO* 19 (10): 34-40.

Tobin, J. 1958. Estimation of relationships for limited dependent variables. *Econometrica* 26 (1): 24-36.

Watson Wyatt Worldwide. 2003. *Changing the Way America Gets Paid: The Fall of the Stock Option and the "Correcting" Impact on Compensation*. Washington, DC: Watson Wyatt Worldwide.

———. 2004. *How Do Employees Value Stock Options: Results From A Special Survey*. Washington, DC: Watson Wyatt Worldwide.

Wilson, T., and H. Altmansberger. 2003. Taking variable pay to a new level. *Workspan* 46(12): 44-48.

Table 1
Descriptive Statistics for Archival Data

Panel A – Sample Sizes by Company

Firm	Training Participants	Obs with $Forfeit_{BT}$	Obs with $Forfeit_{BT}$ and $_{AT}$
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 Subjective Valuations and Black-Scholes Cost

	Observations with Subjective Value Before Training (N=214)								Observations with Subjective 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
$Forfeit_{BS}$	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
$Forfeit_{BT}$	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
$Ratio_{BT}$	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
$AbsDev_{BT}$	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
$Forfeit_{AT}$									126	183,155	334,670	0	22,788	74,894	150,000	2,152,584
$Ratio_{AT}$									126	1.481	1.738	0.000	0.940	1.000	1.717	15.388
$AbsDev_{AT}$									126	0.789	1.620	0.000	0.007	0.268	1.000	14.388
Change in Forfeit									126	96,059	289,112	-969,500	0	40,500	90,314	2,102,584
Change in Ratio									126	-0.752	14.985	-166.172	0.000	0.671	0.988	15.263
Change in AbsDev									126	-1.473	14.893	-166.172	-0.719	-0.354	0.116	13.513

Table 1 (continued)

Panel C – Descriptive Statistics for Other Employee-Level Variables

	Observations with Subjective Value Before Training (N=214)								Observations with Subjective 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
$Loyalty_{BT}$	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
$Loyalty_{AT}$									120	4.4	0.8	1.0	4.0	5.0	5.0	5.0
Change in Loyalty									118	0.2	1.3	-3.0	0.0	0.0	0.0	4.0
$Motivation_{BT}$	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
$Motivation_{AT}$									120	4.4	0.8	1.0	4.0	5.0	5.0	5.0
Change in Motivation									118	0.2	1.3	-3.0	0.0	0.0	1.0	4.0
$Confidence_{BT}$	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
$Confidence_{AT}$									120	4.0	1.0	1.0	3.0	4.0	5.0	5.0
Change in Confidence									118	0.9	1.3	-2.0	0.0	1.0	2.0	4.0
$Concentration_{BT}$	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
TaxRatePct	167	0.328	0.055	0.180	0.300	0.320	0.350	0.440	101	0.320	0.056	0.180	0.300	0.300	0.340	0.440
Years	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	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	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	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	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	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[a]

Variable	N	MEAN	STD
StockPrice	214	36.16	13.43
Volatility	214	0.293	0.032
Dividend	214	0.006	0.010
RiskFreeRate	214	0.038	0.004

Table 1 (continued)

Panel E – Variable Definitions

$Forfeit_{BT}$ and $Forfeit_{AT}$	≡	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 $Forfeit_{AT} - Forfeit_{BT}$.
$Forfeit_{BS}$	≡	The NWSI-computed Black-Scholes (BS) value of options and restricted stock forfeited if the employee recipient leaves his/her employer.
$Ratio_{BT}$ and $Ratio_{AT}$	≡	The ratio of subjective valuation to Black-Scholes value, computed as $Forfeit_{BT}$ / $Forfeit_{BS}$ and $Forfeit_{AT}$ / $Forfeit_{BS}$, respectively. *Change in Ratio* is computed as $Ratio_{AT} - Ratio_{BT}$.
$AbsDev_{BT}$ and $AbsDev_{AT}$	≡	The absolute value of the difference between the subjective forfeit value and the Black-Scholes forfeit value, computed as $\lvert(Forfeit_{BT} - Forfeit_{BS}) / Forfeit_{BS}\rvert$ and $\lvert(Forfeit_{AT} - Forfeit_{BS}) / Forfeit_{BS}\rvert$, respectively. These computations are equivalent to $\lvert Ratio - 1\rvert$. *Change in AbsDev* is computed as $AbsDev_{AT} - AbsDev_{BT}$.
$Confidence_{BT}$ and $Confidence_{AT}$	≡	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 $Confidence_{AT} - Confidence_{BT}$.
$Motivation_{BT}$ and $Motivation_{AT}$	≡	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 $Motivation_{AT} - Motivation_{BT}$.
$Loyalty_{BT}$ and $Loyalty_{AT}$	≡	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 $Loyalty_{AT} - Loyalty_{BT}$.
$Concentration_{BT}$	≡	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?"
TaxRatePct	≡	The employee recipient's fill-in-the-blank response to the following statement in training registration: "Please estimate your current combined marginal federal and state income tax rate."
Years	≡	The number of years the employee recipient has received option grants, based on the oldest active grant in the stock option grant summary information provided by his/her employer (i.e., it omits prior grants that expired or were fully exercised). Each client company typically grants options annually.

Table 1 (continued)

SharesOwned	≡	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."
BlackScholes	≡	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).
ITM	≡	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).
PctOptionsVested	≡	The percentage of the total number of options held by the employee recipient that are vested.
PctOptionsITM	≡	The percentage of the total number of options held by the employee recipient that are in-the-money.
StockPrice	≡	The share price of company stock.
Volatility	≡	The estimated volatility of company stock.
Dividend	≡	The expected annual per-share dividends on company stock, in dollars.
RiskFreeRate	≡	The estimated risk-free rate of return.

NOTES:

[a] These variables are initially collected from a client company representative. Values are listed as the "default" values when employee recipients register for training, but recipients can change the defaults. If a recipient overrode the default values, NWSI used the recipient-provided values in computations.

Table 2
Results of Tests for Training Effects Using Archival Data[a]

Panel A: Valuation-Cost Ratio (*Ratio*) and Absolute Deviation of Valuation from Cost (*AbsDev*) Before Training (H1)

	$Ratio_{BT}$		Recipients' Valuation < Cost ($Ratio_{BT}$ < 1)		$AbsDev_{BT}$	
Company	Median	p[b]	Count	Percent	Median	p[b]
A	0.511	0.005	52 of 74	70.3	0.673	<0.001
B	0.761	0.407	14 of 26	53.8	0.587	<0.001
C	0.653	0.235	22 of 35	62.9	0.735	<0.001
D	0.114	<0.001	31 of 36	86.1	0.923	<0.001
E	0.235	<0.001	43 of 43	100.0	0.765	<0.001
Combined	0.376	<0.001	162 of 214	75.7	0.752	<0.001

Panel B: Determinants of Subjective Valuations[b,c,d]

Dependent Variable:	$Forfeit_{BT}$ (in 1,000s)		$Forfeit_{AT}$ (in 1,000s)	
Independent Variable	Model 1 Matched sample, model without tax rate	Model 2 Matched sample, model with tax rate	Model 3 Matched sample, model without tax rate	Model 4 Matched sample, model with tax rate
Intercept	-67.88 **	68.95	-148.23 ***	318.69 **
$Concentration_{BT}$ (in %)	2.21 ***	2.12 **	4.38 ***	4.22 ***
PctOptionsITM (in %)	0.46	0.91	0.01	0.99
PctOptionsVested (in %)	0.79 **	1.63 *	-0.086	2.46 **
Years	-4.90	-8.54	8.19	-5.15
TaxRatePct (in %)		-6.28		-19.32 ***
$Forfeit_{BS}$ (in 1,000s)	0.32 ***	0.35 ***	1.24 ***	1.34 ***
N	126	101	126	101
Chi^2-statistic	26.65 ***	22.84 ***	52.68 ***	83.15 ***
Adjusted R^2	26.69%	25.52%	57.36%	59.51%

Table 2 (continued)

Panel C: Before- and After-Training Valuation-Cost Ratio (*Ratio*) Frequencies

Before-Training Valuation-Cost Ratio	N	Percent
Discount ($Ratio_{BT} < 1$)	95	75.4
Premium ($Ratio_{BT} > 1$)	31	24.6
Total	126	100.0

	After-Training Valuation-Cost Ratio			
	Discount		Premium	
	N	Percent	N	Percent
Discount ($Ratio_{BT} < 1$)	46	36.5	49	38.9
Premium ($Ratio_{BT} > 1$)	8	6.4	23	18.3
Total	54	42.9	72	57.2

Panel D: Changes in the Valuation-Cost Ratio (*Ratio*) and Absolute Deviation of Valuation from Cost (*AbsDev*) After Training (H2)

	Change in Ratio ($Ratio_{AT}$-$Ratio_{BT}$)		Increase in Ratio (Change in Ratio > 0)		Change in Deviation ($AbsDev_{AT}$-$AbsDev_{BT}$)		Decrease in Deviation (Change in AbsDev < 0)	
Company	Median	p[b]	Count	Percent	Median	p[b]	Count	Percent
A	0.985	<0.001	46 of 53	86.8	-0.002	0.197	27 of 53	50.9
B	0.000	0.761	7 of 15	46.7	-0.363	0.068	11 of 15	73.3
C	-0.117	0.217	6 of 15	40.0	-0.729	0.011	11 of 15	73.3
D	0.701	0.008	18 of 27	66.7	-0.759	<0.001	21 of 27	77.8
E	0.349	0.002	13 of 16	81.3	-0.342	0.003	13 of 16	81.3
Combined	0.671	<0.001	90 of 126	71.4	-0.354	0.001	83 of 126	65.9

NOTES:

[a] Variable definitions are in Table 1, Panel E.

[b] In Panel A, p is the one-sided (two-sided) p-value for a signed-rank test of the median $Ratio_{BT} < 1$ (median $AbsDev_{BT} = 0$). In Panel B, p is the two-sided p-value for the Chi^2 statistic and the reported Adjusted R^2 is for an equivalent OLS regression. In Panel D, p is the two-sided p-value for a signed-rank test of the median *Change in Ratio* = 0 or *Change in AbsDev* = 0.

[c] *, **, and *** indicates significance at the 0.10, 0.05, and 0.01 levels, respectively.

[d] Models estimated with a tobit (Tobin 1958) regression; p-values computed using robust standard errors. When the data are trimmed at the 5% level for $Forfeit_{BT}$, *PctOptionsVested* is no longer significant in models 2 and 4, but other significant results remain. Coefficient estimates are similar in magnitude and statistical significance when estimated with OLS using robust standard errors.

Table 3
Descriptive Statistics for Experiment Data

Panel A – Descriptive Statistics by Experiment Condition and Before-Training Subjective Valuations

Before-Training Subjective Values	Black-Scholes Model Description[a]	Option Values Provided[a]	N	Median *Ratio*				Median *AbsDev*			
				Before Training	After Training	Updated Grant	New Grant	Before Training	After Training	Updated Grant	New Grant
Before-Training Discount (i.e., $Ratio_{BT} < 1$) *N=124*	Present	None	21	0.476	0.557	0.708	0.990	0.524	0.443	0.292	0.406
		Current	24	0.557	0.972	0.708	0.889	0.443	0.084	0.292	0.505
		Current+Table	17	0.557	0.994	0.756	0.792	0.443	0.114	0.245	0.208
	Absent	None	19	0.557	0.557	0.708	0.495	0.443	0.443	0.292	0.505
		Current	20	0.557	0.724	0.715	0.743	0.443	0.362	0.285	0.381
		Current+Table	23	0.557	0.875	0.708	0.505	0.443	0.294	0.292	0.505
Before-Training Premium (i.e., $Ratio_{BT} > 1$) *N = 68*	Present	None	11	1.671	1.950	1.653	1.485	0.671	0.978	0.653	0.485
		Current	9	1.114	1.114	1.039	1.614	0.114	0.189	0.395	0.614
		Current+Table	15	1.671	1.000	1.263	1.238	0.671	0.098	0.599	0.238
	Absent	None	13	1.671	1.560	1.653	1.733	0.671	0.671	0.653	0.733
		Current	12	1.671	1.000	1.145	0.891	0.671	0.000	0.318	0.505
		Current+Table	8	1.671	1.343	1.370	1.263	0.671	0.343	0.369	0.495
Overall			192	0.557	1.000	0.779	0.871	0.443	0.432	0.292	0.485

Panel B – Variable Definitions

Experiment participants provided fill-in-the-blank responses to four questions about the total amount of option value forfeited if they left the firm today: for an original grant *before training* (BT), and then after training for the original grant (*after training*, AT), for an *updated grant*, and for a *new grant* (see Appendix C, Panel C for details).		
Ratio	≡	*Ratio* is computed as a participant's response to a given question divided by the Black-Scholes (BS) value of the options that would be forfeited. Changes are computed relative to before-training responses.
AbsDev	≡	*AbsDev* is computed as the absolute value of the difference between the response to a given question 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|. Changes are computed relative to before-training responses.

NOTES:

[a] Experiment participants are:

- provided (*present*) or not provided (*absent*) with a detailed description of the Black-Scholes model (see Appendix C, Panel A for details); and,
- 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).

Table 4
Results of ANOVA and Planned Contrasts for Training Effects on Initial Grant Using Experiment Data[a,b]

Panel A: ANOVAs

	df	*Change in Ratio* Percentile Rank			*Change in AbsDev* Percentile Rank		
		Mean Square	*F* [c]		Mean Square	*F* [c]	
Before-Training Discount (i.e., $Ratio_{BT} < 1$)							
B-S model description	1	2034.7	4.1	**	3335.5	6.7	***
Option values provided	2	3066.1	6.3	***	5401.1	10.9	***
B-S model description x Option values provided	2	16.9	0.0		28.5	0.1	
Before-Training Premium (i.e., $Ratio_{BT} > 1$)							
B-S model description	1	711.6	0.9		1012.2	0.84	
Option values provided	2	2021.0	2.5	**	1741.7	1.45	
B-S model description x Option values provided	2	943.9	1.2		2348.0	1.95	*

Panel B: Planned Contrasts

	Change in Ratio Percentile Rank		*Change in AbsDev* Percentile Rank	
Contrast	Expected Sign	Contrast Estimate[c]	Expected Sign	Contrast Estimate[c]
Before-Training Discount (i.e., $Ratio_{BT} < 1$)				
B-S model description (present vs. absent)	+	8.2 **	–	-10.4 **
Option values provided (any vs. none)	+	15.0 ***	–	-20.0 ***
Current+table (vs. current)	+	2.2	–	-2.8
Current (vs. none)	+	13.9 ***	–	-18.6 ***
Current+table (vs. none)	+	16.1 ***	–	-21.4 ***
Before-Training Premium (i.e., $Ratio_{BT} > 1$)				
B-S model description (present vs. absent)	–	6.6	–	7.9
Option values provided (any vs. none)	–	-14.5 **	–	-14.4 **
Current+table (vs. current)	+	9.3	+	5.7
Current (vs. none)	–	-19.1 ***	–	-17.3 **
Current+table (vs. none)	–	-9.8 *	–	-11.6 *

NOTES:

[a] Variable definitions are in Table 3, Panel B.

[b] Experiment participants are:

- provided (*present*) or not provided (*absent*) with a detailed description of the Black-Scholes model (see Appendix C, Panel A for details); and,
- 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] *, **, and *** indicates one-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 5
Results of ANOVA Tests for Training Effects on Updated and New Grants Using Experiment Data[a,b]

Panel A: ANOVAs for Training Effects on Updated Grant

	df	*Change in Ratio* Percentile Rank			*Change in AbsDev* Percentile Rank		
		Mean Square	*F* [c]		Mean Square	*F* [c]	
Before-Training Discount (i.e., $Ratio_{BT}$ < 1)							
B-S model description	1	891.7	1.9	*	853.9	1.6	
Option values provided	1	1228.9	2.6	*	3979.1	7.2	***
B-S model description x Option values provided	1	178.5	0.4		2.8	0.0	
Before-Training Premium (i.e., $Ratio_{BT}$ > 1)							
B-S model description	1	0.0	0.0		1054.0	0.8	
Option values provided	1	2724.1	3.2	**	956.9	0.8	
B-S model description x Option values provided	1	393.1	0.5		941.7	0.7	

Panel B: ANOVAs for Training Effects on New Grant

	df	*Change in Ratio* Percentile Rank			*Change in AbsDev* Percentile Rank		
		Mean Square	*F* [c]		Mean Square	*F* [c]	
Before-Training Discount (i.e., $Ratio_{BT}$ < 1)							
B-S model description	1	5878.7	12.2	***	3156.4	5.2	**
Option values provided	1	278.8	0.6		2666.3	4.4	**
B-S model description x Option values provided	1	2800.4	5.8	***	857.8	1.4	
Before-Training Premium (i.e., $Ratio_{BT}$ > 1)							
B-S model description	1	388.2	0.3		402.3	0.4	
Option values provided	1	1715.1	1.4		739.2	0.6	
B-S model description x Option values provided	1	48.1	0.0		1141.6	1.0	

NOTES:

[a] Variable definitions are in Table 3, Panel B.

[b] Experiment participants are:

- provided (*present*) or not provided (*absent*) with a detailed description of the Black-Scholes model (see Appendix C, Panel A for details); and,
- 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] *, **, and *** indicates one-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 6
Examination of Heuristics Used to Estimate Option Value Using Experiment Data[a]

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

			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: Frequencies of Use of Heuristics for Each Subjective Valuation Question[c]

	Heuristic Used																					
	Negative Value		0=ZeroValue		1		2=Intrinsic		3		Subtotal, Negative Value through Category 3		4=ApproxBS		5		6=StockPrice		7		Subtotal, Categories 5 through 7		Total	
Subjective Value	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Before Training			12	6.3	34	17.7	55	28.6	9	4.7	110	57.3	32	16.7	9	4.7	23	12.0	18	9.4	50	26.1	192	100.0
After Training	1	0.5	7	3.6	36	18.8	22	11.5	8	4.2	74	38.6	77	40.1	15	7.8	7	3.6	19	9.9	41	21.3	192	100.0
Updated Grant			5	2.6	39	20.4	40	20.9	14	7.3	98	51.2	34	17.8	29	15.2	13	6.8	17	8.9	59	30.9	191	100.0
New Grant			6	3.2	26	14.1	25	13.5	33	17.8	90	48.6	27	14.6	38	20.5	4	2.2	26	14.1	68	36.8	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 (see Appendix C, Panel C for details). Responses to each question were then categorized to create *Heuristic*. We identify four heuristics that would result in particular subjective valuations: 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 7
Analysis of Post-Task Questions Using Experiment Data

Panel A: Point Allocations to Potential Factors Influencing Subjective Valuations[a,b]

		Mean point allocations to potential valuation components (average for *updated grant* and *new grant*)										
After-Training Heuristic	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[b,c]

		Mean rated agreement with possible decision rules (0=strongly disagree, 10=strongly agree)								
After-Training Heuristic	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

Table 7 (continued)

Panel C: Rated Effort, Knowledge and Confidence[b]

After-Training Heuristic[b]	N	Mean rated task efforts (0=Low, 10=High): Difficulty making estimates	Mean rated task efforts (0=Low, 10=High): Familiarity with estimates	Mean rated task efforts (0=Low, 10=High): How hard worked	Mean rated knowledge (0=Low, 10=High): Option pricing models	Mean rated knowledge (0=Low, 10=High): Options in general	Mean rated knowledge (0=Low, 10=High): 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 D). Participants completed the point allocation task twice, for the *updated grant* and for the *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 subjective valuations (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 E for details.

Figure 1
Diagram of Constructs and Measures

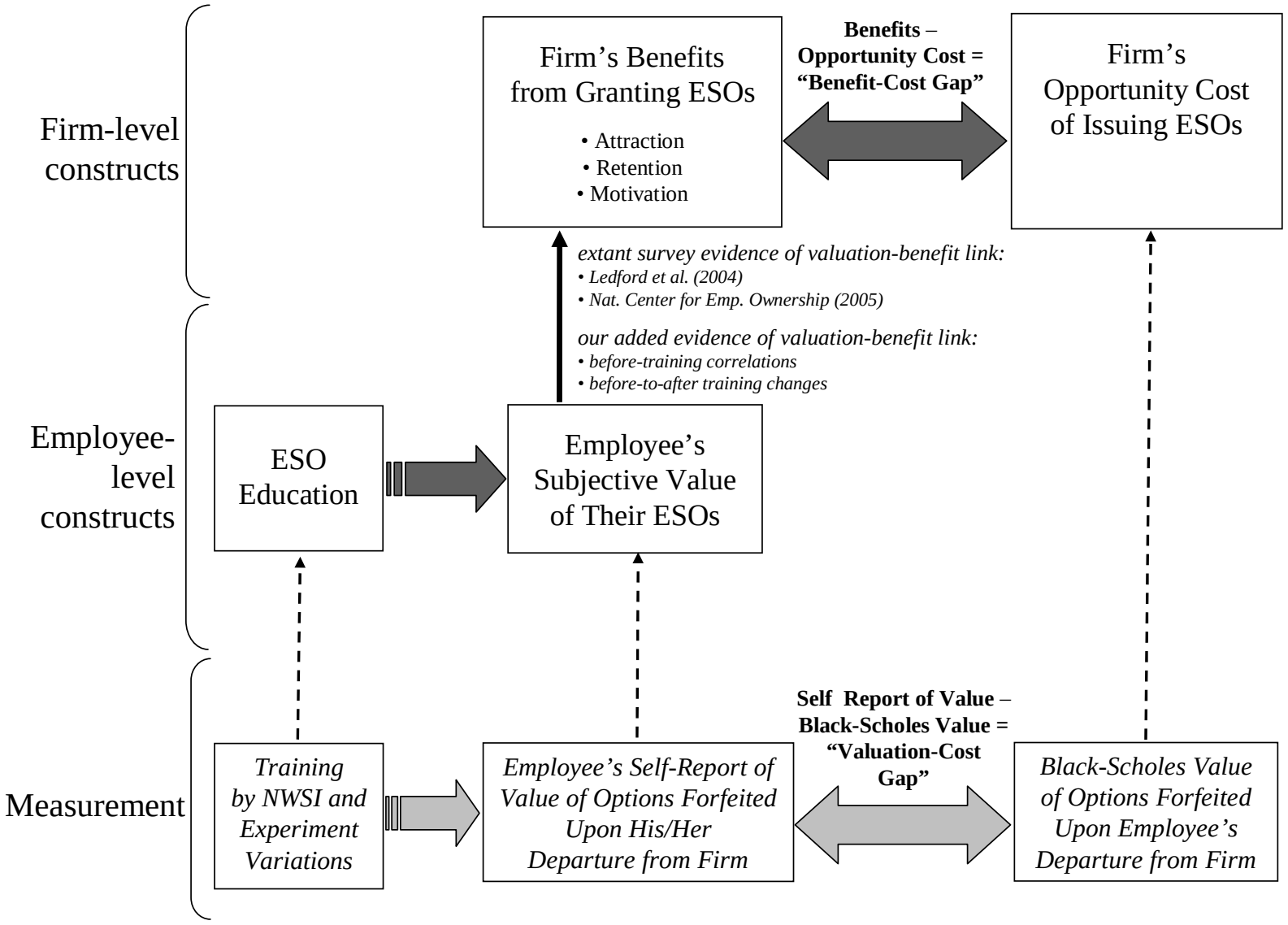
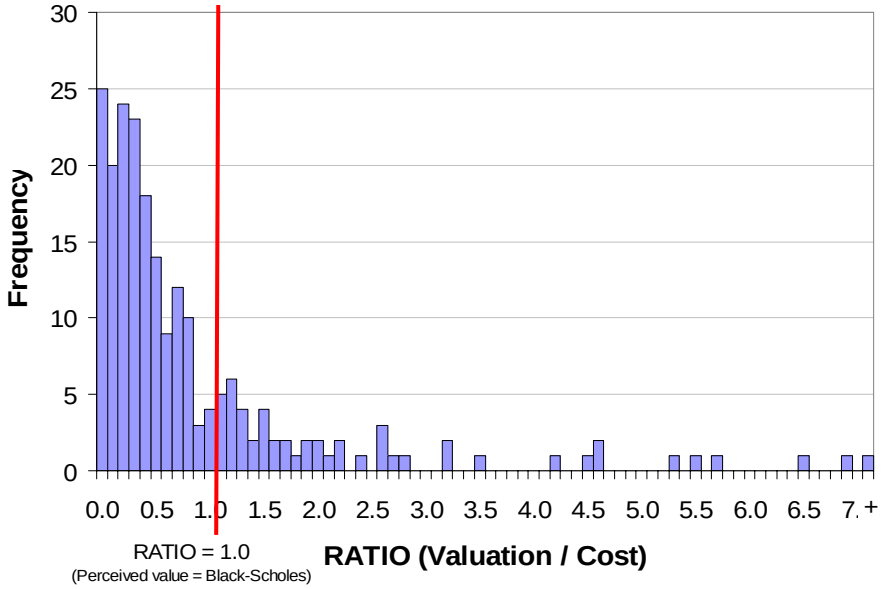


Figure 2
NWSI Client Training Process

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.

NWSI-Client negotiations and data gathering ▷	**Employee recipient registers for training** ▷	**NWSI-prepares Profile Report (see Appendix B)** ▷	**Interactive training session** ▷	**Post-training evaluations *(optional)***
Equity grants B-S inputs	Financial questionnaire: • Confirm B-S inputs • Diversified investments • Future financial goal • Income tax rate • Other share ownership *plus* Stock Option Survey, including before-training ESO subjective valuation (see Appendix A)		Employee recipient receives individualized Profile Report	Stock Option Survey, including after-training ESO subjective valuation (see Appendix A) *plus* Anonymous training evaluation form
239 recipients	*214 survey responses*			*126 matched survey responses*

Figure 3
H1 Results: Valuation-Cost Ratio ($Ratio_{BT}$[a]) for Archival Data

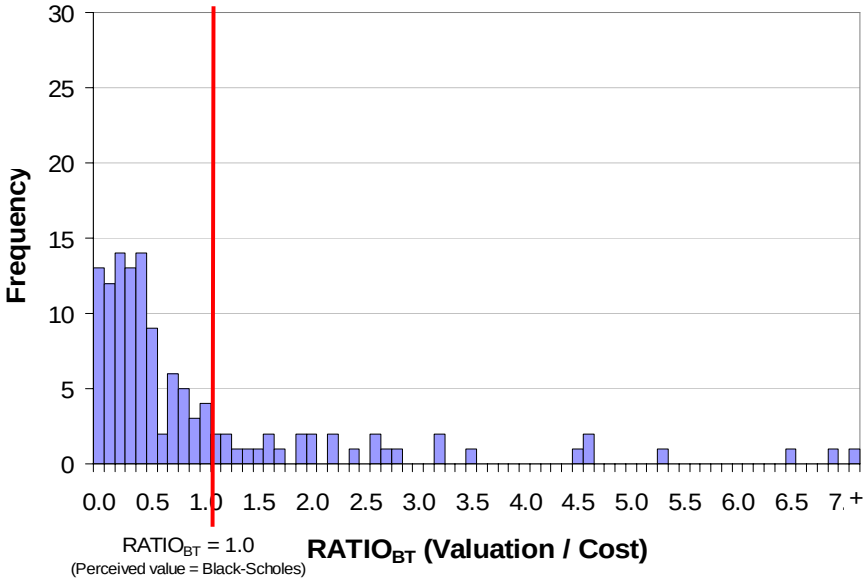


NOTES:

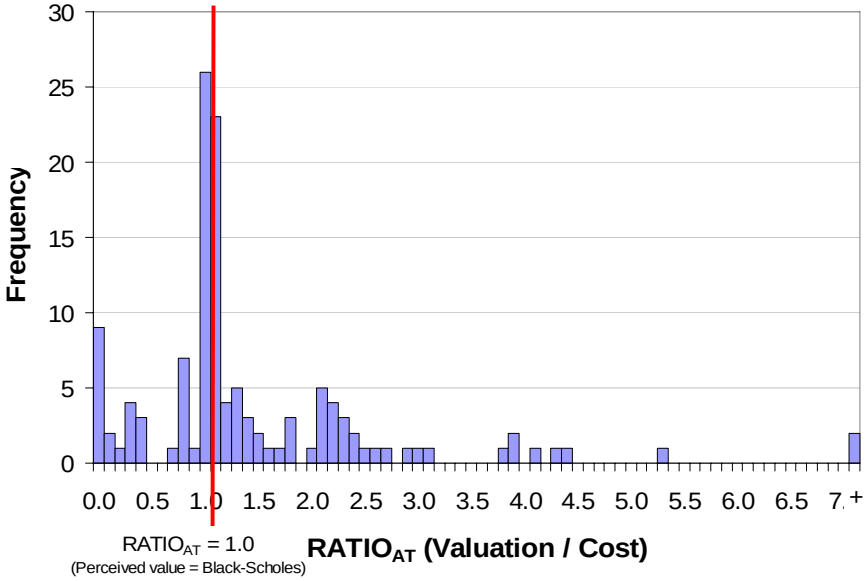
[a] Computed as the employee recipient's fill-in-the-blank response before training (BT) to the following question from the Stock Option Survey (Appendix A), "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?", divided by the NWSI-computed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

Figure 4
H2 Results: Matched Before and After Training Valuation-Cost Ratios (*Ratio*[a]) for Archival Data

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



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

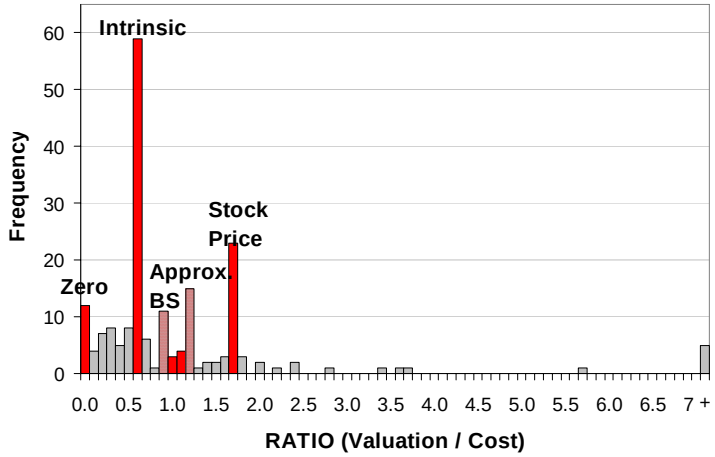


NOTES:

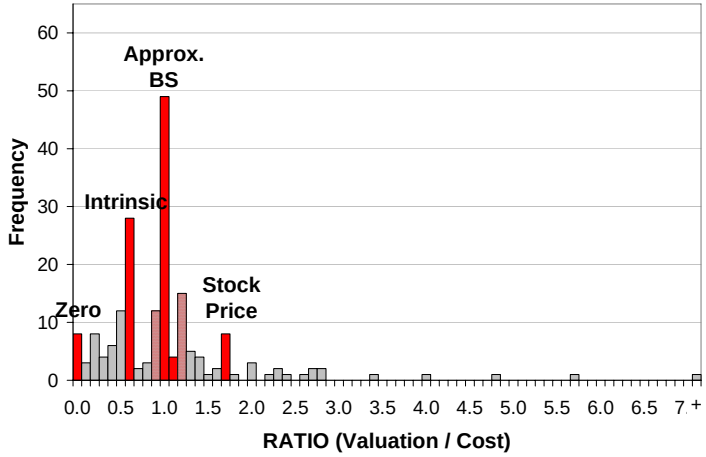
[a] Computed as the employee recipient's fill-in-the-blank response before training (BT) or after training (AT) to the following question from the Stock Option Survey (Appendix A), "If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?",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

Figure 5
Valuation-Cost Ratios (*Ratio*[a]) for Experiment Data

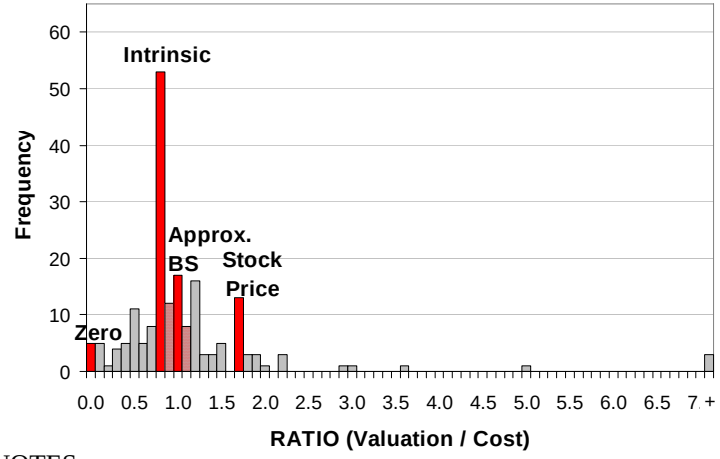
Panel A: Before Training



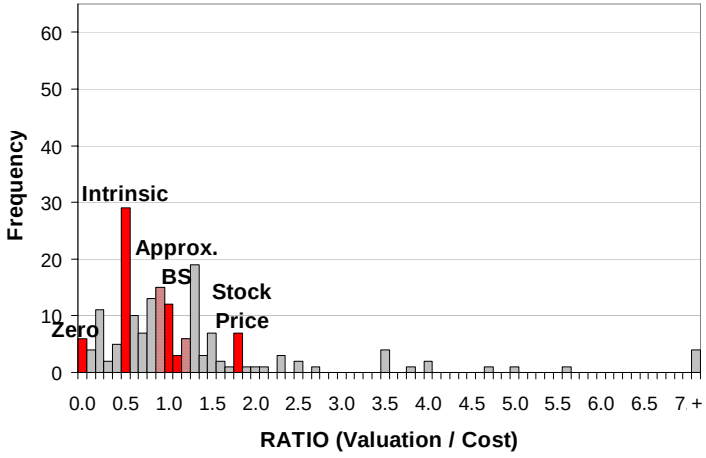
Panel B: After Training



Panel C: Updated Grant



Panel D: New Grant

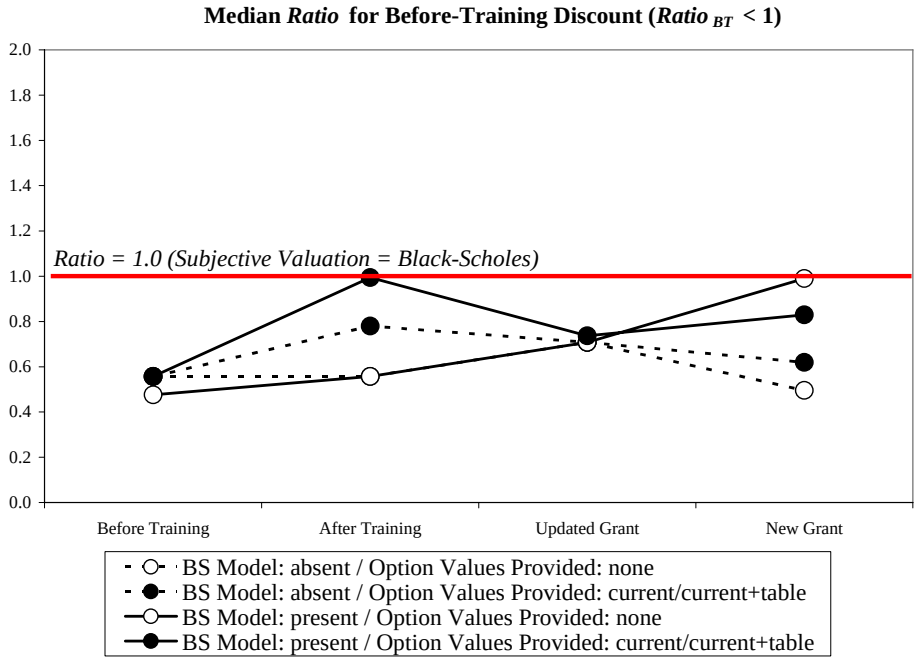


NOTES:

[a] 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 (see Appendix C, Panel C for details).

Figure 6
Graphs of Median Valuation-Cost Ratio and Absolute Deviation of Valuation from Cost Using Experiment Data[a, b]

Panel A: Medians for Valuation-Cost Ratio (*Ratio*)



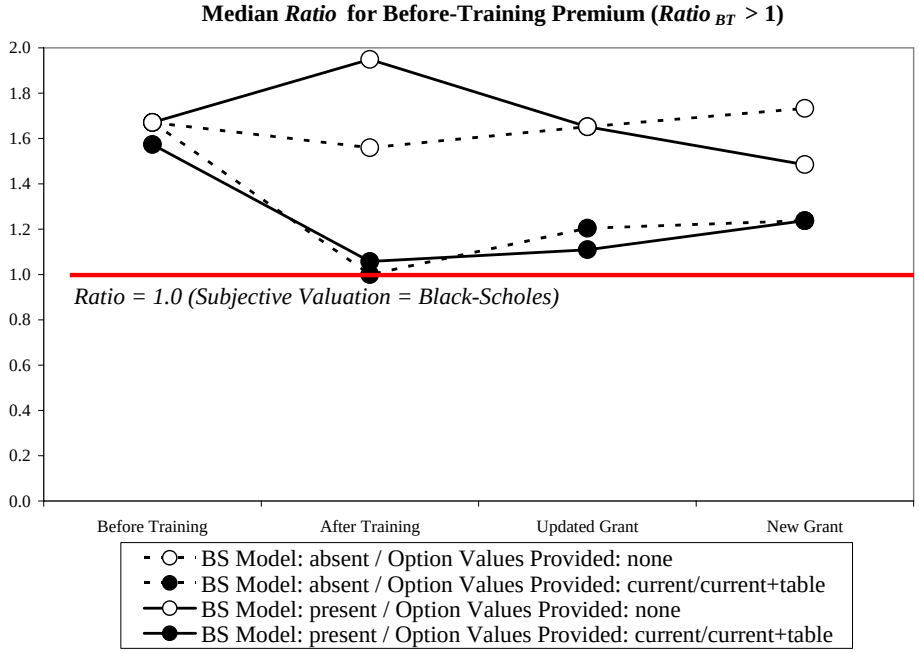
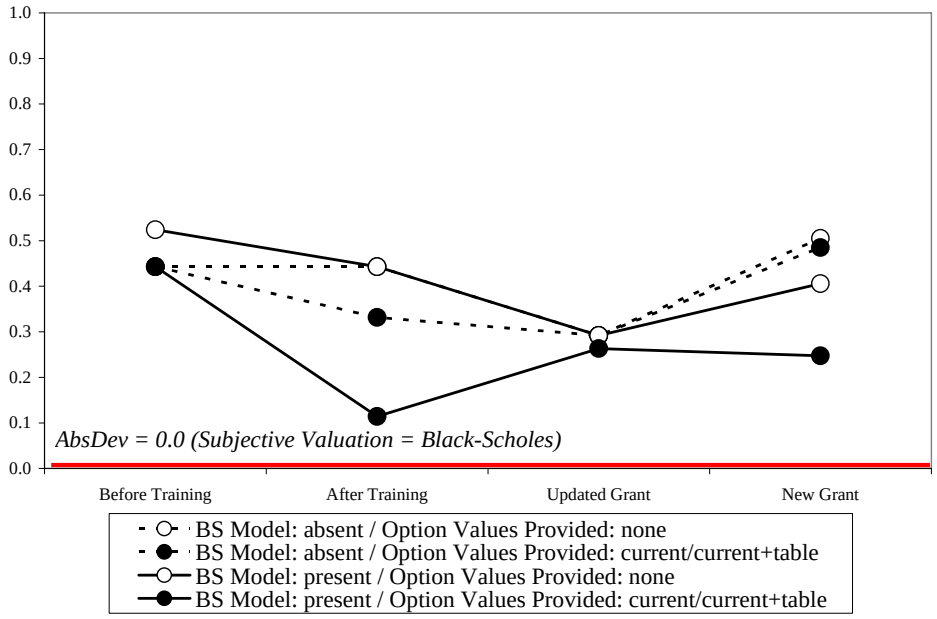


Figure 6 (continued)

Panel B: Medians for Absolute Deviation of Subjective Valuation from Cost (*AbsDev*)

Median *AbsDev* for Before-Training Discount (*Ratio* $_{BT}$ < 1)



Median *AbsDev* for Before-Training Premium (*Ratio* $_{BT}$ > 1)

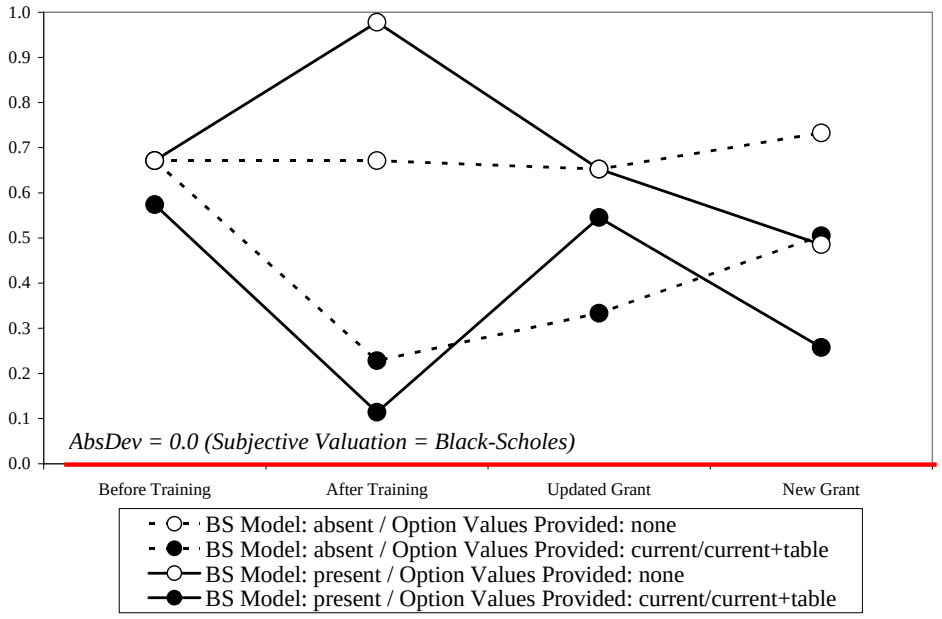


Figure 6 (continued)

NOTES:

[a] Variable definitions are in Table 3, Panel B.

[b] Experiment participants are:

- provided (*present*) or not provided (*absent*) with a detailed description of the Black-Scholes model (see Appendix C, Panel A for details); and,
- 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).

Participants provided subjective forfeit value estimates four times: for the original grant *before training* and then after training for the original grant (*after training*) for the original grant assuming two years have passed (*updated grant*), and for a *new grant* (see Appendix C, Panel C 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.)

$_____

QUESTION 3 – UPDATED ORIGINAL GRANT, PERCEPTION OF VALUE AFTER TRAINING

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, PERCEPTION OF VALUE AFTER TRAINING

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 D: 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 C, Question 3), and one for a new grant (Panel C, 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 C. 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 E: 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