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An Attempt to Manipulate the Results of a Psychomotor Learning Task

Robert Cable Jr.
Western Michigan University

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AN ATTEMPT TO MANIPULATE THE RESULTS OF A PSYCHOMOTOR LEARNING TASK

by

Robert J. Cagle Jr.

A Thesis Submitted to the Faculty of the School of Graduate Studies in partial fulfillment of the Degree of Master of Arts

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INTRODUCTION

The literature contains increasing reference to the effects of experimenter bias on the outcome of psychological studies. It has been demonstrated that an experimenter's perceptions of a subject's behavior and an experimenter's expectations for results influence a wide range of data, from the performance of subjects on a projective test (Hamilton & Robertson, 1965) to the speed with which white rats learn to negotiate a maze (Rosenthal & Fode, 1963). Reviews by Rosenthal (1963, 1964a, 1966, 1967) conclude that experimenter bias may influence research data to a significant degree, usually in the direction of the experimenter's hypothesis. Investigations have been conducted in an effort to reveal the conditions under which experimenter bias will manifest itself and the modes of its transmission. Rosenthal (1963) has suggested procedures to eliminate, or at least minimize, its influence on experimental findings.

An examination of the literature on experimenter bias raises a number of questions, principally about the experimental procedures and the choice of the task to be used. In a study by Cordano & Ison (1963), students were asked to record the number of head turns made by planaria, when the worms were exposed to light. One group was led to expect many head turns, the other group
few. The data sheets turned in by these inexperienced students indicated results in favor of their expectations; but, as independent observation showed, there was no specific correlation between the data sheets and the actual responses of the worms. No definite criteria were established for judging the head turns, which allowed much leeway in recording. In order to be labeled as a demonstration of the experimenter bias effect, it should be established that the experimenter's expectations have been communicated to the subjects and are observable in the subjects' manner of responding.

Typical investigations of bias effect have used the person-perception task (Rosenthal & Fode, 1963b; Rosenthal, Persinger, Mulry, Vikan-Kline & Grothe, 1964a; 1964b; Rosenthal, Kohn, Greenfield & Carota, 1965). In this task subjects are shown a series of photographs and are asked to rate them on a scale from +10 to -10. A rating in the positive direction indicates that the pictured individual has recently experienced success, a negative rating indicates recent failure. Standardization data were collected under neutral conditions, where the experimenters had no expectations for subjects' response tendencies. The average rating given was 0, meaning that the photographs do not influence subjects to rate them in any particular direction.

The systematic investigation of the experimenter bias effect is relatively recent, as the references cited in-
dicate. The pertinent variables are still rather poorly defined. It is the present author's opinion that attempts to examine poorly defined variables should not be confounded by placing the investigation of such variables in the context of a poorly defined experimental task. In spite of the standardization data mentioned above, it is difficult to regard the person-perception task as a "real" one, as a task where the relevant variables are clearly defined, as a task which rests on a solid foundation of relevant research. Furthermore, the question of test-retest reliability of the person-perception task has never been raised save by critics of this area of research (Barber & Silver, 1968).

It was the intent of the present investigation to develop a research design which would specifically avoid the difficulties previously discussed, and thus provide a more fruitful direction for the study of experimenter bias.

For the choice of a task the author turned to the learning literature. A well defined task was selected, a task with a solid foundation of relevant research. Investigations have established a consistent difference between learning curves produced under varied distributions of practice. The positive effect of spaced psychomotor practice as opposed to massed psychomotor practice, in terms of total number of responses produced, is well documented (Oxendine, 1968; Singer, 1968; Weiford, 1968).
Kientzle (1948) exhaustively studied the rest interval variable in an effort to determine the optimum period for a specific task, printing the alphabet upside down and in the reverse order. The procedures used in that study and the maximally efficient rest interval of 45 seconds were replicated.

One of the most important assets to the use of this task is the method of recording the subject's responses. Recording is done by the subject, and a simple summation of the letters produced, regardless of correctness or form, provides the data to be studied. There is no opportunity for gross errors of observation on the part of the experimenter.

Barber & Silver (1968) have reviewed the literature in the area of experimenter bias. Their critical analysis suggests further controls to be initiated and further pitfalls to be avoided. They have cautioned against drawing conclusions from a post hoc analysis of the data and suggested that the relevant comparisons to be made should be stated prior to analysis. They have advised that the probability value for rejecting the null hypothesis be chosen at the outset, and they have criticized the use of overlapping tests of significance. These suggestions were implemented in the present study.

The author determined whether it is possible to systematically distort the results of a well defined task,
printing the alphabet, by the manipulation of instruction and ongoing comments from the experimenter to the subjects. The learning literature indicates that subjects operating under conditions of spaced practice should produce significantly more responses than subjects operating under conditions of massed practice. If these conditions were met and the data were free from the effects of the experimenter's manipulations, then this would seem an appropriate task with which to replicate much of the past literature concerning experimenter bias.
METHOD

Experimenter

The conditions under which experimenter bias has been studied included the following variables: male E versus female Ss, higher status of E in relation to Ss (Rosenthal, 1963), and the use of a relatively experienced E (Ingraham & Harrington, 1966). In the present study the investigator fulfilled these requirements. These variables are important only when the Ss are aware of them. For this reason the introductory comments for each experimental session contained reference to the investigator's graduate student status and to the fact that this task had been used by the investigator on previous occasions and with similar groups of Ss. (See appendix A for the instructions given to each group.)

Subjects

A total of 80 Ss were divided into eight groups of 10 Ss per group. Eight Ss did not appear for their sessions, leaving a total of 72 Ss. An additional eight Ss did not follow the instructions sufficiently to make use of their data, leaving a total of 64 Ss. The lowest number of Ss in any group was seven.

All Ss were undergraduate females enrolled in introductory psychology at Western Michigan University. Their participation was solicited through section instructors. Prior to volunteering Ss were told that a learning task...
was involved and that each $S$ would receive $2.00$ for participation.

**Procedure**

Two of the eight groups of subjects were designated as controls. One group practiced under massed conditions, 20 trials of one minute each. The other group practiced under spaced conditions with a work to rest ratio of one minute to 45 seconds. Three experimental groups experienced massed practice and three groups experienced spaced practice.

All $S$s received basically the same set of instructions. The deviations in instructions consisted of the positively or negatively slanted additions. The comments offered by the experimenter were preplanned and were delivered on the third, seventh, twelfth and fifteenth trials for all groups. (Appendix B)

The massed groups received the positive variables. The first massed experimental group received positive instruction, the second group received positive comments but neutral instructions, and the third group received positive instructions and comments. The spaced groups received the negative variables. The first spaced experimental group received negative instructions, the second group received negative comments but neutral instructions, and the third group received negative instructions and negative comments.
Following completion of the session proper, each S filled out a brief questionnaire intended to assess their awareness of the experimenter's stated expectations, and their own expectation with regard to the outcome of the experiment.

Analysis of data

Per the suggestions of Barber & Silver (1968) a plan for data analysis was outlined prior to running the subjects. An analysis of variance was used to compare the overall difference in quantitative performance between the massed and spaced groups. An analysis of variance was used to examine the possibility of significant differences occurring within either the massed or spaced groups. The latter two comparisons were made to evaluate any differences in the effects of the variables within groups operating under similar practice conditions. The $P < .05$ level of significance was chosen for rejecting the null hypothesis.

In analyzing the questionnaires a simple percentage was calculated. This was based on the number of subjects in each group who answered the questionnaires in accord with the experimenters' expectations, that is, that the massed practice Ss would do well and the spaced practice Ss would do poorly.
RESULTS

Table 1 summarizes the statistical analysis of the data. An analysis of variance was done to determine the overall difference, with respect to mean number of responses produced, between all the subjects operating under conditions of massed practice and all the subjects operating under conditions of spaced practice. The $F$ value was significant ($p < 0.05$). This indicates that subjects operating under conditions of spaced practice performed significantly better than those operating under conditions of massed practice. This is contrary to the expectations stated during the introduction.

Table 1 also illustrates an analysis of variance performed to determine the presence of any significant differences within groups. As the table indicates, there were no significant ($p < 0.05$) $F$ values in this analysis. The latter two statistical operations show that, within the massed experimental groups, it is not possible to differentiate the effects of the positive instructions, positive comments, and a combination of the two. All three conditions had a similar effect on the performance of the subjects exposed to them. This analysis shows that within spaced groups, it is not possible to differentiate the effects of the negative instructions, negative comments, and a combination of the two. All three conditions
had a similar effect on the subjects exposed to them.

**TABLE 1: Analysis of Variance Between Massed and Spaced Groups and Within Groups**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squared</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massed versus</td>
<td>491,452.45</td>
<td>1</td>
<td>491,482.45</td>
<td>16.1*</td>
</tr>
<tr>
<td>Spaced</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Massed</td>
<td>150,431.62</td>
<td>3</td>
<td>50,143.87</td>
<td>1.64</td>
</tr>
<tr>
<td>Within Spaced</td>
<td>43,623.58</td>
<td>3</td>
<td>14,541.19</td>
<td>0.48</td>
</tr>
<tr>
<td>Error</td>
<td>1,709,543.35</td>
<td>56</td>
<td>30,527.56</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,395,081.00</td>
<td>63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(p<.05)*
The latter two analyses of variance point out an additional fact. There was no significant difference between any of the 6 experimental groups and their respective control groups. The analysis failed to indicate a relationship between the mean number of responses produced and the experimental variables that the subject was exposed to.

An examination was made of each questionnaire. The subjects' responses were tallied as to whether or not they expressed an expectation that their overall performance would improve, and whether or not the experimenter sought this kind of result. It should be remembered that the experimenter attempted to communicate positive expectations to the massed subjects and negative expectations to the spaced subjects. A majority of the subjects, in both the massed and the spaced groups, indicated that they and the examiner expected positive results in terms of a constant improvement in performance. A total of 69% of the massed subjects and 83% of the spaced subjects expressed this positive expectation.

(See Appendix C for a copy of the questionnaire and a table of the subjects' responses).
The foundation of the present study rests on data from the learning literature. Research has established that subjects operating under conditions of massed practice do not produce as many responses, in a psychomotor task, as subjects operating under conditions of spaced practice. The current investigation was structured around these data. The typical difference occurring between subjects under massed and spaced practice was to serve as a criterion against which to measure the effects, on subjects response rates, of the experimental variables manipulated.

The analysis of the data indicates that the results of the current study are in agreement with those of the learning literature. Subjects operating under conditions of spaced practice did in fact perform at a significantly ($p < .05$) better level than subjects operating under massed conditions. This would seem to suggest that this type of task is resistant to the attempt at intentional distortion of results, by the experimenter.

Although the results suggest that this task meets the requirements set forth earlier in this paper, and would serve as a suitable basis for replication of studies of experimenter bias, a number of limiting factors should be mentioned. The primary limitations lie in the low $N$ in several groups and the lack of control over Ss appearing...
for more than one experimental session.

While the number of Ss solicited for this study was sufficient to produce stable data, problems arose with the attrition rate. As was mentioned previously, though 80 Ss signed up for the experiment it was possible to use only 64 protocols. Three of the groups had only seven Ss. With an N this small the variations in performance of single Ss had a disproportionate effect on group data.

Consideration was given to the possibility of running small groups of additional Ss in order to bring the N for each group up to 10. This was rejected in favor of maintaining constant environmental conditions. All Ss were run in the same classroom and used identical materials. The instructions were given in as consistent a manner as possible. Had additional groups been run it would have been necessary to find a new classroom location. The fact of having Ss in groups of two or three would have altered conditions such as, the opportunity to hear the experimenter clarify the instructions for other Ss, and the possibility of being distracted by the idle chatter of other Ss.

The second limitation mentioned referred to the lack of control over Ss appearing for more than one session. No attempt was made to screen Ss prior to each session. When their cooperation was solicited, it was made clear that they were to appear for one session only. Toward the end of the study it was brought to the attention of the
investigator that several Ss attended more than one session. It was not possible to determine how large a number this represented or how great an impact it had on the total data. Subjects could have attended different experimental groups operating under the same or different practice conditions.

Additional limitations relate to the assumptions made by the investigator regarding appropriate transmission of his expectations and the efficacy of the experimental variables manipulated. It was assumed that negative instructions and negative comments would depress the rates of responding, and that the converse would hold true for positive variables. It was assumed that the subjects would interpret the experimenter's instructions and comments in an appropriate manner. That is, it was thought that they would understand that the negative instructions suggested that they would not produce a large number of responses. In future studies of this type the experimenter's expectations could be made more explicit. Stating an exact number of responses per trial, as a likely response rate, is one possible means of achieving more explicit communication between experimenter and subject.

The questionnaires indicated that the majority of Ss thought that their performance would improve, in terms of an increasing response rate. These expectations may be accounted for by the material discussed above. There is
an additional possibility. The experimenter assumed that
the Ss would attend sufficiently to the instructions and
comments offered to hear the positive and negative nuances.
It is possible that they did not listen carefully enough
for this process to take place. In support of this, all
subjects expressed concern over understanding the instruc-
tions exactly in order to produce useful data. As has been
mentioned, eight subjects did not grasp the instructions
clearly enough to produce acceptable protocols. This would
lend credence to the possibility of a lack of adequate
attention and concentration on the part of Ss in general.

In conclusion, the study did provide evidence that
this type of psychomotor task, printing the alphabet
upside down and in the reverse order, is resistant to the
intentional distortion of data by the experimenter. There
was a statistically significant difference in mean number
of responses per group, in favor of subjects operating
under conditions of spaced practice. Before this par-
ticular task is used to replicate studies of experimenter
bias, it should itself be replicated, but with adequate
provision for meeting the limitations discussed.
INSTRUCTIONS FOR THE MASSED CONTROL GROUP #1

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task several times before and with comparable groups of students.

This is basically a learning task. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square. Work as quickly and as accurately as possible. In the event of an error make the correction in the next square. Do not go back over your work to correct an error.

Begin when I say go. You will print for 20 minutes. At one minute intervals I will say "next trial" and you are to skip one line and continue working. For example, if I say next trial and you are printing "N" you will skip a line and continue where you left off, printing "M" next. Keep your work covered with one of the sheets of paper so that you may not look back on work completed.

There will be a very brief questionnaire to fill out when you are finished.

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INSTRUCTIONS FOR THE SPACED CONTROL GROUP #2

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task several times before and with comparable groups of students.

This is basically a learning task. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet upside down and in the reverse order, that is, beginning with Z and working backward to A. (demonstration card presented)

You are to place only one letter in each square. Work as quickly and as accurately as possible. In the event of an error make the correction in the next square. Do not go back over your work to correct an error.

Begin when I say go. You will alternately print for one minute and rest 45 seconds. Stop when I say "stop" and begin again on signal. Skip a line between trials. You are to run through the alphabet completely before you begin again, that is, if you end a trial on "N", on the signal to start you would continue where you left off and print "M". Keep your work covered with one of the sheets of paper so that you may not look back on work completed.
There will be a brief questionnaire to fill out when you are finished.
INSTRUCTIONS FOR THE MAESSED EXPERIMENTAL GROUP #3

It is nearly time to begin. I would like to read you these brief instructions: This study is being done in connection with my Master's Thesis in psychology. We have used this task several times before and with comparable groups of students.

This is basically a learning task and was chosen because it is one in which young adults show rather rapid improvement, with a relatively low rate of errors. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square. Work as quickly and as accurately as possible. As I mentioned, the number of errors you make will rapidly diminish, but, in the event of an error make the correction in the next square. Do not go back over your work to correct an error.

Begin when I say go. This will be a short session. You will be asked to print for only 20 minutes. At one minute intervals I will say "next trial" and you are to skip one line and continue working. For example, if I say next trial and you are printing "N" you will skip...
a line and continue where you left off, printing "x".
Keep your work covered with one of the sheets of paper
so that you may not look back on work completed.
There will be a very brief questionnaire to fill out
when you are finished.
INSTRUCTIONS FOR THE SPACED EXPERIMENTAL GROUP #4

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task before and with comparable groups of students.

This is basically a learning task. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square. Work as quickly and as accurately as possible. You will undoubtedly make many errors throughout the session. When this occurs, do not go back and correct your work. Make the correction in the next square. This may sound confusing to you, but you must follow the directions exactly to provide useful data.

Begin when I say go. You will alternately print for one minute and rest 45 seconds. Stop when I say stop and begin again on signal. I realize that this is a somewhat tedious, boring task but we require that you work for a total of 35 minutes.

Skip a line between trials. You are to run through the alphabet completely before you begin again, that is,
if you end a trial on "N", on the signal to start you would continue where you left off and print "N". Keep your work covered so that you may not look back on work completed.

There will be a brief questionnaire to fill out when you are finished.
INSTRUCTIONS FOR THE MASSED EXPERIMENTAL GROUP #5

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task several times before and with comparable groups of students.

This is basically a learning task. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square, work as quickly and as accurately as possible. In the event of an error make the correction in the next square. Do not go back over your work to correct an error.

Begin when I say go. You will print for 20 minutes. At one minute intervals I will say "next trial" and you are to skip one line and continue working. For example, if I say next trial and you are printing "N" you will skip a line and continue where you left off, printing "M" next. Keep your work covered with one of the sheets of paper so that you may not look back on work completed.

There will be a very brief questionnaire to fill out when you are finished.
INSTRUCTIONS FOR THE SPACED EXPERIMENTAL GROUP #6

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task several times before and with comparable groups of students.

This is basically a learning task. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square, work as quickly and as accurately as possible. In the event of an error make the correction in the next square. Do not go back and correct an error.

Begin when I say go. You will alternately print for one minute and rest 45 seconds. Stop when I say "stop" and begin again on signal. Skip a line between trials. You are to run through the alphabet completely before you begin again, that is, if you end a trial on "N", on the signal to start you would continue where you left off and print "M". Keep your work covered with one of the sheets of paper so that you may not look back on work completed.
There will be a brief questionnaire to fill out when you are finished.
INSTRUCTIONS FOR THE MASED EXPERIMENTAL GROUP #7

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task before and with comparable groups of students.

This is basically a learning task and was chosen because it is one in which young adults show rather rapid improvement, with a relatively low rate of errors. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square. Work as quickly and as accurately as possible. As I mentioned, the number of errors you make will rapidly diminish, but, in the event of an error make the correction in the next square. Do not go back over your work to correct an error.

Begin when I say go. This will be a short session. You will be asked to print for only 20 minutes. At one minute intervals I will say "next trial" and you are to skip one line and continue working. For example, if I say next trial and you are printing "N" you will skip
a line and continue where you left off, printing "M". Keep your work covered with one of the sheets of paper so that you may not look back on work completed.

There will be a very brief questionnaire to fill out when you are finished.
INSTRUCTIONS FOR THE SPACED EXPERIMENTAL GROUP #8

It is nearly time to begin. I would like to read you these brief instructions. This study is being done in connection with my Master's Thesis in psychology. We have used this task before and with comparable groups of students.

This is basically a learning task. Before you on the desk you will see a pencil and four sheets of gridded paper. We are asking you to print the letters of the alphabet, upside down and in the reverse order, that is, beginning with Z and working backwards to A. (Demonstration card presented)

You are to place only one letter in each square, work as quickly and as accurately as possible. You will undoubtedly make many errors throughout the session. When this occurs, do not go back and correct your work. Make the correction in the next square. This may sound confusing to you, but you must follow the directions exactly to provide useful data.

Begin when I say go. You will alternately print for one minute and rest for 45 seconds. Stop when I say stop and begin again on signal. I realize that this is a somewhat tedious, boring task, but we require that you work for a total of 35 minutes.

Skip a line between trials. You are to run through
the alphabet completely before you begin again, that is, if you end a trial on "N", on the signal to start you would continue where you left off and print "N". Keep your work covered so that you may not look back on work completed.

There will be a brief questionnaire to fill out when you are finished.
APPENDIX B

Comments Offered To Each Group
COMMENTS OFFERED TO MASSED EXPERIMENTAL GROUPS #5, #7

Trial three  - "You should be hitting eight to ten letters per trial."

Trial seven  - "Good, you are keeping the letters legible."

Trial twelve - "You appear to be a little ahead of the other groups."

Trial fifteen - "Excellent, you are following the instructions as asked."

COMMENTS OFFERED TO SPACED EXPERIMENTAL GROUPS #6, #8

Trial three  - "You should be hitting fifteen to twenty letters per trial."

Trial seven  - "Try to keep the letters legible."

Trial twelve - "You appear to be a little behind the other groups."

Trial fifteen - "Some of you are not following the instructions as asked."
APPENDIX C

Summary of Questionnaire Results
PLEASE ANSWER THESE QUESTIONS TO THE BEST OF YOUR ABILITY. BASE YOUR ANSWERS ON INFORMATION YOU RECEIVED IN THE INSTRUCTIONS, OR ON AN EDUCATED GUESS.

WHAT IS THE NATURE OF THE TASK YOU HAVE COMPLETED?

WHAT DO YOU THINK THE EXAMINER IS TRYING TO PROVE?

WHAT DO YOU THINK THE EXAMINER EXPECTS IN THE WAY OF POSITIVE OR NEGATIVE RESULTS?

HOW DO YOU FEEL THE RESULTS WILL TURN OUT?

USE THIS SPACE FOR ANY COMMENTS YOU WISH TO OFFER. THANKS.
### Summary of Questionnaire Results

<table>
<thead>
<tr>
<th></th>
<th>Massed Subjects</th>
<th>Spaced Subjects</th>
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<tr>
<td>E expectation +</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>S expectation +</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>E expectation -</td>
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</tr>
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<td>S expectation</td>
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<td><strong>64</strong></td>
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