Performance Feedback and its Relationship to Goal Setting

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PERFORMANCE FEEDBACK
AND ITS RELATIONSHIP TO GOAL SETTING

by

Douglas A. Nicola

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Submitted to the
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in partial fulfillment of the
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PERFORMANCE FEEDBACK
AND ITS RELATIONSHIP TO GOAL SETTING

Douglas A. Nicola, M.A.
Western Michigan University, 1982

This study illustrated the effect of information feedback and goal setting on production efficiency. Two male machine operators (ages 29 and 54) working on a low efficiency press were selected for the study. Operators were initially given efficiency information following individual production runs. The next phase involved providing efficiency information and a request that they set efficiency goals for each run. These goals were noted by the researcher and compared with the actual results. In a final phase, high efficiency goals were prompted by the researcher, compared to actual results, and shown to the subjects following each run. Results showed that mean efficiency decreased during production information and employee goal setting phases, and increased during the final phase in which high goals were prompted. Differences between goals and actual efficiency decreased slightly during the study.
ACKNOWLEDGEMENTS

In-field intervention of this sort would not have been possible had it not been for the support of both Scott Nugteren and Larry Murphy, respectively the engineer and manager of the corrugated container company in which the study was held. Their interest in the project cleared the way for research not often possible in a unionized shop.

Despite my own efforts to the contrary, Dr. Dale Brethower's untiring support and verbiage guided this paper to its final form. For that, I would like to extend a special thanks to Dale for his subtle yet effective contingencies.

Douglas A. Nicola
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CHAPTER 1

INTRODUCTION

Low productivity is a matter of great concern for any manufacturing business. Many associate such a corporate ill with apathetic employees, disgruntled supervisors, and a general demise of organizational structure. This study attempts to isolate two factors felt to be relevant to the control of performance for blue-collar workers: goal setting and performance feedback.

Feedback by itself has been the subject of much research and has encompassed a variety of dependent variables. Research indicates that feedback was effective in increasing attending behavior (Sherman and Anderson, 1980), reducing the number of reading errors in students through both individual and group feedback (Thorpe, Chaing, and Darch, 1981), and increasing activity level of subjects through the periodic use of the Depression Adjective Check List (Harmon, Nelson, and Hayes, 1980). Behavioral researchers have used simple feedback to increase one's accuracy in discriminating blood pressure levels (Cinciripini, Epstein, and Martin, 1979), increase motor activity through the use of a biometerometer providing auditory motor activity feedback (Schulman, Suran, Stevens, and Kupst, 1979; Schulman, Stevens, Suran, Kupst, and Naughton, 1978), and decrease automobile driver's speed ten times more effectively than through police surveillance (Van Houten, and Nau, 1981).

Many behaviorally oriented studies have dealt with the use of feedback incorporated with instructions. Instructions took the form of a statement asking the subject to exceed previous levels of performance.
or informing the subject on how he might do better on subsequent trials. These types of information have been used to increase production efficiency of retarded clients in a sheltered workshop (Martin, Pallotta-Cornick, Johnstone, and Goyos, 1980), increase the number of words written in composition by students (Meyers, Artz, and Craighead, 1976), and to increase the frequency of teacher praise for student attending behavior (Cossairt, Hall, and Hopkins, 1973). These studies concurred in that they found directive feedback produced an immediate increment in work efforts throughout the duration of the task. A non-behavioral study in the area noted increases in performance on a multidimensional pursuit task by informing subjects of deviations from a specific performance level, including when and where it occurred (Payne and Hauty, 1955). This study contended that without a means whereby a subject can check his performance, the subject may "unknowingly lower his standard so that his output, although deteriorating, may nevertheless seem acceptable."

One very comprehensive study evaluated the use of feedback with goals versus feedback without goals as independent variables, measuring their effect on credit card processing rate and accuracy (Pritchard, Bigby, Beiting, Coverdale, and Morgan, 1981). Conducted by the Air Force to analyze its possible service applications, the study arrived at nine points governing feedback. Personal feedback was found to be equally effective as impersonal feedback, while absolute (individual) feedback was equal to comparative (group) feedback. Goal setting plus feedback was more effective than feedback by itself and the positive effects
Feedback treatments did not diminish over time. Fifthly, feedback was found to be especially effective on initially poor performers while there was also evidence that treatment affected the subject's rate of learning. The authors suggest in a seventh point that there should be separate feedback for each distinct type of activity and that it is imperative that the subject be able to see a direct connection between his effort and performance. A final point offered that goal setting should be personal, specific, quantitative, with consideration for the subject's ability, set at a level which the subject feels is reasonable to obtain.

Another non-behavioral study compared feedback sources and their importance to supervisors and subordinates through the use of questionnaires given to each group (Grelle, 1980). It concluded that supervisors tend to underestimate such independent variables as feedback from the task itself, co-worker feedback, and comparative feedback. Conversely, the management tended to overestimate the importance of formal rewards, job assignments, and comments from superiors.

Practice effect was noted in two studies reviewed which included a dependent variable of prediction accuracy on recall tests (King, Zechmeister, and Shaughnessy, 1981), and a behavioral study evaluating the effects on cursive letter formation following training (Trap, Milner-Davis, Joseph, and Cooper, 1978). These studies concluded that a major source of facilitation was produced in the test-trials through the subject's knowledge of prior performance.
A large part of the literature evolves around the use of knowledge of results versus no knowledge of results, and hard goals versus easy goals. Edwin A. Locke has stood at the forefront of this material with his studies evaluating accuracy rate on addition problems (Locke, 1967; Locke and Bryan, 1969). Locke concludes that the subject must set and adjust goals in response to knowledge of results (KR) and it is this adjustment that allows him to realize more desirable results. He adds that hard goals consistently produce higher levels of performance that do easy goals, and that subjects with hard goals will work for longer durations. Other non-behavioral studies have focused on the time necessary to depress a microswitch (McCormack, Binding, and Chylinski, 1962), accuracy in comparing one list against another similar list (Erez, 1977), and the duration of time between a stimulus and pushing a reaction button (Church and Camp, 1963). They also found that KR maintained task performance despite task duration and interval length. Erez also noted that self-set goals were significantly higher in the feedback group.

One last area of study involves the use of monetary incentives to influence task behavior. In research evaluating electricity consumption in a university hall (Hayes and Cone, 1977), it was found that pay was a more effective variable than feedback and energy information by itself. Another study used monetary incentives as rewards for naming uses for a piece of cardboard (Locke, Bryan, and Kendall, 1968) and concluded that larger reward magnitudes and higher reinforcement frequencies led to higher output and goals. It also suggested that monetary incentives
may persuade an individual to accept goals or tasks that are assigned to him, but that money is not automatically effective to the degree that it is valued and that incentives were contingent upon certain responses of response rates.

Two literature reviews (Locke, Cartledge, and Koeppel, 1967: Locke, Sarri, Shaw, and Latham, 1981) arrived at the following conclusions which further support much of the literature in the area. Both hard and specific goals were found to be necessary to improve performance in that there is a positive linear relationship between goal level or difficulty, and level of performance. It was found that goals were necessary for KR to improve performance, and that behavior change was greatest for those who developed plans for evaluating their performance in relation to their goals. Also, participation in goal setting was thought to lead to higher goals or at least higher goal commitment and that once goals were defined, more time was spent on goal relevant activities.

In many of the cases cited, knowledge of results was effective only to the extent that it allowed the subjects to judge past performance and adjust subsequent performance. Thus, such end results as production information or money were delayed consequences which also serve as initial discriminative stimuli, adjusting future goals and performance. As a result, a circular chain develops where performance information or money serve both antecedent and consequent controlling functions.

The current study assesses whether increasing the frequency of
performance information and facilitating goal setting will improve performance on a low efficiency machine. This study also attempts to clarify the relationship of these two factors in a situation where output is the product of a two-employee team. Research suggests that such changes will heighten goal setting behaviors and make for a higher or more stable performance depending upon incentives for attaining higher performance. In other words, performance information can facilitate goal setting behaviors which serve short-term antecedent and consequent functions (heightened efficiencies) in accordance with long-term contingencies (incentive pay).
CHAPTER II

METHOD

Subjects

The subjects were two unskilled laborers working at a corrugated container company, who had previously been placed on the machine used in the study. They were 54 and 29 years of age and had been in service to the company for 15 and four years respectively.

Job

The machine used in the study was a Small Printer Slotter (203 Press) owned by the company. This press fabricated corrugated cardboard into unfolded boxes by cutting top and bottom flaps, creasing corners, and printing appropriate company seals, box sizes, content descriptions, etc. The 203 automatically counted the number of pieces of completed product and could be run at variable revolutions per minute (RPM). Standards were pre-determined by the industrial engineer at levels whereby 100% efficiency is said to be attainable at reasonable rates and without significant waste. Two operators ran the 203 Press with each contributing in the set-up and tear-down of the machine for each order. During the actual run of an order, one operator's sole responsibility was that of feeding material into the press. The other operator (who generally is higher paid) determined the speed (RPMs) of the machine and managed the automatic stacker. An electric eye at the end of the stacker controlled the height of the material once on
the pallets. The second operator supplied pallets, monitored the electric eye, and served a quality control function in that he closely examined randomly selected samples as they followed the belts from the press to the pallets.

Work was supplied to the press on a "per order" basis. Thus, an adequate backlog kept the operators busy an entire day while limited orders would eventually mean transferring the operators to the finishing department.

Procedure

During Phase One, production runs and efficiency rates were monitored by the experimenter through computer readouts supplied daily by the company for worker inspection. These reports were not looked at by the subjects during the baseline period. Once a stable baseline had been established, the feedback component of the study was introduced.

At the onset of Phase Two, workers were instructed by the researcher that he was conducting a study in which they would periodically be shown their efficiency rates on particular orders. During this phase, efficiency rates were computed by the researcher every thirty minutes of an order, or at the end of that run whichever came first. These time frames would be defined as a Trial. Both percentage of standard and incentive pay based on that rate were calculated immediately and plotted on graph paper by the researcher and presented before the next trial for the subject's inspection (Appendix A). Employees do not ordinarily have access to efficiency information or incentive calcula-
tions until the following day when the computer readouts were available. As can be seen in Appendix B, one's wage was a combination of an employee's base rate plus incentive factor. Appendix C shows the bonus (incentive) schedule relative to varying percentages of standard. Table 1 shows the actual computation of both the efficiency rate and incentive adjusted pay and illustrates this with an example.

Table 1

Computation of Efficiency Rate and Incentive Pay

<table>
<thead>
<tr>
<th>Efficiency Rate</th>
<th>Incentive Pay</th>
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<tr>
<td>1) Predetermined Standard X Pieces = Earned Hours</td>
<td>Base Wage X Measured Hours X Bonus Factor = Bonus Pay Rate</td>
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<tr>
<td>2) Earned Hours</td>
<td>Bonus Factor</td>
</tr>
<tr>
<td>Measured Hours</td>
<td></td>
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</tbody>
</table>

EXEMPLARY: Pieces : 3150  Efficiency Rate
Time : 3.5 hours 1) .149 X 3150 = 469.35 earned hrs.
Standard: .149 2) 469.35 3.5 = 134% efficiency
Wage : $6.89  Incentive Pay

$6.89 X 3.5 X .34 = $8.19/hr

Prior to initiating the next phase, the two workers met with the researcher to discuss their impression of the project and what had taken place in the second phase. Comments on the project were noted by the researcher while goal setting was introduced.

Employees were instructed that the feedback component of the second phase would be retained in the third phase, but that now they were to jointly set specific efficiency goals for each upcoming order based on
company standards, past performance, and that which they felt could be easily attained. This condition was established in order that there be an unprompted level of effort based on what the employees did with production information and goal setting alone. These rates were noted on their graphs and the workers were told to view them as goals. Following each production run, actual efficiency was plotted against this goal and presented for the employee's visual inspection. No comments were made by the researcher regarding sub/supra-goal performance.

During Phase Four, employees were instructed to set realistic goals, significantly higher than they had realized before but at a level where both machine efficiency and incentive would be optimized. This took the form of statements regarding the individual worker's performance against the goals, and specific encouraging suggestions to meet or exceed the goal. For example, the researcher would often propose goals 10% higher than those suggested by the workers as a means of "giving you something to shoot for". Also, close agreement between actual and predicted rates was highly praised. This condition would indicate any researcher control or potential supervisor control.
CHAPTER III

RESULTS

The introduction of performance information was followed by a negligible reduction in worker productivity accompanied by a 43% reduction in performance variability. Information plus employee-set goals resulted in virtually the same level of effort and production variability as did information by itself. The final phase of the information with researcher assisted goal setting was followed by a 33% productivity increase over the previous phase.

Table 2 presents the vital data for all four phases of the study. Mean efficiency increased from 47.9% during baseline to 60.1% for the

Table 2

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<th>Performance Information Data</th>
<th>As Related To Individual Phases</th>
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<tr>
<td></td>
<td>Phase 1</td>
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<td>------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Baseline</td>
<td>Performance Information</td>
</tr>
<tr>
<td>Number of Trials</td>
<td>76</td>
</tr>
<tr>
<td>Mean Efficiency</td>
<td>47.9%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>36.4</td>
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<tr>
<td>Correlation With Goals</td>
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employee–researcher goal setting phase. Worker variability from one calculation period to the next decreased from a standard deviation of 37.5 during baseline to levels of 15.9, 13.5, and 15.2 for the subsequent three phases respectively. Employee interaction with goal setting resulted in a .73 correlation (Pearson Product Moment) between actual performance and predicted efficiency when employees set their own goals. The final phase of researcher-assisted goal setting realized a .85 correlation over 27 trials showing a close relationship between predetermined, prompted goals and actual results. T-tests conducted between phases revealed that between phases 1 and 2, and 2 and 3, the null hypothesis would be retained. However, between phases 3 and 4, the t value exceeded the critical value \( t = 2.94, t_{49} = 2.01 \), thus rejecting the null and denoting significant change between these two phases.

Figure 1 represents the percentage difference between employee set goals and actual efficiency during Phase 3. Differences between

![Figure 1](image-url)
goals and actual performance may have decreased slightly across the phase in that 19 out of 23 goals fell within ten percent of actual efficiency, and all of the last eight were less than 10% of the actual.

Figure 2 illustrates the relationship between stated goals and actual performance during the final phase of researcher-employee goal setting. While efficiency increased 33% over the previous phase, variability remained relatively unchanged.
CHAPTER IV

DISCUSSION

The results provide clear evidence of experimental control. There were two changes from baseline performance when performance information was introduced in that mean efficiency remained constant throughout the first three phases and then increased significantly in Phase 4, and variability decreased following intervention and remained low throughout the study. Although there was no appreciable change in mean efficiency or variability when employee goals first began, there is a definite relationship between goals set on a given trial and the mean efficiency for that trial. This can be noted in the latter two phases in that actual results closely followed predicted results, even when those predictions were influenced by the researcher.

There are several questions about the data that should be addressed, some of which are due to the fact that it is an in-field intervention. First, during the initial goal setting period (Phase 3), what was the relationship between goals and efficiency at the onset versus the end of the phase? Did the employees' accuracy increase across the phase indicating that "hits" increased accuracy, or did they already know how to predict efficiency accurately? Figure 2 of the Results illustrates that the difference between goals and actual efficiency seemed to decrease across Phase 3 but pointed out several instances of accuracy even at the onset of the phase. Table 2 shows that deviation from the mean during this phase remained consistent with that of Phases 2 and
4. This would suggest that employees had a good idea of how they were performing in regards to the existing incentive program, but even sharpened these skills during the phase. It also suggests that employees were actually performing two behaviors in that they were both setting the goals and performing so as to hit them.

A second question we might look at would be whether the amount or type of work had any effect on efficiency rates and employee willingness to set difficult goals. This highlights the ability of the employee to discriminate between orders of different difficulty. Factors such as number of colors and condition of material all affected worker goal setting, in that these additional concerns would lower the speed at which the operators could run the press in order to avoid color smears, paper binding, etc. Unfortunately, standards were based only on the size and thickness of material and did not consider whether it was to be merely split, or split, colored, creased, stacked, and bundled. Herein lies the problem of standards which is discussed by William F. Whyte (1955, pp. 20-27) in his chapter entitled, "Quota Restriction and Goldbricking." He describes the phenomena of goldbricking as a situation when "workers felt that (a base rate) was the most they could possibly earn with the utmost of skill and effort,...They actively put on the brakes to hold production down...." Thus, much of our variability might be accounted for in the difference between relative difficulty of different orders and standards associated with those orders. The reduction in standard deviation following the introduction of the study might be explained by the researcher's interaction with the em-
ployees, making it more difficult to "goldbrick" orders when it appeared that someone had a genuine interest in efficiency from one order to the next.

A third question concerns the use of social interaction, in lieu of monetary rewards, to provide incentive sufficient to maintain performance. Employees only broke 80% standard on six occasions in 151 trials which would entitle them to any kind of company incentive (see Appendix B). However, efficiency increased significantly in the final phase of the study indicating that interaction with the researcher which resulted in higher goals was in part affecting performance. While one might argue that this might have been in part due to easier production runs, intervention records reveal that many of the jobs were of the same type across all phases, since the 203 was somewhat of a specialty machine. One exception to this is noted in Phase 4 during trials 21 and 22 which are marked by a sharp efficiency decrease. The author recognizes that inclusion of this difficult run skewed results, but production efficiency for the phase was still significantly higher, and close agreement with the goals during these two trials shows that the subjects anticipated the problem and responded accordingly.

Another problem exists in many production facilities whereby overt goals (standards of performance) are set for employees, and management fails to interact with the difference between goals and anything else. That is, everything below standard is treated as "off target" regardless of the employee's goals or prior performance. There also is a tendency in the case of a low efficiency machine to act negatively or
not at all. The following discussion represents the effectiveness of interaction recorded during the final phase of the study (Phase 4).

Researcher: "What rate do you want on this order?"
Employee 1: "80%.
Employee 2: "What the hell do you mean: You haven't hit 80% in six months!"
Employee 1: "I'm going to crank it up."
Employee 2: "O.K."

Actual Efficiency: 86.1%

On several occasions a supervisor would walk by the operation and announce "Turn that machine up," regardless of its current speed. Obviously such attempts at antecedent control were rarely effective and often ignored, while the same nature of comment in a dyad was effective.

Fourthly, what importance should be given to the fact that the researcher had no formal control of the machine's operation, its scheduling, or pay standards associated with it? While it would appear that the current study's results were dependent upon the value of the researcher's interaction, one would expect even more marked results had other incentives been involved, such as realistic standards or pay schedules. During the study, increases in agreement between goals and results were praised, while decreases were treated indifferently. In Phase 4, higher subsequent goals and results were encouraged by the researcher and any significant increases from the previous phase could be attributed to these variables. Some less obvious social reinforcers can also be considered, such as researcher's presence, interest, and record keeping, since variability decreased even when researcher goal intervention was not provided (Phases 2 and 3).
A fifth question concerns the pre-intervention data itself. Baseline production information had to be drawn from company computer records and is probably not indicative of actual worker performance due to an employee practice of "pushing the pencil." It was common for employees to misrepresent certain orders by altering time spent of quantities produced in order to heighten efficiencies. Consider the following employee comment:

Can't make any money unless we off-standard the slow orders (misrepresent time so that it can be applied to orders where there is potential to make incentive). He (supervisor) doesn't sign our sheets so he doesn't figure our down-time and we can't make any money. They bitch about our effectiveness and he's the only one that won't sign out sheets. I'm surprised they don't go by a weekly efficiency. Some machines make money for 3-4 days and sluff off the next day.

In doing this, certain job efficiencies could be increased without a corresponding increase in average daily job efficiency. This practice also took place during the study but did not affect data indicated since results obtained from intervention were made independent of employee records following the Baseline phase. While this may partially explain the range of performance during Baseline (0% - 156% efficiency), it is also safe to assume that based on a comparable standard deviation, Baseline data trends would be accurate, only exaggerated. While interpreting such data however, we should bear in mind that it is self-reported, and only big differences would ever be scrutinized by supervisors.

A sixth problem involves the implementation of long-term contingencies necessary to the continued efficient operation of the machine. In determining these, one would have to examine all of the variables which make for this increased effort. In this case, setting high goals is a product
of at least four different forces. First, there would be the frequently looked at variable, incentive pay. Obviously, the incentive variable cannot account for these data since formal company incentive was rarely received during the study. Secondly, of concern to these workers was job security, or the threat of transfer to another job (finishing department was generally considered less desirable work). Stretching the job to fill the allotted time space is obvious dysfunctional behavior and prevents employees from realizing incentive rewards. Thirdly, a dyad enhances the potential for peer reinforcement and punishment to come into play. The goals set are likely to be heavily influenced by peers and less likely to be influenced by non-systematic management. Finally, the power of interaction between employees and with management must not be overlooked as is noted by earlier employee comments and dramatized by Phase 4. In summary then, some long-term plans might involve having realistic goals with attractive incentives, an adequate backlog of work, job descriptions which hold employees accountable, and structured goal setting with frequent reviews.

This study has attempted to interpret data trends by analyzing several variables, but a comprehensive analysis of all other variables has yet to be done. Thus, there is the need to replicate the study to further isolate those factors which can necessarily be said to affect goal setting and efficiency. Three such examples might involve a two-machine operation, a multiple-baseline intervention, or a supervisor-reversal study. In a two-machine operation, orders might be split between two operations with identical machines, standards, and incentives. The only difference would be the inclusion of supervisor inter-
vention on one machine, focusing on setting and obtaining specific goals, accompanied with immediate feedback and constructive suggestions. Also, one might use a multiple-baseline design where during intervention variables would be added to the study, contingent upon a stabilizing of behavior from the preceding variable. This would measure the direct contribution of each variable to the study along with it's effect on the cumulative intervention. Finally, supervisor-reversal might be used whereby a supervisor trained in soliciting goals, prompting performance changes, and maintaining accurate records, would switch with a supervi sor lacking training in these skills. Measurement of effect would be the increment in efficiency associated with the goal-oriented supervisor, and the decrease in the other supervisor's efficiency.

We have discussed the methodological difficulties associated with the study and indicated some of the research that needs to be done in order to turn to the question of how the present findings relate to earlier research.

In agreement with studies by Meyers et al. (1976), and Cossairt et al. (1973), the current study noted an immediate efficiency increase following goal setting (Phase 4) while also noting consistent work efforts throughout the task following the introduction of feedback.

Support for the Pritchard et al. (1981) study was gained by the study in that goal setting plus feedback was found to be more effective than feedback by itself. Performance differences relative to the job difficulty level also support the idea that feedback should be given for different difficulty levels. Also, the employee should be able to see the connection between his goals and formal performance records.
In comparison to the Greller (1980) study, the current study clearly supports the premise that co-worker and researcher intervention relative to goal setting are instrumental variables controlling much of the worker's behavior. Although in disagreement with that study on the importance of job assignments, the current study found that this element did play a part in worker behavior probably because these assignments were immediate and based on the amount of work done in a particular day, and not based on desirable long term assignment goals as Greller refers to in his study. The current study supports the inadequacy of formal rewards (when viewed as unattainable) contingent upon reported performance rather than measured performance, and random comments from supervisors.

The current study reiterates some of the same conclusions noted by Locke et al. (1967), and Locke et al. (1981) in his literature reviews while not acknowledging some of the same motivational forces. Locke states, and this study agrees, that goals and knowledge of results were necessary in order that performance might be improved. Locke explains this through detailed evaluation and planning on the part of the subject following such information, while this study makes no such conclusions or inferences.

The current study has noted the effectiveness of goal setting and performance feedback and their combined effect on production efficiency. Also, the importance of the dyad work environment where the product is the effort of both parties used and demonstrated the effectiveness of the behavioral intervention with a dyad rather than a single worker or a loosely structured group of workers. The most important ingredient
the study adds to the current body of literature is that it takes place in a real setting, applying the hypothesis from many of the referenced authors. In doing so, it acknowledges the extraneous variables so tightly controlled in these other studies but supports their arguments for the generalizability of their findings.
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BIBLIOGRAPHY


*Journal of Applied Psychology, 1968, 52,* 104-121.


