The Effects of Virtual Feedback and Virtual Environment on Productivity

Sadie Martin
Western Michigan University, sadiema99@gmail.com

Follow this and additional works at: https://scholarworks.wmich.edu/honors_theses

Part of the Industrial and Organizational Psychology Commons, and the Other Psychology Commons

Recommended Citation
https://scholarworks.wmich.edu/honors_theses/3423

This Honors Thesis-Open Access is brought to you for free and open access by the Lee Honors College at ScholarWorks at WMU. It has been accepted for inclusion in Honors Theses by an authorized administrator of ScholarWorks at WMU. For more information, please contact wmu-scholarworks@wmich.edu.
THE EFFECTS OF VIRTUAL FEEDBACK AND VIRTUAL ENVIRONMENT OF PRODUCTIVITY

Sadie Martin

Western Michigan University, 2021

Feedback is a procedure frequently used in organizational behavior management across a variety of settings, and it was the most commonly used independent variable within the first three decades of publication in the Journal of Organizational Behavior Management (1977-2009; Balcazar et al., 1989; Nolan et al., 1999; VanStelle et al., 2012). Despite the popularity of feedback in businesses, there has been little research analyzing the effects of virtual feedback and virtual environment on productivity. With technological advances in today’s society, more companies are opting for remote work, and this trend will likely increase with events such as the COVID-19 pandemic (Buscaglia, 2020). As remote work increases, it is important to establish the effectiveness of virtual feedback delivery methods. The purpose of this study is to analyze and compare the effects of virtual feedback modalities given from a remote environment on productivity. The current study will use a single factor, four-group design to compare the effectiveness of four different conditions of feedback: (a) baseline (no feedback), (b) live virtual feedback, (c) typed feedback, and (d) pre-recorded video feedback. The number of puzzles solved by each participant and the average amount of time it took each participant to solve each puzzle will be evaluated to determine the effectiveness of the feedback conditions.
ACKNOWLEDGEMENTS

First, I would like to thank my thesis chair Dr. Heather McGee for her continuous guidance and support during my undergraduate career. Her immense knowledge and plentiful experience within the field of psychology have continued to inspire me throughout this project. The completion of my thesis could not have been achieved without the mentorship and encouragement provided from Dr. McGee.

Additionally, I would like to thank my other committee members, Dr. Douglas Johnson and Juan Lopez, for their support and guidance throughout this process. Their applied experience and extensive knowledge in the field of organizational behavior management provided unique perspectives and insightful ideas that helped me to develop the content and structure of my thesis.

Lastly, I would like to thank my family and friends for supporting me throughout the completion of my thesis and all of my academic endeavors.

Sadie Martin
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS .............................................................................................................. ii

LIST OF TABLES ...................................................................................................................... iii

INTRODUCTION ...................................................................................................................... 1

The Effects of Virtual Feedback and Virtual Environment on Productivity ....................... 1

Feedback Combinations ....................................................................................................... 1

Feedback Characteristics ..................................................................................................... 4

Feedback Environment ........................................................................................................ 8

The Current Study ................................................................................................................ 10

METHOD ................................................................................................................................ 10

Participants and Setting ...................................................................................................... 10

Materials/Apparatus ............................................................................................................. 11

Experimental Design ........................................................................................................ 11

Dependent Variables .......................................................................................................... 11

Independent Variables and Procedures ............................................................................. 12

No Feedback ......................................................................................................................... 12

Live Virtual Feedback .......................................................................................................... 12

Typed Feedback .................................................................................................................... 12

Pre-recorded Video Feedback ............................................................................................. 13

POTENTIAL RESULTS ......................................................................................................... 13

REFERENCES ...................................................................................................................... 16
Feedback refers to information about previous performance that sets the occasion for a person to change their behavior in the future (Daniels & Bailey, 2014). Feedback is a procedure frequently used in organizational behavior management (OBM), and multiple studies have demonstrated its effectiveness in increasing performance across a variety of settings and industries, including education, manufacturing, healthcare, food service, etc. (Ludwig et al. (2010); Matey et al. (2019), Moon et al. (2017); Stephens & Ludwig (2005). According to Warrilow et al. (2020), feedback was the most commonly used independent variable within the first three decades of publication in the Journal of Organizational Behavior Management (JOBM), comprising 65%, 71%, and 68% of articles published across that period of time (1977-2009; Balcazar et al., 1989; Nolan et al., 1999; VanStelle et al., 2012). While feedback is effective in improving performance, it is important to consider the multiple characteristics of feedback that contribute to these changes. Prue and Fairbank (1981) discussed the variation of feedback across multiple dimensions, including the source that provides feedback (e.g., supervisor, self), the feedback recipients (e.g., group, individual), feedback content (e.g., comparison of performance with previous performance, comparison of performance with group performance), components of feedback (e.g., information provided, feedback comparison), frequency of feedback (e.g., hourly, daily), and feedback medium (e.g., written, graphic, verbal).

Feedback Combinations

Balcazar et al. (1985) conducted an objective review of the effectiveness of various feedback combinations across 126 applications from 69 feedback studies published in the *Academy of Management Journal (AMJ), Journal of Applied Behavior Analysis (JABA), Journal of Applied Psychology (JAP), and Journal of Organizational Behavior Management (JOBM).*
between 1978 and 1984. The authors reviewed the effectiveness of four different feedback combinations: (a) feedback-alone; (b) feedback and behavioral consequences; (c) feedback and goal setting; and (d) feedback, goal setting, and behavioral consequences. The results showed that applications of feedback alone produced the lowest level of consistent effects (28%) and the largest portion of non-effects (15%). The combination of feedback with goal setting and/or behavioral consequences proved to be more consistently effective in increasing productivity than feedback alone. In their discussion, the authors recommended the use of functional differential consequences to increase productivity. A functional differential consequence is “one that effects the future probability of responses that produce it” (Balcazar et al., 1985, p. 83), and it is a consequence that is likely to be highly generalized so that it will be consistently effective regardless of the individual or behavior, or momentary states of deprivation or satiation that the individual experiences (Balcazar et al., 1985). The consequences should be delivered dependent on desired behavior. The authors concluded that feedback is most effective when combined with goal-setting and/or behavioral consequences.

Alvero et al. (1998) conducted a follow up review (1985-1998) of all issues of the same four journals reviewed by Balcazar et al. (1985). In this follow up review, the authors identified seven different feedback combinations: (a) feedback alone, (b) feedback and antecedents, (c) feedback and behavioral consequences, (d) feedback and goal setting, (e) feedback, antecedents, and behavioral consequences, (f) feedback, goal setting, and behavioral consequences, and (g) feedback, antecedents, goals, and behavioral consequences. While this study reviewed several of the same feedback combinations as Balcazar et al. (1985), it is important to note that it analyzed the effects of three additional feedback combinations: (a) feedback and antecedents; (b) feedback, behavioral consequences, and feedback, and (c) feedback, behavioral consequences,
goals, and other antecedent stimuli. Feedback alone was found to be the most popular condition, having been implemented in 29% of the 37 reviewed feedback applications. However, this condition did not result in the most consistent effects (47%). The most consistent effects were found in applications using feedback in combination with antecedents (100%). The results of this study corroborate the findings of Balcazar et al. (1985) indicating that effects are most consistent when feedback is used in combination with other procedures. However, in contrast to Balcazar et al. (1985) which found that feedback and consequences produced the most consistent effects, this review found the combination of feedback and antecedents to be most consistently effective.

Sleiman et al. (2020) conducted a follow-up review to Alvero et al. (1998) and Balcazar et al. (1985) that reviewed 96 applications from the same four journals and reported on the effects of feedback combinations on performance. Sleiman et al. (2020) used the What Works Clearinghouse (WWC; Kratochwill et al., 2010) Standards to further evaluate the experimental design rigor of each application. Overall, twenty-six applications met standards out of 96, and six of these applications met standards with reservations. This study found that the most commonly used intervention combination was feedback and antecedents (all applications: 32.29%; applications that met standards: 30.77%). While the condition of feedback alone did produce a very large effect size (all applications: ES = 0.81; applications that met standards: ES = 0.79), the combination of feedback, antecedents, and behavioral consequences produced the highest effect size (ES = 0.91). This study showed that feedback alone positively affected performance, however, the effect of feedback was stronger when combined with antecedents and behavioral consequences. The authors concluded that one explanation for the very large effect size produced by the feedback-only interventions could be that researchers selected feedback-only interventions for performances that already had natural antecedents and behavioral consequences in place.
Therefore, it is possible that the feedback-only interventions may have had confounding variables (antecedents & behavioral consequences) that were not controlled for, resulting in an unintentional combination of feedback and natural antecedents and behavioral consequences.

Feedback Characteristics

In addition to feedback combinations, Balcazar et al. (1985) identified and reviewed six characteristics of feedback: (a) feedback source, (b) feedback privacy, (c) feedback participants, (d) feedback content, (e) feedback mechanism, and (f) feedback frequency. The review found that supervisors or managers were the most commonly used source of feedback (54 applications), and they produced the largest proportion of consistent effects (50%). There were no strong differences between publicly posted and private feedback percentages of consistency (39% and 43% respectively) or among the categories of participants. Presenting individual performance was the most frequently used feedback content strategy (63 applications), but the combination of individual performance and individual standards of performance produced consistent effects in all four of the experiments in which this strategy was applied. The most frequently used feedback mechanism was graphs, which also had the highest consistent feedback effects (54%). Although daily feedback was used more often (62 applications), it was not shown to be more effective than weekly feedback. This review identified 40 applications of feedback: 11 applications were found to have unknown effects, three were found to have no effects, 17 were found to have mixed effects, and only nine out of the 40 applications were found to have consistent effects. Based on these results, the authors concluded that feedback is by no means uniformly effective. As explanation, they cited Prue and Fairbank (1981), who suggested that feedback can function both as discriminative stimuli that cause changes in work behavior as well as conditioned reinforcement which strengthens the behaviors for which it serves as consequence. The authors
suggest that since all feedback characteristics probably involve discriminative stimuli and/or conditioned reinforcement, they will probably be effective exactly to the extent that they are associated with functional, differential consequences (Balcazar et al., 1985).

Alvero et al. (1998) identified and reviewed the same six feedback characteristics as Balcazar et al. (1985) across a total of 43 articles and 68 applications. The results of feedback privacy, feedback medium, and feedback frequency were the most significantly different from Balcazar et al.’s (1985) findings. In Balcazar et al.’s (1985) literature review, the authors did not find significant differences in consistency effects among forms of privacy. However, Alvero et al. (1998) found the combination of private and public feedback to be most consistently effective (80% of applications). Private feedback was identified as the most commonly used form of feedback (54%) in contrast to the findings of Balcazar et al. (1985) which found public feedback to be the most common. Balcazar et al. (1985) found that the most common feedback medium was the use of graphs, which was also the condition that resulted in the highest effect size. However, Alvero et al. (1998) found that the use of graphs with written feedback and graphs with verbal feedback resulted in the highest levels of consistent effects (86% and 75% respectively). In addition, Alvero et al. (1998) found that feedback was most commonly delivered through written feedback alone (17/64 or 27% of feedback applications). In the previous review (Balcazar et al., 1985), daily feedback was found to be most frequently used, but it was not considered to be more consistently effective than weekly feedback. Alvero et al. (1998) concluded that daily, monthly, and the combination of daily and weekly feedback resulted in higher levels of consistency effects (71%, 80%, and 80%, respectively) than feedback delivered weekly (52%). In their discussion, Alvero et al. (1998) noted the changes made to the characteristic sub-categories that could explain the disparity between the two studies: (a) the
addition of supervisors plus researchers as a source of feedback, (b) the addition of the verbal, written, and graphic feedback combination for feedback medium, and (c) the addition of several sub-categories under feedback content, including the comparison of one group’s performance to a different group’s performance. The authors concluded that there are two significant problems with understanding the effectiveness of feedback. The first problem is that the literature has not always differentiated among feedback when it is implemented alone or when it is combined with other procedures. The second problem is that feedback has many different characteristics. As a solution to these problems, the authors suggest that further research should be done to analyze how feedback could serve a particular behavioral (i.e., reinforcing, discriminative, establishing operation) function.

In addition to the six feedback characteristics reviewed by Balcazar et al. (1985) and Alvero et al. (1998), Sleiman et al. (2020) reviewed the effects of two additional feedback characteristics: feedback immediacy (feedback given within 60 s or not) and feedback nature (positive or negative). The authors reported that feedback delivered within 60 s of observed behavior was most effective (all applications: ES= 0.87; applications that met standards: ES= 0.86). However, they also found that most feedback was not delivered within 60 s of observed behavior (all applications: 87.50%; applications that met standards = 92.31%). In regards to feedback nature, positive feedback was most effective and it occurred most often (all applications: 75%, ES= 0.80; applications that met standards: 73.05%, ES= 0.81). However, the results indicated that a large to very large effect size (> .6) was produced for all types of feedback nature. The results of Sleiman et al. (2020) support those of Balcazar et al. (1985) and Alvero et al. (1998) in that (a) feedback privacy does not impact feedback effectiveness, (b) more frequent feedback is more effective than less frequent feedback, and (c) supervisors are an effective
source of feedback. In concordance with the results of Alvero et al. (1998), Sleiman et al. (2020) found that the combination of graph/table, verbal, and written medium produced the highest effect size for all applications (ES= 1.07) and applications that met standards (ES= 0.98). In contrast to the two previous reviews, Sleiman et al. (2020) found that feedback delivered to the individual produced the largest effect sizes (all applications: 51.04%, ES= 0.80); applications that met standards: 65.38%, ES= 0.80), whereas Balcazar et al. (1985) and Alvero et al. (1998) found the highest consistent effects when feedback was delivered to a group. While the results of Sleiman et al. (2020) support the findings of Balcazar et al. (1985) and Alvero et al. (1998) that supervisors are an effective source of feedback, Sleiman et al. (2020) did find that self-generated feedback produced the largest effect size for all applications. In comparison to other feedback sources including supervisors, researchers, and self-generated feedback, mechanical feedback produced a smaller effect size (all applications: 6.25%, ES= 0.74; applications that met standards: 0%, ES= 0.00). In their discussion, the authors suggest that further research be done to evaluate the effects that feedback delivered by technology, rather than a person, may have on performance. In addition, the authors suggest that more research be done to see if there are ways to improve feedback effectiveness when it is not socially mediated.

Feedback medium, also referred to as feedback mechanism, is a characteristic of feedback that has been studied frequently. However, some conditions of feedback medium have been studied more frequently than others. Balcazar et al. (1985) reviewed 47 applications of feedback mechanism and found the most commonly used applications to be graph feedback (20 applications), written feedback (nine applications), and verbal and graph feedback (six applications). According to Balcazar et al. (1985), the least commonly used applications of feedback mechanism were mechanic feedback via videotape (one application), mechanic and
verbal feedback (one application), and written and graph feedback (three applications). Sleiman et al. (2020) reviewed 96 applications of feedback medium and found graph/table and verbal feedback (22 applications), verbal feedback (19 applications), and graph/table feedback (19 applications) to be the most commonly used applications of feedback medium. The least commonly used applications of feedback medium were mechanical and written feedback (one application); graph/table, written, and mechanical feedback (one application); and mechanical, verbal, and written feedback (two applications). According to Balcazar et al. (1985) and Sleiman et al. (2020), verbal feedback and graph feedback are two commonly researched applications of feedback medium. However, both studies found that the effects of mechanical feedback alone, and in combination with other feedback mediums, has been studied less frequently than other feedback medium conditions. Although some studies have analyzed the effects of mechanical feedback, there is still research that needs to be done. In addition to mechanical feedback medium, further research should be done to analyze the effects of virtual feedback (e.g. live video feedback, pre-recorded video feedback) on performance.

**Feedback Environment**

Not only are characteristics of feedback important, but recent research shows that feedback is affected by the environment it is given in. Johnson, Dickinson, and Huitema (2008) studied the effects of incentive pay and objective feedback. Their study used a 2 x 2 factorial design with four conditions: (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. The results showed that incentive pay was effective in increasing the number and rate of the tasks completed. However, objective feedback showed no statistical significance in comparison to the conditions without feedback. In their discussion, the authors concluded that
objective feedback in the form of a computer display, did not increase performance when compared to the no feedback conditions. While this study examined the effects of virtual feedback medium on performance, it is important to note that the tasks in this study were completed by participants in a face-to-face environment. The authors suggested that further research should be done to examine the effects of not only virtual feedback medium, but virtual and remote work environments as well.

Warrilow et al. (2020) examined the effects of virtual feedback in a between-group repeated measures design. Their study analyzed the effects of four experimental conditions: (a) no feedback, (b) computer-delivered feedback (written feedback delivered via computer screen), (c) feedback via cell phone text message, and (d) feedback via face-to-face interaction. Relative to the no feedback condition, the face-to-face feedback condition was the only feedback condition to show a statistically significant difference in performance ($p = .05$). Neither the computerized-feedback condition nor the text message feedback condition produced significant effects relative to the no feedback condition. The computerized-feedback condition produced the second highest performance gains with a 3.8% higher initial gain and a 10.2% higher final gain in performance relative to the no feedback condition. While the no feedback condition and the computer-delivered feedback conditions both produced effects that gradually increased, the face-to-face feedback condition and the text message feedback condition both showed moderate increases in performance across experimental sessions. In their discussion, the authors suggested that further research needs to be done to examine the effects of additional feedback modalities like live-video feedback, previously recorded video feedback, or emails. The authors suggested the need to examine more details beyond just feedback in general, specifically research regarding the details for feedback implementation. Their study found that virtual feedback modalities were
less effective than face-to-face feedback. However, the authors recommend that if remote work is necessary and direct contact is not possible, managers should use feedback methods that have greater social presence.

The Current Study

The current study will extend the research of Warrilow et al. (2020) by analyzing the effects of virtual feedback on performance. The purpose of this study is to analyze and compare the effects of virtual feedback modalities given from a remote environment on productivity. It is possible that natural antecedents and behavioral consequences are unintentionally combined with feedback when delivered in a face-to-face environment, and as a result, larger effects on performance may be produced (Sleiman et al., 2020). Virtual feedback delivered from a remote environment may remove these natural antecedents and behavioral consequences. However, with the technological advances in today’s society, more companies are opting for remote work, and this trend will likely increase with events such as the COVID-19 pandemic (Buscaglia, 2020). As remote work increases, and in some cases, becomes permanent, it is important to establish the effectiveness of virtual feedback delivery methods. Therefore, the current study will examine the effects of virtual feedback to determine the most effective modalities of virtual feedback given from a remote environment.

METHOD

Participants and Setting

A total of 120 to 160 students will be recruited for the current study. Participants will be randomly separated into four groups. Each group will consist of 30 to 40 participants. Participants may be recruited through undergraduate courses and recruitment flyers posted on the campus of a university or through an online research participant resource, such as MTurk or
Prolific. A small monetary reward of $5 may be given to participants after their completion of their final session. A task will be sent via e-mail to the participants. Tasks will be completed and transferred online and asynchronously through e-mail. Participants may complete this task at home on their computers, phones, tablets, or other electronic devices. Once participants have finished the task, they will send the completed task to the researchers via e-mail. All feedback will be given remotely.

Materials/Apparatus

The experimental task will consist of easy logic puzzles. Experimental tasks will be completed on mobile phones with an application called Logic Grid Puzzles. Types of electronic devices that may be used for the current study include computers, phones, and tablets. In addition to these devices, participants will be required to use electronic devices that have cameras during the virtual feedback condition. The video-conferencing application, WebEx, must be downloaded on the device.

Experimental Design

The current study will use a two factor (type of feedback and time), four-group design comparing the effects of four different conditions of feedback: (a) baseline (no feedback), (b) live virtual feedback, (c) typed feedback, (d) pre-recorded video feedback. Participants will be randomly assigned to one of the feedback conditions. Each group will consist of 30-40 participants. Each participant will be given a 30-minute time block to complete as many puzzles as they can during the time given. After completing their session, participants will be asked to screenshot their results and email the screenshot to the researchers. Each participant will complete five sessions. Participants must complete all the puzzles characterized under the “casual puzzle” difficulty.
**Dependent Variables**

Two dependent variables will be measured during each session. The first dependent measure will be the number of logic puzzles solved by each participant. The second dependent measure will be the average amount of time that it took each participant to solve each puzzle.

**Independent Variables and Procedures**

The independent variables will be the type of feedback: (a) No feedback, (b) live virtual feedback, (c) typed feedback, and (d) pre-recorded virtual feedback. Participants will receive a text message reminder 15 minutes before their scheduled session.

**No Feedback**

Participants in this condition will not receive any form of feedback concerning their performance. The results of this condition will serve as control for the current study. Participants in this condition will receive a text message reminder 15 minutes prior to their session without any form of feedback.

**Live Virtual Feedback**

Participants will receive feedback through a video-conferencing platform called WebEx. Participants and researchers will have access to the sight of each other in this condition, however it will be through video call. Participants will select an available time slot to meet virtually with one researcher. Participants in this condition will receive a text message reminder 15 minutes prior to their session. A WebEx link will be included in the reminder text. Participants will click the link to receive their live virtual feedback from the researcher. The researcher will provide the participants with a graph showing their previous performance and a helpful tip for their upcoming session.

**Typed Feedback**
This condition will consist of typed feedback, in which participants will receive feedback through text messages. Participants will receive text message reminder 15 minutes prior to their session. In addition to the reminder, the text message will also include feedback in the form of a graph showing previous performance and a helpful tip for the participants. In this condition, participants will only have access to typed feedback via text message, but they will not have access to the sight of the researcher.

*Pre-recorded Video Feedback*

Participants will receive feedback in the form of pre-recorded videos. The researcher will record a video feedback discussing each participant’s performance from the previous session. In this condition, participants will have access to the sight of the researcher, but it will not be live feedback. Participants will receive a text message reminder 15 minutes prior to their session. The text message will include the reminder and a link to pre-recorded video feedback regarding their previous performance. Researchers will provide participants with a graph showing their previous performance and a helpful tip in the pre-recorded video feedback condition.

**POTENTIAL RESULTS**

The researchers hypothesize that the live virtual feedback condition will produce the largest effects on productivity, while the no feedback condition will produce the smallest effects. The live virtual feedback condition shares characteristics and is the most similar to face-to-face in-person feedback. Warrilow et al. (2020) recommended that managers use feedback methods with more social presence. The live virtual feedback condition has the highest social presence as the feedback is delivered remotely, but maintains face-to-face interaction through a computer screen. The no feedback condition is hypothesized to produce the smallest effects. This
hypothesis corresponds with the findings of Warrilow et al. (2020) which found that no feedback produced the smallest effect size and produced no statistical significance.

While the researchers hypothesize that the live virtual feedback condition will produce the largest effects on productivity, it is possible that typed feedback or pre-recorded virtual feedback could produce the largest effects. The typed feedback condition could produce the largest effects as it requires less work to access the feedback in comparison to the live virtual feedback and pre-recorded video feedback conditions. Sleiman et al. (2020) found that more immediate feedback produced the highest effects on performance. As this condition requires less work to receive feedback, it may also allow participants to receive their feedback quicker than participants in the other conditions. The pre-recorded video feedback condition could produce the largest effects because it has similar qualities of live video feedback (e.g. sight of the researcher), however, the feedback can be accessed more immediately and with less effort than live video feedback. In addition, it is possible that live video feedback, pre-recorded video feedback, and typed feedback all produce similar effect sizes and show no differences among the three conditions, but still produce higher results than the no feedback condition. A possible explanation for these findings could be that there are not enough differences among the three conditions. Although the feedback conditions may be too similar to show significant differences in performance, it is likely that the feedback conditions will produce higher results than the no feedback conditions. This hypothesis is supported by the results of Johnson (2013) which found that the use of evaluative feedback and objective feedback resulted in statistically significant higher performance than no feedback.

A third potential result of this study is that there are no differences between any of the feedback conditions, including no feedback. A possible explanation could be that virtual
feedback does not have the same power as in-person feedback likely because of real or perceived social contingencies associated with in-person feedback. In this case, social presence may serve as a natural behavioral consequence that increases the effectiveness of in-person feedback. In a virtual environment, the natural antecedents and consequences that are in place during in-person feedback may be missing. If this is true, future researchers, practitioners, and businesses should focus on adjusting programmed antecedents and consequences beyond feedback in order to increase performance and compensate for the loss of natural behavioral contingencies that would occur in an in-person environment.
REFERENCES


https://doi.org/10.1300/jo75v21n01_02


https://doi.org/10.1300/j075v07n03_05


https://doi.org/10.1300/J075v10n01_02


