

**Using Internal Controls and Incentive Compensation to Motivate Employees in a
Multidimensional Task**

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ABSTRACT

Employees often perform tasks that involve multiple dimensions of performance. In this study, we examine whether firms can effectively use internal controls to complement incentive compensation to align employee behavior with company goals in a multidimensional task. We conduct an experiment in which we manipulate the presence of incentive compensation and internal controls on multiple task dimensions. Our findings suggest that when firms tie compensation to multiple task dimensions, employees divide their effort between task dimensions resulting in lower overall performance. However, when firms implement internal controls on one dimension of a task rather than tying compensation to that dimension, employees are able to improve their performance on the task dimension with an internal control without hurting their performance on another compensated task dimension. Indeed, in our experiment we find that overall employee performance on a multidimensional task can be higher when firms compensate employees on one dimension and implement internal controls on the other dimension than when firms compensate both dimensions. This study highlights the importance of complementing monetary incentives with internal controls in a multidimensional task setting.

Key Words: Internal Control, Incentives, Compensation, Multidimensional Tasks

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I. Introduction

In today's complex business environment, employees are often responsible for performing tasks involving multiple performance dimensions (Holmstrom and Milgrom 1991). Firms must determine how to best induce desired employee behavior in this environment. To align employees' interests with those of the organization, firms implement management control systems, which can consist of various control mechanisms, including incentive compensation, monitoring systems, and internal controls (Zimmerman 2011). Importantly, firms frequently implement multiple control mechanisms simultaneously, such as incentive compensation and internal controls (Simons 1987). However, there is limited research investigating how various types of controls interact to affect employee performance.

Researchers and practitioners have numerous, and divergent, views of how incentive compensation and internal controls can and should be used within organizations (Haun 1955; Simons 1987; Merchant and Van der Stede 2007; Romney and Steinbart 2009; Zimmerman 2011). Further, different research streams differ in how they define "controls." Research in management accounting typically defines controls as processes that help "ensure the proper behaviors of the people in the organization" (Merchant 1985, 4). Accordingly, research in management accounting often explicitly refers to incentive compensation systems as controls (e.g., see Simons 1995; Tayler and Bloomfield 2011; Christ et al. 2012b). Auditing and financial reporting research on controls has traditionally focused on *internal controls* and their role in ensuring the accuracy of financial information, and typically views incentive compensation as a factor that increases the risk of material misstatement, rather than a control (e.g., see Heiman-Hoffman et al. 1996; Gul et al. 2003). Despite their divergent treatment in the literature, internal controls and incentive compensation often operate as complements in practice (Simons 1995; Ittner et al. 2003). In this study, we examine how internal controls and incentive compensation jointly influence employee performance in a multidimensional task.

Accounting theorists have long been interested in settings where firms can compensate employees on multiple dimensions of their performance (e.g., see Holmstrom and Milgrom 1991; Prendergast 1999). Employees can be compensated based on their performance on a variety of different tasks (e.g., employees are paid for processing transactions and supervising subordinates; managers at accounting firms are paid for overseeing audit/tax engagements and acquiring new clients), or on various dimensions of the same task (e.g., transactions must be processed accurately and in a timely manner; customer service professionals are compensated based on their prompt completion of customer service calls and on customer evaluations of service quality). In such settings, employees must decide how to allocate their effort among different tasks or task dimensions.

Incentive compensation serves an informational role in these settings, directing employees to increase effort on the compensated dimensions of their task and away from the uncompensated dimensions (Holmstrom and Milgrom 1991; Prendergast 1999; Choi et al. 2012a). Theorists argue that when contracts are complete (i.e., employees are compensated on all performance dimensions), individuals will appropriately allocate effort among multiple dimensions of a task (Prendergast 1999).¹ However, research in psychology suggests that even with complete contracts, individuals may be unable to respond appropriately to conflicting incentives (Emmons and King 1988; Payne et al. 1993; Locke et al. 1994; Slocum et al. 2002; Kehr 2003). Specifically, Kehr (2003) argues that when individuals work towards achieving two goals that may be in conflict, the conflict diverts cognitive capacity from goal completion toward self-regulatory processes such as planning or time allocation, impeding individuals' ability to realize their objectives in a way consistent with theoretical outcomes. Indeed, because of human limitations, firms often make trade-offs between contract completeness and contract complexity,

¹ As discussed by Prendergast (1999, 13), complete contracts imply that “any measure of performance that (on the margin) reveals information on the effort level chosen by the agent should be included in the compensation contract.”

such that the optimal contract is incomplete (Williamson 1985; Choi et al. 2012a). Further, complete contracts are rare in practice (Williamson 1985; Holmstrom and Milgrom 1991; Baker 1992, 2000, 2002; Ittner et al. 1997; Ittner and Larcker 1998; Banker et al. 2000; Bailey et al. 2011), possibly due to managers' understanding of the natural, cognitive limitations of employees (Choi et al. 2012a). Instead, firms typically employ a combination of incentive compensation and internal controls to induce desired employee behavior (Simons 1987).

To investigate the influence of incentive compensation and internal controls on employee performance, we conduct an experiment in which subjects complete a simplified data-entry task that has two measurable task dimensions. We employ a $2 \times 2 + 1$ experimental design and manipulate whether task dimensions are compensated, subject to an internal control, or neither. Specifically, on one task dimension, input accuracy, we either compensate participants based on accuracy, or subject participants to an internal control on accuracy. On a second task dimension, input speed, we either compensate participants based on speed performance, or not. We fully cross these two factors, creating four experimental conditions: (1) *Accuracy Compensation*, (2) *Accuracy Internal Control*, (3) *Speed Compensation/Accuracy Internal Control*, and (4) *Speed and Accuracy Compensation*. We include one additional condition for comparison purposes, *Speed Compensation*, where we neither compensate accuracy nor subject participants to an internal control on accuracy, but where we compensate participants based on speed. In all conditions, we compare participants' accuracy and speed to their individual-specific, pre-test results, allowing us to measure performance improvement following implementation of the incentive compensation and internal control manipulations.

Our results reveal that when firms compensate employees on multiple dimensions of a task, employees divide their effort among these multiple dimensions. However, when firms implement internal controls on one dimension of a task rather than tying compensation to that dimension, employees are able to improve their performance on the task dimension with an

internal control (e.g., input accuracy) without hurting their performance on a different, compensated task dimension (e.g., input speed). Further, we find that, in our setting, overall employee performance on a multidimensional task is *higher* when employees are compensated on one dimension and are subject to an internal control on the other dimension than when employees are compensated on both task dimensions.

Taken together, our findings suggest that when both incentive compensation and internal controls are used on different task dimensions, employees do not divide their attention or experience goal conflict among the task dimensions to the same extent as when faced with incentive compensation on all dimensions. Rather, employees appear to rely on internal controls to help them achieve an organization's stated objectives (even without incentive compensation), while pursuing high performance on the organization's compensated objectives. Thus, these results suggest that even in settings where compensating all task dimensions is possible, complete contracts may be less effective than incomplete contracts that rely partially on internal controls.

Our study extends prior literature and informs practitioners in several important ways. First, we examine conflicting theoretical predictions from agency and psychology research regarding the effectiveness of multidimensional contracts to motivate employee performance. We do so by comparing an incomplete contract complemented with internal controls on specific task dimensions to a multidimensional, complete contract where all dimensions are compensated. Contrary to prior expectations from agency theory and consistent with psychology research, our study reveals that using a combination of incentive compensation and internal controls results in stronger overall performance than incentive compensation alone. This finding helps explain the prevalence of firms using a combination of incentive compensation and internal controls, despite implications from agency models suggesting that complete incentive contracts will yield optimal performance.

Second, our study integrates academic research on incentive compensation and internal controls, investigating the possibility that these two control types can be used as complements to improve firm performance. Previously, investigations of incentive compensation and internal controls have developed as two separate streams of research. Managerial accounting research focuses on incentive compensation within the context of operational performance and considers incentive compensation as an effective management control mechanism (e.g., see reviews by Bonner et al. 2000; Bonner and Sprinkle 2002). Alternatively, financial reporting and auditing research suggests that incentive compensation should be considered a risk factor (e.g., see Heiman-Hoffman et al. 1996; Gul et al. 2003), and instead focuses on traditional internal controls that prevent or detect errors or fraud. Our study reveals that incentive compensation and internal controls can serve as effective complements and together can improve operational performance.

Third, our study can assist practitioners who are developing multidimensional incentive contracts. Our results highlight the costs of tying compensation to multiple task dimensions, and suggest that practitioners may benefit from compensating some performance dimensions while implementing internal controls on other performance dimensions.

The remainder of our paper proceeds as follows. In Section II, we provide a theoretical development of our hypotheses. Section III describes the study's experimental methodology. In Section IV, we provide our results; and we conclude in Section V.

II. Literature Review and Hypothesis Development

According to the COSO Enterprise Risk Management framework (COSO 2004), controls are designed to help the organization achieve three objectives. The first objective relates to the efficient and effective use of the organization's resources for operations. The second objective relates to the preparation of reliable financial statements. The third objective relates to the organization's compliance with laws and regulations. As academic research on the effectiveness

of controls has developed, two separate and somewhat divergent research streams have emerged, focusing on different aspects of these objectives.

The first stream relates to management accounting and focuses primarily on the first COSO objective: the ability of controls to ensure the efficient and effective use of the organization's resources for operations. *Management control systems* are typically defined as a broad array of processes designed to align employee interests with the objectives of the organization (Zimmerman 2011; Merchant 1985). Merchant (1985, 4), for example, defines a control as a process that helps "ensure the proper behaviors of the people in the organization" and notes that "proper" employee behavior should be consistent with the organization's strategy. Broadly defined, a management control is any mechanism which encourages employees to act in accordance with the objectives of the organization. Accordingly, prior research in management accounting that focuses on the impact of incentives on employee behavior and performance often explicitly refers to *incentive compensation* as a control (e.g., see Simons 1995; Tayler and Bloomfield 2011; Christ et al. 2012b).

The second stream of controls research relates to auditing and financial reporting and focuses on the second COSO objective: the effectiveness of controls to ensure reliable financial reporting (e.g., see Trotman and Wood 1991; Hansen 1997; Caplan 1999; Krishnan 2005; Doyle et al. 2007; Ashbaugh-Skaife et al. 2008, 2009; Hammersley et al. 2008; Hoitash et al. 2009). This literature has traditionally focused on *internal controls*, and their role in ensuring the accuracy of financial information. Further, this literature stream often examines the tendency for incentive compensation to incite opportunistic behavior by executives and other employees. Consequently, this stream of literature typically views incentive compensation as a *risk factor* rather than a control (e.g., see Heiman-Hoffman et al. 1996; Gul et al. 2003).²

² Heiman-Hoffman et al. (1996) find that practicing auditors rank incentive compensation as the eighth most important fraud warning sign out of 30 commonly-cited fraud warning signs. Further,

Despite the differential treatment of internal controls and incentive compensation in the accounting literature, internal controls and incentive compensation often operate as complements within organizations. For example, firms sometimes implement internal controls relating to regulatory compliance standards to which employees must adhere in order to earn pecuniary rewards (Simons 1995; Ittner et al. 2003). However, firms frequently implement internal controls that are simply “norm-based” (i.e., not tied to incentives) to encourage and aid employees in accomplishing firm objectives that are not explicitly compensated (Romney and Steinbart 2009, 200-203; Simons 1987; 1995). While these internal controls often provide performance-based feedback, they do not have direct implications for employee compensation.³ For ease in exposition, and to distinguish between control types in this manuscript (i.e., incentive compensation vs. internal controls) we use the phrase “internal controls” to refer to norm-based internal controls (absent any tie to compensation).

Though management accounting research has largely ignored traditional internal controls (e.g., preventive and detective controls), it has provided a vast stream of literature examining how incentive compensation influences employee effort and task performance in operational settings (e.g., see Bonner and Sprinkle 2002 for a review). This research shows that, in general, monetary incentives lead to greater employee effort, which in turn leads to performance improvements. Bonner and Sprinkle (2002) discuss several task, environmental, individual, and incentive scheme variables that have been shown to moderate the general effects of incentives on employee performance. In the current study, we focus on one of these task variables: the multidimensionality of employees’ tasks.

Gul et al. (2003) argue that managers with high accounting-based incentive compensation are likely to manage earnings with discretionary accruals in order to increase their own compensation.
³ Simons (1995) argues that, in the presence of incentive compensation, a lack of norm-based internal controls are a primary contributor to firm crises in which employees engage in suboptimal or fraudulent behavior to meet performance targets.

Several prior studies have investigated the effects of incentive compensation in multidimensional task settings (e.g., see Holmstrom and Milgrom 1991; Baker 1992; Feltham and Xie 1994; Hemmer 1996; Prendergast 1999; Kachelmeier et al. 2008; Fischer and Huddart 2008; Kachelmeier and Williamson 2010; Choi et al. 2012a; 2012b; Hecht et al. 2012). Multidimensional task settings include settings where employees attend to several different tasks as part of their job (e.g., processing transactions and supervising subordinates), as well as settings where employees perform a single task with multiple dimensions (e.g., producing a high quantity of output while maintaining a high quality output). Though we focus our investigation on an operationalization of a single task with multiple dimensions, our theory and hypotheses (discussed below) apply to both settings.

In developing our hypotheses, we first discuss our predictions that derive from prior research, which demonstrates that internal controls can improve work performance while holding compensation constant. We then motivate and discuss the important, but generally held supposition that multidimensional contracting can harm performance on task dimensions relative to single-dimension compensation. After discussing these points, we motivate this paper's primary contribution to the literature—how internal controls and incentive compensation can serve as complements in improving employee performance.

Effects of Internal Control on Employee Performance

Within most agency models, individuals are assumed to be motivated largely by self-interest (Baiman 1990). Accordingly, employees are assumed to be primarily motivated by monetary incentives. Despite this, a relatively large body of research has developed showing that individuals are also motivated by preferences not traditionally assumed in standard economic models (e.g., see Camerer 2003; Camerer and Fehr 2004; Osterloh and Frey 2004; Fischer and Huddart 2008). For example, individuals are motivated by intrinsic motivation (Deci 1971), personal norms such as honesty (see Schwartz 1977; Evans et al. 2001), social norms (Asch 1951;

Taylor and Bloomfield 2011), and, most relevant to the current study, stated goals and objectives (Locke et al. 1981; Lindenberg 2003; Christ et al. 2012a).

In a multidimensional task setting, two properties of internal controls are likely to lead to improvements in employee performance. First, internal controls can act as salient stimuli providing performance feedback to redirect employee cognition toward the firm's non-compensated objectives, thus increasing the employee's motivation to improve performance on these objectives. Second, feedback from internal controls can reduce the cognitive effort necessary to accomplish a task, thus freeing cognitive capacity for task realization. We discuss both of these internal control properties below.⁴

Lindenberg (2003) argues that firms can manage employee motivation by managing employees' cognitive processes. Specifically, Lindenberg (2003) recommends that firms govern employee motivation by promoting two competing cognitive frames within organizations—the gain frame and the normative frame. Employees in the gain frame act to improve their resources, while employees in the normative frame seek to adhere to organizational norms, such as institutionalized policies and procedures (March and Olsen 1995). Lindenberg (2003) argues that the gain frame is stronger than the normative frame because it more directly links effort to the improvement of one's self. Thus, when firms tie employee compensation to performance on specific dimensions of the employees' task or job, the gain frame is likely to displace the normative frame unless a salient stimulus is introduced to redirect employee cognition toward the normative frame (Lindenberg 2003). Consistent with prior research (Christ et al. 2012a), we argue that internal controls can serve as such a stimulus. Specifically, internal controls can increase the salience of an employee's non-compensated objectives, thus increasing an employee's motivation to accomplish his/her non-compensated objectives.

⁴ We do not seek to disentangle these two performance enhancing effects of internal controls in the current study. Rather, we seek to understand how incentive compensation and internal controls differentially and jointly impact employee performance in a multidimensional task.

Research in psychology on decision aids (e.g., see Kachelmeier and Messier 1990; Todd and Benbasat 1994; Bonner et al. 1996; Eining et al. 1997) suggests that feedback from internal controls can reduce the cognitive effort employees exert on various mental processes such as memory retrieval, information search, problem representation, etc. (Bonner 2008, 341). For example, Bonner et al. (1996) test the effectiveness of two decision aids: (1) a list that reminds auditors of the membership of different financial statement errors in a transaction cycle and audit objective categories and (2) a mechanical aggregation aid that decomposes the estimation of conditional probabilities into individual error probabilities then mechanically assesses the conditional probability of errors. The second tool is better for improving auditor judgments because it counteracts a task organization-knowledge mismatch, thus reducing the cognitive effort needed for task completion (Nelson et al. 1995). Similar to appropriate decision aids, internal controls can reduce the cognitive effort needed to perform a given task dimension because employees are able to rely on the feedback provided by the internal control to help perform on that dimension. For example, quality controls within manufacturing organizations reduce the cognitive effort employees exert in monitoring the quality of their output, allowing employees to focus on producing *more* output.

Importantly, not all internal controls provide feedback to individuals working within the internal control system. *Preventive controls* provide immediate feedback because they prevent certain actions attempted by the controlled individual (e.g., an erroneous journal entry). In addition, *detective controls* may provide feedback only to superiors who monitor internal control systems, while allowing the “controlled” behavior to continue unrestricted. However, detective controls may also provide feedback to individuals working within the internal control system, allowing “controlled” behavior to continue while flagging the behavior for the individual (e.g., highlighting a missed performance target). Christ et al. (2012a) examine the differential effects of these three types of internal controls on employee performance in a multidimensional task, and

demonstrate that internal controls impact employee performance in a manner consistent with the above theories. In their study, employees perform a multidimensional task and are always compensated on one task dimension (speed), with the *type* of internal control implemented on the other task dimension (accuracy) varied between subjects. The authors find that internal controls can improve employee performance on the non-compensated dimension of the employees' task. Further, they show that relative to other types of internal controls, detective controls that provide immediate feedback can improve employee performance on the task dimension that is subject to an internal control without decreasing employee performance on the compensated dimension of the task.⁵ Thus, the findings in Christ et al. (2012a) support the notion that (1) internal controls increase the salience of non-compensated objectives, thus increasing employee motivation and performance on those objectives, and (2) individuals rely on internal controls to accomplish non-compensated firm objectives in much the same way that auditors and financial analysts rely on decision aids, allowing employees to improve task performance.

Our first hypothesis is a replication of one of the findings in Christ et al. (2012a).

Specifically, we predict:

HYPOTHESIS 1. In a multidimensional task where only one dimension is compensated, individuals will perform better on non-compensated task dimensions if an internal control is imposed on those dimensions.

The Effect of Multidimensional Incentive Compensation Contracts on Employee Performance

Holmstrom and Milgrom (1991) were among the first to study how the multidimensional nature of employees' work might moderate the effect of incentive compensation on employee effort and performance. The authors argue that in multidimensional settings "incentive pay serves not only to allocate risks and to motivate hard work, but it also serves to direct the allocation of the agents' attention among their various duties" (p. 25). According to this argument, incentive

⁵ Based on these findings, we restrict our investigation of internal controls to detective controls with immediate feedback. We discuss the implications of this choice on the generalizability of our findings in Section V.

compensation in multidimensional settings serves two roles. First, incentives increase employee effort, consistent with the one-dimensional principal-agent model traditionally discussed in the accounting and economics literatures (Holmstrom and Milgrom 1991; Bonner and Sprinkle 2002). Second, incentive compensation serves an informational role by directing employees to expend more effort on the dimensions of their task or job that are rewarded and less effort on the dimensions of their task or job that are not rewarded (or that are rewarded to a lesser degree), all else equal (Prendergast 1999, 8).⁶ Indeed, a key take-away from incentive compensation research is that incentives have attention-directing effects, which influence an individual's experience with performance measures (Feltham and Xie 1994; Atkinson et al. 1997; Lambert 2001).

Holmstrom and Milgrom (1991, 33) include the caveat, however, that employees will divide their attention among multiple compensated dimensions only if the dimensions are substitutes rather than complements (i.e., only when increased effort on one dimension necessarily reduces effort in another dimension). Such an argument implies that employees will not reduce effort on a given compensated dimension when compensated on separate, *complementary* dimensions. Psychology research, however, suggests that individuals are not good at dividing attention among multiple tasks, even if those tasks are complementary (Emmons and King 1988; Payne et al. 1993; Locke et al. 1994; Slocum et al. 2002; Kehr 2003). Kehr (2003) argues that when individuals work towards achieving two goals, goal conflict diverts employees' cognitive capacity from the task itself to self-regulatory processes such as planning, deciding how to allocate time, etc. Such regulatory processes consume cognitive capacity that could instead be used for

⁶ Economic theory predicts that when responding to monetary incentives in a multidimensional task, individuals divide effort among task dimensions in complex ways. For example, Holmstrom and Milgrom (1991, 29) assume that employees have a concave wage function (implying diminishing monetary returns to effort on each task dimension) and a convex personal cost function (implying an increasing personal cost to effort in each task dimension). *Ceteris paribus*, economic theory predicts that individuals will shift more effort to a given task dimension when incentives for that task dimension are increased relative to other dimensions.

goal realization. In other words, when employees must choose how to accomplish two dimensions of a task, employees may divert cognitive capacity from goal achievement to self-regulation.⁷

These two streams of literature from economics and psychology both suggest that when individuals are compensated on multiple dimensions, their performance on any *one* dimension will be better when included in a single-dimensional contract than when included in a multidimensional contract. Specifically:

HYPOTHESIS 2. In a multidimensional task, individuals will perform better on a compensated task dimension when they are compensated on one dimension (only) than when they are compensated on multiple dimensions.

Complete Contracts vs. Incomplete Contracts with Internal Controls

Although prior theoretical research has not directly addressed whether the implementation of internal controls will have the same attention-directing effects as providing incentive compensation on multiple task dimensions, arguments set forth in traditional agency theory suggest that internal controls will serve an informational role similar to incentive compensation and, therefore, will cause employees to divide their attention among task dimensions. Thus, one might expect that, similar to our prediction in hypothesis 2, imposing internal controls on one task dimension may hinder performance on a second task dimension.

However, as explained earlier, internal controls have properties not shared by incentive compensation. Namely, decision-aid research suggests that internal controls can reduce the cognitive effort employees exert on various mental processes and improve employee performance. Thus, we expect that in a multidimensional task setting, incomplete contracts with internal controls can help employees reduce the cognitive effort they exert on non-compensated task dimensions, allowing them to shift more effort to compensated task dimensions, and avoid some

⁷ Kachelmeier et al. (2008) provide one example consistent with this conjecture. In their study, participants are more productive (produce more output) when compensated on quantity alone than when compensated on both quantity and creativity.

of the attention diversion and goal conflict associated with more complete contracts (Emmons and King 1988; Payne et al. 1993; Locke et al. 1994; Slocum et al. 2002; Kehr 2003).⁸

Taken together, these streams of literature support the notion that when firms provide employees with incentive compensation on one dimension of a task and subject them to internal controls on the other dimensions, employees will not divide their attention and/or experience goal conflict among multiple task dimensions to the same extent that they would when compensated on all task dimensions. This has potential implications for performance in every task dimension. First, when firms compensate employees on a given task dimension, employee performance on other task dimensions will decrease more when the other dimensions are compensated rather than subject to an internal control. Second, when firms compensate employees on a given task dimension, employee performance on that task dimension will increase more when the other dimensions are subject to an internal control rather than compensated. We formally state these interaction hypotheses as follows:

HYPOTHESIS 3a.: In a multidimensional task, tying compensation to one dimension of performance hurts performance in a separate dimension more when the separate dimension is compensated rather than subject to an internal control.

HYPOTHESIS 3b. In a multidimensional task, tying compensation to one dimension of performance improves performance in that dimension more when the separate dimension is subject to an internal control rather than compensated.

Importantly, if employees focus available attention primarily on performance in one of the multiple compensated dimensions in a given setting, we may only find support for one of these two interaction hypotheses. In other words, though compensating on multiple dimensions may

⁸ Although we expect that internal controls will help employees avoid *some* of the goal conflict and attention/effort diversion associated with complete contracts, we do not expect that internal controls will completely inoculate employees from such effects. In other words, we do not predict that implementing an internal control on an employee's task will have no effect on employee performance on other task dimensions.

hurt performance more than using a mix of incentive compensation and internal controls, the diminished performance may not be seen in all task dimensions.⁹

Our first several predictions (hypothesis 1 through hypothesis 3b) are derived directly from our theory. These hypotheses suggest a testable outcome relating to overall performance (across all dimensions). Specifically, if hypotheses 1, 2, and 3 hold, overall performance is likely to improve when employees are compensated on one task dimension and internal controls are imposed on other task dimensions as compared to situations in which all task dimensions are compensated. We state this expectation formally as follows:

HYPOTHESIS 4. In a multidimensional task, individuals perform better on the task overall when they are compensated on one dimension and subject an internal controls on other dimensions than when they are compensated on all dimensions.

III. Experimental Method

We tested our hypotheses in an experimental lab where participants completed a data-entry task. One hundred twenty-five undergraduate business students took part in our study.¹⁰

Experimental Task and Manipulations

To test our predictions, we employ a 2 x 2 +1 experimental design in which we manipulate between subjects whether data-entry task dimensions are compensated, subject to internal controls, or neither. Specifically, on one task dimension, input accuracy, we either compensate participants based on accuracy, or we subject participants to an internal control on accuracy. On a second task dimension, input speed, we either compensate participants based on speed, or not. We fully cross these two factors, creating four experimental conditions: (1)

⁹ Holmstrom and Milgrom (1991) argue that if an incentive compensation system weights multiple task dimensions equally, employees will not always allocate their effort equally among all dimensions. All else equal, employees will allocate more of their effort toward task dimensions that they perceive to be less “noisy,” more easily measured, and more easily maximized.

¹⁰ We used student subjects for our task, as opposed to more experienced professionals, because our data-entry task (discussed below) is well-suited to the abilities of a typical undergraduate student. As such, we expect results stemming from this study will be generalizable to multiple settings where individuals perform multidimensional tasks for which they have been hired.

Accuracy Compensation, (2) *Accuracy Internal Control*, (3) *Speed Compensation/Accuracy Internal Control*, and (4) *Speed and Accuracy Compensation*. We include one additional condition for comparison purposes, *Speed Compensation*, where we neither compensate accuracy nor implement internal controls on accuracy, but where we do compensate speed. Because our focus in the current study is on the joint impact of incentive compensation and internal controls (and not on the impact of multidimensional internal controls), we hold constant in all conditions that there is no internal control on speed.¹¹ In all conditions, we compare accuracy and speed to individual-specific, data-entry pre-test results, allowing us to measure performance improvement following implementation of the incentive compensation and internal control manipulations.

Participants completed seven phases of the experiment: (1) introduction, (2) demographic questions, (3) pre-test data-entry task, (4) further instructions, (5) comprehension test, (6) main data-entry task, and (7) post-experiment questionnaire.

Participants read the following as part of the introduction to the study:

“For today's study you will perform a data-entry task (i.e., a typing tutor type task). **We want you to type as quickly and as accurately as possible.**”
(emphasis as in the original)

Following previous studies that examine similar constructs (e.g., see Shalley 1991; Kachelmeier et al. 2008), we described both goals (accuracy and speed) so that participants in all conditions would be operating under the same explicit goals—to type quickly and accurately.

¹¹ We chose not to manipulate the presence of an internal control on speed for several reasons. As mentioned above, the focus of the current study is on the complementary nature of internal controls and incentive compensation, not on the impact of implementing internal controls on multiple dimensions absent incentive compensation. Thus, fully crossing the presence or absence of internal controls and incentive compensation on both task dimensions would add four conditions to our design that are not needed for testing our primary hypotheses of interest. Indeed, we are able to test our internal control-related hypotheses using the accuracy internal control manipulation alone. Further, while the magnitude of the effects we observe in our study may depend in part on the specific dimension where internal controls are implemented, directional effects are unlikely to be influenced by this choice (Libby et al. 2002).

Participants then read specific instructions on how to complete the task, including an example of how the data-entry task worked.

After participants finished reading the introduction, they completed a questionnaire providing demographic information. As part of this set of questions, we asked participants to provide their year in school, gender, GPA, and information relating to their perceived typing speed and experience.

Next, participants began the pre-test data-entry task, which consisted of the same 1,011 characters (12 lines of data on 3 screens) for all participants.¹² We did not implement internal controls on any of the characters, and participants were all paid a flat rate during this pre-test task. Performance on this task allowed us to establish a baseline performance level specific to each participant.

After finishing the pre-test task, participants read an additional set of instructions. In these instructions, we reminded participants of their goal to type quickly and accurately (“We want you to type as fast and as accurately as possible”). We then introduced one of five experimental conditions (varied between participants).

1. *Accuracy Compensation* condition: participants were compensated based only on the accuracy of their data entry. Participants were told, “You will be compensated on these screens based on how accurately you type the words on the screen. *Therefore, the more accurate your output, the more money you will earn*” (emphasis as in original).¹³ No internal control was imposed on the task.

¹² The data-entry task is similar to that used by Christ et al. (2011a). For both pre-testing and testing the material came from the company history and a news release of Millenniata, Inc., a start-up company that produces archival quality DVDs (and DVD writers) that “will preserve data for generations” (Millenniata 2011). The material described the history of Barry Lunt, the originator and founder of the company, how he developed the technology, and the benefits of the technology.

¹³ In all settings with incentive compensation, the compensation was based on pre-testing such that the average expected pay per condition would be the same. The scale was designed to create a uniform distribution of payouts over the advertised payout range (\$5 to \$15 with an average

2. *Accuracy Internal Control* condition: participants were subjected to an internal control that was designed to detect and highlight participants' data-entry errors. Participants were told that internal controls would be implemented on some characters such that if participants entered the wrong character, the incorrect character would turn red but the cursor would advance (i.e., a detective control with immediate feedback). As part of the instructions, we told participants to try entering the wrong characters on a sample line of text. Further, participants were told, "You will be paid a flat wage of \$10 for participating today."
3. *Speed Compensation/Accuracy Internal Control* condition: participants were compensated based on how quickly they typed (as above) and that they would be subject to internal controls on accuracy (also described above).
4. *Speed and Accuracy Compensation* condition: participants were compensated based on both data-entry speed and data entry accuracy. Participants were told "You will be compensated on these screens based on how quickly and accurately you type the words on the screen. *Therefore, the faster you type, and the more accurate your output, the more money you will earn*" (emphasis as in original). No internal control in this condition.
5. *Speed Compensation* condition: participants were compensated based only on their data-entry speed. "You will be compensated on these screens based on how quickly you type the words on the screen. *Therefore, the faster you type, the more money you will earn*" (emphasis as in original). No internal control was imposed in this condition.

After reading the instructions (and experimenting with the implemented internal control, if applicable), participants answered a series of comprehension questions to determine whether

payout of \$10). Consistent with several studies in experimental economics, we did not inform participants of the exact conversion rate between their actions and their payouts, but did provide the range and expected average payoff that would be earned (Bloomfield et al. 2009a; Bloomfield et al. 2009b). We note that this design choice mirrors many settings in practice, where vague compensation structures are quite common (Ittner et al. 2003; Gibbs et al. 2003; Rajan and Reichelstein 2006).

they understood the manipulations (as shown in the Appendix). If participants answered any questions incorrectly, the relevant instructions were repeated and the participant was required to answer the questions correctly before beginning the main data-entry task of the experiment.

Following the comprehension test, participants completed the main data-entry task, consisting of 3,209 characters (38 lines, 8 screens of data). For participants assigned to conditions with internal controls, we assigned these internal controls randomly to approximately 20 percent of the characters.¹⁴ We imposed internal controls on the same characters in all conditions subject to internal controls.

After completing the main data-entry task, participants completed a post-experiment questionnaire and received their compensation according to the compensation scheme for their experiment condition.

Measures

To test our hypotheses, we develop measures of data-entry accuracy, data-entry speed, and overall performance.

To observe differences in data-entry accuracy across conditions, we allow participants only a single opportunity to enter the correct character (i.e. participants cannot backspace).¹⁵ To measure data-entry accuracy, we calculate the ratio of errors to total characters in the main data-entry task and subtract it from the participant's ratio of errors to total characters in the pre-test task.¹⁶ If participants have a positive value for this measure of accuracy, it suggests the participant

¹⁴ We imposed internal controls on 20 percent of the characters to mirror internal control environments in practice, where internal controls are not imposed on every facet of employees' tasks.

¹⁵ Because this was a unique typing task (e.g., no backspacing, participants had to tab to go to next line and manually click to enter first line, etc.), we omit from analyses the first screen on which participants typed in the pre-test task. This allowed the participants to get used to the unique typing environment and not create an artificially low pre-test score.

¹⁶ Subtracting the pre-test score from the task score, in addition to randomization, helps remove any differences caused by factors other than our manipulations (e.g., differences in intrinsic typing ability).

improved their data-entry accuracy in the main data-entry task relative to the pre-test task. This measure is formally computed as follows:

$$Accuracy = \frac{Total\ errors\ made\ in\ pretest\ task}{Total\ characters\ (pretest)} - \frac{Total\ errors\ made\ in\ test\ task}{Total\ characters\ (test)}$$

To measure data-entry speed, we first time, to the thousandth of a second, how long it takes participants to type each character. We then calculate each participant's average time per character in the main data-entry task and subtract it from their time per character in the pre-test task. As with our measure of accuracy, a positive value for this metric suggests an improvement in performance on the main data-entry task relative to the pre-test task. The measure is formally stated below:

$$Speed = \frac{\sum Time\ spent\ entering\ characters\ in\ pretest\ task}{Total\ characters\ (pretest)} - \frac{\sum Time\ spent\ entering\ characters\ in\ test\ task}{Total\ characters\ (test)}$$

To measure overall performance, we first conduct a z-transformation of the accuracy (speed) measures by subtracting from the measure the average accuracy (speed) of all participants, then divide by the accuracy (speed) standard error of all participants. We then average an individual's z-transformed accuracy and speed measures, yielding an equal weighting of both performance dimensions, and add 1. This transformation implies that accuracy and speed are equally weighted in measuring overall performance.¹⁷ Higher values signify better overall performance.

¹⁷ By normalizing speed and accuracy scores, we remove distributional differences in the speed and accuracy measures, allowing us to average the two measures to yield a single overall performance measure that equally weighs both performance dimensions. Though we encouraged participants to "type as quickly and as accurately as possible," emphasizing the importance of both speed and accuracy, participants were not aware of this overall performance measure. Our purpose in analyzing this measure is not to suggest, *ex post*, how participants should have maximized "overall performance," but rather, to allow for a test of H4 using a reasonable proxy for performance across both task dimensions.

We summarize our hypotheses in Figure 1. As discussed in the next section, this figure also describes which dependent variable(s) we use for testing each hypothesis, and shows the specific contrast tests we use to test our hypotheses.

(Insert Figure 1 here)

IV. Results

Participants took an average of 25.7 minutes to complete the task. In estimating their own data-entry speeds (in WPM) before and after the task, participants' average response was 62.6 and 54.2 WPM, respectively. Sixty-eight percent of the participants were male.

As a preliminary test of how incentive compensation and internal controls affect performance in our setting, we first test to see if the data-entry speed and accuracy measures are significantly different from zero when incentive compensation and internal controls are implemented in isolation. A positive outcome that is different from zero for either speed or accuracy indicates that an individual improved on that dimension from the pre-test task to the main data-entry task.

As shown in Panel A of Table 1, when we subject participants to an internal control on accuracy without incentive compensation (i.e., the *Accuracy Internal Control* condition), participants' data-entry accuracy is significantly greater than zero ($p < 0.001$), suggesting that the internal control is effective in improving accuracy. Furthermore, when we provide participants with incentive compensation based on how accurately they typed without subjecting them to internal controls (i.e., *Accuracy Compensation*), participants' accuracy is significantly greater than zero ($p < 0.001$), suggesting that the incentive compensation on accuracy is also effective in increasing accuracy. As seen in Panel B of Table 2, when we provide participants with incentive compensation based on how fast they typed without subjecting them to internal controls (i.e., *Speed Compensation*), participants' speed is significantly greater than zero ($p < 0.001$). Further, as seen in Panel C of Table 2, participants in all conditions improved their overall performance (p

< 0.001 in all conditions). This suggests that either implementing internal controls, incentive compensation, or some combination of both serves to improve performance on multiple dimensions relative to having employees perform a task with no direct influence of internal controls, incentive compensation, or both internal controls and incentive compensation.¹⁸

(Insert Table 1 here)

Tests of Hypothesis 1 and Hypothesis 2

To test our hypotheses, we conduct planned contrasts of the different conditions. We present formal statistical tests in Tables 2 (accuracy), 3 (speed), and 4 (overall performance). Panel A of each of these tables contains descriptive statistics for the relevant dependent measure. Panel B of each of these tables contains the pertinent tests of our hypotheses for the dependent variable listed in that table. For the data-entry speed results (Table 3), we also provide a benchmark of words per minute in order to better comprehend the size of effects for differences in typing speed at the character level.

In hypothesis 1, we predict that individuals will perform better on a non-compensated task dimension if an internal control is imposed than if there is no internal control. To test this prediction, we perform a contrast comparison to examine whether participants' data-entry accuracy is higher when participants are compensated on speed with an internal control on accuracy (the *Speed Compensation/Accuracy Internal Control* condition), than when participants are compensated on speed only (without an internal control on accuracy) (the *Speed Compensation* condition). As seen in Table 2, Panel A and B, the cell means and statistical results are consistent with our prediction. Accuracy is 0.142 when participants are compensated on speed with an internal control on accuracy, and is only 0.004 when participants are compensated on speed alone,

¹⁸ We cannot rule out the possibility that participants improved overall performance in all conditions because of increased familiarity with the task or better learning how to type. However, tests of our hypotheses are based on differential improvement between conditions, as explained subsequently. Thus, the possible influence of learning effects does not alter the inferences we make in this study.

with no internal controls on accuracy. The accuracy difference is significant ($F = 12.22$; $p < 0.001$). Thus, our evidence supports hypothesis 1.

In hypothesis 2 we predict that individuals will perform better on a given dimension of a task when they are compensated solely on that dimension as opposed to when they are compensated on multiple dimensions. To test this prediction, we perform two contrast comparisons. First, we test whether participants have higher data-entry accuracy when compensated based solely on accuracy (the *Accuracy Compensation* condition) than when they are compensated based on both accuracy and speed (the *Speed and Accuracy Compensation* condition). Second, we test whether participants have higher data-entry speed when compensated based solely on speed (the *Speed Compensation* condition) than when they are compensated based on both speed and accuracy (the *Speed and Accuracy Compensation* condition). As seen in Panel A of Tables 2 and 3, cell means are consistent with our predictions. Accuracy is 0.039 when participants are compensated on speed and accuracy, and 0.101 when participants are compensated on accuracy alone. Speed is 0.004 when participants are compensated on speed and accuracy, but is 0.014 when participants are compensated on speed alone. As seen in Panel B of Tables 2 and 3, the accuracy difference is significant ($F = 2.45$; $p = 0.057$) and the speed difference is significant ($F = 4.70$; $p = 0.016$). Thus, our evidence supports hypothesis 2.

(Insert Tables 2 and 3 here)

Tests of Hypothesis 3 and Hypothesis 4

In hypothesis 3a, we predict that when firms compensate employees on a given task dimension, employee performance on other task dimensions will decrease more when the other task dimensions are compensated rather than subject to an internal control. To test this hypothesis, we use contrast coding to compare the *Speed and Accuracy Compensation* condition to the *Speed Compensation/Accuracy Internal Control* condition. We expect that accuracy in the *Speed and Accuracy Compensation* condition will be lower than the *Speed Compensation/Accuracy Internal*

Control condition. As seen in Panel A of Table 2, cell means are consistent with our predictions. Accuracy is 0.039 in the *Speed and Accuracy Compensation* condition and is 0.142 in the *Speed Compensation/Accuracy Internal Control* condition. As reported in Table 2, Panel B, the contrast is significant ($F = 6.89$; $p = 0.005$), supporting hypothesis 3a.

Hypothesis 3b predicts that when firms compensate employees on a given task dimension, employee performance on that task dimensions will increase more when the other task dimensions are subject to an internal control rather than compensated. We test this hypothesis using contrast coding. We expect speed in the *Speed Compensation/Accuracy Internal Control* condition to be greater than the *Speed and Accuracy Compensation* condition. As seen in Panel A of Table 3, cell means are not consistent with our predictions. Speed is 0.001 in the *Speed Compensation/Accuracy Internal Control* condition but 0.004 in the *Speed and Accuracy Compensation* condition. The comparison between these two conditions is not significant ($F = 0.33$, $p = 0.567$). These results do not support hypothesis 3b. As discussed in our theoretical development of hypothesis 4, finding support for only one of our hypothesis 3 predictions is not entirely surprising. Hypothesis 3b results suggest, when viewed in conjunction with hypothesis 3a results, that when presented with incentive compensation on multiple task dimensions, participants in our study focused on maximizing speed at the expense of accuracy.

While analyses relating to hypothesis 1 through hypothesis 3b represent the most direct tests of our theory, tests of hypothesis 4 provide additional insights regarding the implications of our theory for overall performance in a multidimensional task setting. Hypothesis 4 predicts that performance *overall* (on all dimensions) will be greater when compensation is tied to one dimension and internal control is tied to the other dimensions relative to when compensation is tied to all task dimensions. We test this prediction by comparing performance between the *Speed and Accuracy Compensation* and *Speed Compensation/Accuracy Internal Control* conditions. As seen in Panel A of Table 4, cell means are consistent with our predictions. Overall performance is

0.904 when participants are compensated on speed and accuracy, and is 1.174 when participants are subject to an internal control on accuracy and are compensated on speed. As reported in Table 4, Panel B, the results are marginally significant ($F = 2.18$; $p = 0.071$), providing support for hypothesis 4.¹⁹

(Insert Table 4 here)

Supplementary Analysis

An alternative explanation for some of our findings is that our (task-specific) internal control on accuracy provides individuals stronger motivation to type accurately than does compensating individuals on accuracy. In other words, according to this argument, our result occurs because our internal control on accuracy is “stronger” than our accuracy-based incentive compensation. If this were the case, we could make no claims regarding the additive benefit of compensating on a single dimension while implementing internal controls on other dimensions (as opposed to simply compensating on all dimensions). To rule out this alternative explanation, we compare the typing accuracy of individuals who are paid a flat wage with an internal control on accuracy (the *Accuracy Internal Control* condition) to the typing accuracy of individuals who are paid based on how accurately they type with no internal control on accuracy (the *Accuracy Compensation* condition). The results suggest that this comparison is not significant ($F = 0.91$; $p = 0.342$ two-tailed). Thus, when we compare internal controls on accuracy and incentive compensation on accuracy in isolation in our task, we find that internal controls and incentive compensation provide similar motivation to individuals. However, when incentive compensation is also provided on speed, internal controls on accuracy are more effective at improving accuracy than compensating on accuracy, consistent with our hypotheses.

¹⁹ Interestingly, overall performance is no better in the *Compensate Speed/Control Accuracy* condition than in the *Control Accuracy* condition ($F = 0.64$; $p = 0.427$ two-tailed). We discuss potential reasons for this result in Section V.

V. Conclusions

This study provides important insights in what is, to our knowledge, the first attempt to investigate the complementary impact of internal controls and incentive compensation. Consistent with our predictions, we find that when firms tie compensation to multiple task dimensions, employees divide their effort between task dimensions resulting in lower overall performance. However, we find evidence suggesting that when firms implement internal controls on one dimension of a task rather than tying compensation to that dimension, employees are able to improve their performance on the task dimension that is subject to an internal control without hurting their performance on another compensated task dimension. Finally, we provide evidence that, given the unique properties of internal control and incentive compensation, firms may be able to better achieve their multidimensional goals by compensating on one dimension of a task and implementing internal controls on the other dimension than they can by compensating on both dimensions of a task. These findings provide important contributions to the current literature and are relevant to researchers and practitioners.

The conclusions of our study are subject to limitations that provide opportunities for future research. First, we examine the constructs in this study using an abstract task. Specifically, we employ a simple data-entry task with two performance dimensions to investigate how basic differences between internal controls and incentive compensation differentially impact behavior in a multidimensional setting. However, while changes in the multidimensional task setting will likely impact effect sizes we observe, they are unlikely to alter the directional effects (Libby et al. 2002).

Second, we do not examine how employees perform when they are compensated on multiple dimensions of a task as well as being subject to internal controls on one or more of those same task dimensions. In other words, we chose not to examine how employees would perform if we paid them based on speed and accuracy, as well as subjecting them to internal controls on

accuracy. We also chose not to investigate how employees perform when they are subject to internal controls on multiple dimensions. We leave to future research an examination of how employees perform when multidimensional contracts and internal controls are implemented on the same dimensions, or when internal controls are implemented in multiple dimensions.

Third, we limit the multidimensional task in our study to two dimensions. However, the theory we draw from would predict that results would be stronger with additional task dimensions. We leave the empirical tests of this prediction to future research.

Fourth, we find that overall performance is no better when participants are compensated on speed and subject to an internal control on accuracy (*Speed Compensation/Accuracy Internal Control* condition) than when they are paid a flat wage and subject to an internal control on accuracy (*Accuracy Internal Control* condition). Although we did not predict this result, an argument made by Holmstrom and Milgrom (1991, 32) may help explain the finding. They argue that when employees are motivated to exert effort without explicit incentives to do so (i.e., they are intrinsically motivated to work), an optimal contract can be to pay a fixed wage to employees. In our study, the experimental task may have elicited participants' intrinsic motivation to type quickly, thus improving employee performance under a flat-wage incentive contract. Expanding on Homstrom and Milgrom's conjecture, this suggests that in cases where employees are intrinsically motivated to exert effort on certain task dimensions, an optimal contract may be to offer employees a flat wage while implementing internal controls on other task dimensions.

Fifth, the internal control used in this study is detective in nature, and provides immediate feedback to the participant about his/her performance. However, some internal controls do not provide feedback directly to the employee, but instead are used primarily to inform superiors about the employees' work. We selected this internal control type because prior research shows that this type of internal control is ideal for improving performance on "controlled" task dimensions without the negative consequences associated with other types of controls (e.g.,

diminished trust, decreased intrinsic motivation) (Christ et al. 2012a). However, the results of this study may not be generalizable to settings with internal controls that do not provide immediate feedback to employees. Future research could examine how different aspects of internal controls (e.g., feedback, limits to autonomy, etc.) interact with incentive compensation to influence employee behavior in multidimensional work settings. Importantly, however, our findings demonstrate that complete contracts, where all task dimensions are compensated, need not be superior to incomplete contracts with (some form of) internal controls. This study is the first to provide empirical evidence to that end, and is an important first step in a continuing investigation of the complementary nature of incentive compensation and internal controls.

Appendix

After reading the instructions (and experimenting with the implemented control, if applicable), participants answered a series of true/ false comprehension questions to determine whether they understood the manipulations. If participants answered any questions incorrectly, the relevant instructions were repeated and the participant was required to answer the questions correctly before beginning the main part of the experiment. The specific questions were:

1. If you make a mistake when entering a letter you can hit delete and try to fix the mistake.
2. To advance the cursor to the next line once you have finished typing you must hit "Tab."
3. Aside from differences in compensation, the typing task that you will now perform is the same as the typing task you just performed.
 - Answer depends on experimental condition.
4. You will make more money the faster you type.
 - Answer depends on experimental condition
5. You will make more money the more accurately you type.
 - Answer depends on experimental condition
6. You should not refresh a page or try to go back to a previous page.

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Figure 1 Experimental Conditions, Dependent Variables, and Hypotheses

Speed Dimension		Accuracy Dimension		
		No Accuracy Compensation	Accuracy Compensation	Accuracy Internal Control
	No Speed Compensation		Accuracy Compensation	Accuracy Internal Control
	Speed Compensation	Speed Compensation	Speed and Accuracy Compensation	Speed Compensation/ Accuracy Internal Control

Dependent Variables:

$$Accuracy = \frac{Total\ errors\ made\ in\ test\ task}{Total\ characters\ (test)} - \frac{Total\ errors\ made\ in\ pretest\ task}{Total\ characters\ (pretest)}$$

$$Speed = \frac{\sum Time\ spent\ entering\ each\ character\ in\ test\ task}{Total\ characters\ (test)} - \frac{\sum Time\ spent\ entering\ each\ character\ in\ pretest\ task}{Total\ characters\ (pretest)}$$

Overall performance is calculated by first taking a z-transformation of the accuracy (speed) measures by subtracting from the measure the average accuracy (speed) of all participants, then dividing by the accuracy (speed) standard error. We then average an individual's z-transformed accuracy and speed, and add 1. Higher values signify better overall performance.

Hypotheses:

H1: Dependent Variable: Accuracy. Prediction: Speed Compensation/Accuracy Internal Control > Speed Compensation

H2: Dependent Variable: Accuracy. Prediction: Accuracy Compensation > Speed and Accuracy Compensation
 Dependent Variable: Speed. Prediction: Speed Compensation > Speed and Accuracy Compensation

H3a: Dependent Variable: Accuracy. Prediction: Speed and Accuracy Compensation < Speed Compensation/Accuracy Internal Control)

H3b: Dependent Variable: Speed. Prediction: Speed Compensation/Accuracy Internal Control > Speed and Accuracy Compensation

H4: Dependent Variable: Overall Performance. Prediction: Speed Compensation/Accuracy Internal Control > Speed and Accuracy Compensation

TABLE 1
Speed and Accuracy Improvements from Pre-Test to Main Data-entry Task

Panel A: Is Accuracy Improvement Greater than Zero?

	Mean Accuracy^a	<i>t</i>-value	<i>p</i>-value
Accuracy Internal Control	0.110	3.78	<0.001
Accuracy Compensation	0.101	3.69	<0.001
Speed Compensation	0.004	0.14	0.889
Speed Compensation/Accuracy Internal Control	0.142	5.08	<0.001
Speed and Accuracy Compensation	0.039	1.43	0.154

Panel B: Is Speed Improvement Greater than Zero?

	Mean Speed^a	<i>t</i>-value	<i>p</i>-value
Accuracy Internal Control	0.000	-0.11	0.909
Accuracy Compensation	-0.006	-1.75	0.083
Speed Compensation	0.014	4.19	<0.001
Speed Compensation/Accuracy Internal Control	0.001	0.34	0.732
Speed and Accuracy Compensation	0.004	1.17	0.244

Panel C: Comparison of Overall Performance

Condition	Mean Overall Performance^a	<i>t</i>-value	<i>p</i>-value
Accuracy Internal Control	1.023	7.52	<0.001
Accuracy Compensation	0.845	6.60	<0.001
Speed Compensation	1.067	8.17	<0.001
Speed Compensation/Accuracy Internal Control	1.174	8.99	<0.001
Speed and Accuracy Compensation	0.904	7.06	<0.001

^a As defined in Figure 1, a significant, positive mean accuracy (speed) [overall performance] indicates that participants' accuracy (speed) [overall performance] improved from the pre-test task where there were never any internal controls or incentive compensation, to the main data-entry task where internal controls and incentive compensation on were manipulated between conditions.

TABLE 2

Effects of Internal Control and Incentive Compensation Manipulations on Accuracy

Panel A: Descriptive Statistics Related to Accuracy: Mean [Stdev]

Description	Accuracy Internal Control	Accuracy Compensation	Speed Compensation	Speed Compensation/ Accuracy Internal Control	Speed and Accuracy Compensation
Number of Participants	23	26	25	25	26
Pre-Test Accuracy	0.174 [0.207]	0.259 [0.215]	0.281 [0.196]	0.204 [0.220]	0.191 [0.159]
- <u>Main Test Accuracy</u>	<u>0.064 [0.048]</u>	<u>0.158 [0.144]</u>	<u>0.277 [0.183]</u>	<u>0.062 [0.040]</u>	<u>0.152 [0.120]</u>
= Accuracy	0.110 [0.166]	0.101 [0.107]	0.004 [0.126]	0.142 [0.198]	0.039 [0.095]

Panel B: Planned Comparison Tests of Hypotheses**H1:** Speed Compensation/Accuracy Internal Control > Speed Compensation: $F = 12.22$, $p < 0.001$ **H2:** Accuracy Compensation > Speed and Accuracy Compensation: $F = 2.45$, $p = 0.057$ **H3a:** Speed and Accuracy Compensation < Speed Compensation/Accuracy Internal Control: $F = 6.89$, $p = 0.005$

See Figure 1 for variable definitions and listing of hypotheses. All reported p -values are one-tailed when testing directional hypotheses.

TABLE 3
Effects of Internal Control and Incentive Compensation Manipulations on Speed

Panel A: Descriptive Statistics Related to Speed: Mean [Stdev]

Description	Accuracy Internal Control	Accuracy Compensation	Speed Compensation	Speed Compensation/ Accuracy Internal Control	Speed and Accuracy Compensation
Number of Participants	23	26	25	25	26
Pre-Test Speed	0.226 [0.067]	0.246 [0.088]	0.26 [0.048]	0.233 [0.077]	0.255 [0.065]
- <u>Main Test Speed</u>	<u>0.227 [0.065]</u>	<u>0.252 [0.086]</u>	<u>0.246 [0.043]</u>	<u>0.232 [0.076]</u>	<u>0.251 [0.060]</u>
= Speed	0.000 [0.006]	-0.006 [0.018]	0.014 [0.026]	0.001 [0.011]	0.004 [0.017]
Approximate Improvement in Words Per Minute	0.00	-1.80	4.20	0.30	1.20

Panel B: Planned Comparison Tests of Hypotheses

H2: Speed Compensation > Speed and Accuracy Compensation: $F = 4.70$, $p = 0.016$

H3b: Speed Compensation/Accuracy Internal Control > Speed and Accuracy Compensation: $f = 0.33$, $p = 0.283$

See Figure 1 for variable definitions and listing of hypotheses. All reported p -values are one-tailed when testing directional hypotheses. The approximate improvement in words per minute (WPM) is computed by assuming that each word is five characters (standard assumption in calculating WPM) and then multiplying Speed * 5 *60.

TABLE 4
Effects of Internal Control and Incentive Compensation Manipulations on Overall Performance

Panel A: Descriptive Statistics Related to Overall Performance: Mean [Stdev]

Description	Accuracy Internal Control	Accuracy Compensation	Speed Compensation	Speed Compensation/Accuracy Internal Control	Speed and Accuracy Compensation
Number of Participants	23	26	25	25	26
Overall Performance	1.023 [0.638]	0.845 [0.615]	1.067 [0.743]	1.174 [0.657]	0.904 [0.671]

Panel B: Planned Comparison Tests of Hypotheses

H4: Speed Compensation/Accuracy Internal Control > Speed and Accuracy Compensation: $F = 2.18$, $p = 0.071$

See Figure 1 for variable definitions and listing of hypotheses. All reported p -values are one-tailed when testing directional hypotheses.