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THE EFFECTS OF FEEDBACK MODALITY ON PERFORMANCE

by

Garrett D. Warrilow

A thesis submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Master of Arts
Psychology
Western Michigan University
April 2017

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THE EFFECTS OF FEEDBACK MODALITY ON PERFORMANCE

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Western Michigan University, 2017

Giving employees information about their performance is a common method for employers seeking to improve or change performance. With the popularity of the internet and computers feedback today is often provided through emails, text messages, and video meetings. While feedback has continued to evolve within and across organizations little has been done to assess the impact its delivery through various modalities has. This study explored and evaluated the relationship between the modality which objective feedback is delivered, and the differential effects it produced on performance of a check entering task. This experiment was a laboratory study employing a between-group repeated measures design with random assignment to one of the following four experimental conditions; 1) no feedback, 2) computer delivered feedback, 3) feedback via cell phone text message and, 4) feedback via face-to-face interaction. Inspections of the graphic displays of results reveal unique response patterns, and notable differences in performance across the four conditions. The most prominent difference in performance is seen between the groups receiving objective feedback (through any modality) and the group which received no feedback.

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ACKNOWLEDGMENTS

A special thank you to Doug Johnson, Alyce Dickinson and Denise Ross for all your guidance throughout this project and my academic career.

Garrett D. Warrilow

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INTRODUCTION

Feedback has long remained one of the most common organizational approaches for improving employee performance, fostering learning and development, and enhancing job satisfaction (Andiola, 2014; Baker, Perreault, Reid, & Blanchard, 2013; Mulder & Ellinger, 2013). The common techniques for providing feedback can range from annual performance reviews in which a supervisor gives a summary of the worker's performance over the past year during a face-to-face meeting to more comprehensive methods such as providing information on an ongoing and real-time basis (e.g., supplying counters for units packed, widgets built, or similar tasks). Feedback has also been one of the most common research topics within organizational behavior management. Feedback has served as the most frequently used independent variable in the *Journal of Organizational Behavior Management's* published works, accounting for 65%, 71%, and 68% of the studies published across the first three decades of its publication (1977-2009) respectively (Balcazar, Shupert, Daniels, Mawhinney, & Hopkins, 1989; Nolan, Jarema & Austin, 1999; VanStelle et al., 2012).

Across the many applications and research studies, it has frequently been recognized that feedback does not easily lend itself to simple analyses when trying to understand its function. According to Peterson (1982), feedback can act as any other physical stimulus does and serve multiple functions. Depending on its temporal relation with behavior, feedback could be used as an antecedent for subsequent behavior or a consequence for prior behavior. If given the appropriate history, feedback could serve as a conditioned stimulus, conditioned reinforcer, conditioned punisher, discriminative

stimulus, or motivating operation. As is the case with other stimuli, it can change functions over time as well as serve multiple functions simultaneously.

In an applied setting the delay between the behavior of interest and the presentation of feedback often makes it difficult to argue that feedback serves as a discriminative stimulus or direct reinforcer (Peterson, 1982). A discriminative stimulus is a stimulus that is correlated with the immediate availability of reinforcement for engaging in a particular behavior, whereas a reinforcer is delivered immediately following the targeted behavior. In a work setting it is often impossible for a manager to arrange for feedback to be delivered in such an immediate fashion in order to meet the technical demands of these definitions. Instead the common practice is to hold weekly, monthly, quarterly, or annual performance reviews and informal meetings during which feedback is given with a significant temporal delay following or preceding the targeted behavior. Despite failing to meet the immediacy criterion embedded in many basic behavioral concepts and principles, feedback can still successfully impacts employee performance (assuming it is high quality feedback in accordance with the organizational behavior management literature).

Many argue that verbal mediation is likely what explains these effects in spite of the time gaps (Agnew & Redmon, 1992; Malott, 1992; Peterson, 1982). For example, after receiving feedback during a meeting with a supervisor, the employee might state “I must work harder to fulfill more orders this year.” He or she will likely continue repeating this statement, or some functionally equivalent variant of it, over and over again and these statements are likely to have some evocative properties due to the prior supervisory feedback. As the employee works harder to complete orders, the task-

relevant behaviors are reinforced by the occurrence of an increasing tally of fulfilled orders. Furthermore, the employee is likely to emit statements such as “my supervisor is going to be really thrilled with the number of orders that I’ve produced” or, “at least I’m not going to be chewed out during my next meeting with the boss.” Both the sight of numerous fulfilled orders and the sound from verbal self-evaluations are likely to acquire reinforcing properties due to the relation between the presence of these response products and other reinforcing events (e.g., positive evaluations by others, tangible benefits related to higher productivity, removal of an implied or explicit threat, etc.). This assortment of conditioned reinforcers may maintain the task-relevant behaviors in strength throughout the process. Eventually, the employee may successfully complete the number of fulfilled orders that the supervisor specified during the previous meeting. Despite the passage of a significant period of time between the feedback from the supervisor and the final successful level of fulfilled orders, the feedback still maintains a functional, albeit indirect, effect on the employee’s behavior. The analysis is made difficult by the fact that a number of overt and covert stimuli and behaviors (often verbal in nature, but not necessarily) intervene to bridge the temporal gap, but the effectiveness of the feedback can easily be demonstrated empirically. The immediate change, before the relevant conditioned reinforcers were established, can be explained in terms of rule-governed behavior, behavior that results from a stated rule; the process which maintains the increased performance, however, is contingency-shaped behavior or behavior that results from current consequences and is generated by the individual as a result of the supervisor’s performance review and the verbal mediation which follows it.

The specific function of feedback and the related intervening verbal stimuli can be analyzed in a number of plausible ways. Feedback can serve as a direct reinforcer or punisher for certain work behaviors. For example, an employee may ask his or her supervisor's opinion regarding a recent performance or work product. The consequence for the behavior of requesting feedback is immediately delivered. Depending on the nature of the evaluation (e.g., "your craftsmanship is amazing" or "eh, I've seen much better"), that employee may increase or decrease future instances of such feedback solicitation. As noted above, feedback can also indirectly maintain reinforcing and punishing contingencies, such as when certain self-generated verbal evaluations (e.g., "I'm doing great" or "I'm below expectations") are effective as verbal reinforcers or punishers due to a history of these statements being differentially paired with external sources of feedback. Feedback could also exert control over respondent behavior, such as when feedback functions as a conditioned stimulus. For example, the presentation of feedback may immediately elicit feelings typically labelled as "anxiety," "anger," or "pride."

As with any physical stimulus, feedback may also function as a motivating operation. Michael (2004) explains that motivating operations are changes or events that 1) alter the effectiveness of a reinforcing stimulus, and 2) change the likelihood of all behaviors that have produced that stimulus in the past. The most basic form of this antecedent can be illustrated with unconditioned motivating operations (i.e., motivating operations that do not require a learning history to influence behavior), such as depriving an organism of water. Water deprivation will simultaneously make water more

reinforcing and increase the likelihood the organism will engage in the behaviors which have secured water in the past.

In a work setting it would typically be impractical or unreasonable to manipulate most unconditioned motivating operations (e.g., restrict employee intake of food or water; alter variables related to biological survival of workers), so the typical environmental contingencies in business and industry will likely involve conditioned motivating operations (McGee & Johnson, 2015). These are more complex forms of motivating operations that require a learning history to be effective. Although feedback would not qualify as an unconditioned motivating operation given that employees are not biologically predisposed to react to feedback in a particular manner, it is possible for feedback to acquire the properties of a conditioned motivating operation. Feedback could make the consequences for engaging in certain behaviors more or less reinforcing and would in turn either evoke or abate those behaviors. For example, if the manager informs an employee that he or she has not been producing enough parts lately, this operation could serve to make the sight of increased part production more reinforcing to the employee and cause the employee to engage in behaviors related to increased production.

Despite the volume of studies examining the effect of feedback, there is little consensus as to the typical mechanism under which feedback functions to change behavior; nor what variables in the feedback are necessary for it to be effective (Alvero, Bucklin, & Austin 2001). Put differently, while there is overwhelming research on the implementation of feedback, there remains an absence of research on both the functional and formal elements that make feedback optimally effective. Part of the difficulty in elucidating these issues may be that many previous studies have not differentiated the

type and format of feedback used in the experiment. For example, Wilson, Boni, and Hogg (1997) describe their study as using corrective feedback, but a closer look at their methodology reveals that the managers delivered objective results, praise with performance improvement, *and* corrective feedback. Gerson (1978) termed his intervention ‘objective feedback’, but since his ‘objective feedback’ was presented as either positive (good performance) or negative (bad performance), this intervention was more fitting of what would be defined as evaluative feedback.

These discrepancies create a nebulous framework for understanding the aspects of feedback that impact the performance of interest. This has led some authors to call for research to analyze and identify the numerous components subsumed under the broad label of feedback (Johnson, 2013). For the current study, objective feedback will be defined as measurable/observable data of participants’ past performance (e.g., you completed 231 tasks) lacking any and all evaluative language and/or gestures (e.g. without a thumbs up, saying good job, etc.).

Authors such as Daniels and Bailey (2014) have stated that for feedback to be effective it should convey specific information about performance. Objective feedback provides the performer with specific information as to what contributes to desirable performance, as defined by management, and provides a value against which performance can be evaluated. Objective feedback has been the subject of many past research studies with varying conclusions regarding its effectiveness in isolation. In one early example by Chapanis (1964), participants spent hour-long sessions typing random digits into a teletype, an electromechanical typewriter that could send and receive typed messages through various communication channels. Participants in one experimental

condition never received feedback on their performance. In the remaining three experimental conditions, participants received objective and individualized feedback on their performance in the form of a physical counter mounted above their workstation. In one of these feedback conditions, the counter kept a cumulative total of their progress across sessions. In the second feedback condition, the counter was reset to zero every session so as to provide a numerical summary specific to that session's progress, rather than cumulative progress across sessions. In the last feedback condition, the counter was reset and participants were requested to write down their current total every 15 minutes. At the conclusion of the experiment no significant differences between conditions were demonstrated. As such, Chapanis found that objective, individualized feedback in the *form of a physical counter* did not improve performance in comparison to no feedback.

Johnson, Dickinson, and Huitema (2008) examined feedback in a 2x2 factorial design. In their study, four separate conditions were utilized including a) incentive pay without objective feedback, b) incentive pay with objective feedback, c) fixed pay without objective feedback, and d) fixed pay with objective feedback. Participants were asked to use keyboards to type in the dollar amounts of checks displayed in a data entry program on the computer. The participants' completion rate (checks per minute) and total checks completed were displayed via the computer screen and updated every 30 seconds throughout the session. While the monetary incentives proved to be effective in increasing the number and rate of entered checks, the conditions in which objective feedback was given showed no significant difference in comparison to those conditions without feedback. As such, Johnson, Dickinson, and Huitema found that objective,

individualized feedback in the *form of a computer display* did not improve performance in comparison to no feedback.

Crowell, Anderson, Abel, and Sergio (1988) tested the effects of task clarification, social praise, and objective feedback on bank teller-customer interactions. The experimenters posted anonymous individualized charts of mean scores for the tellers' transaction-interactions in a room accessible to employees only. Furthermore, the bank managers would verbally acknowledge this objective feedback during daily meetings, although they were instructed to not evaluate the performance of their employees (the praise condition was implemented at a later date). These scores were based on 11 behaviors targeted and observed in each conversation the tellers had with customers over the previous week. At the conclusion of the experiment Crowell et al. found a gradual increase in teller-customer interactions scores when objective feedback was used, resulting in a 6% increase in interaction quality overall. Additionally, Crowell et al. found that when feedback was removed performance diminished, but improved upon its reintroduction. As such, Crowell et al. found that objective, individualized feedback in the *form of data posted on a wall and face-to-face interactions* did improve performance in comparison to no feedback.

Johnson (2013) conducted a laboratory experiment at a large university examining the effects of objective feedback alone, evaluative feedback alone, combined evaluative and objective feedback, and a no feedback condition on the same data entry task as Johnson et al. (2008). In all three feedback conditions, the feedback about specific performance was personally delivered by the researcher during face-to-face conversations in a small private room. While participants in the no feedback condition saw a decline in

performance, the evaluative alone, objective alone, and combined evaluative and objective feedback conditions each saw increases in performance at 85, 88 and 175 total checks completed respectively, translating to a 1.89, 1.95, and 3.89 checks per minute increase. As such, Johnson found that objective, individualized feedback in the *form of face-to-face interactions* did improve performance in comparison to no feedback.

Although objective and individualized feedback was used across all of the previous studies and all involved tasks representative of the workplace, the effects of this feedback were not uniform. Half of these studies found such feedback to be effective in improving performance, whereas half of these studies found the feedback to be ineffective. This parallels the findings from literature reviews of feedback, which have found feedback in isolation to be inconsistently effective (Alvero et al. 2001; Mulder & Ellinger, 2013). Such inconsistency suggests that a source of uncontrolled variance is operating across these different studies examining the same phenomena. One potential source of variability is the form through which feedback is delivered. Across the above studies, a variety of methods such as visible counters, displays on computer screens, public wall postings, and personal interactions were used to deliver feedback. These differences may have been a contributing factor for the mixed results regarding feedback implementation.

It is important to understand the potential effects that the mode of feedback delivery has on performance, especially as modern technology expands the potential options for delivering feedback. Traditional forms of feedback delivery, such as print media and face-to-face interactions still remain, but the rapid development of the internet and computer technology has opened a host of new options. These new modes for

expressing feedback include, but are not limited to, computer displays, email correspondence, text messages, video conferencing, and social media communications. It is possible that these different modes of delivery will have different effects on performance. While feedback has continued to evolve both within organizations and research studies, little has been done to assess the impact its delivery through various modalities and modern technology options.

To better understand why different modes of expressing feedback may have different effects on performance, a theoretical consideration will be provided below. As mentioned above, the studies by Johnson et al. (2008) and Johnson (2013) had differing conclusions regarding the effectiveness of objective feedback in comparison to no feedback, despite the same primary researcher, experimental task, experimental setting, and university for participant recruitment. One possibility for resolving this apparent discrepancy is to consider the different methods for delivering feedback: Johnson et al. delivered feedback to college students via a computer screen, whereas the later Johnson study delivered feedback to college students via a face-to-face interaction. This may be an important distinction because college students, even those who have never participated in research before, are not blank slates upon entering research studies. Rather, they bring with them repertoires acquired from an extensive exposure to both idiosyncratic and common cultural contingencies.

This collection of historical events will likely involve experiences with authority figures from occupational, educational, and family settings who readily have powerful sources of reinforcement and punishment at their disposal. It is reasonable to speculate that, generally speaking, when authority figures show an interest (e.g., spend time

observing, etc.) in an individual's specific performance, additional consequences will be provided by authority figure based upon the observed performance. Supervisors start observing behavior of individual employee performance to figure out if rewards or discipline are needed, teachers start observing behavior of individual student performance to figure out if praise or correction is needed, parents start paying attention to observing the performance of their children in order to provide either admonition or affection, and so forth. One result of these culture-wide contingencies is that many, if not most, participants bring with them a common experience to experiments: When the authority figure is paying attention, related evaluation and consequences will be forthcoming.

One of the most commonly used modes for delivering feedback comes via face-to-face interactions. As stated above, even when objective feedback is given, due to employees' history of having evaluation paired with the presentation of feedback by the supervisor, the same behavior may occur as if evaluative components were included. It is also possible that the participants create their own verbal rules such as, "They are judging my performance, I need to do the best that I can" or "I must work harder so they don't think I am a poor performer" resulting in rule-governed behavior to facilitate greater rates of responding and performance. Thus, feedback may be perceived or considered a form of evaluation for the participants. However, this history does not necessarily require the explicit development of a verbal rule to be effective. The mere similarity of stimulus conditions between past and present circumstances may be enough to evoke similar behavior. Typically, it is found that generalization occurs on a gradient directly correlated with the similarity between the original stimulus and the novel stimulus (Michael, 1993).

For example, in Johnson's 2013 study the supervisor's delivery of feedback may have resulted in an inference of evaluation from the supervisor, even though only objective feedback was explicitly provided. Although care was taken to avoid any form of evaluation being implied, when the objective feedback was delivered it is quite possible that the participant's history of supervisor feedback and evaluation pairing generalized, evoking the same response as if evaluative information had been delivered. This may be because the circumstances of having a researcher personally deliver information about performance has enough common features with past instances of authority figures commenting on performance to exert similar control over responding. Following the same logic, Crowell et al.'s (1988) publicly displayed charts would, and did, result in the same outcome due to being combined with personal acknowledgement from an authority figure, the supervisor. Other forms of feedback delivery, such as physical counters and computer screens, may not evoke the same level of responding due to stimulus change decrement. That is, in comparison to a researcher providing feedback, the stimulus conditions of an inanimate object providing feedback may prove too dissimilar to pre-experimental learning history to have any evocative properties. If true, it is likely that face-to-face feedback will be more effective in changing current behavior than alternatives.

In the Chapanis (1964) and Johnson et al. (2008) studies, feedback was not paired with a supervisor or observer but instead came from a nonliving counter and computer program. Again, learning history may have played a role in participants' responding as computer generated feedback is never paired with any form of evaluation and shares few common elements with historical sources of evaluation. As such, when feedback was

delivered in this format it failed to increase performance above no feedback conditions. As the stimulus from which feedback is delivered changes, so do the properties that control employee performance. It is possible that in face-to-face conditions employee behavior is controlled partially by the presence of the manager, the tone in the manager's voice and body language, and the amount of time they spend speaking on certain topics. These properties would be completely absent in many technological counterparts. It is difficult to know whether the decrement in stimulus conditions would be great enough with text messages or email that foster or inhibit generalization. Unlike physical counters or computer software tracking, these sources are not automatically generated. Rather, someone must take the time and effort to observe an individual's performance and then craft a summary of it, much like face-to-face interactions. However, many of the properties associated with face-to-face interactions are lost (e.g., tone, facial expression, body language).

Given the possibility of differential stimulus change decrement with feedback delivery methods, it is important to understand and compare a range of modes for expressing feedback. This becomes even more critical when one considers the growing range of options for delivering feedback related to technological innovations. Some initial research in this area has already begun. For example, Earley (1988) examined the behavior of employees processing magazine subscriptions and compared the effects of daily feedback from a computer system to daily feedback delivered by a supervisor (using the computer system as a basis for feedback). Performance was higher when the feedback was self-collected directly from the computer source rather than delivered by a supervisor. There is one important consideration to be made when interpreting these

results: The employees reported that they did not believe the supervisory feedback to be accurate (even though it was). Given that the employees and supervisor had an already established history working together at the same magazine publisher, it is difficult to know if this prior relationship influenced the results. As recent research has shown (Johnson, Rocheleau, & Tilka, 2015; Palmer, Johnson, & Johnson, 2015), accuracy of feedback is an important determinant of its effectiveness. Like the Earley study, Slowiak and Lakowske (2015) also compared feedback from a computer against feedback from a supervisor, although participants in their study could choose whether or not to solicit feedback from these sources. Unlike the Earley study, Slowiak and Lakowske found no differences between computer and face-to-face feedback sources.

Kaufman, Coddling, Markus, Tryon, and Kyse (2013) found when training teachers to implement a new behavior intervention, teachers who received verbal (face-to-face) feedback had a more immediate change in performance as compared with when they received written feedback. However, both were found to be relatively effective and received high acceptability ratings by the teachers. Similarly, Chae, Moon, Lee, and Oah (2015) compared the effects of feedback delivered via an email with the effects of feedback delivered face-to-face on the assembly of mobile phones. For both email and face-to-face feedback, the same professor delivered the feedback and many of the participants had a history with this professor (i.e., former students of his). Face-to-face feedback was found to be consistently more effective than email feedback and this effect was even more pronounced when the supervisor had a prior history with the recipient of feedback.

Overall, the studies to date illustrate the need for further research. Inconsistent effects have been discovered when comparing face-to-face feedback with alternatives. In addition, little has been done to compare various alternative modes for delivering feedback.

METHOD

Experimental Design

This study utilized a between-group repeated measures design with random assignment to the following four experimental conditions; 1) no feedback, 2) computer delivered feedback, 3) feedback via cell phone text message and, 4) feedback via face-to-face interaction.

Setting

This study took place in a laboratory setting at Western Michigan University. In the laboratory room were four computers, each having an adjustable chair, separated by cubicle walls. There were no windows in the laboratory room and the door to the laboratory was closed during the experimental sessions to assure subjects had a reasonable degree of privacy. The researcher was located behind a cubicle wall that did not allow him or her a direct view of the participants' actions.

Participants

Subjects were recruited via flyers (example in appendix A) posted around the university and presented at the start of classes, as well as via in-person classroom presentations (script can be found in appendix B) with instructor permission by the primary experimenter or trained research assistant.

Inclusionary criteria. Participants were included in the study if they were 18 years or older and were willing and able to receive periodic text messages.

Exclusionary criteria. Participants unable or unwilling to receive text messages were excluded from participation in the study.

Experimental Task

The experimental task was a check-proofing task, similar to the job of a proof operator at a bank and used in many other studies on feedback (Johnson, 2013; Johnson et al., 2008; McGee, Dickinson, Huitema, & Culig, 2006; Slowiak, Dickinson, & Huitema, 2011). A computer program developed using Visual Basic displayed a graphic of a check with randomly generated dollar amounts between \$10.00 and \$999.99. The participant entered the amount using the keypad and pressed the “Enter” key or used the mouse to click “Next Check” at which point another check appeared for the participant to enter. The computer continued to present checks until the experimenter or research assistant entered the room, stopped the subject where they were, and ended the session.

Participant Selection and Assignment

Interested individuals contacted the primary experimenter by email or by his telephone number obtained from a recruitment flyer or classroom presentation. Upon the initial contact the experimenter asked for times the individual was available to come in to have the experiment explained (see appendix C for the initial contact email). If the person was still interested in participating after having the experiment explained, he or she read and signed the informed consent document (see appendix D), then fill out a pre-experiment survey (see appendix E) which was used to collect demographic data and to determine if he or she was willing to accept text messages for purposes of the study.

After completing the survey the experimenter or trained research assistant spoke with the participant. Participants meeting the exclusionary criteria were thanked for their participation and informed that their assistance was no longer needed. Those who met the inclusionary criteria were randomly assigned to one of the four experimental conditions (which they remained in for the duration of the experiment) using a random number generator and spreadsheet, and then immediately began the first baseline session. After completing the baseline session the participant scheduled his or her remaining sessions. Mutually convenient times for the researchers and participant were established and confirmed via email 24 hours previous to the next session.

Identifying information was stored in a locked filing cabinet on WMU's campus in the Principal Investigator's office. It will be kept for a minimum of three years after which it will be destroyed.

Experimental Conditions

Baseline sessions. Participants who met the inclusionary criteria, read and signed the informed consent document, and filled-out the pre-experiment survey immediately began one of two baseline session (a session completely absent of the independent variable, feedback). During the first session participants were told it was an introductory session, had the experimental task explained to them, and had any questions answered until they fully understood the task. The subject was told of the importance of attempting to enter as many checks as possible until the experimenter returned to end the session. The participants then completed the check entering task for 45 consecutive minutes. When the participant came back for his or her second scheduled session they were asked if they had any questions, again reminded of the importance of entering as many checks

as possible, and then allowed to engage in the check entering task for 45 minutes. The average performance of the baseline sessions served as the covariate for a one-factor analysis of covariance (ANCOVA) that was conducted using the average performances during the latter experimental sessions.

General procedures. In each of the experimental conditions, participants completed five 45-minute sessions in which they engaged in the experimental task. Before the beginning of each session participants were reminded they should do the best they can for the duration of the time. After the conclusion of each session, feedback was given (except for those in the no feedback condition) dependent on the experimental condition under which the participant was assigned.

In this study the experimenters were meant to fill the role of the supervisor in the workplace. As it is reasonable to expect a supervisor's presence to affect the output of a worker, and due to the fact that it would be unreasonable to expect a supervisor to sit with his or her workers throughout the workday, the experimenter was seated out of sight behind a cubicle wall after beginning the program. This was done to help keep scores from being inflated due to participant reactivity.

Feedback via face-to-face interaction. At the conclusion of the participant's second baseline session the experimenter terminated the session and had the subject sit in another room for a few minutes. Once the subject left the room the experimenter collected the performance data. After the data were gathered the experimenter joined the subject in the other room and vocally stated how many total checks the participant entered and the total correct checks entered with a statement such as, "You entered ____ total checks during today's session with ____ total checks entered correctly." Participants

were allowed to ask questions and comment on this feedback, however the experimenter did not solicit any specific response. Every effort was made by the experimenters to use an even tone with minimal body language (e.g., a flat affect with minimal gestures) to ensure no evaluative components were included in the feedback delivered. If any participants had asked for an assessment of their performance, the experimenter would have replied that they could not say (in practice, participant behavior never required the implementation of this procedure). This process was repeated for the five remaining sessions.

Computer delivered feedback. Participants received the same feedback information regarding their total checks entered and the rate of checks completed as the face-to-face condition, however it was provided via the computer instead of vocally from the experimenter. At the conclusion of the 45-minute session the computer program automatically generated a message which stated, “Number of checks completed: ### (the number they completed).” Under this was the statement “Number of checks completed correctly: ### (the number they entered correctly was be displayed).” Under this line the statement, “Check completion rate: ## (with the rate in checks per minute the subject completed displayed).” A screenshot of the computer generated message can be viewed in Appendix F. When the experimenter entered the room he or she asked, “Did the program tell you how you did?” and sought some form of acknowledgement (e.g., a head nod, an “ok” hand signal or thumbs up, a verbal response "yes" or "yeah", etc.) but no additional information was solicited. The participants were allowed to ask questions about the feedback. The experimenters made every effort to answer those questions with an even tone and flat affect to eliminate any possible evaluative components being

included in the feedback. If the participant asked if his or her total checks entered and/or rate was “good,” the experimenter replied that they were not allowed to say. This process was repeated for the five remaining sessions.

Cell phone text message feedback. In this condition participants received feedback via a text message sent from the experimenter. At the conclusion of the second baseline session and each experimental session the experimenters informed the participants that they would be sending them a text from their phone number (they told the subjects the phone number from which to expect the text) within the next two to five minutes with how many cumulative checks and the number of checks completed correctly during the day’s session. The text message read, “You entered ____ total checks during today's session with ____ total checks entered correctly.” This message was sent after two minutes and within five minutes of the participant leaving the sight of the experimenter. This process was repeated for the five remaining sessions.

No feedback. Participants in this condition received no feedback about their performance at the conclusion of each session.

Debriefing

After any participant completed all five sessions under experimental conditions he or she was asked to fill out a post-experiment survey to help identify any threats to experimental validity as well as take measures on how participants think they performed during the course of the experiment. This survey can be seen in appendix G. Following their completion of the survey the subjects had the experiment’s purpose explained to them. The script for the debriefing can be seen in appendix H.

Measures

The main dependent measure was the average number of checks completed correctly per session. Secondary measures included, 1) the number of checks completed accurately per session, 2) the number of seconds spent off-task, and 3) survey responses. The computer automatically recorded the number of checks completed, the number completed correctly, and the number of seconds spent not performing the task. Participants' self-report data was collected as part of the post-experimental survey.

Data Analyses

Data collected for measures 1 through 3 (noted above) were evaluated by completing a one-factor ANCOVA on performance during experimental conditions and utilizing baseline performance average as covariate measures.

RESULTS AND DISCUSSION

Results

Recruitment efforts yielded 125 individuals who came in and filled out the pre-experiment survey. The participants ranged from 18 to 41 years of age, averaging 19.9 years old with a standard deviation of 2.53 years. The sample consisted of 35 males and 90 females. When asked what ethnicity the volunteers primarily identified themselves as 79 individuals responded White or Caucasian, 22 as Black or African American, five as Hispanic, one as Palestinian American, four as multiracial, one as Filipino, one as Sikh, two as Indian, one as Native American, and four stated they would prefer not to answer.

Of the 125 volunteers, seven were not willing to accept text messages for the study and as such were excluded from participating. The data of an additional seven participants were discarded due to behavioral observations that suggested a complete

disengagement with the experimental setup for a significant portion of time (e.g., simply ignoring the computer and spending entire session on their cell phone or studying a textbook). This left 111 participants assigned to the four conditions. Through attrition the final experimental session saw 85 total participants completing all seven sessions, with 22 participants completing all sessions under the no feedback condition, 20 under the text message feedback condition, 24 under the computer based feedback condition, and 19 under the face-to-face feedback condition

Total checks entered. ANCOVAs were run to assess whether there were statistically significant differences within the sessions and for overall performance of the four conditions for the total number of checks entered. Visual inspection of graphed data (Figure 1) suggested that the independent variables appeared to exert their effects after the second experimental session. As such, the average performance during the baseline sessions were used as the covariate, and the average performance during the final three experimental sessions were used as the dependent measures. An ANCOVA based upon these sessions reveal marginally significant differences ($p = 0.059$) for the total checks entered, as shown in Table 1. Table 2 shows the adjusted means for the final three experimental conditions. Raw scores and the graphical representations of all experimental sessions can be viewed in Appendices I and J.

Since the ANCOVA revealed a p-value which approached significance, Fisher-Hayter pairwise comparisons were made to determine to where this value could be attributed. Comparing the face-to-face group to the text message feedback, computer feedback, and no feedback groups yielded studentized q's of 1.05, 0.44, and 3.53 respectively (q-critical = 3.71). The Fisher-Hayter calculations comparing the text

message feedback group against the computer feedback and no feedback groups yielded q 's of 0.67 and 2.49. Finally, comparing the computer feedback group against the no feedback group found $q = 3.29$.

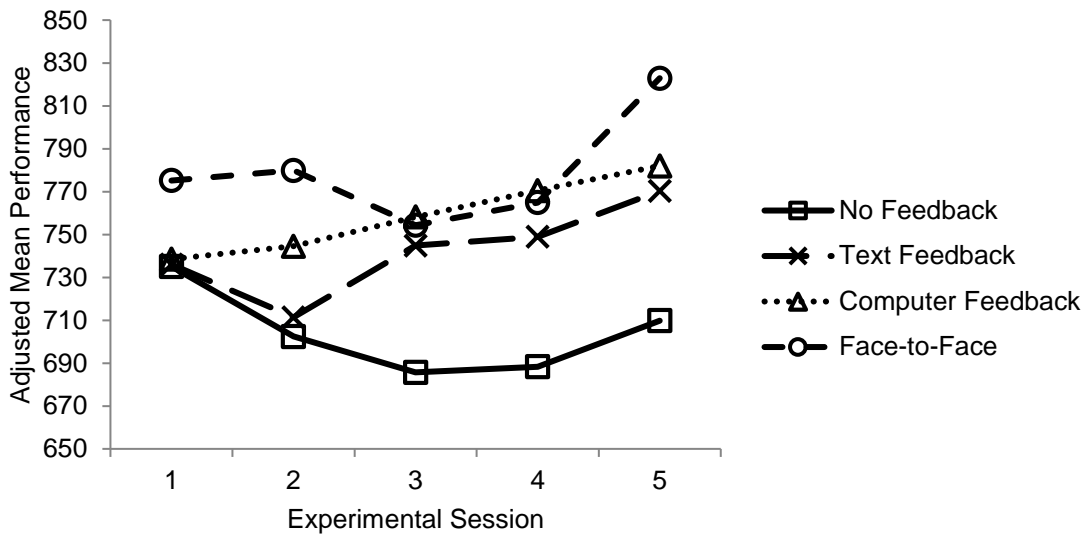


Figure 1. Adjusted Means Across Sessions: Total Checks Entered.

Table 1

Source Table for Analysis of Covariance: Total Checks Entered

Source	SS	dF	MS	F	p
A.T.	93935	3	31312	2.58	0.059
Resw	971265	80	12141		
ResT	1065200				

Table 2

Adjusted Means for Total Checks Entered

Condition	<i>n</i>	Checks
No Feedback	22	694.6
Text Message Feedback	20	754.6
Computer Feedback	24	770.3
Face-to-face Feedback	19	780.8

Correct checks entered. The analysis for correct checks entered followed that of the total checks entered with the average performance during the baseline sessions being used as the covariate, and the average performance during the final three experimental sessions being used as the dependent measure. Figure 2 displays the adjusted means of correct checks entered by group for the five experimental sessions. Raw scores and the graphical representations of all experimental sessions can be viewed in Appendices I and J.

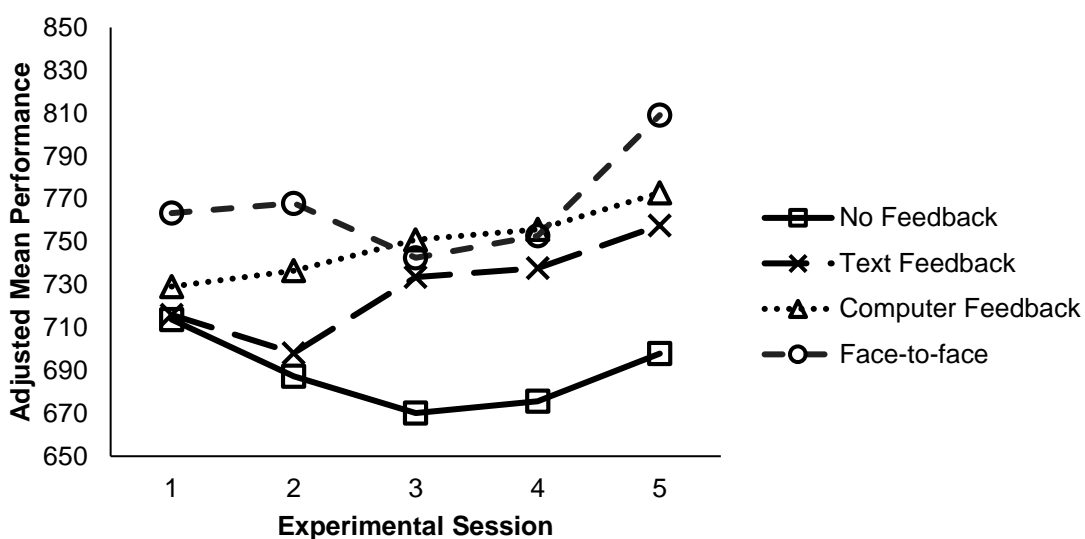


Figure 2. Adjusted Means Across Sessions: Correct Checks Entered.

Table 3 presents the source table for the ANCOVA, and Table 4 presents the adjusted averages across the final three sessions for correct checks entered for each group. The ANCOVA yielded $p = 0.053$. Since the ANCOVA revealed a p-value which approached significance, Fisher-Hayter pairwise comparisons were made to determine to where this value could be attributed. Comparing the face-to-face group to the text message feedback, computer feedback, and no feedback groups yielded studentized q's of 1.01, 0.35, and 3.55 respectively (q-critical = 3.71). The Fisher-Hayter calculations comparing the text message feedback group against the computer feedback and no feedback groups yielded q's of 0.71 and 2.56. Finally, comparing the computer feedback group against the no feedback group found $q = 3.41$.

Table 3

Source Table for Analysis of Covariance: Correct Checks Entered

Source	SS	dF	MS	F	p
A.T.	98168	3	32723	2.68	0.053
Res _W	977210	80	12215		
Res _T	2926088				

Table 4

Adjusted Means for Correct Checks Entered

Condition	n	Checks
No Feedback	22	681.2
Text Message Feedback	20	743.0
Computer Feedback	24	759.9
Face-to-face Feedback	19	768.2

Time off-task in seconds. Following the analysis of the total checks entered and correct checks entered, an ANCOVA was calculated for time off-task using the average performance during the baseline sessions as the covariate, and the average performance during the final three experimental sessions as the dependent measure. Figure 3 displays the adjusted means of time off-task by group for the five experimental sessions. Raw scores and the graphical representations of all experimental sessions can be viewed in Appendices I and J.

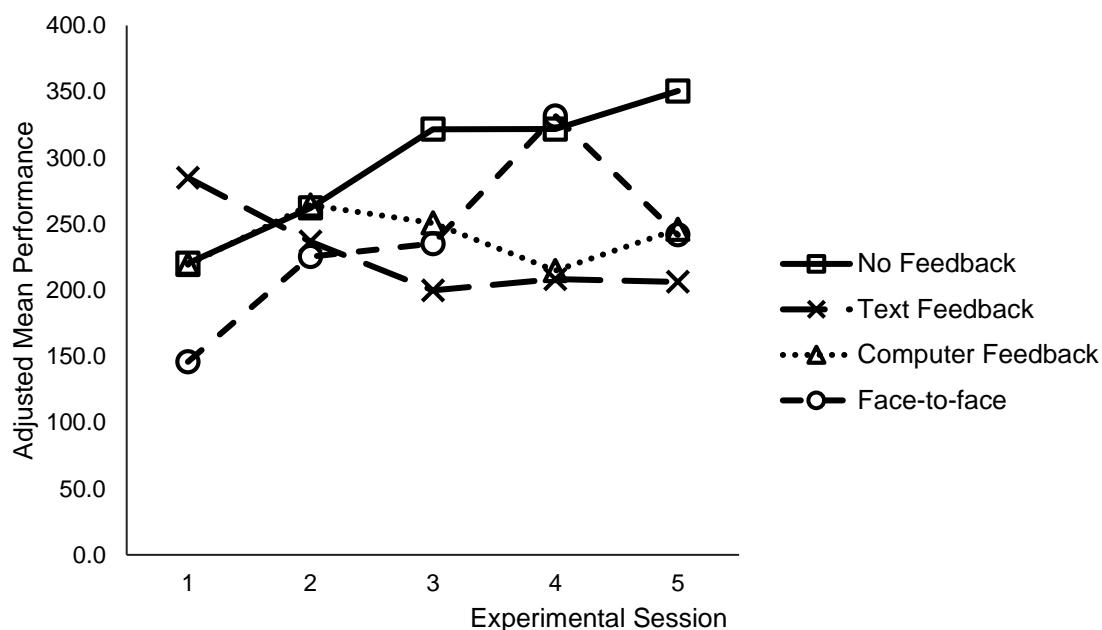


Figure 3. Adjusted Means Across Sessions: Time Off-Task.

Table 5 below presents the source table for the ANCOVA, and Table 6 presents the adjusted means for time off-task for each group. The ANCOVA yielded $p = 0.133$.

Table 5

Source Table for Analysis of Covariance: Time Off-Task

Source	<i>SS</i>	<i>dF</i>	<i>MS</i>	<i>F</i>	<i>p</i>
A.T.	180899	3	60300	1.92	0.133
Res _W	2513770	80	31422		
Res _T	6833578				

Table 6

Adjusted Means for Time Off-Task

Condition	<i>n</i>	Time (s)
No Feedback	22	328.8
Text Message Feedback	20	204.3
Computer Feedback	24	236.4
Face-to-face Feedback	19	268.8

Discussion

The results suggest that feedback conditions improved performance relative to the no feedback condition for both the total number of checks entered ($p = 0.059$) and number of correct checks entered ($p = 0.053$).

The no feedback group had the lowest adjusted mean for number of checks entered and the lowest adjusted mean for correct checks entered for all five of the experimental conditions. This group averaged 10% less productivity in comparison to the conditions in which feedback was delivered. The observed differences in performance from the three groups which received objective feedback and the no feedback group seem to contradict the findings of Chapanis (1964) and Johnson et al. (2008). However, these

findings should be interpreted with caution as the statistical differences between groups were not significant.

Viewing the data for the various performance metrics graphically also revealed a number of trends within the data. Much like Kaufman et al. (2013) found, the greatest level of performance immediately following the introduction of feedback came from the group which received it via a face-to-face interaction. While the no feedback, text message feedback and computer feedback groups were all within 20 checks entered of each other for the first experimental sessions, the face-to-face feedback group outperformed the next highest by 34 checks. In other words, the face-to-face group outperformed the second highest, the computer feedback group, by approximately 5% more checks. However, after the first experimental session this difference all but disappeared as performance in the face-to-face group nearly mirrored the performance of the no feedback condition. Performance for both of these groups declined for the third and fourth sessions, and then had a large increase in production for the fifth and final session. It should be noted however, that the face-to-face condition did consistently outperform the no feedback condition by 5-14% in regards to number of checks entered and entered correctly, and was on-task 21% more of the time as well.

The no feedback condition group's decline in performance matches what Johnson found in his 2013 study. Additionally, although the face-to-face feedback condition saw a dip in performance during the middle sessions, by the end this group showed an overall increase in its raw average of 80.3 total checks entered, nearly matching what Johnson found in his objective feedback only condition where an 88 check increase was demonstrated.

The computer feedback and text message feedback conditions appear to nearly mirror each other. Both the computer and text message feedback groups demonstrated consistent increases (except the second experimental session for those receiving text message feedback) in checks entered and correct checks entered, and also showed trends of decreasing time off-task. However, while both evoked similar response patterns, the group receiving the computer feedback outperformed those receiving text messages for measures of checks entered both in total and correct for each experimental session.

The consistent improvement seen in the text message and computer feedback condition, along with the variable pattern of responding from the face-to-face group lead to a number of changes in regards to the top performing group. The first two experimental sessions found the face-to-face group with the highest total number of checks entered and correct checks entered, and the lowest time off task. However, the computer feedback group exceeded the face-to-face condition's performance in all three measures during the third and fourth sessions, only to be surpassed when the face-to-face group's performance jumped back up for the final session.

When considering Michael's (1993) statement regarding generalization occurring on a gradient directly correlated with the similarity between the original stimulus (i.e., face-to-face feedback from a supervisor) and the novel stimulus (in this case, computer feedback) it is interesting to examine and compare the response patterns of the groups. The face-to-face group showed an immediate jump followed by decreasing performance until the final session. The computer feedback group did not have the immediate jump but did demonstrate consistent improvements every session. The text message group, which would fall somewhere between face-to-face feedback and computer feedback on

the stimulus continuum, demonstrated a blend, or a response pattern that would fall on the gradient Michael referred to, of these two. The text message group did not see the large immediate improvement in performance the face-to-face group saw, but instead saw a moderate increase nearly equal to that of the computer feedback group. However, during the second experimental session the text message group mirrored the trend of the face-to-face group showing a decrease in performance, unlike the computer group which saw its performance continue its steady improvement. For the final three experimental sessions the text message group acted much like the computer feedback group in that its performance increased consistently across the sessions, while the face-to-face group saw two more decreases in performance followed by a large final increase. It is worth noting this large final increase was demonstrated across all four conditions.

It is assumed that many participants in the study brought a common experience to this experiment that when a supervisor is attending to their performance evaluation and consequences follow. In this study, no evaluation was presented through the feedback, nor consequences for improvements or decreases in performance. This may explain some of the response patterns observed. For example, when the feedback was delivered via face-to-face interaction the response was a performance that substantially exceeded that of any other group, perhaps as a result of generalizing the previously paired feedback-consequence/evaluation relation. When, after a second round of feedback was given and again no evaluations nor consequences were presented, their performance decreased. As each session continued and no feedback/consequence was delivered decreases in performance continued. This change in performance might be explained in terms of extinction as the conditioned reinforcer of praise for improvement is withheld. It might

also be considered negative punishment as the removal of the threat of admonition for decreases in performance lead to decreases in the check entering behavior.

The same may have occurred with the text message. The participants' received the messages absent of evaluation and consequence and as such their responding decreased. However, with the text messages the participants now had a record of how they had been doing and could thus generate goals or establish verbal rules to perform better than last time. One participant's response to how often they looked at the feedback illustrates this idea, "I would always look at the number of checks I entered correctly, and I would calculate the number of checks I entered incorrectly. I would then, when the next session would finish, check my number of correct checks entered, and I would often compare it to the weeks before. Since it was all in the same text and easy to compare."

As there was no written feedback in the face-to-face condition the participants were left to try to recall two pieces of three-digit data between sessions, which could be as long as a week apart, which may be very similar to the last set of feedback they received. For example, if a participant entered 715 checks total and 705 correctly this week, it may prove difficult to recall and discriminate whether he or she improved when told they entered 718 total checks with 708 correct during the next session, not to mention across several sessions in which her or she may perform in the mid-700s for both total checks entered and correct checks entered. Subjects unable to recall if their performance improved may again come into contact with an extinction contingency as they do not realize their results have improved, the putative conditioned reinforcer. If one considers the feedback as a motivating operation, failure to contact the reinforcing properties of the feedback (signs of improvement) will fail to have an evocative effect on

behaviors that lead to increased performance, and thus will fail to increase the effectiveness of said feedback.

The observed increase in performance during the final session for all groups could be explained by generalization. It is common at the conclusion of a project to receive evaluation of one's work, and as such knowing it is the final session would function as a stimulus discriminant indicating the availability of the putative conditioned reinforcer of praise for good performance, thus evoking check entering behavior.

The immediate and dramatic change in the face-to-face condition's performance, compared to the previous session in which no feedback was given, is consistent with the responding seen in rule-governed behavior. Those receiving the computer and text message feedback seem to follow the pattern of contingency-shaped behaviors with a slow increase in behavior as they come into contact with their reinforcer. This may have been a result of the verbal mediation participants engaged in after being given feedback, like the participants who explained "...I tried to make it a challenge each time to try and complete more checks than previously as well as to try and not enter any wrong."

It is also worth noting when calculating the correlation between the accuracy ratings and the difference between the first and last session for total checks entered, correct checks entered, and time off-task, Pearson's product-moment correlations of 0.05 ($p = 0.66$), 0.06 ($p = 0.65$), and 0.07 ($p = 0.56$) were found respectively. This suggests there is no correlation between subjects' performance and how accurate the participants believed the feedback to be. In fact, the only post-experiment survey question showing any significant correlation with performance, albeit a weak one, was how well participants believed and reported they performed when comparing how they did at the

beginning of the experiment and at the end. This yielded $r = 0.26$ (-0.26 for time off-task) and a $p = 0.01$.

Limitations and Future Directions

There were a number of factors which may have limited this study's ability to draw clear conclusions in regards to the effects of feedback's modality on performance.

Before beginning this study, a power analysis utilizing data collected from previous research using the same measure was conducted to determine the number of participants that might be necessary to demonstrate the effects of an independent variable. This analysis concluded that 106 participants would need to complete the study. After a year and a half 125 total participants were recruited but only 85 people completed all seven sessions with integrity. This low sample size made the analyses less powerful, which may in turn have led only to the approximation of statistical significance (e.g., $p = 0.053$ and $p = 0.059$).

The experimental task was intended to be relatively mundane and boring. While this may assist in teasing apart the fine differences an independent variable is making, it may also serve to suppress its effects. In this study the participants engaged in the check entering task for seven, 45-minute sessions. Having participants engage in a task as tedious and monotonous as entering check amounts for this length of time may have decreased the rate of checks entered and entered correctly as participant endurance waned. Participants may have been motivated by the feedback to do better and as such worked more consistently throughout the sessions, but may not have been able to maintain a pace that might have further differentiated performance. Unfortunately, no within-session measures were taken to evaluate if this drop-off existed. As such it may be

worth evaluating these same experimental procedures with sessions 20 to 30 minutes in length, or running the same procedures with these within-session measures taken.

Shortening the duration of sessions may also help with retention of participants, which proved to be an issue as nearly 25% of participants withdrew.

This study was designed to approximate work conditions. As such, participants were allowed to be off-task while the “supervisor” was not watching them. However, there were a fair number of participants who were on their phones for extended periods of time, talked with other participants, and even streamed movies and TV shows during their sessions. While allowing this to take place helps justify the experiments external validity, and those who did not honestly engage in the task had their data excluded (e.g., they did not appear to make an effort to enter as many checks as they could during one or all of their sessions), these participants’ performances may still have confounded others’ performance and represent a threat to the experiment’s internal validity.

In order to clarify and develop scientific evidence in regards to the effects of various characteristics of feedback, objective feedback was the only type of feedback examined in this study. As noted above, it is possible that the lack of formal evaluation or consequence for performance on the task may have led to decreases and differential performance. As such, a future study utilizing these modalities with evaluative feedback should be undertaken to see if different patterns of responses are yielded. Johnson’s 2013 study gives evidence that adding an evaluative component can have large effects as those receiving both objective and evaluative feedback nearly doubled the performance improvements of those receiving only objective or only evaluative feedback.

While this study used face-to-face interactions, text messages, and computer pop-ups to deliver feedback there exists many additional modalities in which feedback to participants might be delivered. It would be interesting to continue the evaluation of modalities falling on the continuum between face-to-face and computer feedback, such as live-video feedback, previously recorded video feedback, or emails.

As it is possible that the responding demonstrated was a result of verbal mediation and goal-setting engaged in by the participants, it would also be useful to experimentally manipulate and examine the effects of more formally established goals either developed by the participants, to mirror what may have taken place in this study, or by the experimenters.

CONCLUSION

It appears there is a significant effect on performance when comparing those who receive objective feedback to those who receive no feedback at all. While the modality of delivery does not appear to significantly increase or decrease performance when objective feedback is given, it does seem to effect the patterns of responding.

In the future it would be worthwhile to continue to explore the relationship between modality of feedback delivery and effects on performance. Providing additional evidence for the specific response patterns observed in this experiment, as well as evaluating additional feedback practices that are becoming more and more common in the workplace would be useful for those in scientific community looking to explain past and contradictory findings, as well as those in applied settings looking to get the most out of their employees.

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Appendix A
Recruitment Flyer

Appendix B
In-Class Recruitment Script

In-class Recruitment Script

Hello, my name is _____ and I am working with Garrett Warrilow in the Instructional Design and Management Lab here at Western. We are currently looking for individuals to participate in a study designed to test the effects of various work conditions on performance.

The study is focused on improving work conditions and as such may benefit you in your future profession.

Any volunteer will undergo seven – one hour sessions on campus, equaling seven total hours of commitment.

Your participation is completely voluntary and you may withdraw at any time. Your willingness to participate in this study or your withdrawal from this study at a later time will not hurt your grade in this class or any other class.

If you would like to learn more about this study, please contact Garrett Warrilow by emailing him at Garrett.d.warrilow@wmich.edu. The email for Mr. Warrilow is also printed on the board behind me.

Thank you for your time!

Appendix C

Initial Contact Email/Letter

Email Script for Initial Contact

Hello _____,

Thank you for your interest in my study. Before you begin your first session, I need you to meet with one of my research assistants so that he or she can explain the study to you, and you can make a decision as to whether or not you would like to participate. Assuming you decide to participate, we will also schedule your next meeting at this time.

If you decline to participate, the initial meeting will take around 15 minutes. If you decide to participate we will begin your first session immediately following the initial meeting. In total this first session with the meeting included should take approximately one hour to one hour and 15 minutes. In addition to this first session you will be asked to complete six - 45 minute sessions. During the last of these six meeting you will be asked to fill out a survey and undergo a debriefing making the final session closer to one hour to one hour and 15 minutes in total.

Please send me the days and times you are available to meet during the next week, and I will schedule your initial meeting.

Best,

Garrett Warrilow

Appendix D
Informed Consent Document

**Western Michigan University
Department of Psychology**

Principal Investigator: Douglas A. Johnson, Ph.D
Student Investigator: Garrett Warrilow
Title of Study: Effects of Work Conditions on Performance

You have been invited to participate in a research project titled " Effects of Work Conditions on Performance " This project will serve as Garrett Warrilow's thesis for the requirements of the Industrial/Organizational Behavior Management Master's Degree. This consent document will explain the purpose of this research project and will go over all of the time commitments, the procedures used in the study, and the risks and benefits of participating in this research project. Please read this consent form carefully and completely and please ask any questions if you need more clarification.

What are we trying to find out in this study?

The purpose of this study is to investigate the effects of various work conditions on performance of a task.

Who can participate in this study?

Participants will be included in the study if they are 18 years or older and are able to pass a short demographic survey. Any participants who do not complete all sessions under the experimental conditions will have their data excluded.

Where will this study take place?

All sessions will take place in Wood Hall 2521 (inside hallway marked 2505) at Western Michigan University.

What is the time commitment for participating in this study?

Any participant will undergo seven - one hour session for a total time commitment of seven hours.

What will you be asked to do if you choose to participate in this study?

Any participant will be asked to complete a pre-experiment and post-experiment survey. Additionally, participants will be asked to engage in a check-entering task on a computer on seven separate occasions for 45 minutes on each occasion.

What information is being measured during the study?

Performance change across sessions on the check entering task as well as the pre-experiment and post-experiment survey

What are the risks of participating in this study and how will these risks be minimized?

The check entering task may lead to finger fatigue from typing. The task may also induce boredom for some individuals. Some participants may also become uncomfortable from sitting in one place for 45 minutes at a time. Every effort will be made to provide comfortable seating to aid with the discomfort of sitting for an extended period of time.

What are the benefits of participating in this study?

Subjects may benefit from knowing they are helping to advance science and helping to create a better work environment in the future.

Are there any costs or compensation associated with participating in this study?

There are no costs nor compensation associated with participating in this study.

Who will have access to the information collected during this study?

All information obtained in this study will remain strictly confidential. Your name will not appear on any papers on which this information is recorded, nor will you be identified in public presentations on the study.

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.

Should you have any questions prior to or during the study, you can contact the primary investigator, Douglas Johnson at (269) 387-4424 or douglas.johnson@wmich.edu. You may also contact 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 consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

I have read this informed consent document. The risks and benefits have been explained to me. I agree to take part in this study.

Please Print Your Name

Participant's signature

Date

Appendix E
Pre-Experiment Survey

Pre-Experiment Survey

Date _____

Age: _____ Gender (please circle one): M F Prefer not to answer

Ethnicity you primarily identify yourself as:
_____Email Address:

Phone Number: (_____) _____

Please rank order the communication channels below (1 being the most preferred, 3 being the least preferred). If you are unable to receive, or would like to opt-out of receiving, communications by any of these means place an X on the line and rank the remaining channels.

_____ Phone Call _____ Text message _____ Email

Place a check mark next to any class you have taken or are currently enrolled in.

___ PSY 1000 General Psychology ___ PSY 3440 Organizational Psychology

___ PSY 1400 Intro to Behavior Analysis ___ PSY 3600 Concepts of Behavior

Analysis

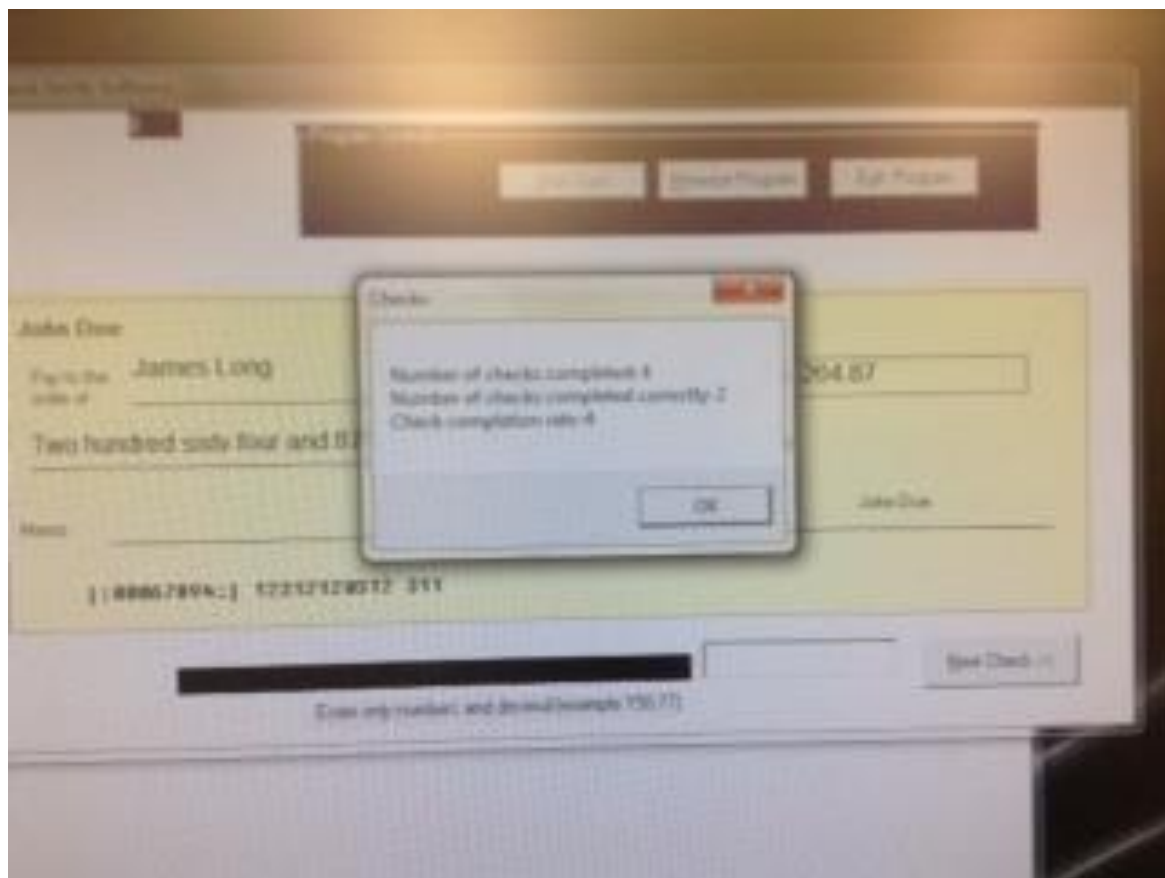
___ PSY 3000 Research Methods/Statistics ___ PSY 4600 Survey of Behavior Analytic

Research

___ PSY 3300 Advanced Research Methods

Thank you for completing the survey! You may now give this form to the researcher.

Appendix F
Computer Feedback Image



Appendix G
Debriefing Script

Debriefing Script

(After completing the last check entering session) You have now completed your last check entering task session. Please fill out this survey about the experiment.

(After completing the survey) Thank you for your participation in this study. I would like to briefly discuss its purpose with you. The study looks to compare the effects on performance of delivering feedback via various modalities.

Depending upon random assignment, you were placed into one of four conditions: 1) no feedback, 2) computer delivered feedback, 3) feedback via cell phone text message or, 4) feedback via face-to-face interaction.

Please do not discuss this study with anyone else because we have not yet completed it.

Do you have any questions about this study or your participation?

Thank you again for your participation.

Appendix H
Post-Experiment Survey

Post-Experiment Survey

Participant # _____ Date _____

1. How challenging did you find the check entering task?

1 2 3 4 5 6 7 8 9 10

Not challenging

Moderately
Challenging

Very Challenging

Explain your ranking:

2. How exciting/boring did you find the check entering task?

1 2 3 4 5 6 7 8 9 10

Very boring

Neither boring
nor exciting

Very exciting

Explain your ranking:

3. How do you believe you performed on the check entering task comparing the start of the experiment to the end of the experiment?

1 2 3 4 5 6 7 8 9 10

Performed
much worsePerformed
the same
throughoutPerformed
much better**Explain your ranking:**

4. How often did you think about, look at, and/or read, the feedback you were given on your performance?

NA	1	2	3	4	5	6	7	8	9
I did not receive any feedback	I never looked at, thought about, or read the feedback even at the time it was given to me.		I sometimes looked at, thought about, or read the feedback at the time it was given to me				I always looked at, thought about, and/or read the feedback at the time it was given to me, and sometimes beyond that.		I always looked at, thought about, and/or read the feedback at the time it was given to me and multiple times beyond that.

Explain your ranking:

5. Did you believe the feedback you received about your performance was accurate?

NA	1	2	3	4	5	6	7	8	9
I did not receive any feedback	I did not believe the feedback was accurate				I somewhat believed the feedback was accurate				I believed the feedback was completely accurate

Explain your ranking:

6. In the past, most of my interactions with authority figures giving feedback have been...

1	2	3	4	5	6	7	8	9	10
Always Negative				Equally Positive and Negative					Always Positive

7. In the past I have played computer and video games....

Appendix I

Tables of Raw Averages for Total Checks Entered, Checks Entered Correct and Time Off-Task

Table 7

Raw Averages for Total Number of Checks Entered

Condition	Session 1	Session 2	Session 3	Session 4	Session 5	Average
No Feedback	748.8	728.5	710.3	699	740.8	734.7
Computer	687.8	693.7	728.5	725.8	732.3	709.8
Text	745.8	732.3	763	761	779.5	747.6
Face-to-face	751.5	738.2	718.9	725.4	775.5	742.8

Table 8

Raw Averages for Total Checks Entered Correct

Condition	Session 1	Session 2	Session 3	Session 4	Session 5	Average
No Feedback	744.7	722.2	698.6	703.8	729.3	719.7
Computer	676.7	677.4	702.5	708.1	719.6	696.9
Text	722.3	711	740	745.1	771.3	738
Face-to-face	737.5	737.7	702.6	713.7	762	730.7

Table 9

Raw Averages for Total Time Off-Task

Condition	Session 1	Session 2	Session 3	Session 4	Session 5	Average
No Feedback	211.5	263.6	328.3	365.8	347.4	286.5
Computer	274.8	323	300.4	263.3	300	296.5
Text	279.2	269.2	169.2	195.7	188.6	219.3
Face-to-face	210.4	273.3	342.6	420.5	361.9	330.5

Appendix J

Graphs of Raw Averages for Total Checks Entered, Checks Entered Correct and Time Off-Task

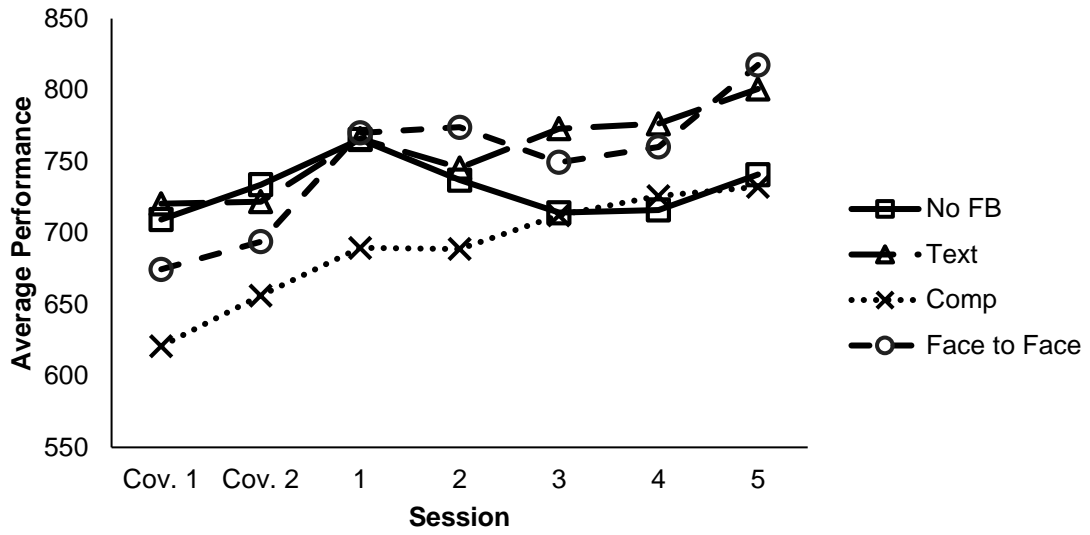


Figure 4. Raw Means Across Sessions: Total Checks Entered.

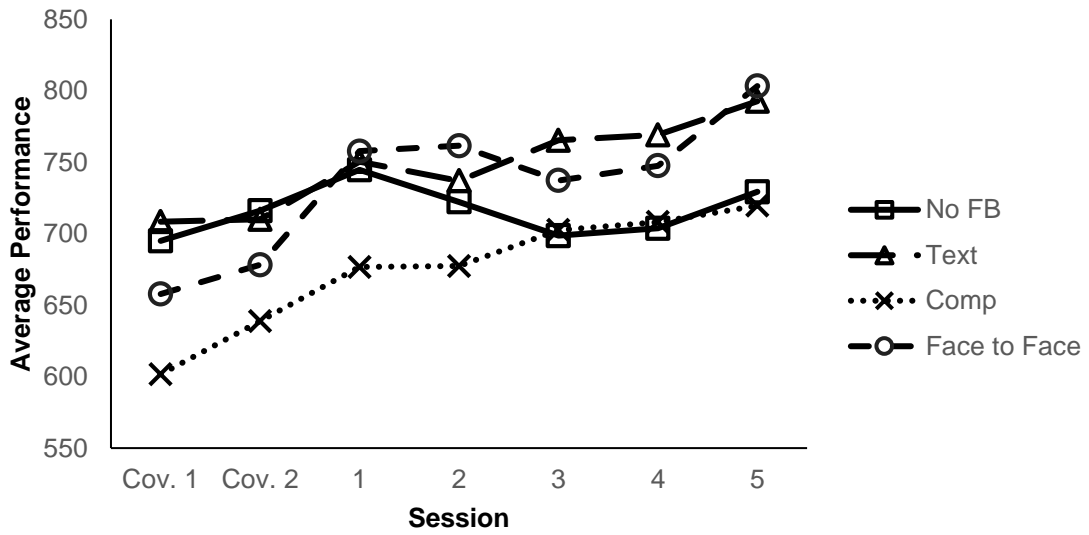


Figure 5. Raw Means Across Sessions: Correct Checks Entered.

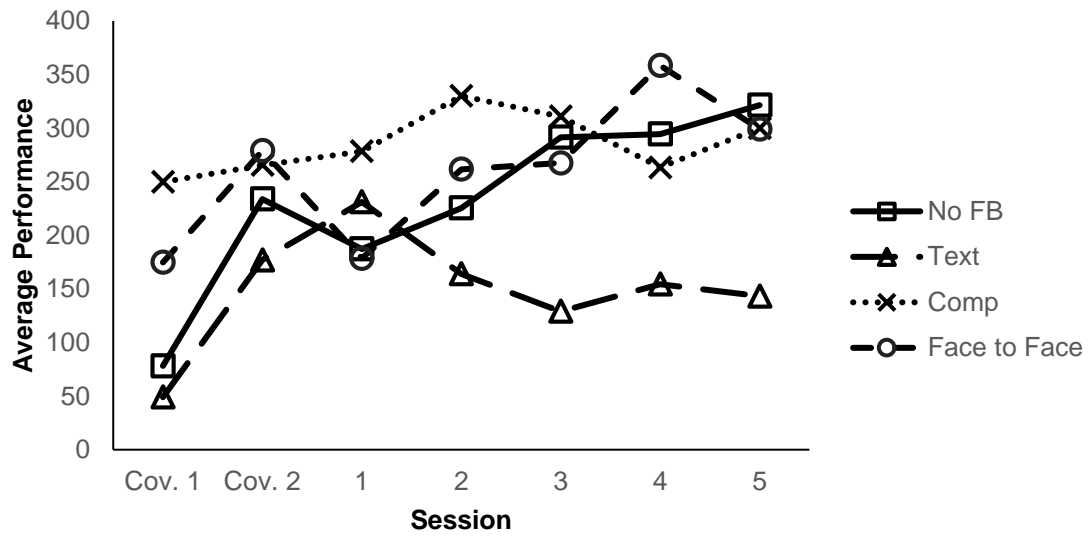


Figure 6. Raw Means Across Sessions: Time Off-Task.

Appendix K
HSIRB Approval Letter

WESTERN MICHIGAN UNIVERSITY



Human Subjects Institutional Review Board

Date: September 22, 2015

To: Douglas Johnson, Principal Investigator
Garrett Warrilow, Student Investigator for thesis

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 15-09-13

This letter will serve as confirmation that your research project titled "The Effects of Feedback Modality on Performance" has been **approved** under the **expedited** category of review by the Human Subjects Institutional Review Board. 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 in this project (e.g., ***you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study."*** 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 HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

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

Approval Termination: September 21, 2016

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