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The Effects of Combined Evaluative and Memo, Matrix, and Graphic Objective Feedback on Performance When Receiving Fixed Pay

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THE EFFECTS OF COMBINED EVALUATIVE AND MEMO, MATRIX, AND GRAPHIC OBJECTIVE FEEDBACK ON PERFORMANCE WHEN RECEIVING FIXED PAY

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The purpose of this current study was to examine the relative effectiveness of written feedback in the form of a memo that displays the performer's current performance (memo feedback), written feedback in the form of a matrix that displays the performer's current performance along with past performance (matrix feedback), and graphic feedback that displays the performer's current performance along with past performance on a line graph (graphic feedback) when individuals receive fixed pay. The memo, matrix, and graphic feedback displayed "objective" feedback. Participants were 70 undergraduate students who were randomly assigned to one of the four conditions. Participants attended a covariate session and five experimental sessions, which were 45 minutes each. The experimental task was a computerized medical data entry task, and the primary dependent variable was the average number of correctly completed medical records per session. The results were analyzed using a monotone ranked-based analysis of covariance (ANCOVA). There were no statistically significant performance differences between the different mediums of feedback. Given the ambiguity of the current results, further research is clearly required.

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by

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INTRODUCTION

Feedback continues to be one of the most frequently implemented interventions in organizational behavior management (OBM) (Alvero et al., 2001; Balcazar et al., 1985-1986; Balcazar et al., 1989; Nolan et al., 1999; VanStelle, et al., 2012). According to the results of several periodic reviews, feedback was implemented in 65% to 71% of studies published in the *Journal of Organizational Behavior Management* between 1977 and 2009 (Mentzer & Alvero, 2013). One of the most prominent advantages of feedback is the relatively low cost associated with its implementation. Feedback can also be a simple intervention to put in place because, in comparison to other performance improvement technologies, little training is required to teach personnel how to implement it (Balcazar et al., 1985-1986; Cook & Dixon, 2006; Prue & Fairbank, 1981), although implementing it in alignment with best practices may require an additional training and understanding.

Performance feedback has been defined in a number of different ways by researchers and practitioners in OBM; however, two features are common to most definitions. The first is that feedback provides information about an individual's or group's past performance. The second is that the purpose of feedback is to alter future performance (Brethower, 1972; Connellan, 1978; Daniels & Bailey, 2014; Prue & Fairbank, 1981; Rummler & Brache, 1995). These features conform to the historical roots of the term "feedback" in psychology in general, which originated from cybernetics and control systems engineering (Duncan & Bruwelheide, 1985-1986; Peterson, 1982). In these fields "feedback allows for error correction in that the information about the present state or functioning of a system is used to control the future state or functioning of that system" (Duncan & Bruwelheide, 1985-1986, p. 93).

Just as there is no consensus about the definition of feedback, there is no consensus about the behavioral function(s) of feedback. Furthermore, as stated by Peterson (1982, p. 101), feedback "is, first and foremost, a physical stimulus, irrespective of the form it takes, and therefore could have some or all of the possible effects of any stimulus". That is, the behavioral function(s) of feedback depends upon the specific situation and context. Regardless, it is important to understand the possible functions of feedback because this understanding can determine how and when to use feedback to maximize its effectiveness (Aljadeff-Abergel et al., 2017; Alvero et al., 2001).

Several behavior analysts have stated that feedback might function as a discriminative stimulus due to its correlation with the availability of a reinforcer or punisher (Agnew & Redmon, 1992; Balcazar et al., 1985-1986; Daniels & Bailey, 2014; Duncan & Bruwelheide, 1985-1986; Kopelman, 1986; Locke et al., 1981; Malott & Whaley, 1976; Mayer et al., 2014; Peterson, 1982). If the feedback is provided prior to a specific behavior or class of behaviors, it is often correlated with some type of reinforcement or punishment resulting from what can be classified as "good" or "poor" performance. That is, the presence of feedback might be correlated with the availability of approval or praise for good levels of performance or disapproval for poor levels of performance. Due to this correlation of feedback with differential rewards and punishers, feedback would come to evoke behavior as a discriminative stimulus. Balcazar et al. also maintained that the discriminative effects of feedback could generalize to new situations and settings; that is, that feedback could evoke behavior in a different setting before it had been correlated with differential rewards, although those effects would be temporary unless it was correlated with rewards in that new setting.

It has been suggested, however, that in most situations feedback, as an antecedent, may function as a motivating operation rather than as a discriminative stimulus (Agnew, 1998; Aljadeff-Abergel et al., 2017; Alvero et al., 2001; Bucklin et al., 2003; Duncan & Bruwelheide, 1985-1986; Johnson et al., 2008; Michael, 1982; Peterson, 1982). A stimulus must be differentially correlated with the availability of a reinforcer in order to be a discriminative stimulus. That is, when the discriminative stimulus is present, the reinforcer is available contingent upon a response, and when the discriminative stimulus is not present, the reinforcer is not available. In many situations in business and industry, the consequence for productive performance is available regardless of whether feedback precedes the response. For example, assume that sales representatives receive a monthly bonus when their sales reach a specific dollar amount. The bonus is available with or without feedback. Weekly performance feedback is then provided, and the sales representatives increase their sales. The feedback cannot be a discriminative stimulus because the monthly bonus was available before the feedback was provided. Instead, in this case, the feedback could be functioning as a motivating operation, increasing the reinforcing value of each sales contact and evoking behaviors that lead to sales contacts.

It has also been proposed that feedback may function as a conditioned reinforcer due to repeated pairings with a variety of organizational reinforcers (Balcazar et al., 1985-1986; Bucklin et al., 2003; Duncan & Bruwelheide, 1985-1986; Johnson et al., 2008). Behavioral consequences tend to be more effective when provided as immediately and frequently as possible, and, in most work settings, feedback is typically provided more immediately and frequently than other organizational rewards (Braksick, 2007; Brown, 1982; Daniels & Bailey,

2014; Petrock, 1978; So, Lee, & Oah, 2013). Because of this, the delivery of feedback may lead to performance improvements.

Many behavior analysts have argued that while feedback may be more immediate and frequent than other organizational reinforcers, its delivery often still violates the temporal requirements of discriminative stimuli and conditioned reinforcers (Agnew & Redmon, 1992; Malott, 1993; Peterson, 1982). That is, feedback is presented too far before the targeted performance to function as a discriminative stimulus and too far after targeted performance to function as a conditioned reinforcer. Instead, the effects of feedback may be best explained as rule control. When performance is controlled by rules, it is not affected by the actual contingencies themselves, but rather by a verbal description of the relevant contingencies. When individuals receive feedback, it may prompt them to say something like, "If I don't engage in this work task now, I will get in trouble with my manager". The feedback does not directly evoke work behavior; instead, the self-stated rule functions as a motivating operation that creates an aversive condition that the productive behavior lessens, negatively reinforcing each instance of the target behavior. In other words, the rule is repeated by the worker (usually covertly) and describes the delayed consequences which creates what can be called discomfort (Malott, 1993). Engaging in the target behavior reduces this discomfort a bit which reinforces the target behavior.

Although research has shown that feedback has the possibility of improving performance, there are some studies that show the opposite (Alvero et al., 2001; Balcazar et al., 1985-1986; Houmanfar & Hayes, 1998). In fact, when describing how the results of their review differed from others in the past, Balcazar et al. (1985-1986) stated, "The outstanding difference is the finding that feedback is by no means uniformly effective" (p. 75). One possible reason for

differences in its effectiveness is that feedback applications vary considerably (Alvero et al., 2001; Balcazar et al., 1985-1986; Houmanfar & Hayes, 1998; Peterson, 1982). Recognizing that feedback may have different effects depending upon how it is delivered, OBM professionals have, for decades, sought to develop a classification system that will aid in identifying the characteristics that are associated with its effectiveness (Alvero et al., 2001; Balcazar et al., 1985-1986; Fairbank & Prue, 1982; Ford, 1980; Frederiksen, 2013; Houmanfar & Hayes, 1998; Mentzer & Alvero, 2013; Park et al., 2019; Prue & Fairbank, 1981; Wine et al., 2019). For example, in 1981, Prue and Fairbank stated that, "Careful consideration of each dimension of feedback prior to implementation is likely to lead to increased numbers of successful...feedback programs" (p. 14). Ultimately, a universal classification system could be used by professionals to determine which feedback characteristics are optimal in a given context.

Balcazar et al. (1985-1986) developed a feedback classification system and conducted an extensive literature review, which was later replicated and extended by Alvero et al. (2001) and Mentzer and Alvero (2013). All three reviews analyzed different applied feedback interventions from the *Academy of Management Journal* (*AMJ*), *Journal of Applied Behavior Analysis* (*JABA*), *Journal of Applied Psychology* (*JAP*), and *Journal of Organizational Behavior Management* (*JOBM*). Balcazar et al. looked at articles published from 1974 until 1984, Alvero et al. looked at those from 1985 until 1998, and Mentzer and Alvero looked at those from 1999 until 2011. These reviews examined whether feedback was used alone or in combination with other intervention components, and classified feedback applications in terms of six feedback characteristics (source, frequency, medium, privacy, participants, and content). Mentzer and Alvero added three additional characteristics: (a) precision of the information about performance (specificity); (b) extent to which the feedback reflected true performance (correctness); and (c)

how immediately the feedback was provided after the target behavior (immediacy). All three reviews analyzed how consistently feedback affected performance based on the identified characteristics.

The authors of these reviews found very few experimental comparisons of the effects of different feedback characteristics. Thus, while the results from these reviews are useful, they are not definitive for several reasons. First, they are based on structural classifications of the feedback applications, not experimental comparisons. Second, the feedback applications were typically combined with other interventions, thus their effects were confounded. And third, the feedback applications varied along several different characteristics, making it impossible to isolate the effects of any particular characteristic. It should also be noted that Mentzer and Alvero (2013) were the only authors to include laboratory investigations of feedback in addition to applied investigations in their review.

Perhaps due, at least partially, to the three methodological problems stated in the preceding paragraph, results of the three reviews (Alvero et al., 2001; Balcazar et al., 1985-1986; Mentzer & Alvero, 2013) were different. Differences were found regarding the characteristics that had the most consistent effects in five of the categories: (a) source; (b) participants; (c) content; (d) medium; and (e) frequency. Differences were also found regarding the most frequently used characteristic in five categories: (a) source, (b) privacy; (c) content; (d) medium; and (e) frequency. This latter finding gives support to the notion that experimenters are not using the reviews to guide their research. That is, the most consistently effective feedback characteristics were not the most frequently used characteristics in the subsequent reviews. On the other hand, the former statement about disparities among the reviews regarding the consistency of the effects implies that the results from the reviews are not reliable and thus

should not, in fact, be used to guide their use. Because of the limited number of direct experimental comparisons and the differences in the results of the three feedback reviews, Mentzer and Alvero (2013) asserted that, "[T]he research community may want to consider the value of conducting research on feedback characteristics in the context of a basic study if the goal of their research is to implement feedback in an applied environment" (p. 26).

The relative effectiveness of different feedback mediums is among many of the questions that remain. Feedback medium is defined as "the means used to communicate the feedback information to the recipients" (Balcazar et al., 1985-1986, p. 69) or "the way in which feedback was provided" (Mentzer & Alvero, 2013). Examples include vocal, written, graphic, and mechanical (e.g., video). When determining the consistency of effects, all authors reported the percentage of applications that had consistent effects (all participants improved their performance), mixed effects (some, but not all participants improved their performance), no effects, and unknown effects. Balcazar et al. (1985-1986), Alvero et al. (2001), and Mentzer and Alvero (2013), respectively, found that the most consistently effective medium was vocal plus graphic (55% effective, 6 of 11), written plus graphic (86% effective, 6 of 7), and vocal, written, and tabular (83% effective, 5 of 6). Balcazar et al. (1985-1986), Alvero et al. (2001), and Mentzer and Alvero (2013), again respectively, found that the most frequently used medium was graphic (32%, 37 of 114), written (27%, 17 of 64), and vocal (24%, 42 of 176). The purpose of the current study is to examine the relative effectiveness of written and graphic feedback; two of the most consistently effective and frequently used feedback mediums as reported in these reviews.

Written Feedback

Written feedback can be defined as feedback provided via a document containing text (Mentzer & Alvero, 2013). Studies have shown that this type of feedback can improve performance. Gaetani et al. (1985) analyzed the effects of self-generated written feedback with two machinists. They implemented an ABAC design sequence in which A was hourly pay, B was hourly pay with written feedback, and C was commission pay with written feedback. The feedback was a daily invoice generated for each machinist that indicated the total dollar amount of work charged to customers during the day and was calculated at the end of the work day. The performance of both machinists nearly doubled when the feedback was added to hourly pay and began to decrease to baseline levels when the feedback was removed. The owner refused to continue the reversal phase for more than seven days because the decrease resulted in lower profits. When commission pay with feedback was implemented in the last phase, performance rose substantially and remained high and consistent for the entire phase which lasted forty days. The authors also noted that the written feedback system in this study was relatively cost-effective and had a high return on investment because it only required about 15 minutes of employee time per day.

Fox and Sulzer-Azaroff (1990) assessed the effects of written feedback with respect to increasing the amount of fire escape safety training (trials) conducted by direct care staff at a facility serving developmentally disabled adults. For the feedback, either a supervisor or an expert in fire evacuation procedures provided staff with a written account (memo) of the number of assigned trials completed each week by all staff members and included one to three sentences of positive comments on performance. Initially, one feedback memo was distributed to the entire team, but it was found that some team members would not always see the feedback.

Subsequently, one copy of the memo was given to each team member to correct for this. This brief written feedback procedure led to considerable increases in the percentage of assigned trials completed by the staff, and, in some cases, the number of completed trials exceeded the amount required. Further, some of the staff reported that they would appreciate feedback on other aspects of their job and that adding some type of vocal feedback in combination with the written feedback might have been beneficial.

In another study, Henry and Redmon (1991) analyzed written feedback in combination with vocal evaluative feedback with machine shop workers to increase compliance with Statistical Process Control (SPC), a quality control program. Each day, workers filled out checklists that outlined each task that was to be completed in compliance with the SPC program. The supervisors provided each worker with an index card that summarized the score they received (percentage of tasks correctly completed) that day. The supervisors also provided a vocal statement that indicated if performance was excellent, good, fair, poor, or unsatisfactory based on individual scores. During baseline, task completion averaged around 79% for the workers overall. When feedback was introduced, task completion increased and maintained at 100% for all three workers. Task completion decreased when the baseline phase was reintroduced, clearly demonstrating that the feedback procedure was responsible for the changes in performance.

Chae et al. (2020) conducted a study with written feedback to analyze the impact authority relations may have on performance. Participants received written feedback either in the form of a memo that was handed to them in person or an email. They were assigned to 1 of 4 conditions: 1) authority figure with memo feedback, 2) authority figure with email feedback, 3) non-authority figure with memo feedback, or 4) non-authority figure with email feedback. Both

forms of written feedback improved performance for all groups. However, those who received the feedback from a perceived authority figure performed higher than those in the non-authority figure groups.

Warrilow et al. (2020), in a laboratory study, compared the effects of feedback when it was provided face-to-face, by the computer, or texted. One-hundred eleven undergraduate students were randomly assigned to one of the following four conditions: (a) no feedback, (b) computer delivered feedback (written), (c) texted feedback via cell phone (written), and (d) face-to-face (vocal) feedback. The task was a computerized check-proofing task designed to stimulate the job of a proof operator at a bank; the same task used in Johnson et al. (2008) and Johnson (2013). Results found a statistically significant difference between groups for the number of checks correctly completed. The highest performing group was the face-to-face feedback group and the lowest performing group was the no feedback group.

Graphic Feedback

Like written feedback, graphic feedback has been shown to increase performance in a variety of settings. Graphic feedback can be defined as feedback provided via a graph of performance (Mentzer & Alvero, 2013). Jones et al. (1985) conducted an applied study with psychiatric emergency room personnel to determine the effects of graphic feedback on the completion of three mandatory civil commitment forms (notices of rights, imminent harm applications, and witness lists). First, instructional meetings were conducted between the mental health coordinator and each staff member to go over the three forms and an accompanying job aid for each to clarify how to fill them out correctly. During this meeting, staff members were also shown a graph of the mean percentage of target forms the group correctly completed over the past few weeks. Staff members were also given the option to receive an individual copy of

the updated group feedback graph each week. Thirty-three of the thirty-four staff members accepted this offer. The percentage of correctly completed forms rapidly and significantly improved when the feedback was introduced, and these improvements were maintained during a six-month follow-up.

In another applied study, Brown and Sulzer-Azaroff (1994) used graphic feedback to increase the customer service of bank tellers. An ABABC design was used, with Phase A serving as the baseline condition. Observations were conducted in baseline where experimenters observed the tellers and recorded how many incidences of the target behavior (smiling, greeting, and looking at customers) occurred. Phase B was the observation plus chips condition during which tellers handed out colored poker chips to customers asking that they use them to rate their service. Each teller was assigned a different color chip. The customers would then use these chips to rate their customer service experience by dropping them into one of five compartments ("extremely satisfied", "very satisfied", "satisfied", "somewhat satisfied", and "unsatisfied") in a box located in the lobby. Phase C was the addition of feedback where group and individual graphic feedback were provided based on the customer satisfaction data that were collected via the chips. Group feedback was posted in the lunch room over the coffee machine and individual feedback was given to each teller in a sealed envelope. Graphic feedback increased all three dependent variables considerably: rates of smiling, greeting, and looking at customers increased by 196%, 83%, and 30% respectively.

Anderson et al. (1988) analyzed the effects of task clarification and graphic feedback on cleaning behaviors for staff at a university bar. The general manager first went over cleaning checklists in a staff meeting and defined and outlined each item on the checklists. Publicly posted individual graphic feedback was then introduced. Staff members were assigned code

numbers to preserve their confidentiality. The line graphs were displayed on a wall near the general manager's office where employees clocked in and out and indicated the percentage of items completed correctly on the checklists. Task clarification resulted in a 13% increase in the average number of items completed over baseline levels. The addition of graphic feedback resulted in an average increase of 61.7% over baseline.

Written Feedback versus Graphic Feedback

The number of studies that have compared the effects of written and graphic feedback are quite small. In one such study, Houmanfar and Hayes (1998) analyzed the effects of privately delivered written feedback and publicly posted graphic feedback on graduate students' task completion. In Experiment 1, they examined the effects of privately delivered written feedback only. The written feedback consisted of a memo stating the percentage of tasks they had completed in the current week along with the percentage of tasks they had completed in previous weeks. An ABAB design was used with A being baseline and B being written feedback. When the written feedback was provided, task completion scores increased. However, while they decreased slightly when the feedback was removed, they remained the same when the written feedback was introduced. Median task completion was approximately 95% during the reversal phase and remained 95% when the written feedback was reintroduced. One explanation for these results is that the feedback clarified the task requirements for the graduate students and they continued to perform the tasks when the written feedback was removed. Regardless, the effects of the weekly written feedback were not clearly demonstrated.

In Experiment 2, the authors manipulated feedback in an ABABACAC design in which A was baseline, B was private written feedback, and C was publicly posted graphic feedback. The private written feedback was given by a supervisor in the form of a memo that included the

student's percentage of task completion over the past weeks. The publicly posted graphic feedback consisted of the individual's performance and the individual performance of others in their group. The data were coded for each graduate student so that students could identify their own data, but not the data of other students. The public feedback, similar to the private written feedback, depicted performance for the current week and previous weeks.

The effects of both the written and graphic feedback implementations were inconsistent and unclear. Overall, no effects were found for either written or graphic feedback on task completion. Interestingly, this is the only study that the author could locate in this body of research in which the written feedback included both current and cumulative past performance. That is, the experimenters controlled for this variable by having both the written and graphic feedback depict cumulative past performance so that both interventions were similar in this dimension. While this control is an important feature when considering comparisons of written and graphic feedback, neither type of feedback affected performance in this study.

Doll et al. (2007) analyzed five cleaning behaviors of workers in a ski shop to determine the effects of task clarification, behavioral checklists, graphic feedback, and written feedback on these target responses. After the two-week baseline phase, the first intervention consisting of task clarification, performance checklists, and graphic feedback was implemented. There were five target cleaning behaviors to be completed each day (seven days a week), which meant there were a total of 35 target behaviors to be completed each week. The store manager explained how to correctly complete the target cleaning behaviors during a task-clarification meeting and distributed a cleaning checklist to use as an example. Checklists for the target cleaning behaviors were posted next to the cash register. There were columns representing each day of the week next to each cleaning behavior, and employees were to initial in the appropriate column next to

the behavior once it was completed. The behavior was to be completed before closing each day and a new checklist was posted each week. Graphs depicted the percentage of correct cleaning behaviors (out of 35) that were completed each week and were posted next to the cash register. In the second intervention, graphic feedback was withdrawn, and written feedback was added in the form of a posted list of target behaviors that were not completed in the previous shift. During baseline, the average completion of each behavior ranged from 13% to 60%. During the first intervention, the target behaviors were correctly completed an average of 83.2% of the time. During the second intervention, means increased to 100% for all target behaviors except one.

Despite the higher performance in the written feedback phase, the results are not conclusive because an ABC design was used. ABC designs lack experimental control because the sequence of the interventions may affect the results (Komaki & Goltz, 2001). In the current study, the written feedback intervention may not have had the same effect on performance if it had not followed the graphic feedback intervention. Additionally, the type of feedback provided differed during the two interventions. The graphic feedback displayed the percentage of behaviors performed correctly, while the written feedback listed the specific behaviors that had not been completed during the previous shift. Thus, the precision of the feedback differed (Mentzer & Alvero, 2013). Both Williams and Geller (2000) and Park et al. (2019) found that specific feedback resulted in higher levels of performance than global feedback, although in the latter study, the effects of the specificity of feedback depended on its frequency. That is, specific feedback was more effective when the feedback was infrequent while global feedback was just as effective when the feedback was frequent. Regardless, the results of these two studies suggest that the increases in performance during Doll et al.'s (2007) Phase C could well be due to the change in feedback specificity rather than the change from graphic to written feedback.

Although the written feedback improved performance more than the graphic feedback, during informal interviews after the study was over, participants noted that they disliked the written feedback because it made them feel defensive. This is most likely due to the fact that the written feedback only addressed the behaviors that were not completed. This interpretation is supported by the results of a study by Sigurdsson and Ring (2013). These researchers examined whether individuals preferred graphic data displayed as either correct or incorrect performance. Participants overwhelmingly preferred data graphed as correct performance.

The results of the two studies that have compared written feedback and graphic feedback are questionable. In Houmanfar and Hayes (1998) neither written nor graphic feedback affected performance in meaningful ways. These results conflict with the results of the studies described in the preceding two sections of this manuscript. In Doll et al. (2007), methodological constraints (the ABC design and the difference in specificity of feedback in the two conditions) nullify a sound comparison of the two types of feedback.

Written Feedback with Graphic Feedback Added

Very few studies have examined the effects of adding graphic feedback after a written feedback system has already been in place. Furthermore, in all of those studies the graphic feedback was publicly posted. Nordstrom et al. (1988) conducted a series of experiments in a large OBM training program for managers in city government. In Experiment 2, an intervention was designed to increase the typing and proofing accuracy of two typists. A multiple baseline design was used in ABCB fashion, with Phase A being baseline, Phase B being goals and written feedback, and Phase C being goals, written feedback, and graphic feedback. A feedback sheet, called an assignment report (AR), was developed and used to provide private, individual written feedback. This weekly report depicted the number of pages typed, number of pages typed

correctly, and percentage of pages typed correctly for each typist. Written evaluative feedback (praise) was also included on the AR, in the form of comments such as "Your typing percentage is up 15% over last week!" or "Your score was 100% this week. I knew you could do it. Fantastic!" The ARs were given to each employee on Friday afternoons. In Phase C, the graphic feedback depicted the weekly percentages of pages typed correctly for each typist and was publicly posted outside the manager's office three times a week. Goal setting and written feedback alone significantly improved performance. During baseline, the average number of overall pages typed correctly was 55%. When goal setting and written feedback were introduced, performance increased immediately to an average of 82% correct. A few weeks into this intervention typing performance began to steadily decline, which led to the introduction of graphic feedback in Phase C. This resulted in an increase in performance with the average number of pages typed correctly increasing to 85%. When the graphic feedback was removed performance further increased to an average of 93% correct during the final nine weeks of the experiment. During a one year follow up, the interventions had been discontinued and performance had decreased to 37.5% correct.

One reason why the addition of graphic feedback led to increases in performance (when performance began declining in the previous condition) might be due to the public nature of it. The written feedback was delivered privately whereas the graphs were publicly displayed by the manager's office. It is also the case that because the graphic feedback displayed the performance of both typists, they could compare their performance to the other's performance. Both VanStelle (2012) and Einarsson (2016) found that this type of social comparison feedback led to higher performance than individual feedback even when provided privately. Thus, both the public nature of the feedback as well as the social comparison feedback could have contributed to the

increases observed in the graphic feedback phase. It is not clear why performance continued to increase after the graphic feedback was removed.

Kim et al. (2005) examined whether publicly posted written feedback would increase the number, percentage, and amount (weight) of correctly separated recyclables on a collage campus and what effects, if any, the addition of graphic feedback would have. Written feedback boards were publicly displayed and indicated the percentage of cans and paper cups correctly separated and the weight of paper recycled the day prior. Graphic feedback boards were adhered to recycling containers and two vending machines and displayed the same information as the written feedback but in line graph form. An A-B-BC-A design was used in which A was baseline, B was written feedback, and C was graphic feedback. Written feedback significantly increased the percentage, number, and weight of recyclables collected. The addition of graphic feedback led to increases across all measures, however none of these increases was statistically significant. When both the written and graphic feedback was removed in the final phase, all measures, except one (the percentage of correctly separated paper cups) decreased significantly.

In this study, graphic feedback did not increase performance after participants had received written feedback. The reason for this may be attributed to the public nature of the written feedback. Posting written feedback may have led to social contingencies that increased the recycling measures to such a level that further increases, brought about by the graphic feedback, were difficult to obtain.

In both Nordstrom et al. (1988) and Kim et al. (2005), written feedback led to significant performance improvements, which is consistent with what many researchers have found in the past. The addition of graphic feedback led to further performance improvements, however these improvements were quite small. Further, the results of the two studies are not conclusive. In

both, performance increases may have been constrained due to features other than the written feedback per se. In Nordstrom et al., the written feedback was combined with goal setting. In addition, the written feedback consisted of both objective and evaluative feedback, which has been shown to increase performance more than just one or the other (Johnson, 2013). In Kim et al. as indicated previously, the written feedback was publicly displayed. Thus, the data from Kim et al. suggest that public written feedback may be as effective as public graphic feedback; however, the results may not generalize to private written and graphic feedback. The author was not able to locate any studies that examined the effects of adding private graphic feedback to private written feedback.

Graphic Feedback with Written Feedback Added

Similar to the lack of research on the effects of adding graphic feedback to written feedback, there is a lack of research on the effects of adding written feedback to graphic feedback. In one of the few studies examining this comparison, Hawkins et al. (1992) analyzed the effects of vocal and graphic feedback alone and in combination with written feedback in order to assess whether the more "stringent" written feedback procedure would further improve the performance of staff in a nursing home. The design was an AB design with replications across three units in the facility.

The geriatric nursing assistants (GNA) carried out a maintenance program for residents who were recently discharged from an incontinence treatment unit in the facility. They received instructions on how to conduct a prompted voiding procedure and were then assigned to resident rooms. A self-monitoring form listed the schedule of prompted voiding procedures to be completed and GNAs were asked to indicate whether or not they completed the prompting procedure with each resident and whether the resident was wet or dry. Once the form was

completed, the GNAs initialed it and left it at the resident's bedside to be collected by the experimenters each day. The experimenters used these forms to calculate the mean percentage of assigned prompted voiding procedures that were completed (out of the total number that were assigned) to generate graphic feedback. The supervisors then used this graphic feedback to provide vocal evaluative feedback to each GNA. Praise was given when at least 60% of assigned prompted voids were completed and corrective feedback was given when GNAs completed less than 60%.

The combination of graphic and vocal evaluative feedback resulted in an average of 69.2% completion of prompted voiding procedures. Bi-weekly written evaluative feedback was then added in which GNAs who completed at least 60% of their assigned prompted voids received a letter of praise and those who completed less than 60% received a letter stating that they needed to improve their performance. Additionally, a letter was sent to all GNAs every three months which summarized their individual performance (based on the bi-weekly letters) during this period. GNAs were informed that these summary letters would be placed in their personnel files to be used during annual performance evaluations.

Although graphic and vocal evaluative feedback were effective (69% completion), the average percentage of completed prompted voids increased to 80% when written evaluative feedback was added. The addition of written feedback may have increased performance because it was more likely to result in a tangible consequence (e.g., corrective action or career advancement) due to its use in annual performance reviews. Caution is warranted when interpreting the results, however, because the data were derived from GNA self-reports. The GNAs benefitted from improved performance, especially when the written feedback was introduced because it was also used for evaluative purposes during performance reviews. As

such, the increases in performance attributed to the addition of written feedback could potentially be inflated. Recognizing that the GNAs could inflate their data, the researchers implemented procedures to discourage that. First, nurse supervisors informed the GNAs that unreliable recording on the self-monitoring forms would be the same as falsifying medical records and would be dealt with accordingly. Second, supervisors conducted unannounced checks for prompted voiding and the authors reported that the inter-rater reliability of these records was quite high, although they did not report those data in the article. It is likely that these procedures did curtail data inflation by the GNAs.

Eikenhout and Austin (2004) compared the effects of graphic feedback alone and graphic feedback in combination with written and vocal feedback to improve customer service in a large department store. An ABAC design was used in which A was baseline, B was graphic feedback, and C was an intervention package that included graphic, written, and vocal feedback. Experimenters observed employees in three different store areas and collected data on behaviors related to customer service to determine the percentage of customer interactions in which all target behaviors occurred. During Phase B, data on group performance were graphically displayed near the time clock so that employees could easily see them each day. All prior session data were included on the graph. During the Phase C, supervisors wrote positive comments on the posted graphs at least once weekly when performance improved, which served as the written feedback. Vocal group feedback was given during weekly team meetings wherein supervisors would praise employees for improvements in customer service performance. In addition, supervisors would also look for instances where employees were displaying good customer service behaviors while on the floor and praise employees "on the spot". Both the graphic feedback and the intervention package (which included written and vocal feedback) led to

significant increases across all target behaviors when compared to baseline phases. The behaviors occurred an average of 62.59% of the time during the first intervention and 64.98% of the time during the package intervention. Thus, while the package intervention resulted in slightly better performance, the difference in performance between the two interventions was small, only 2.39%, which is not meaningful.

The graphic feedback in both studies led to significant performance improvements. However, the addition of written feedback only led to significant further performance improvements in Hawkins et al. (1992). The reason for the differences in the effects of the addition of written feedback might be attributed to the way this feedback was provided. In Hawkins et al., the written feedback was given individually and privately, rather than publicly displayed group feedback as in Eikenhout and Austin (2004). Providing feedback privately might have increased the likelihood that individuals were actually attending to the feedback. Further, the written feedback in Hawkins et al. included praise or corrective statements dependent upon performance, whereas in Eikenhout et al. written feedback consisted of praise on overall performance. The specificity of the written feedback in Hawkins et al. may have been the reason for the significant improvement in performance. Further, the written feedback was used during annual performance reviews and was more likely to result in other tangible rewards.

Summary of the Research

While several authors have developed classification systems that identify different dimensions of feedback interventions that researchers have included in their applications, well-controlled experimental comparisons of the different dimensions remain rare (Alvero et al., 2001; Balcazar et al., 1985-1986; Fairbank & Prue, 1982; Ford, 1980; Frederiksen, 2013; Houmanfar & Hayes, 1998; Mentzer & Alvero, 2013; Park et al., 2019; Prue & Fairbank, 1981;

Wine et al., 2019). The identification of feedback dimensions allows practitioners and researchers to consider various options when considering feedback procedures but until the relative effectiveness of the dimensions is established, it will not be possible to determine which characteristics will make feedback optimally effective in a given setting. One feedback dimension that warrants further research is the medium used to deliver feedback. Several reviews have found not only that written and graphic feedback are the most consistent, effective, and frequently used mediums (Balcazar et al., 1985-1986; Alvero et al., 2001; Mentzer & Alvero, 2013), but as the current review shows, there is little solid research that compares their effectiveness.

It is difficult to draw conclusions from the existing research regarding the relative effectiveness of written and graphic feedback due to at least three factors. First, the number of studies examining this comparison is very small. Second, when either written or graphic feedback was shown to result in higher levels of performance than the other, in each study, other dimensions were varied as well. For example, Doll et al. (2007) found that written feedback improved performance more than graphic feedback; however, the written feedback identified the specific cleaning behaviors that had not been completed while the graphic feedback only identified the percentage of total cleaning behaviors completed. Thus, the precision of the feedback was altered as well as the medium of presentation. Somewhat similarly, Hawkins et al. (1992) reported that the addition of written feedback improved staff performance when it was added to graphic feedback. Once again, however the nature of the written feedback was considerably different and linked to the performance evaluations of the staff, unlike the graphic feedback. In contrast, Nordstrom et al. (1988) found that the addition of graphic feedback to written feedback improved typist performance significantly; however, the graphic feedback

displayed the performance of both typists and was publicly posted while the written feedback was individualized and given to the typists privately.

The third reason it is difficult to draw conclusions about the relative effectiveness of written and graphic feedback is due to the experimental designs used. Kim et al. (2005) added graphic feedback to written feedback and found that while the graphic feedback increased recycling behaviors, the increase was not meaningful. Eikenhout and Austin (2004), in contrast, added written and vocal feedback to graphic feedback and reported that while the written feedback increased customer service behaviors, the increase was not meaningful. In these studies, the sequencing of the interventions may well have affected the results. It should also be noted that in both Kim et al. (2005) and Eikenhout and Austin (2004), both the written and graphic feedback were publicly posted. One potential implication of the results of these studies is that the public nature of the feedback may have rendered the medium irrelevant. That is, written and graphic feedback may have similar effects if presented publicly.

Regardless, more studies are necessary to assess if and when the effects of written and graphic feedback differ. The current study was designed to examine the effects of written and graphic feedback while controlling other feedback dimensions. A between group design was adopted in order to prevent any possible sequence effects. Three feedback mediums were assessed: written feedback in the form of a memo that displays the performer's current performance, written feedback in the form of a matrix that displays the performer's current performance along with past performance, and graphic feedback that displays the performer's current performance along with past performance. The following section discusses the potential practical advantages of these three feedback mediums.

Comparison of Written, Matrix, and Graphic Feedback

Although research has not demonstrated that written or graphic feedback is more effective than the other, both have several practical advantages and disadvantages. One advantage of both written and graphic feedback in contrast to vocal feedback is that they provide a concrete product, which can then be displayed either privately or publicly. It also allows the supervisor to easily monitor and keep track of performance and file the feedback for subsequent use, such as in annual performance reviews. Similar to the studies reviewed in this manuscript, in most studies, written feedback has consisted of a form, index card, memo, or letter that indicates the performer's current performance in text form (Fox & Sulzer-Azaroff, 1990; Gaetani et al., 1985; Hawkins et al., 1992; Henry & Redmon, 1991; Nordstrom et al., 1988). At times, the written feedback has included some type of evaluative statement (praise or prompts to improve) along with the performance data. Mentzer and Alvero (2013) discussed another possible type of written feedback called "tabular" feedback, which is provided via a table or chart. For the purposes of this study, tabular feedback that provides information on both current and past performance was referred to as "matrix" feedback.

Performance data can be displayed graphically in a number of different ways, although the reviews of feedback have not distinguished between them when evaluating their effects (Alvero et al., 2001; Balcazar et al. 1985-1986; Mentzer & Alvero, 2013). Regardless of the particular graphic display used, all graphic feedback inventions have been classified under the same medium category, "graphic". The most common type of graphic feedback display is a line graph (Sigurdsson et al., 2018), followed by a bar graph. The line graph is also the most frequently recommended type of graphic display, not only in OBM, but in behavior analysis in

general (Balcazar et al., 1985-1986; Bailey & Burch, 2002; Cooper et al., 2020; Parsonson & Baer, 1986; Sigurdsson et al., 2018).

The studies reviewed in this manuscript reflect the behavior analytic tradition of using line graphs (Anderson et al., 1988; Brown & Sulzer-Azaroff, 1994; Doll et al., 2007; Eikenhout & Austin, 2004; Jones et al., 1985; Kim et al., 2005; Nordstrom et al., 1988). Bar graphs were used in two studies (Houmanfar & Hayes, 1998; Hawkins et al., 1992). In one of those (Houmanfar & Hayes, 1998), the bar graphs depicted current performance along with past performance, whereas in the other (Hawkins et al., 1992), the bar graphs depicted only current performance.

The main advantage of written feedback is that many organizations already provide written feedback which means they typically have existing procedures for using this type of feedback. Familiarity with the process makes written feedback a desirable option and increases the likelihood that it will be maintained after implementation (Prue & Fairbank, 1981). Furthermore, unlike graphic feedback and to some extent matrix feedback, supervisors may require training on how to construct the graphs or matrix, and recipients may need to be trained in how to read and understand graphic and matrix feedback.

A disadvantage of written feedback in the form of a memo is that it typically takes more time to read. Matrix and graphic feedback are designed to summarize performance information in a format that is easier to read at a glance. A disadvantage of graphic feedback is that it can be overwhelming for the recipient if there is too much information provided at once or if the individual does not know how to read graphs (Sigurdsson et al., 2018). For example, Hardesty et al. (2018) found that the vast majority of 60 entry-level direct care staff preferred data depicted as a bar graph versus a line graph. Furthermore, they preferred a bar graph that depicted only

current performance over a bar graph that depicted current performance along with past performance. Written comments indicated that they preferred the bar graph because it was simpler and easier to read and understand. In contrast, experienced therapists preferred data depicted as a line graph stating that they preferred it because they could see changes/trends over time, it was easier to read, and they had more exposure to line graphs than bar graphs.

Despite the fact that entry-level staff in Hardesty et al. (2018) preferred a graph that depicted only their current performance, authors have stressed that the primary advantage of line graphs is, in fact, that they display data over time and thus enable individuals to see changes and trends in the data (Balcazar et al., 1985-1986; Sigurdsson et al., 2018). Not only does this provide supervisors, researchers, and practitioners with evaluative data with respect to whether a particular intervention is working, but improvements in performance, can themselves, function as conditioned reinforcement for the performance of feedback recipients (Balcazar et al., 1985-1986; Sigurdsson et al., 2018). As indicated earlier, written feedback typically does not provide data about past performance.

Matrix feedback may be a good alternative to both written and graphic feedback in that it has several benefits of both: (a) it is a written form of feedback and thus is familiar to both supervisors and recipients; (b) it does not require much training to produce or understand; (c) it summarizes performance data in a more readable format than written feedback; and (d) it displays both current and past performance. On the other hand, graphic feedback might make performance trends more prominent.

Regardless of the putative advantages of written and graphic feedback, experimental comparisons of the two should control for the content of the information provided. For example, if graphic feedback were found to result in better performance than written feedback, the

difference might be due to the fact that the graphic feedback displayed past performance along with current performance rather than to written versus graphic display. Matrix feedback provides this control and thus will be one of the types of feedback examined in the current study.

Purpose of the Current Study

The purpose of the current study was to examine the relative effectiveness of written feedback in the form of a memo that displays the performer's current performance (memo feedback), written feedback in the form of a matrix that displays the performer's current performance along with past performance (matrix feedback), and graphic feedback that displays the performer's current performance along with past performance on a line graph (graphic feedback) when individuals received fixed pay. The memo, matrix, and graphic feedback displayed "objective" feedback.

Objective feedback can be defined as measurable, factual data about performance that does not include any type of evaluation (i.e., praise or criticism) and, in psychology, has historically been referred to as "knowledge of results" (Derthick, 2018; Johnson et al., 2008). In contrast, evaluative feedback indicates how well an individual is performing. In actual work settings, when supervisors have access to objective performance data, they are likely to comment on those data when giving that feedback to performers. Furthermore, when performers perform well and supervisors do not comment on it, it may actually be aversive to performers and suppress performance (Dickinson, 1989). Thus, to increase the generality of the results to actual business settings, the experimenter also provided vocal evaluative feedback based on the participant's performance along with the memo feedback, matrix feedback, and graphic feedback.

There were four conditions in the current study: (a) memo and vocal evaluative feedback with fixed pay; (b) matrix and vocal evaluative feedback with fixed pay; (c) graphic and vocal evaluative feedback with fixed pay; and (d) vocal evaluative feedback with fixed pay. The evaluative feedback replicated Johnson (2013) and Derthick (2018). Participant performance was classified as "excellent", "good", "average", or "poor" depending on the participant's performance in the previous session and the experimenter said various feedback statements relevant to each classification to the participant. Based on prior research, it was expected that the combination of objective and evaluative feedback will result in higher levels of performance than evaluative feedback alone (Gaetani & Johnson, 1983; Johnson, 2013).

With respect to the four conditions in this study, it was predicted that performance would be ordered from highest to lowest as follows: (a) graphic and vocal evaluative feedback with fixed pay; (b) matrix and vocal evaluative feedback with fixed pay; (c) memo and vocal evaluative feedback with fixed pay; and (d) vocal evaluative feedback with fixed pay. A monotone one-factor analysis of covariance (ANCOVA) method (Huitema, 2011) was used to determine whether the groups performed differently.

Currently, no studies have compared the effects of written memo, written matrix, and graphic feedback. Furthermore, studies that have compared written and graphic feedback all have methodological constraints, as discussed in the previous sections of this manuscript, yet several reviews have found that they are the most frequently implemented and consistently effective mediums of feedback delivery (Alvero et al., 2001; Balcazar et al., 1985-1986; Mentzer & Alvero, 2013). Feedback is relatively inexpensive in comparison to other OBM interventions, but it does require time and effort to implement, which means research should enable organizations to implement the feedback procedures that will be most efficient and lead to the best

performance results. Analyzing the different effects of written and graphic feedback provides a more complete framework to optimize its effectiveness in organizational settings.

METHOD

Participants

Seventy undergraduate students enrolled at Western Michigan University were recruited for participation in this study. Before recruitment, approval for the study was obtained from the University's Human Subjects Institutional Review Board. The approval letter is provided in Appendix A. Students were either recruited online by the instructor, who posts the recruitment script to the class website, or online by e-mail, by sending a condensed version of the recruitment flyer to groups of students (Appendix B).

Potential participants who communicated with the researcher were contacted via e-mail with the consent form (Appendix C). Recruits who read the consent form and wanted to participate were assessed to determine if they qualified for the study by filling out a Qualtrics survey (Appendix D). This survey contained a consent statement and a short questionnaire.

There were five exclusionary criteria. First, recruits could not have participated in any other research that used the medical record task. Second, they were excluded if they currently held or had held a data processing position. In past studies, those who had performed the experimental task or another data entry task performed considerably better than naïve performers, introducing extreme variability into the data set. Third, recruits could not have taken PSY 3444, Advanced Organizational Behavior Management. Knowledge of how performance feedback affects performance could have influence how participants responded. Fourth, recruits had to be able to complete six 45-minute sessions in one semester, within the available time slots. Lastly, they had to have a computer available on which they had a webcam and installed Microsoft Excel (downloadable for free using their university account).

Participants were paid $7.50 per session via Venmo. All participants were paid after debriefing, which followed their last session.

Of the 70 participants, 80% (n=56) identified as female, 19% (n=13) identified as male, and 1% (n=1) self-identified as nonbinary, with an average age of 20.2 years.

Setting

All meetings occurred online. The introductory session for prospective participants was scheduled with the researcher via e-mail. This first meeting was held virtually over WebEx (software provided for free to students by the university) and oriented participants to the requirements of the study. Any questions the participants had prior to sessions were e-mailed to the researcher who responded within 24 hours.

Twenty-four hours prior to each experimental session, the researcher e-mailed the participants the WebEx link. Once they joined the session, researchers emailed them the task. Once the session was completed the program automatically closed and participants closed out of WebEx then sent the saved Excel file to the researcher, so they were able to view the session data. Participants were required to set aside time for these 45-minute sessions so they could be in front of their computer for the entirety of the session, and they had to work independently and not interact with others.

Participants were be told their WebEx recording may or may not be viewed, but that it was a requirement of their participation. If a participant did not record a session, they were excluded from the study. On average, researchers randomly reviewed one recording out of every five submitted. If a participant completed more records than expected or performed outside the average, the researcher may have also watched the recording.

Apparatus

A computerized medical record task meant to simulate the job of a medical data entry clerk was used as the experimental task. Once the participant started the task, a screen appeared with "patient" data. The data included a patient's ID number, gender, and heart rate (beats per minute). The acceptable ranges for heart rate for males and females were displayed at the top of the screen. Participants first entered the patient ID number into a box on the screen, then determined if the patient's heart rate was within or out of range and clicked a corresponding button on the screen. When they completed the task, they clicked the "Submit" button, which generated another record. A screen shot of a medical record is in Appendix E.

Participants had access to their own computers, the Internet, and their cell phones as alternatives to the experimental task. However, they were not allowed to open another Excel file (or close the Excel window which contains the program) on the computer during their session due to the risk that it could have crashed the program, losing their data. These off-task activities served as analogues to off-task activities in the workplace. If the off-task activities were not available to participants, they might have engaged in the medical record task simply because there was nothing else to do, negating the effects of the independent variables. Participants were told they were not monitored during the sessions and that session recordings were only viewed if any oddities occurred with their data.

Workers frequently engage in off-task activities using company computers or personal mobile devices. A survey from OfficeTeam, a staffing firm, found that the average employee spends about 56 minutes each day on a cell phone engaging in non-work activity (Morris, 2017). Employees aged 18 to 34 years spend even more time on their cell phones engaging in non-work activity (70 minutes each workday), which is the most of all age groups. According to another

recent survey by Career Builder (2016) of 5,217 employees, 55% cited cell phone use and texting as the biggest productivity hindrance and 41% cited the Internet. Eighty-two percent of workers with smartphones indicated that they keep their devices within eye contact at work, and, of these workers, 65% spend their time on their cell phones personal messaging, 51% check the weather, 44% check the news, and 24% play games. These data support the ecological validity of the off-task activities in the current study.

Dependent Variables

The primary dependent variable was the average number of correctly completed medical records per session. The following three measures served as secondary dependent variables: (a) the amount of time spent on-task, i.e., the average number of minutes spent engaging in the experimental task per session, (b) accuracy, i.e., the average percentage of records correctly completed each session, and (c) data entry rate, i.e., the average number of correctly completed records per minute while on-task.

The computer program automatically recorded the time-off-task, defined as pauses in responding longer than 30 seconds, and calculated the time-on-task by subtracting the cumulative number of seconds off task from the total session time. The computer program also automatically recorded the data entry rate, and number of correct and incorrect patient record entries. After a participant completed a session, the participant was instructed to save the file in an easily found location on their computer. They were then prompted to e-mail that saved file to the researcher. The researcher then unlocked the file to retrieve the data for that session. Data was saved to a password protected flash drive to ensure prevention of data loss. At the end of the study, the primary researcher calculated the average time spent on-task per session and the average percentage of data entry tasks completed correctly per session.

After participants finished their last session, during debriefing, the experimenter asked them to complete a questionnaire that assessed their satisfaction and stress with the condition to which they were assigned (Appendix F).

Independent Variables

The feedback medium was the independent variable and there were four experimental conditions: (a) fixed pay with written objective feedback in the form of a memo (memo feedback) and vocal evaluative feedback, (b) fixed pay with written objective feedback in the form of a matrix (matrix feedback) and vocal evaluative feedback, (c) fixed pay with graphic objective feedback and vocal evaluative feedback, and (d) fixed pay with vocal evaluative feedback only. Fixed pay was $7.50 per session. All participants were paid when they were debriefed after their last session.

Fixed pay with memo objective and vocal evaluative feedback. Immediately before each session, via WebEx with the webcam on, the experimenter gave participants feedback based on their performance in the previous session. The objective feedback was in the form of a memo (email) that had the sentence, "During your previous session, you correctly completed _____ records" on it (Appendix G). The memo was emailed to the participant once they joined the WebEx (rather than 24-hours prior) to ensure the vocal evaluative feedback directly followed their receipt of the memo feedback.

Once participants confirmed they read the memo, the experimenter gave vocal evaluative feedback. The evaluative feedback procedures replicated Johnson's (2013) procedures. Participant performance was classified as excellent if participants correctly completed 350 or more records, as good if they correctly completed 300 to 349 records, as average if they correctly

completed 200 to 299 records, and as poor if they correctly completed fewer than 199 records per session.

These values were determined using the mean performance and standard deviation from 24 participants in Derthick (2018). The participants, who performed the same task that was used in the current study, completed five sessions, received fixed pay, and were given both objective and evaluative vocal feedback before each session (they did not receive in-session feedback). The vocal evaluative feedback procedures were the same as in the current study.

Excellent performance is approximately equivalent to performance that is 1.0 standard deviation or more above the mean; good performance is approximately equivalent to performance that is between 0.5 and 1.0 standard deviation above the mean; average performance is approximately equivalent to performance that is between -0.5 and +0.5 standard deviation from the mean; and poor performance is approximately equivalent to performance that is more than -0.5 standard deviation below the mean. The evaluative feedback given to participants was based on these classifications, but participants were not told about them or the criteria for meeting them.

The experimenter said one of 40 evaluative statements that correspond to the participant's performance level (excellent, good, average, or poor) to the participant. There were 10 evaluative statements for each performance level that were randomly selected, with the exception that no one statement was repeated two sessions in a row (Appendix H). Experimenters were trained to deliver these statements without reading them, so that they sounded natural, but were able to refer to the list of statements to ensure treatment integrity. The instructional script is provided in Appendix I.

Fixed pay with matrix objective and vocal evaluative feedback. As in the previous condition, before each session, via WebEx with the webcam on, the experimenter gave participants feedback based on their previous performance. The objective feedback was given in the form of a matrix that indicated the number of records correctly completed during all previous sessions (Appendix J). The matrix (in the form of a Word document) was emailed to the participant once they joined the WebEx (rather than 24-hours prior) to ensure the vocal evaluative feedback directly followed their receipt of the matrix feedback. The vocal evaluative feedback procedure was the same as in the previous condition. The instructional script was also be the same as in the previous condition (Appendix I).

Fixed pay with graphic objective and vocal evaluative feedback. As in the previous two conditions, before each session, via WebEx with the webcam on, the experimenter gave participants feedback based on their previous performance. The objective feedback was given in the form of a line graph that indicated the number of records correctly completed during all previous sessions (Appendix K). The graphic feedback (in the form of a Word document) was emailed to the participant once they joined the WebEx (rather than 24-hours prior) to ensure the vocal evaluative feedback directly followed their receipt of the graphic feedback. The vocal evaluative feedback procedure was the same as in the other conditions. The instructional script was also the same as in the two previous conditions (Appendix I).

Fixed pay with vocal evaluative feedback only. Participants in this condition only received vocal evaluative feedback before each session. The vocal evaluative feedback procedure was the same as in the other conditions. The instructional script is in Appendix L.

Experimental Design

A randomized between group with repeated measures design was used. Seventy participants were randomly assigned to one of the four groups using a random number generator for numbers one through four. Participants attended one pre-experimental session to assess keyboard proficiency and five 45-minute experimental sessions.

Statistical Analysis

The one-factor ANCOVA was used to analyze the differences among the groups for the main dependent variable (the average number of correctly completed medical records). Performance during the pre-experimental session served as the covariate and data from sessions two through six was used to analyze differences among the groups. Prior to conducting the ANCOVA, the homogeneity of the regression slopes was tested to determine whether the ANCOVA was appropriate.

Pearson product moment correlations were used to determine the strength of the relationship between the average number of correctly completed medical records and the three secondary dependent variables: time-on-task, accuracy, and data entry rate. ANOVAs were used to determine if participants in the four conditions answered the satisfaction and stress questionnaire items differently.

Experimental Procedures

Introductory session. Twenty-four hours prior to the introductory session, researchers e-mailed potential participants the consent form and a Qualtrics link to the potential participant questionnaire, and a version of the experimental task (used for training the participant). A meeting invitation for the agreed-upon time for the introductory session (which was held via WebEx) was also sent to the participant. If potential participants were interested in participating

in the study, they read the consent form prior to the introductory session. The experimenter then verified that the participant was eligible to participate by sending them the link to the potential participant survey. If they did not meet the inclusionary criteria (or if they did not select that they consented to participate), they were thanked for their time and dismissed. If participants met the inclusionary criteria and selected that they consented to participate, the experimenter assigned them a participant number using a list of random numbers. The experimenter then introduced the participant to the experimental task and asked them to practice the medical record task for about 5 minutes. Once familiar with the task, participants scheduled their experimental sessions with the researcher. The instructional script is in Appendix M.

Keyboard proficiency assessment session. Twenty-four hours prior to the first session, researchers e-mailed them a WebEx link for the session. Once the participant joined the WebEx, the experimenter started recording the WebEx and sent them an Excel file with the experimental task and instructions and instructed participants to "do their best" on the experimental task during that session. To encourage participants to, in fact, do "their best", participants were paid three cents per correctly completed record. Twenty-four participants in Derthick (2018) who were exposed to contingencies similar to the ones used in the current study (i.e., same task, same number of sessions, and given both objective and evaluative feedback) correctly completed an average of 247 records. Thus, if participants performed at this average, they would have received approximately the same amount of money they received in subsequent sessions ($7.50 per session).

Comparison of covariate data from Einarsson (2016) and Einarsson (2018) revealed that participants performed considerably better when paid incentives than when paid hourly during

this session. Thus, these data suggest that incentive pay results in a better measure of keyboard proficiency than hourly pay.

Once the 45-minutes were done, the program automatically closed, prompted participants to save the file, and reminded them to e-mail the file to the researcher. Participants then closed out of the WebEx, which automatically ended and saved the recording to the primary researcher's password protected WebEx account. Participants were paid after they were debriefed at the end of the study. The instructional script can be found in Appendix N.

Experimental sessions. Participants completed a total of five 45-minute experimental sessions. Twenty-four hours prior to the session, researchers sent participants a WebEx meeting link (to provide relevant feedback prior to the session). Once the participant joined the session, the experimenter emailed an Excel file with the experimental task and instructions and began recording the WebEx. Once the experimenter gave the participant feedback, they were instructed to start the experimental task. Once the 45 minutes were done, the task automatically stopped, prompted participants to save the file, and reminded them to e-mail the file to the researcher. Participants then closed out of the WebEx, which automatically ended and saved the recording to the primary researcher's password protected WebEx account.

Debriefing. After participants completed their final session, they scheduled a debriefing meeting with the researcher (via e-mail). At least 48 hours prior to the debriefing session the researcher sent a WebEx meeting link for the session. Before they were debriefed, all participants were given feedback about their performance in their last session at the start of the WebEx meeting. The researcher then e-mailed a link to the Qualtrics survey containing the Stress and Satisfaction Questionnaire that was completed during the debriefing session. Once participants completed the survey, the experimenter read the debriefing script (Appendix O),

gave participants their pay receipt via e-mail (Appendix P), paid the participant via Venmo, and answered any questions they may have had. The experimenter then thanked them for their time and dismissed them.

RESULTS

Primary Analyses

The means and standard deviations for the average number of correctly completed records (the primary dependent variable) can be found in Table 1 below. The data are shown for the four groups during the covariate and the average of the five experimental sessions. Table 2 displays the adjusted means for the average of the experimental sessions for each group.

Table 1
Means and Standard Deviations for Correctly Completed Records

		Sessions			
		Covariate		Experimental	
Condition	*n*	Mean	SD	Mean	SD
No objective Feedback	16	169.2	85.5	204.0	82.5
Memo Feedback	18	183.8	89.7	221.1	80.9
Matrix Feedback	18	231.6	91.0	243.5	91.1
Graphic Feedback	18	238.3	87.8	256.4	73.0
Overall	70	205.7	88.5	231.3	81.9

Table 2
Adjusted Means for Number of Correctly Completed Records

Condition	Adjusted Mean
No objective Feedback	221.0
Memo Feedback	230.2
Matrix Feedback	233.9
Graphic Feedback	244.3
Overall	232.4

The one-factor analysis of covariance (ANCOVA) was carried out (Huitema, 2011), the source table for which can be found in Table 3 below. The analysis failed to confirm the hypothesized relationship between the four groups ($F = 0.40$, $p = 0.756$). Average performance was higher for participants who received graphic feedback in comparison to those who received

no objective feedback, memo feedback, or matrix feedback. Although there were no statistically significant performance differences between the different mediums of feedback, a visual inspection of the trend for the contingent and critical group appears to suggest an upward trend that does not appear to be present in either the independent and supportive or independent and critical groups.

Table 3
ANCOVA Source Table for Number of Correctly Completed Records

Source	*df*	*SS*	*MS*	*F*	*p*
Covariate	1	77497	77497	14.34	0.001
Experimental Conditions	3	6497	2166	0.40	0.756
Error	65	371674	5718		
Total	4	83994			

Figure 1 depicts the adjusted means for the number of correctly completed records for each of the four experimental sessions.

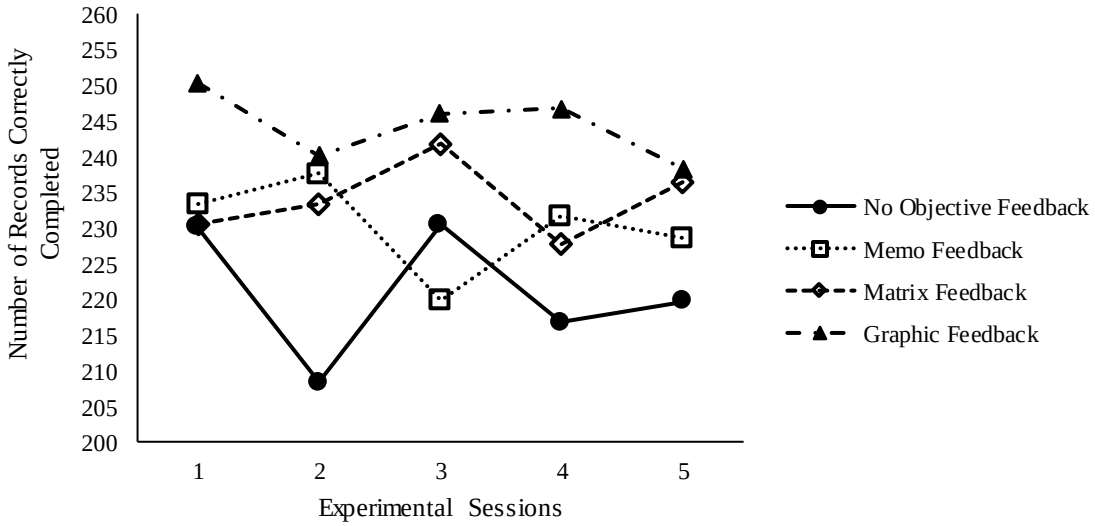

Figure 1. Adjusted means across experimental sessions for each of the four conditions.

Figure 2 displays the percentage of participants in each group whose average performance was categorized as poor, average, good, or excellent across the five experimental sessions. The evaluative feedback participants received depended upon this classification. These

data indicate that the performance criteria for the four categories were accurate. About 52.6% of the participants performed at the predetermined average level. Thirty-three percent performed at the poor level, 8.5% at the good level, and only 5.6% at the excellent level. Participants in the no objective feedback condition were told their performance was classified as poor the most throughout the study, with no one qualifying as an excellent performer, on average. Participants in the graphic feedback condition had the highest percentage of good performers and the lowest level of poor performers, on average. Participants in the matrix feedback condition had the highest percentage of excellent performers.

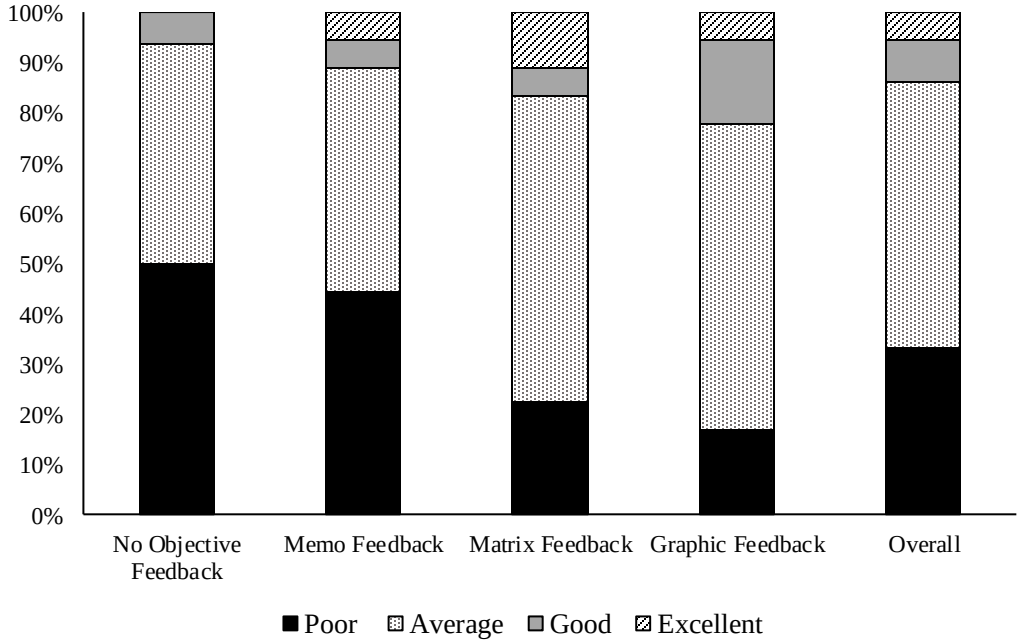

Figure 2. Average percentage of participants whose performance was poor, average, good, or excellent.

Secondary Analyses

Table 4 depicts the means and standard deviations for accuracy, rate, and time on task, the secondary dependent variables during the five experimental sessions. Accuracy was lowest for the no objective feedback condition (M = 89.71%), and relatively high for the memo

feedback (*M* = 96.67%), matrix feedback (*M* = 95.94%), and graphic feedback (*M* = 96.64%). Participants completed an average of 6.05 records correctly per minute while on task, with participants in the graphic feedback condition completing the highest rate (*M* = 6.55) and those in the no objective feedback condition completing the lowest (*M* = 5.37). On average, participants spent about 37.72 minutes on task (84% of time was spent on task).

Table 4
Means and Standard Deviations for Accuracy, Rate, and Time on Task

		Accuracy		Rate		Time on Task	
Condition	*n*	Mean	*SD*	Mean	*SD*	Mean	*SD*
No objective Feedback	16	89.71%	16.70%	5.37	1.61	37.37	7.32
Memo Feedback	18	96.67%	5.34%	5.89	1.30	36.85	7.66
Matrix Feedback	18	95.94%	6.44%	6.39	1.57	37.61	8.36
Graphic Feedback	18	96.64%	3.54%	6.55	1.37	39.05	6.48
Overall	70	94.74%	8.01%	6.05	1.46	37.72	7.46

Table 5 shows the Pearson's product moment correlations that indicate the strength of the relationship between the primary dependent variable and the three secondary dependent variables. All the correlations were statistically significant at the 0.05 level except for the relationship between accuracy and time on task. The highest correlation was between correctly completed records and rate (*r* = .862).

Table 5
Correlations Between the Primary and Secondary Dependent Variables

	Time on task	Rate	Accuracy
Correctly Completed Patient Records	.732*	.862*	.336*
Time on task		.312*	.062
Rate			.442*

*$p < 0.05$

Questionnaire Analyses

After the final session, participants completed a survey that assessed their satisfaction and stress levels. Each question was scaled using a Likert scale, where 1 = strongly disagree and 5 =

strongly agree. The means and standard deviations for each of the four questions can be found in Tables 6, 7, 8, and 9.

Table 6
Means and Standard Deviations for "I liked receiving feedback about my performance."

Condition	Mean	SD
No objective Feedback	4.00	1.10
Memo Feedback	3.67	1.14
Matrix Feedback	4.06	1.16
Graphic Feedback	4.06	1.31
Overall	3.95	1.18

Table 7
Means and Standard Deviations for "I was stressed or anxious when receiving feedback."

Condition	Mean	SD
No objective Feedback	1.88	1.15
Memo Feedback	1.67	0.84
Matrix Feedback	2.00	1.28
Graphic Feedback	2.22	1.11
Overall	1.94	1.10

Table 8
Means and Standard Deviations for "I was satisfied with the feedback I received."

Condition	Mean	SD
No objective Feedback	3.44	1.36
Memo Feedback	3.56	1.20
Matrix Feedback	3.83	1.29
Graphic Feedback	4.11	1.08
Overall	3.74	1.23

Table 9
Means and Standard Deviations for "I tried to improve my performance from session to session."

Condition	Mean	SD
No objective Feedback	3.81	0.91
Memo Feedback	3.72	1.13
Matrix Feedback	3.61	1.24
Graphic Feedback	3.61	1.46
Overall	3.69	1.19

ANOVAs were conducted for each of the four questions to determine if participants answered the satisfaction and stress questions differently between the conditions. Tables 10, 11, 12, and 13 display the ANOVA source tables for each question. There were no significant differences between the conditions.

Table 10
ANOVA Source Table for "I liked receiving feedback about my performance."

Source	*df*	*SS*	*MS*	*F*	*p*
Experimental Conditions	3	1.883	0.628	0.451	0.718
Error	66	91.889	1.392		
Total	69	93.772			

Table 11
ANOVA Source Table for "I was stressed or anxious when receiving feedback."

Source	*df*	*SS*	*MS*	*F*	*p*
Experimental Conditions	3	2.910	0.970	0.792	0.503
Error	66	80.861	1.225		
Total	69	83.771			

Table 12
ANOVA Source Table for "I was satisfied with the feedback I received."

Source	*df*	*SS*	*MS*	*F*	*p*
Experimental Conditions	3	4.712	1.571	1.030	0.385
Error	66	100.660	1.525		
Total	69	105.372			

Table 13
ANOVA Source Table for "I tried to improve my performance from session to session."

Source	*df*	*SS*	*MS*	*F*	*p*
Experimental Conditions	3	0.482	0.161	0.120	0.954
Error	66	96.604	1.464		
Total	69	97.086			

DISCUSSION

Primary Analyses

The purpose of the current study was to examine the effectiveness of different mediums of objective feedback in combination with evaluative feedback when participants received fixed pay. This study analyzed written feedback in the form of a memo that displays the performer's current performance (memo feedback), written feedback in the form of a matrix that displays the performer's current performance along with past performance (matrix feedback), and graphic feedback that displays the performer's current performance along with past performance on a line graph (graphic feedback) when individuals receive fixed pay. The analysis failed to find a statistically significant difference between the four groups. Because of that, the results are ambiguous with respect to whether these different feedback mediums improve performance.

Despite no statistically significant difference between the groups, the adjusted means did provide evidence that supported the hypothesized order of conditions. Participants in the graphic feedback condition completed the highest number of correctly completed records (M = 244.3), followed by matrix feedback (M = 233.9), memo feedback (M = 230.2), and no objective feedback (M = 221). These results demonstrate the need for further research on feedback mediums to justify the added effort and expense needed to implement a feedback system.

Performance across the four conditions was variable. Matrix feedback resulted in a minor performance improvement (5.7 record difference, 2.5% improvement), with memo feedback (4.7 record difference, 2.0% decrease), no objective feedback (10.3 record difference, 4.5% decrease), and, lastly, graphic feedback (12 record difference, 4.8% decrease) resulting in

performance decreases. Performance in the four conditions was variable across sessions, and, due to time constraints, the study was terminated before the performance of the groups stabilized. It is not clear whether performance would have decreased or increased if the study had continued, which is a limitation of the study. Given the ambiguity of the current results, further research is clearly required.

Secondary Analyses

The correlations between the primary dependent variable and the secondary dependent variables were all statistically significant, except for the relationship between accuracy and time on task. The strongest correlation was between the number of correctly completed records and rate (r = .862), followed by time spent on task (r = .732), and accuracy (r = .336). These data are consistent with those reported by Einarsson (2018), Sundberg (2015), and Urschel (2015), who used the same experimental task. Johnson (2005), who used a different rate-oriented task, also found significant correlations between his main dependent variable (the number of correctly completed simulated bank checks) and these three variables; however, the size of the correlations were ordered differently. In Johnson's study, the strongest correlation was between the number of correctly completed checks and time spent on task (r = .849), followed by rate (r = .791) and then accuracy (r = .299). The data from the aforementioned studies indicate that all three variables influenced the primary dependent variable, which is no doubt due to the fact that in all of these studies, the performance measure (the number of correctly completed records or checks) included both a quantity and quality criterion.

Questionnaire Analyses

Participants in the matrix and graphic feedback conditions reported the highest ratings for the questions, "I liked receiving feedback about my performance (M = 4.06)" and "I was

satisfied with the feedback I received (M = 3.83 and 4.11, respectively)." However, those participants also reported the highest levels of stress/anxiety when receiving matrix and graphic feedback in response to the question, "I was stressed or anxious when receiving feedback (M = 2.00 and 2.22, respectively)." Interestingly, participants in the no objective feedback condition answered the question, "I tried to improve my performance from session to session" the highest (M = 3.81), followed by memo feedback (M = 3.72), and, lastly, matrix feedback and graphic feedback (M = 3.61).

Strengths of the Study

This study was conducted entirely remotely and was one of the first to do so with this experimental task. Additionally, because the participants completed sessions in remote work settings, they were exposed to similar variables that are found in applied settings when working remotely. When participants conduct this task in a laboratory setting, they are more likely to work on the task simply because they do not have any other appealing off-task activities. With a remote setting, they are more readily exposed to off-task activities that would imitate a realistic work from home environment.

As this was one of the first times this task was used remotely, there was a lot discovered that will allow future researchers to replicate a similar study. Drawing from the limitations of this study, researchers can create a study that attempts to control for some of the challenges and variables introduced to this study. One of these discoveries was clear instructions and controlled interactions with participants is vital in controlling for variables that could affect performance. Very explicit instructions were given to participants on how to complete the task correctly and effectively, sessions were scheduled for specific times chosen by participants, researchers were available for technical support throughout the sessions, and reminder e-mails were sent 24 hours

prior to the sessions. Due to extensive technical support needed to run these sessions with the given task, care was taken with onboarding research assistants and participants so that expectations and instructions were clear to ensure the task was carried out properly. Email communications also included reminders on both the most critical and most often forgotten (or incorrectly done) parts of the sessions.

Examination of the average percentage of participants whose performance fell into the poor, average, good, or excellent categories (Figure 2) revealed that the predetermined performance criteria were accurate for average performers. Most participants who received feedback were being told that their performance was average throughout the study (52.6%). Of the remaining participants, 33.3% fell in the poor performance category, and only 8.5% qualified and good and 5.6% as bad. It is unclear if these percentages are due to the performance criteria being inaccurate, or the independent variable lacking control over performance (thus leading to poor performers). Repeated provision of negative feedback is certainly not ideal, nor recommended, from an applied perspective, even though Johnson et al. (2015) found that critical evaluative feedback increased performance as much as positive evaluative feedback.

Limitations of the Study

Performance had not stabilized for any of the conditions before the sessions were terminated. It was not possible to continue the study due to time and money constraints. If the study had continued, however, a difference may have emerged between the groups. Recruitment of participants was also much more difficult than previously expected. The study was planned to last one semester (January 2022 until April 2022), however, fewer students volunteered to participate in this study than planned. Therefore, the study had to continue for a year longer than

originally predicted to recruit a large enough sample of students. This delay in data collection was not anticipated and required additional resources and more time than expected.

Minimum performance standards were not used in the current study which is a limitation because minimum performance standards are implicit, if not explicit, in applied settings. Employees must meet some minimum level of performance to avoid being terminated by supervisors. In the current study, 23 performers, three to eight in each of the four conditions, completed fewer than 199 records during several sessions. This would not be acceptable performance in an applied setting.

As in Johnson (2005), there were two reasons why minimum performance standards were not used during the experimental sessions. First, they may have inflated the performance of participants in the no objective feedback conditions. Participants could not easily monitor their own performance on the task. For example, participants in the lowest performing group, the no objective feedback group, correctly completed an average of about 221 records in 45 minutes. It would have been difficult and time consuming for them to manually count each completed record. Therefore, if pay had been contingent on a minimum standard, participants in the no objective feedback conditions may have worked harder than they did to ensure they would meet or exceed the standard and, hence, be paid for the session. Second, if participants in the no objective feedback conditions did not meet the standard during a session, they would not have been paid for that session. Because they only received objective feedback after they completed all five sessions, they would not have known that they failed to perform well enough to be paid, which would have been undesirable from an ethical perspective.

In addition to having a minimum performance standard for the experimental sessions, having a minimum requirement for the covariate session may also have produced more realistic

performance. Rather than telling performers to "do your best" during the covariate session they could have been told "you must complete at least X records to receive payment for this session" or "you must complete at least X records to continue your participation in the study". These instructions would have set clearer expectations for their future performance.

Participants in the study were recruited from undergraduate psychology courses and may have interacted with each other about the study. As such, there is a possibility that participants in one condition may have told participants in a different condition about the feedback or pay they were receiving (or, in the case of feedback, were not receiving), revealing the differences between the conditions. This could have led participants to perform differently. Participants were asked not to discuss the study with other participants, but it is not possible to determine whether they followed this instruction. The pool of participants was also very small and required the study to be carried out for a significantly longer period than expected.

Due to the remote nature of the study, performance could have been hindered. In Derthick (2018), the same experimental task was used with sessions conducted in a laboratory setting, where every participant used the same desktop computer with Microsoft Windows installed. This reduced the variability and technical difficulties that could be introduced when using personal laptops, as was done in the current study. In the current study, sessions were conducted in a place of the participants' choosing where they could engage in the task uninterrupted for 45 minutes.

After analyzing session recordings, it was found that many participants chose to do their sessions in the campus library and/or in personal residencies on their personal laptops. Success of sessions required proper programs and access to Excel, webcams, and internet. While most participants did not have trouble getting access to the tools and programs required, the

experimental task used provided many obstacles. There were many technical problems that required extensive problem-solving (specifically for Apple MacBook users) for sessions to run effectively and the task to save data correctly. Some participants dropped out due to technical frustrations and the task not being compatible with their computers.

Participants could have also spent less time engaging in the task because there were more competing contingencies in the environment that they completed sessions in. When participants are in a laboratory setting, they have less access to off-task activities. They may spend more time engaging in the task simply because they have nothing else to do. When they complete sessions remotely, there are more distractions that can be present that naturally would not be present during sessions in a laboratory. In Derthick (2017) participants spent 40.28 minutes on task as compared to 37.72 minutes in the current study. In both studies, participants were told they can take a break as often as they wanted to and could spend time engaging in off-task activities, but they spent more time on task in the laboratory setting than the remote setting. There are some off-task activities that were not permitted in the laboratory (such as talking on the phone as it could distract other participants, eating, etc.) that they could have done during the remote sessions.

It is possible participants in the laboratory setting engaged in the task also because of fear of "getting caught" by a researcher if they were to be on their cell phones or browsing the internet on the computer. Participants were told prior to each session they could engage in off-task activities, however there could have been perceived social pressure to stay on task when in the presence of the researcher. When working remotely, the researcher is not in the same room as the participant even though participants were on camera and recorded the entire session to provide the feeling of their performance being measured and evaluated.

Future Research

Given that no significant feedback effect was found, future research should investigate whether different mediums of objective and evaluative feedback can improve performance. As mentioned earlier, feedback is one of the most frequently implemented interventions in organizational behavior management (Alvero et al., 2001; Balcazar et al., 1985-1986; Balcazar et al., 1989; Nolan et al., 1999; VanStelle, et al., 2012). Ideally, in the future, studies would be extended until performance in all conditions stabilized. Second, it might also be beneficial to replicate this study with participants who are not able to earn extra course credit in addition to pay for their participation. Unfortunately, the screening questionnaire did not ask participants to indicate whether they were receiving extra course credit. However, many participants remarked that they were receiving extra credit and, in fact, were given proof of their participation to give to their instructors. In addition, several of them told the researchers that the extra credit was more important to them than the pay. Thus, it is possible that the availability of extra credit, which was not contingent on performance, may have controlled their performance more strongly than the feedback contingencies. It might also be of value to examine the effects of higher fixed pay to match minimum wage requirements more closely. Further, higher fixed pay may be necessary to offset the possible control of the receipt of extra credit.

Examining the effects of different mediums of feedback using combined evaluative and objective feedback in an organization that uses fixed pay would be particularly enlightening. Such a study would eliminate several of the previously mentioned limitations, namely the: (a) omission of a minimum performance standard; (b) possible control of participant performance by the receipt of course credit; (c) low fixed pay; and (d) elevated performance criteria for average, good, and excellent performance.

Future research should continue explore different ways of delivering combined evaluative and objective feedback. For example, few studies have compared vocal versus written combined objective and evaluative feedback or written versus graphic combined feedback. Different feedback mediums and modalities may influence its effectiveness, appeal to employees, and ease of use (Alvero et al., 2001; Balcazar et al., 1985-1986; Warrilow, 2017).

Summary

While the results of this study were not statistically significant, they contribute to the feedback literature by replicating the procedures of Derthick (2018) in a remote setting. Participants in the remote setting performed lower than those in the laboratory setting, so further research could be constructed around increasing participant performance when working remotely. Further, due to the nonsignificant findings more research is needed on the different feedback mediums. This was one of the first studies to compare memo, matrix, and graphic feedback mediums. This topic is practically important to organizations because feedback has had inconsistent effects on performance, which may be largely due to the use of different mediums of feedback.

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Appendix A

HSIRB Research Approval Letter

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: February 4, 2022

To: Douglas Johnson, Principal Investigator
Amber Derthick, Student Investigator for dissertation

Re: Initial - IRB-2022-6
Performance on a Simulated Medical Data Entry Task

This letter will serve as confirmation that your research project titled "Performance on a Simulated Medical Data Entry Task" has been reviewed by the Western Michigan University Institutional Review Board (WMU IRB) and **approved** under the **Expedited** 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The conditions and duration of this approval are specified in the policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes to this project (e.g., ***add an investigator, increase number of subjects beyond the number stated in your application, etc.***). Failure to obtain approval for changes will result in a protocol deviation.

In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the IRB or the Associate Director Research for consultation.

The Board wishes you success in the pursuit of your research goals.

Sincerely,

Amy Naugle

Amy Naugle, Ph.D., Chair
WMU IRB

For a study to remain open after one year, a Post Approval Monitoring report (please use the continuing review submission form) is required on or prior to (no more than 30 days) February 2, 2023 **and each year thereafter until closing of the study.**

When this study closes, submit the required Final Report found at https://wmich.edu/research/forms.

Note: All research data must be kept in a secure location on the WMU campus for at least three (3) years after the study closes.

Appendix B

Recruitment Script and Flyer

Hello, my name is Amber Derthick. I am a graduate student in psychology, and I am looking for participants for my doctoral dissertation. This project studies how individuals perform a simulated medical data entry task.

The data entry task is a simple, computer-based task that requires the person to read and enter numbers using the computer's keyboard. You will be working on this task remotely, using your own computer. There will be six sessions during the semester, each 45 minutes long, which you can schedule as you like, but no more than once per day. You will earn about $45.00 if you complete the entire study.

To participate, you must not have held or currently hold a data processing job, must not have participated in other studies that have used the medical data entry task, must not have taken Advanced Organizational Behavior Management (PSY 3444), must be available for 6 sessions throughout the semester, and have your own computer with a webcam and WebEx installed on it. WebEx is a program that is provided free to students by the university.

Your participation is voluntary, and you may withdraw from the study at any time. If you do choose to withdraw, you will be paid for your participation up to the point of withdrawal. Your participation, lack thereof, or withdrawal from the study will not affect your grade in this class or any other. Your identity and your performance in this study will be kept confidential.

If you are interested in participating and you would like further information about this study, please e-mail amber.l.derthick@wmich.edu.

Thank you for your time and for any of you who choose to participate, thank you in advance for your help with my dissertation!

WESTERN MICHIGAN UNIVERSITY

IRB Protocol Number: IRB-2022-6
Principal Investigator: Jonathan Baker

Research Participants Needed

Would you like an opportunity to participate in research and **earn money throughout the Fall 2022 semester**?

I am looking for individuals to participate in a study designed to determine how well individuals perform a simulated medical data entry task. The data entry task is a simple, computer-based task that requires someone to read and enter numbers using the computer's keyboard.

You must meet the following requirements:

- Not have previously participated in other performance management studies that utilized the medical data entry task
- Not be or have been employed in a data entry position
- Not have taken Advanced Organizational Behavior Management (PSY 3444)
- Be available for six 45-minute sessions throughout the Fall 2022 semester
- Have your own computer with a webcam

Session pay:

- You can earn about $7.50 per 45-minute session; about $45.00 for the entire study

Where:

- Remote on your own computer

If you have any questions or are interested, please reach out to me via email **amber.l.derthick@wmich.edu** or by phone at 810-965-5971.

Appendix C

Consent Form

Western Michigan University
Department of Psychology

Principal Investigator: Jonathan C. Baker, Ph.D.
Student Investigator: Amber L. Derthick, M.A.
: Performance on a Simulated Medical Data Entry Task

You are invited to participate in a research project titled "Performance on a Simulated Medical Data Entry Task" and the following information in this consent form will provide more detail about the research study. Please ask any questions if you need more clarification and to assist you in deciding if you wish to participate in the research study. You are not giving up any of your legal rights by agreeing to take part in this research or by signing this consent form. After all of your questions have been answered and the consent document reviewed, if you decide to participate in this study, you will be asked to sign this consent form.

What are we trying to find out in this study?
This study aims to gather information about individuals' performance levels on a computer-based simulated medical data entry task.

Who can participate in this study?
We are recruiting college students enrolled in courses at Western Michigan University. There are five criteria you must meet to participate. You must not be or have been employed in a data entry position. You must not have previously participated in research that used the medical data entry task. You must not be taking or have taken Organizational Psychology (PSY 2444) or Advanced Organizational Behavior Management (PSY 3444). Finally, you must be available for six 45-minute sessions to be completed during the Spring 2020 semester. You must have your own computer with a functional webcam.

Where will this study take place?
The initial meeting and the start of each subsequent meeting after that with the researcher will be held via WebEx, a video-conferencing application, on your personal computer. Therefore, you will need to have WebEx installed on your computer. For students of Western Michigan University (WMU), WebEx is available for free. Future sessions will again be held on your personal computer. For these, you will need to install Loom, a video-recording program available for free from Google, and Microsoft Excel, available for free for students of WMU.

What is the time commitment for participating in this study?
You must be available for six 45-minute sessions throughout the semester.

What will you be asked to do if you choose to participate in this study?
You will be asked to perform a computer-based medical data entry task, a task designed to simulate the job of a medical transcriptionist. The computer program will provide data corresponding to "patients." You will first look for the "Patient ID number" and type it into the correct location. Then, you will look at whether the patient is male or female and based on the ranges provided for the respective gender, you will determine whether the patient's data is "within range" or "outside of range" by clicking the appropriate button. After your last

experimental session, you will be asked to answer questions about your experiences during the study. Following that, your performance during the study will be reviewed and any questions you have about the study will be answered.

What information is being measured during the study?
The computer will automatically take measures of your performance on the medical data entry task. You will also be recording your sessions using Loom and providing those recordings to the experimenter. At the end of the study, you will be asked to indicate your satisfaction and stress with the procedures in the study.

What are the risks of participating in this study and how will these risks be minimized?
You may experience some minor physical discomfort, minor fatigue, or minor stress when you are performing the task. These risks will be minimized by the fact that you will be able to take breaks whenever you want during the session. During these breaks, you may choose to play a game on your computer, browse the internet, or spend time on your cell phone.

What are the benefits of participating in this study?
You will be contributing to the field of research on performance. You may also learn about this research through participation in the study. This study will add to our understanding of how working conditions affect performance, satisfaction and stress. The findings from laboratory studies such as this can be applied in the workplace.

Are there any costs associated with participating in this study?
Besides the relatively large time commitment, there are no costs associated with participation in this study.

Is there any compensation for participating in this study?
For each 45-minute session, you will earn about $7.50, for a total of about $45.00 You will be paid via Venmo at the end of the sixth and final session. If you decide to withdraw from this study, you will be paid for your performance up to the point of withdrawal.

Who will have access to the information collected during this study?
The principal investigator, the student investigator, and the research assistants will have access to the information collected during this study. When you begin the study, you will be assigned a number so that your individual progress can be tracked while your identity is held strictly confidential. When the data of the study are presented or published, only group data will be presented. Neither your name nor any identifying characteristics will be used. Video recordings will be stored on a password-protected computer accessible only by the student investigator and will be deleted upon the conclusion of data analysis.

What if you want to stop participating in this study?
You can choose to stop participating in the study at any time for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences either academically or personally if you choose to withdraw from this study. The investigator can also decide to stop your participation in the study without your consent. If you have any questions before or during the study, you may email Amber Derthick at

amber.l.derthick@wmich.edu. You may also contact the primary investigator, Dr. Jonathan Baker at jonathan.c.baker@wmich.edu, the Chair, Human Subjects Institutional Review Board at (269) 387-8293 or the Vice President for Research at (269) 387-8298 if questions arise during the course of the study.

This study was approved by the Western Michigan University Institutional Review Board (WMU IRB) on January 26, 2023

I have read this informed consent document. By clicking on the link below, I agree to take part in this study and agree to the use of video and audio recordings.

https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_5j4X7ATUThLE6zQ

Appendix D

Potential Participant Questionnaire

Participant number: _____

Which gender do you most identify with? Please check one.

_____Male

_____Female

_____I prefer to self-describe: _____

_____I prefer not to say

Age: _____

Have you ever participated in a study at Western Michigan University that required you to use a medical data entry task (a screenshot of the task is available if you are not sure)?

Yes No

Have you taken, or are you currently taking Advanced Organizational Behavior Management (PSY 3444)?

Yes No

Do you currently or have you held a position that involved data entry?

Yes No

Do you have your own computer with a functional webcam?

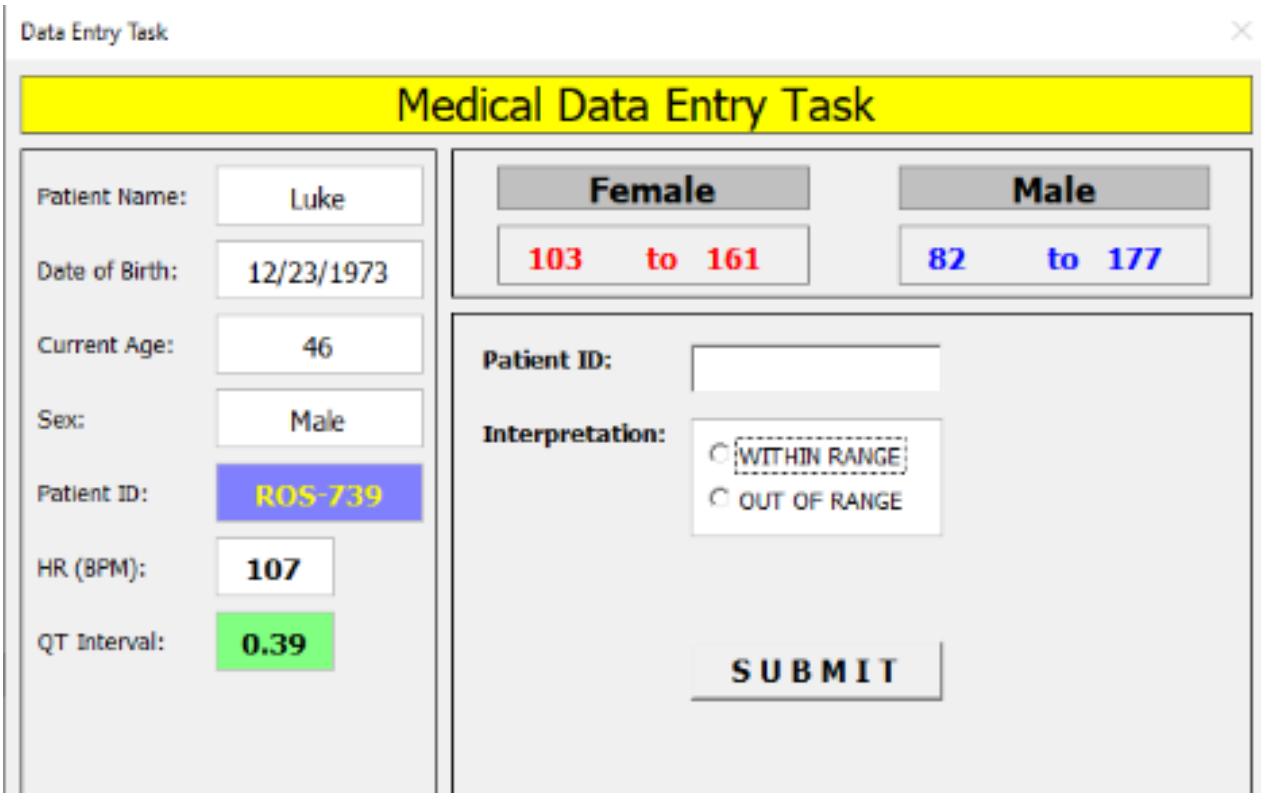
Yes No

By selecting "I consent" below and submitting this form, you indicate that you have reviewed the consent form and agree to voluntarily participate in this research study.

I consent I do not consent

Appendix E

Medical Record Task Screenshot


Data Entry Task
Medical Data Entry Task
Patient Name:
Luke
Date of Birth:
12/23/1973
Current Age:
46
Sex:
Male
Patient ID:
ROS-739
HR (BPM):
107
QT Interval:
0.39
Female
103 to 161
Male
82 to 177
Patient ID:
Interpretation:
WITHIN RANGE
OUT OF RANGE
SUBMIT

Appendix F

Satisfaction and Stress Questionnaire

Participant # _____

Satisfaction and Stress Questionnaire

Using the evaluation scale, please circle the number which reflects your opinion.

Evaluation Scale: Strongly Disagree 1---------2---------3---------4---------5 Strongly Agree

1. I liked receiving feedback about my performance 1------- 2------- 3------- 4------- 5
2. I was stressed or anxious when receiving feedback 1------- 2------- 3------- 4------- 5
3. I was satisfied with the feedback I received 1------- 2------- 3------- 4------- 5
4. I tried to improve my performance from session to session 1------- 2------- 3------- 4------- 5

Appendix G

Memo Objective Feedback Sample

Participant #: _____

During your previous session, you correctly completed _____ records.

Appendix H

Vocal Evaluative Feedback Statements

Evaluative Feedback Statements

Records	**Performance Levels**	**Evaluative Statements**
350 or more	Excellent	• You completed a *really* impressive number of records! • Your performance was *outstanding*! • Your performance was *amazing*! • Your performance during your last session was really impressive! • You are e*asily* one of the best performers! • Your performance was *incredible* during your previous session! • You did an *excellent* job during your last session! • Your performance *easily* topped out the others! • What an *astounding* performance last session! • Your performance during your previous session was *astonishing*!

Records	Performance Levels	Evaluative Statements
300-349	Good	• Your performance is one of the better performances we've seen recently. • Your one of the better performers. • Your performance was very impressive. • You did a great job. • Your performance is among some of the high-ranking performers. • You did a good job last session. • You completed an impressive number of records. • You completed a substantial number of records. • Your performance was better than most. • You completed a substantially high amount of records.

Records	Performance Levels	Evaluative Statements
200-299	Average	• Your performance is about what the average person does. • You completed a normal number of records. • Your performance is what a pretty typical performer completes. • Your performance is a standard level of performance. • Your performance was what the average number of performers completed. • Your performance is what the standard performer typically completes. • Your performance is a pretty typical performance. • Your performance is pretty common for the average performer. • Your performance was pretty normal for the standard performer. • Your performance is generally the average performance.

Records	Performance Levels	Evaluative Statements
199 or less	Poor	• Unfortunately, you completed a low number of records. • You completed a pretty low number of records. • You performed below average. • You completed a number of records that is under the standard. • Your performance is somewhat low. • Your performance is not considered a great performance. • Your number is low-ranking. • You completed a substandard number of records. • Your performance is considered a sub-par number of records. • You completed an unfavorable number of checks.

Appendix I

Instructional Script: Memo, Matrix, and Graphic Objective Feedback Conditions

SESSION 2-6 (MEMO, MATRIX, AND GRAPHIC FEEDBACK)

Send the following text in an e-mail to the participant, with the subject line "Medical Record Data Entry Task – Session X, Participant [###]" (replacing [###] with the participant's number).

> *Hello [Participant's Name],*
>
> *Please read the following before you begin your session:*
>
> *Before you begin each session, you will meet with the researcher via WebEx. A WebEx meeting link will be sent in a separate email. Once you are finished you may begin the task.*
>
> *As a reminder, you may minimize the data entry task, but under no circumstances should you close the program or open another Excel file. If you do, you will have to begin the session over again.*
>
> *You may or may not be monitored during the session, but your performance will be. Once the 45 minutes are up and the task automatically ends, please follow the instructions provided within the task window. Then, attach the newly-saved task file to an e-mail addressed to amber.l.derthick@wmich.edu.*
>
> *Thank you for your participation,*
> *[Your Name]*

During the session, before the participant starts the task, start recording the WebEx and provide feedback (via WebEx with webcams on):

Email the participant the Excel file with the task and their memo/matrix/graphic feedback once you're both on the WebEx.

Only read this next paragraph after session 2 (for sessions 3-6 skip to the italicized sentence beginning "You should have recently received…"):

You received three cents per record correctly completed in the last session. In all of the remaining sessions you will receive $7.50 regardless of how many records you complete. We will pay you, via Venmo, after your last session.

You should have recently received an email from me with the number of records you correctly completed last session. Please take a moment to look at your performance.

Give the participant some time to review it. Then say one of the evaluative statements based on performance out loud to the participant.

Important! If the participant asks a question about his/her performance or any information on the objective feedback, say "*I'm sorry, I can't answer that question, but I can tell you...*" and then say one of the evaluative statements aloud to the participant based on performance.

If the participant asks how many records they need to complete for good or excellent performance, tell them, "*I'm sorry, I can't tell you that.*"

To help you, a table indicating the performance levels are below. However, be sure not to tell participants what performance corresponds to what evaluative category.

"Remember that you can take a break from the task at any time. You *may choose to play a game on your computer, browse the internet, spend time on your cell phone, or just sit and relax for as long as you want to. The task will automatically stop once the 45 minutes are up. Once the task stops, please follow the instructions provided within the task window. Then, attach the newly-saved task file to an e-mail addressed to amber.l.derthick@wmich.edu. Also, remember that you will be paid $7.50 for this session and your next sessions. Do you have any questions?"*

Answer any participant questions and have them start the task. Record values on the participant's spreadsheet.

Performance and Evaluative Categories

Records	**Performance Levels**
350 or more	Excellent
300-349	Good
200-299	Average
199 or fewer	Poor

Appendix J

Matrix Objective Feedback Sample

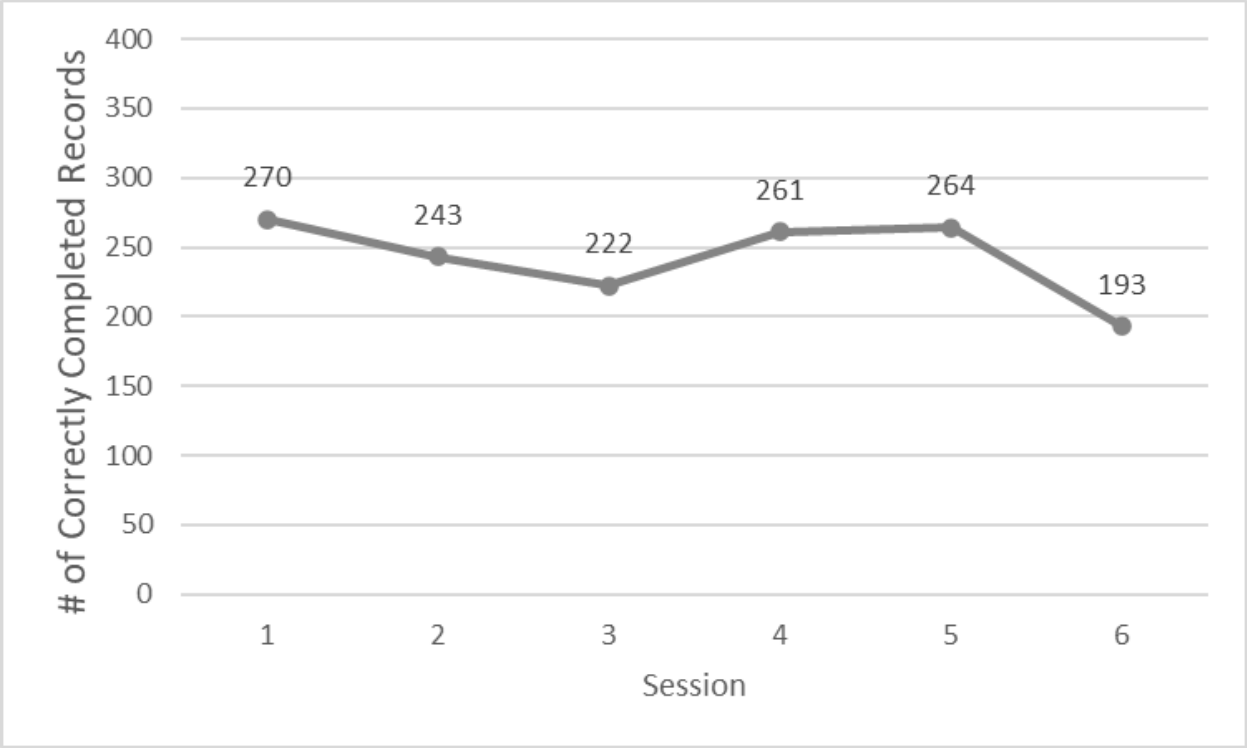
Participant # _____

Session	# of Correctly Completed Records
1	205
2	273
3	285
4	301
5	319
6	312

Appendix K

Graphic Objective Feedback Sample

Participant # _____



Appendix L

Instructional Script: Vocal Evaluative Feedback

SESSION 2-6 (VOCAL EVALUATIVE FEEDBACK)

Send the following text in an e-mail to the participant, with the subject line "Medical Record Data Entry Task – Session X, Participant [###]" (replacing [###] with the participant's number).

> *Hello [Participant's Name],*
>
> *Please read the following before you begin your session:*
>
> *Before you begin each session, you will meet with the researcher via WebEx. A WebEx meeting link will be sent in a separate email. Once you are finished you may begin the task (which will be sent to you once you've joined the session).*
>
> *As a reminder, you may minimize the data entry task, but under no circumstances should you close the program or open another Excel file. If you do, you will have to begin the session over again.*
>
> *You may or may not be monitored during the session, but your performance will be. Once the 45 minutes are up and the task automatically ends, please follow the instructions provided within the task window. Then, attach the newly-saved task file to an e-mail addressed to amber.l.derthick@wmich.edu.*
>
> *When you are ready, open the medical record data entry task file attached to this e-mail and start the experimental task.*
>
> *Thank you for your participation,*
> *[Your Name]*

During the session, before the participant starts the task, start recording the WebEx and provide feedback (via WebEx with webcams on):

Only read this next paragraph after session 2 (for sessions 3-6 skip to part where you provide feedback):

You received three cents per record correctly completed in the last session. In all of the remaining sessions you will receive $7.50 regardless of how many records you complete. We will pay you, via Venmo, after your last session.

Say one of the evaluative statements based on performance out loud to the participant.

Important! If the participant asks how many records they need to complete for good or excellent performance, tell them, "*I'm sorry, I can't tell you that.*"

To help you, a table indicating the performance levels are below. However, be sure not to tell participants what performance corresponds to what evaluative category.

"Remember that you can take a break from the task at any time. You *may choose to play a game on your computer, browse the internet, spend time on your cell phone, or just sit and relax for as long as you want to. The task will automatically stop once the 45 minutes are up. Once the task stops, please follow the instructions provided within the task window. Then, attach the newly-saved task file to an e-mail addressed to amber.l.derthick@wmich.edu. Also, remember that you will be paid $7.50 for this session and your next sessions. Do you have any questions?"*

Answer any participant questions then remind them to start the task. Record values on the participant's spreadsheet.

Performance and Evaluative Categories

Records	**Performance Levels**
350 or more	Excellent
300-349	Good
200-299	Average
199 or fewer	Poor

Appendix M

Instructional Script: Introductory Session

INTRODUCTORY SESSION (ALL GROUPS)

Forty-eight hours before meeting with the participant for their introductory session, send them the below text in an e-mail, along with a copy of the consent form which you will attach to the same e-mail. Also send the participant a separate 30-minute WebEx meeting invitation scheduled at the agreed-upon time for the introductory session meeting.

Hello [Participant's Name],

Thank you for participating in our research study.

Before *you meet with the researcher via WebEx, please do the following:*

1. *Read through the attached consent form*
   Once you have read the consent form, if you choose to participate, then please fill out the consent form and questionnaire by visiting https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_5j4X7ATUThLE6zQ (this is the same link that is within the consent form document)
2. *If you do not have Microsoft Excel installed on your computer, please follow these steps:*
   a. *Visit http://wexchange.wmich.edu*
   b. *Log in with your WMU username and password*
   c. *Click the Home button at the top left*
   d. *Click on "Install Office" at the top right*
   e. *In the drop-down, select "Office 365 Apps"*
   f. *Follow through with the installation process*

You will receive a separate e-mail for a WebEx meeting invitation scheduled for the time we discussed. When that time comes, please click on the link within that e-mail to open up and begin the meeting with me.

If you have any questions between now and then, please don't hesitate to ask.

I look forward to meeting with you,

[Your Name]

During your WebEx meeting with the student, you will do the following:

1. Ensure that they:
   a. Filled out the Qualtrics consent form and questionnaire
   b. Have a functioning webcam
   c. Installed Microsoft Excel 365 on their computer
2. Next, walk the participant through how to use the experimental task (email them the Excel file with the task). To do this, again share your screen with the student. Open "Medical Data Record Entry Task – Researcher" file. Tell the student that may have to click to "Enable Macros" just underneath the top ribbon when they first open up the

program. Then, enter in "999" for the participant number and click the "Start" button. Now, read aloud the following script while indicating the relevant areas on your screen:

> *The computer program will provide you with data corresponding to patients. You should first look for the "Patient ID number" and type it into the correct location. Then, look at whether the patient is male or female. You can determine that by looking at the "Gender" box or by whether there is an "F" or "M" in the ID number. Next, based on the ranges provided for the respective gender, determine whether the patient's data are "within range" or "outside of range" by clicking the appropriate button. When you are satisfied with your response, click the "submit" button to close the current patient's record and generate the next record. Let's try one."*

Complete two records on your screen before continuing with the below script:

> *Today, we would like for you to get comfortable with the task, so you will only perform the task for five minutes. Future tasks will be 45 minutes each.*

Close out of your Excel window and ask the participant to share their screen on WebEx. Finally, have them start the experimental task and read the following script:

> *The computer will keep a running total of the number of completed and correctly completed records. You won't be monitored during the session, but your performance will be. You may minimize the data entry task, but under no circumstances should you close the program or open any other Excel files. If you do, you will have begin the session over again. If you choose to take a break, feel free to browse the internet, spend time on your cell phone, or play on your computer. Today, we'd like you to practice the task for five minutes. After the five minutes have passed, the program will automatically end and will prompt you to save the file. At that point, please wait for my instructions. Please enter your participant number into the box and click "Start" when you are ready.*

Once the "Save As" dialogue box opens on the participant's Excel window, walk them through how to save the file and attach it to an e-mail addressed to amber.l.derthick@wmich.edu. Once they have sent the e-mail, respond to any questions they might have. After the participant feels comfortable with the procedures, schedule their next session (or all six, if possible) and thank them for their time and participation.

Appendix N

Instructional Script: Keyboard Proficiency Assessment Session

SESSION 1: KEYBOARD PROFICIENCY ASSESSMENT SESSION (ALL GROUPS)

Send the following text in an e-mail to the participant, with the subject line "Medical Record Data Entry Task – Session 1, Participant #[###]" (replacing [###] with the participant's number).

Hello [Participant's Name],

Please read the following before you begin your session:

During this 45-minute session, please do your best to correctly complete as many records as you can. We are assessing your keyboard proficiency on the task, which could affect how you perform the task in the future. You will be paid $0.03 per correctly completed record for this first session (for example, if you complete 100 records, you will earn $3.00). We will pay you, via Venmo, at the end of the study for this session and every following session that you attend. As a reminder, you may minimize the data entry task, but under no circumstances should you close the program or open another Excel file. If you do, you will have to begin the session over again.

You may or may not be monitored during the session, but your performance will be. Once the 45 minutes are up and the task automatically ends, please follow the instructions provided within the task window. Then, attach the newly saved task file to an e-mail addressed to amber.l.derthick@wmich.edu. Remember, for this session, it is very important that you complete as many records as you can because we are assessing your keyboard proficiency.

When you are ready, open the medical record data entry task file attached to this e-mail and start the experimental task.

Thank you for your participation,
[Your Name]

Appendix O

Debriefing Script

Debriefing Script

Forty-eight hours before meeting with the participant for their debriefing session, send them the text below in an e-mail. Also send the participant a separate 30-minute WebEx meeting invitation scheduled at the agreed-upon time for the debriefing session meeting.

Hello [Participant's Name],

Thank you for your participation in our research study.

You will receive a separate e-mail for a WebEx meeting invitation scheduled for the time we discussed. When that time comes, please click on the link within that e-mail to open up and begin the meeting with me.

If you have any questions between now and then, please don't hesitate to ask.

I look forward to meeting with you,

[Your Name]

At the start of your WebEx meeting with the participant, provide feedback on their final session using the same feedback process provided in sessions 2-6. Then ask them to complete the stress and satisfaction questionnaire by sending them the following email during the WebEx meeting:

Please complete the stress and satisfaction questionnaire by visiting the following link: https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_0SW7f9QFtfuIanc

Then, proceed with the following scripts and steps.

"Thank you for participating in this study. Before I explain the purpose of the study, let's discuss your final receipt and pay. You completed six sessions and earned $##.##. We will pay you via Venmo.

To pay the participant via Venmo, acquire their account name so Amber can perform the transfer, paying them for the entire study. Then, continue with the following:

Do you have any questions about your performance during the study? [Answer any questions.]

The purpose of this study was to compare the effects of objective feedback in the form of a memo, matrix, graph, or no objective feedback when individuals were given fixed pay and vocal evaluative feedback.

You were one of the participants who received (memo, matrix, graphic, no) objective feedback.

We allowed flexibility with how you spent your time at the computer during the session because we believe that without interesting alternative things to do, individuals might work on the task the entire session, regardless of how they are paid. Do you have any questions about the study? [Answer any questions.]

Again, thank you for your participation. I really appreciate your continued participation throughout the semester. Lastly, I ask that you please do not discuss this study with anyone because we have not yet finished collecting data.

After the debriefing session is over e-mail a copy of their pay receipt to the participant.

Appendix P

Pay Receipt

Number of Records Correctly Completed During Each Session

Participant #: _____

Session Number	Session Date	Number of Records Correctly Completed	Pay
1			***3 cents per record***
2			**$7.50**
3			**$7.50**
4			**$7.50**
5			**$7.50**
6			**$7.50**

TOTAL PAY: _____