TOWARD A FUNCTIONAL APPROACH TO GOAL SETTING

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A variable that may be associated with performance improvements is goal setting (within and across days). Easy-to-achieve goals will likely produce gradual trends in improvement and difficult-to-achieve goals steeper trends. The purpose of the current experiments was to study the effects of setting easy-to-achieve and difficult-to-achieve goals on the level, trend, and variability of correct, incorrect, and skip responses for math tasks when reinforcement contingencies and numbers of practices were held constant. Five undergraduate students answered math problems on flash cards in 30s timings. Single case design elements were used to evaluate the effects of different types of goals on the speed and accuracy of performance. The results revealed that goal setting primarily increased the frequency of incorrect responses and both the level and trend of skip responses. The implications of these findings and other important variables that influence the effectiveness of goal setting are discussed. In addition, the authors suggest guidelines to follow when implementing goals to improve performance.

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INTRODUCTION

Goal setting is a common practice in many areas of our society. Politicians, employers, educators, and coaches all set goals. Investigators have conducted more than 600 laboratory and applied research studies on the topic (Weinberg, Harmison, Rosenkranz, & Hookom, 2005). These studies of goal setting have occurred in an array of contexts including education (e.g., Fuchs, Butterworth, & Fuchs, 1989), sports (e.g., Burton, Naylor & Holliday, 2001), dietary and physical activity (e.g., Shilts, Horowitz, & Townsend, 2004), occupational health and safety (e.g., Ludwig & Geller, 2000), and business (e.g., Latham & Pinder, 2005).

In 1990, Locke and Latham completed an extensive review of goal setting research. Of the 201 studies they reviewed, Locke and Latham (1990) concluded that goal setting improved performance in 183 studies. The effects of goal setting on performance have been documented across more than 88 tasks, involving more than 40,000 participants on four continents (Locke & Latham, 2006). The tasks used in these goal setting studies ranged from simple experimental tasks (such as listing nouns) to complex tasks (such as reading comprehension tasks and management simulations), and the diversity of populations studied varied across sex, age, race, socioeconomic status, and type of employment. In addition, the effects of goal setting on performance have been documented for durations ranging from 1 minute to 36 months (Burton, Naylor & Holliday, 2001).

Goals and How They Work

Different researchers have defined goals and conceptualized how they work in

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different ways. As an example, Locke, Saari, Shaw, and Latham (1981) defined a goal as "what an individual is trying to accomplish…the object or aim of an action." Behavior analysts have suggested that goals function as discriminative stimuli, conditioned reinforcers (Fellner, & Sulzer-Azaroff, 1984), establishing operations, and rules. For example, Fellner and Sulzer-Azaroff (1984) suggested that goals function as discriminative stimuli when the presence of the goal increases the probability that the goal-directed behavior will occur. Furthermore if meeting the goals repeatedly correlates with a positive consequence or removal of a negative consequence, goal attainment can function as conditioned reinforcement. Fellner and Sulzer-Azaroff (1984) also suggested that goals might affect performance similarly to the way verbal stimuli affect verbally mediated behavior (rule governed behavior). The authors point out that when an individual attains a goal before reinforcement occurs, their behavior is under the control of an instruction rather than a discriminative stimulus. Nevertheless, to understand how goals come to control occurrences of behavior, the authors maintained that it is important to identify first whether the behavior of interest is event governed or verbally mediated as the latter is under the control of verbal stimuli whereas the former results from direct contact with consequent events contingent on behavior in the presence of the discriminative event.

Other researchers have suggested that goals function as establishing operations (cf., Olson, Laraway, & Austin, 2001). Agnew (1998) juxtaposed two examples to show that goals can function as establishing operations and as discriminative stimuli. In her example of goals as establishing operations, she described a situation where service employees received immediate feedback on their performance. Agnew pointed out that

goal setting designed to improve an employees' performance does not make the reinforcer (praise from supervisor) more likely, but rather makes the reinforcer more valuable. In her example of goals as discriminative stimuli she describes a situation where a monetary bonus occurs contingent on improved performance. In this situation, the reinforcer is only available in the presence of the goal and not in its absence.

Malott (1992) explained that a goal or rule statement may function as a conditioned establishing operation "that establishes noncompliance with the rule as a learned aversive condition" (p. 54). In this analysis, stating the rule generates an aversive condition that momentarily increases the reinforcing effectiveness of completing the project and increases the likelihood of making last minute preparations that have produced a similar outcome in the past.

Extending earlier work that theorized goals as rules, O'Hara and Maglieri (2006) suggested that, "when employees understand a goal statement, it functions as a rule, or more specifically, a relational network" (cf., Hayes, 1989). However, they specified that effective goal statements differ from rules as described by Hayes (1989) in that "[goals] specify a level of performance." The authors suggest that when employees establish goals, they establish arbitrary comparison relations between the level of performance set in the goal statement and their ongoing self-statements about their current performance. Consequently, employees work to reduce those "less than" comparison relations between their current level of performance and the level specified by the goal statement.

Empirical Findings on Goal Setting

Goal Setting Research in Organizations

Most of the research conducted on goals flows from cognitive psychology, with industrial and organizational settings serving as the most frequently used theoretical contexts for research. In a comprehensive review of the cognitive psychology literature from 1969 to 1980 related to goal setting, Locke and his colleagues (1981) found two major themes related to: (a) the effects of setting various types of goals on task performance; and (b) the variables that influence the effectiveness of goal setting. Based on their review of the effects of setting various types of goals, they concluded that specific goals that are difficult to achieve led to higher performance levels than easy-to-achieve goals, "do-your-best goals", or setting no goals at all. As an example, if tax advisors typically file between 10-15 tax returns per day in March and management wanted to increase their rate of performance, management might set a number goal of 30 tax returns filed per day for each advisor rather than encourage the staff (a) to file as many taxes as they can, or (b) to work harder, and that such a specific goal that is difficult to achieve will prove more effective than a general goal (such as, "Complete more tax returns."), and easy goal (such as, "Complete 2 more tax returns in March than you did last year."), or setting no goal at all.

In terms of the variables influencing the effectiveness of goal setting, Locke et al. (1981) concluded that goal setting will most likely improve performance when the participants have the necessary prerequisite skills for the task within their repertoire, when the participants see their progress in relation to their goal, and when participants

receive specially arranged consequences (such as money) related to achieving the goals.

As an example of the effects of goal specificity on performance change, Ivancevich (1976) found that sales personnel working for a large retail sales organization who set specific goals showed statistically significant improvement on two performance measures compared to sales personnel that were urged to do "the best they can" or received no goals. In terms of the relationship between setting lofty goals rather than easier-to-achieve goals, Locke (1982) asked undergraduate students to complete a 1-min brainstorming task in which they listed uses for common objects. Before the task began, the students were assigned one of 14 goal levels ranging from listing 2 uses to listing 28 uses. He found that the students who received a challenging goal (such as listing 28 different uses) listed more uses for common objects than those who received an easier-to-achieve goal relative to their baseline performances.

As an example of the power of providing participants with reports of their progress relative to goals, Nemeroff and Cosentino (1979) found that managers who received feedback on their performance and set specific goals based on that feedback performed significantly better on a 43-item questionnaire that assessed their subordinates' perceptions of their behavior than participants within the feedback only or the control group. As an example of the mediating power of receiving programmed consequences on the ability of goals to affect performance, Pritchard and Curtis (1973) found that participants who were offered high incentives performed better on a sorting task than those offered small or no incentives when goal level was controlled (Locke et al., 1981).

In a more recent review of the empirical research on goal setting theory Locke and Latham (2002) identified what they called "the essential elements of goal-setting theory," which included (a) the core properties of an effective goal (such as specificity and difficulty), (b) moderators of goals effects (such as feedback, task complexity), and (c) the mechanisms through which goals affect performance (such as choice and direction). Based on their review, Locke and Latham (2002) concluded that goal setting is most effective when people are committed to their goals, especially when goals are difficult. According to the authors, two variables that influence goal commitment are (a) the degree to which the goal is important to the person, and (b) self-efficacy. Researchers in organizational/industrial psychology have identified variables that influenced goal commitment or employee "buy in" and that these variables included making the goal public to an "important" audience (Hollenbeck, Williams, & Klein, 1989), having leaders communicate an inspiring vision (Roman, Latham, & Kinne, 1973), offering incentives (Pritchard & Curtis, 1973), and paying for performance (Lee, Locke, & Phan, 1997).

Goal Setting in Sports Research

Researchers in sports psychology have extensively investigated goal setting as an independent variable with athletes in team sports across tasks, durations, and populations (cf. Burton, Naylor, & Holliday, 2001). In a comprehensive review of the sports psychology literature related to goal setting, Burton and his colleagues (2001) found that 44 out of 56 goal setting studies in sports demonstrated moderate to strong effects and that these effects were consistent with the two major themes identified by

Locke et al. (1981) related to (a) the effects of setting various types of goals on task performance and (b) the variables that influence the effectiveness of goal setting.

Goal Setting Research in Education

Researchers have investigated goal setting in education as an independent variable with students across settings (for example elementary and high school), skill levels (for example general education and special education), academic areas (for example, math and reading), and tasks (for example, tests and homework). Considerable research on goal setting in education has been conducted in the context of Curriculum-Based Measurement (Fuchs, Fuchs, Deon, 1985; Fuchs, 1986; Fuchs, Fuchs, & Stecker, 1989; Fuchs, Fuchs, & Hamlett, 1989; Fuchs, Butterworth, & Fuchs, 1989; Fuchs, Bahr, & Rieth, 1989; Fuchs, Fuchs, & Hamlett, 1993; Codding, Lewandowski, & Eckert, 2005; Swain, 2005). The findings on goal setting in education align closely with those from the organizational/industrial literature. As an example, Fuchs et al., (1985) found that special education students for whom teachers set highly and moderately ambitious goals scored higher on the Passage Reading Test and the Stanford Diagnostic Reading Test than those students who received unambitious goals. In addition, Codding et al. (2005) found that fourth and fifth grade students computed more correct digits correct per minute compared to their mean baseline levels when they were asked to complete more digits correct than during the previous sessions and shown a bar graph of their previous performance.

One difference between findings from goal setting studies in education and those reported by Locke et al. (1981) involved the effectiveness of participant-selected goals.

Several studies have shown that participant selected goals lead to better performance than teacher assigned goals (Codding et al., 2005; Mithaug & Mithaug, 2003; Olympia, Sheridan, Jenson, & Andrews, 1994). In addition to replicating the findings from the organizational/industrial literature, researchers in education have also made new discoveries regarding variables that mediate the effectiveness of goal setting.

As an example of one such discovery, Fuchs, Fuchs, and Hamlett (1989) conducted a study in which they trained 30 special education teachers how to implement curriculum-based measurement (CBM) procedures, and then instructed them to set ambitious goals. In addition, the experimenters trained the teachers to use 1 of 2 types of decision rules for adjusting students' goals: (a) dynamic goal decision rules, or (b) static goal decision rules. The dynamic goal decision rules stated that (a) if the regression line was less steep than the aimline teachers were to make an instructional change, (b) if the regression line was as steep as the aimline teachers were to continue collecting data, and (c) if the regression line was steeper than the aimline teachers were to increase the goal level. The static goal decision rules were the same as the dynamic goal decision rules except when the regression line was steeper than the aimline. In these situations teachers were to continue collecting data. Data were displayed on a graph showing the pupil's performance over time, an aimline reflecting the desired slope of improvement baseline to goals, and a regression line superimposed over the data points that had been collected since the last instructional change and extrapolated to the goal data. The results showed that teachers in the dynamic goal group increased their number of goals more frequently and set more ambitious goals than the static goal group. Consequently, the students in the dynamic goals group performed better on

math achievement tests than the participants in the control group in terms of content mastery.

Limitations of the Extant Research

For over 25 years, researchers in several disciplines have studied both the function of goals and their effects on performance in a variety of contexts, with a variety of different participants, and using a variety of different performance tasks. As a result of this copious research, multiple accounts of how goals work and approaches to goal setting exist. Nevertheless, much is still unknown. For example, few studies have isolated goal setting as an independent variable unto itself rather than as a part of a larger treatment package, and few studies have measured the effects of goal setting on performance trends.

Goal Setting as an Independent Variable

While researchers have identified numerous variables that influence the effectiveness of goal setting, the conditions under which goal setting proves effective remain unclear. Consequently, many interventions and instructional arrangements designed to improve performance use goals as part of a treatment package (cf., Codding, et al. 2005), which leads to high variability in how goals affect performance because these packages combine goals with other variables rather than isolating the effects of goals alone. To learn more about the effects of goals alone on performance, research is needed that looks more closely at experimental procedures employed to

gain a better understanding of the relationship between procedures used to set goals and the effects likely produced by those procedures.

Also, the study of goal setting needs more research that employs within-series designs that focus on parametric analyses (Hayes, Barlow, and Nelson-Gray, 1999). In 1960, Sidman demonstrated the importance of the parametric study of variables and suggested that, "only by exposing and tracking down major sources of variability can true generality be achieved" (p. 160). Furthermore, he added that by analyzing variables in this way, "we would be in a position to make more complete specification of the effects of our experimental manipulation[s]" (Sidman, 1960, p. 160). Similarly, when researchers study goals in isolation, the results of this research should help determine whether different goal levels have widely differing effects on performance as a function of other variables such as participant characteristics and contexts.

Measurement in Goal Setting Research

All graphed behavioral data have three parameters: level, trend, and variability. While research has documented the effects of goal setting on two of those parameters (level and variability) few studies have studied the effects of goals on trend (Fuchs, Fuchs, Hamlett, 1989; Sweeney et al., 2003). When treated as a dependent variable, trend is highly sensitive to changes in the independent variable. As reported by Lindsley (2000), Lindsley, and his colleagues divided 12,000 graphed examples of performance into 18 separate performance level bands. They found that all 18 performance level bands had the same median trend but widely varying levels, thus indicating that level and trend were independent parameters of the same graphed behavior. Koenig and

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Kunzelmann (1980) arrived at similar conclusions when they found that for almost 9,000 1st-through 6th-grade schoolchildren, trend and level of graphed performance were not correlated.

Trend and the Current Study

The two experiments reported here sought to investigate trend—a previously unstudied parameter of graphed human performance—as a dependent variable in goal setting research, as well as its relation to goal difficulty within an experimental preparation that controlled explicitly for reinforcement contingencies and number of practices.

GENERAL METHODS USED ACROSS BOTH EXPERIMENTS

Participants and Setting

Five undergraduate students served as participants for Experiments 1 and 2. The participants' ages ranged from 18 to 27 years and none of the participants studied math as their major in college or had jobs that involved accounting or complex computation. Sessions occurred in small experimental rooms on a university campus. The rooms contained a table, a computer, three chairs, and other materials needed to conduct sessions (such as one data sheet, flash cards, one pencil, one timer, and one binder containing graphs of the participants' performance). During all sessions, the participants sat on a chair positioned in the middle of the table facing a wall, and the experimenter sat at the end of the table, to the right of the participants. Sessions lasted between 10 and 20 min and occurred once a day, on either two or three days within any given week.

Stimulus Materials

In Experiment 1 stimuli consisted of 100 flash cards containing whole number subtraction and division problems and division math facts and in Experiment 2 stimuli consisted of 200 flash cards containing whole number addition, subtraction, multiplication, and division problems and division math facts.

Table 1

Subtraction and Division Problems Used in Experiment 1

Subtraction Problems					Division Problems				
21-7	29-14	35-9	40-13	46-23	20/4	26/13	33/3	38/2	45/9
22-17	30 -11	35-16	41-21	46-24	20/5	27/3	33/11	38/19	45/9
23-14	30-18	36-23	42-8	47-14	21/7	27/9	33/11	39/3	46/2
25-9	31-27	36-16	42-16	47-15	22/2	27/9	34/2	39/3	46/23
26-11	31-25	37-11	43-21	48-12	22/11	28/2	34/17	42/3	48/4
27-14	31-27	37-12	44-15	48-16	24/3	28/14	35/5	42/14	48/12
27-14	32-12	37-14	44-17	49-11	24/8	30/3	35/7	44/4	49/7
27-24	33-6	38-5	44-19	49-18	24/12	30/10	36/6	44/11	50/2
28-9	33-24	39-16	45-19	50-19	25/5	32/4	36/12	44/22	50/5
28-19	34-17	39-19	45-33	50-27	26/2	32/8	36/18	44/22	50/5

Note. The subtraction and division problems that were printed on flash cards and used in Experiment 1.

Each whole number problem was printed horizontally in size 20 font and then glued onto a three-by-five inch white index card, with the problem appearing on the front of the card and the problem's answer appearing on the back. In Experiment 1, the minuends of the subtraction problems ranged between 21 and 50 and the subtrahends ranged between 5 and 23 (for example 29 – 14 =). In the division problems, the divisors ranged between 20 and 50 and the dividends ranged between 2 and 23 (for example 34 / 17 =). In Experiment 2, the addition problems' addends ranged from 11 to 99 (for example 64 + 16 =). In the subtraction problems for Experiment 2, the minuends ranged from 20 to 96 and the subtrahends ranged from 14 to 74 (for example 73 – 36 =). In the multiplication problems the multiples ranged from 2 to 19 (for example 16 x 5 =). In the division problems the divisors ranged from 12 to 98 and the dividends ranged from 2 and 9 (for example 68 / 4 =).

Measurement

The target responses measured in this study included correct responses, incorrect responses, and skip responses. Responses were scored as correct if the participants said the correct answer to the math problem on the flash card they were looking at. An incorrect response occurred when the participants said the incorrect answer to the math problem they were looking at. Skip responses occurred when the participants said, "Skip" when presented with any math problem.

Experimental Tasks

In each session in Experiment 1 the participants completed two experimental tasks: one composed of subtraction problems and another task composed of division problems. In Experiment 2, addition and multiplication problems were included. Each task was tested using a series of 30-s timings; during each timing the participant looked at the math problem on the flash card, said the answer, and then flipped the flash card over onto the table. After turning the card, the participant looked at the answer, and then looked at the math problem on the next flash card in the set and said the correct answer, the incorrect answer, or "Skip."

Pre-Training

A pre-training condition sought to teach the participants how to respond appropriately to math problems on flash cards and ensure that any changes in data during each participant's initial experimental condition were not due to practice effects associated with becoming more familiar with how to complete the task and manipulate

the cards. During pre-training, the experimenter showed the participants a set of flash cards that were only used during pre-training. Similar to the flash cards used during the experiments, math problems were printed on one side of each card and the answer was printed on the other side. Then the experimenter instructed the participants to look at a problem, say the answer aloud, and then turn the flash card over so the answer was face-up on the table. If they could not correctly answer the math problem, they were instructed to say, "Skip" then flip the flash card over, and go to the next flash card. After delivering the instructions, the experimenter demonstrated the responses described above. Immediately following the demonstration, the experimenter handed a set of flash cards to the participant and instructed them to practice the task. Once the participants demonstrated each response correctly (correct, incorrect, and skip responses) pre-training ended.

General Procedures

Before starting any experimental task, the experimenter put a set of 50 flash cards on the table in front of the participant with the math problem facing up and said, "You are going to go through these flash cards and answer as many math problems as you can. If you do not know the answer to a math problem say, 'Skip' and go to the next one."

Timings began once the participant acknowledged they were ready to start, after which the experimenter said, "Start" while pressing the start button on a digital timer set to count down from 30 s. During the timings the experimenter watched the participant and recorded each response they emitted as either a correct, incorrect, or a skip on a

data collection sheet. Once the timer counted down to zero the experimenter said, "Stop" and pressed the stop button on the timer. Following each 30-s timing, the experimenter counted the participant's responses and said, "That time you had (x) correct answers, (x) incorrect answers, and (x) skips per minute." Following this feedback to the participant, the experimenter shuffled the flash cards, put them on the table in front of the participant, and reset the timer for another timing. The same steps were repeated for all tasks.

At the conclusion of the experiment all but one participant received extra credit for their participation in this study in a class they were currently taking. Participant 2 received $19.48 for their participation time.

Interobserver Agreement (IOA)

IOA percentages for all dependent variables were computed for approximately 30% of the sessions throughout both experiments. IOA percentages between the experimenter and a trained independent observer were calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100, and ranged from 98.9% to 99.6%, with a mean of 99.3%.

Experimental Design

The effects of daily improvement goals on the level, trend, and, variability of correct, incorrect, and skip responses were evaluated using an alternating treatment design, with a reversal to baseline.

EXPERIMENT 1

Experimental Design

Independent and Dependent Variables

The independent variable for Experiment 1 was the difficulty of daily

improvement goals set for each participant. Specifically, the experiment employed two

levels of difficulty: (a) difficult-to-achieve daily improvement goals, and (b) easier-to-

achieve daily improvement goals. The difficult-to-achieve daily improvement goals were

determined using a goal line drawn on each participant's graph, a Standard Celeration

Chart (Pennypacker, Gutierrez Jr, Lindsley, 2003). The goal line drawn on the chart

reflected a rate of improvement where participants would double their last performance

in the previous session within one week's time if their correct responding remained on

the goal line. For example, if the participant made 6 correct responses per minute in the

last session of the previous condition, and that session happened to fall on a

Wednesday, the experimenter drew a goal line from 6 per minute on that Wednesday to

12 per minute on the following Wednesday on the standard celeration chart. The

intersection of that goal line with the particular calendar day during which data were

collected determined the daily improvement goal for the participants. Thus, the actual

number of correct problems that participants needed to achieve daily varied for each

participant, while the proportional rate of improvement (doubling each week) remained

constant across participants.

The easier-to-achieve daily improvement goals were set using a goal line that

reflected a rate of improvement where the participants doubled their last performance in

the previous session in approximately four weeks, rather than weekly doubling of

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performance as in the difficult-to-achieve goals condition. For example, if a participant emitted 6 correct responses per minute in the last session of the previous condition, and that session happened to fall on a Wednesday, then the experimenter drew a goal line from 6 per minute on that Wednesday to 7.5 per minute on the following Wednesday on the standard celeration daily chart. Thus, as with the difficult-to-achieve goals condition the actual number of correct responses that participants needed to achieve to meet their daily improvement goal in the easier-to-achieve goals condition varied from participant to participant, while the overall rate of imposed progress remained constant across participants.

The dependent variables for Experiment 1 were the level, trend, and variability of (a) correct, (b) incorrect, and (c) skip responses for each participant. The level of correct, incorrect, and skip responses was calculated by totaling the number of correct, incorrect, or skip responses recorded during five 30-s timings for each task. The trend of correct and incorrect, and skip responses was calculated by first determining the F value of the slope using the method of least squares according to Equation 1

$$\frac{Y' = R_{xy}S_y}{S_x}(X - Mx) + My \tag{1}$$

After determining the F value, the log-linear regression was transformed to the original units and then scaled to reflect my assessment of trend using the formula:

Slope value = 10 ^ (Scalar * log-linear slope)

where scalar = 7 days.

The scalar value reflects the period over which imposed rate of growth was defined (i.e., count per minute per day per week).

The results are described in terms of proportional change effect magnitudes

because the data were recorded and analyzed on the daily per minute standard celeration chart (SCC), which has a multiplicative (logarithmic) scale for its y-axis for rates, and an add-subtract (equal interval) scale for its x-axis for days of the week. "As data points increase in value over time, they indicate increasing rates of change. Because growth is proportional, the [SCC's] ratio scale produces straight accelerating lines if the…rate of change is being maintained" (Johnson & Layng, 1992).

The proportional change effect magnitudes reported here for level were calculated by reading the values of the highest and lowest level from the trend lines at the moment of change and then dividing the highest level by the lowest level. For example, Participant 1's level of correct responses for subtractions problems was 5.2 per minute in the last session of baseline. In the first session of treatment Participant 1's level of correct responses was 9.6 per minute. By dividing the highest level (9.6) by the lowest level (5.2) the result is an increasing proportional change effect magnitude of X1.8.

The proportional change effect magnitudes for trend were calculated in two ways depending on the direction of the comparison trend line and the treatment trend line. When the comparison trend line and the treatment trend line were in opposite directions, I multiplied the value of the accelerating line by the value of the decelerating line. When the comparison trend line and the treatment trend line were in the same directions, I divided the larger value by the smaller value. For example, Participant's 1's trend of incorrect responses was decelerating at /1.12 in baseline for subtraction problems. In treatment the trend of incorrect responses was accelerating at X1.37. By multiplying the value of the accelerating line (1.37) by the value of the decelerating

value (1.12), the result is an increasing change effect magnitude of X1.5. Measuring the amount of variability in the comparison condition and in the treatment condition, and then dividing the larger value by the smaller value calculated the proportional change effect magnitudes for variability. For example, Participant 1's variability of incorrect responses was X1.1 in baseline and X3 in the treatment condition. By dividing the larger value (3) by the smaller value (1.1) the result is a proportional change effect magnitude of X2.7.

For the purposes of this research, proportional change effect magnitudes of less than 1.25 per week were recorded as no effect because changes of such small proportion are not likely to be clinically significant in most applied contexts. For example, imagine that a second grade student was learning to answer subtraction problems correctly and at the beginning of the year the teacher set a distal goal of 60 correct responses per minute. If the student's level of correct responses was 10 per minute on the first day of class and their trend of correct responses reflected a rate of improvement where they doubled their last initial performance within nine week's time (X1.1 increase), at this rate it would take 45 weeks (more than an entire school year) for them to achieve the goal. What defines a rate of improvement as clinically significant may depend on the particular performance, the context, the individual's baseline levels, the level of the distal goal, and the deadline for achieving that goal. However given that goal setting is primarily used to increase low levels of performance and progress is often measured infrequently both in education and business, few goals would be achieved in either context if performance improved at such slow rates.

Baseline

Baseline measures were taken across all experimental tasks during which participants did not receive a daily improvement goal. In baseline, the experimenter made the following statement before a task began: "Let's work on (mathematical operation). At the end of each practice I will tell you how fast and accurate you were. Do your best!" Sessions ended when the participants completed five 30-s timings for subtraction and division. The number of baseline sessions ranged from three to eight and differed across participants.

Difficult-to-Achieve Goals Condition

This condition was similar to baseline except that before timings began, the experimenter said, "Your goal for (mathematical operation) for today is (some number) correct per minute." If the participant met their goal, the experimenter did not deliver feedback beyond reporting the number of correct, incorrect, and skip responses to the participant and the next timing was presented or the session ended if it was the tenth timing of the session. If the participant failed to meet the goal, the experimenter delivered no feedback and proceeded with the next timing.

Easier-to-Achieve Goals Condition

This condition was identical to the difficult-to-achieve goals condition except that the goals given were based on the slower imposed rate of growth as described above rather than on the faster imposed rate of growth imposed in the difficult-to-achieve goals condition.

Results

With 5 participants and between 2 and 4 experimental tasks, these experiments

produced 16 different individual graphs. Given this high number of graphs, I elected

instead to report results primarily as change effects across the level, trend, and

variability in participants' performance and to do so in tabular form. However, I present

only the complete graphed data for one experimental task for each participant in the

hopes that doing so will give readers a sense of what the participants' graphed

individual performances looked like.[*]

Figure 1 shows correct, incorrect, and skip responses for subtraction problems

for Participant 1. Participant's 1's performance for subtraction problems is graphed on a

standard celeration chart (SCC).[†] The *y*-axis on the SCC is a logarithmic scale (count

per minute), which ranges from .001 per minute at the bottom to 1000 per minute at the

top, and the *x*-axis is an equal interval scale (calendar days), which begins with 0 and

ends with 140. The vertical lines on the chart correspond to the days of a 20-week

period. The horizontal lines on the chart correspond to rate lines. The horizontal lines

drawn on 0.4 correspond to the total time the participant participated in timed practice

for subtraction problems each day (2 min 30 s). A closed circle represents cumulative

rate of correct responses per minute (total number of correct responses divided by 2.5

minutes); an X represents cumulative rate of incorrect responses per minute (total

number of incorrect responses divided by 2.5 minutes), and a triangle represents skip

response rates.

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[*] Any reader who would like to receive a copy of all graphs from all of the participants in these studies
may receive such graphs via electronic mail by contacting me.
[†] Standard celebration charts can be purchased from Behavior Research Company,
www.behaviorresearchcompany.com

Figure 1. The daily rates of correct, incorrect, and skip responses recorded each session across 5 30-s timings for substraction problems for Participant 1. Correct responses are represented by a closed circle, incorrect responses are represented by an X, and skip responses are represented by an open triangle.
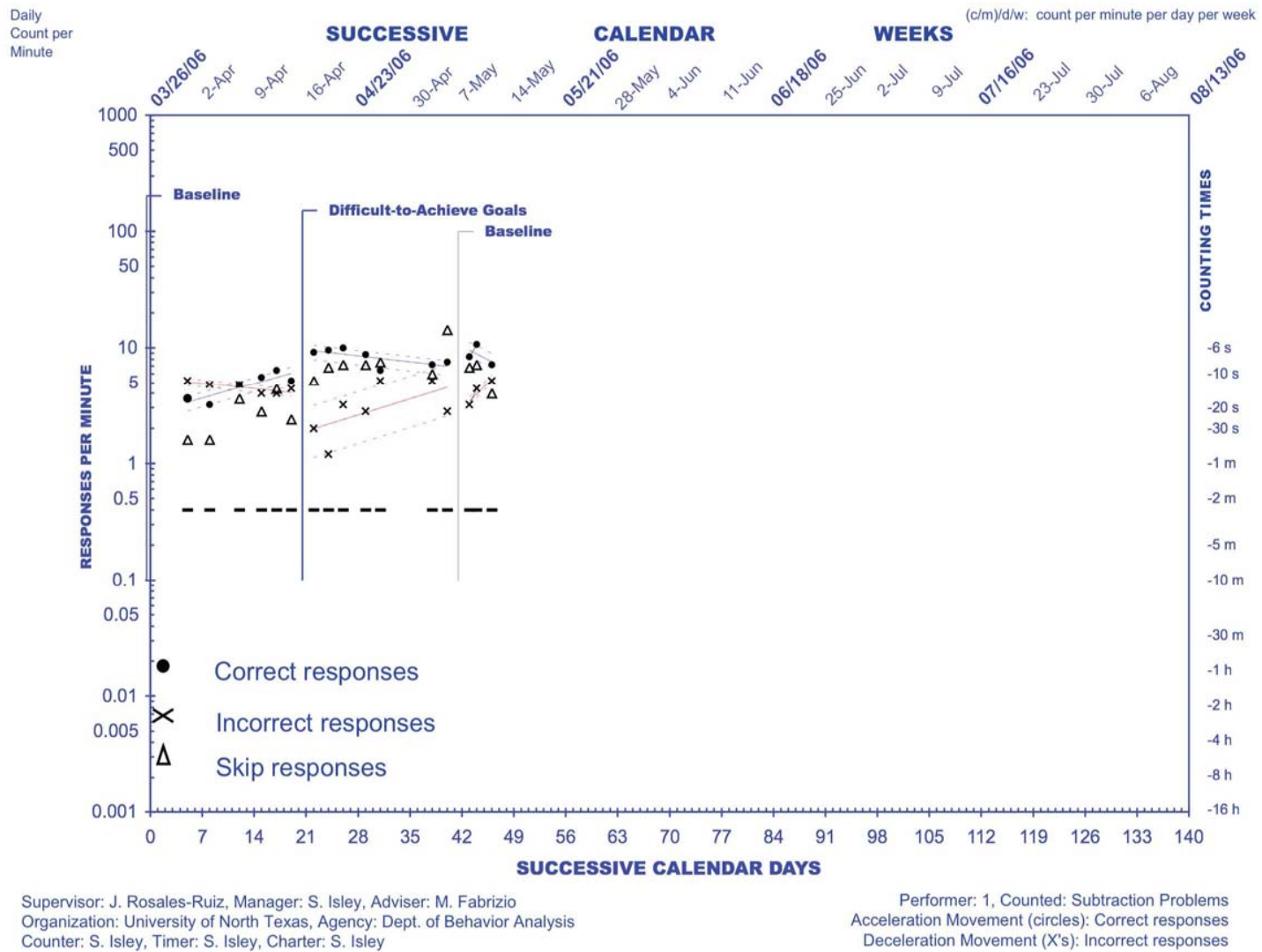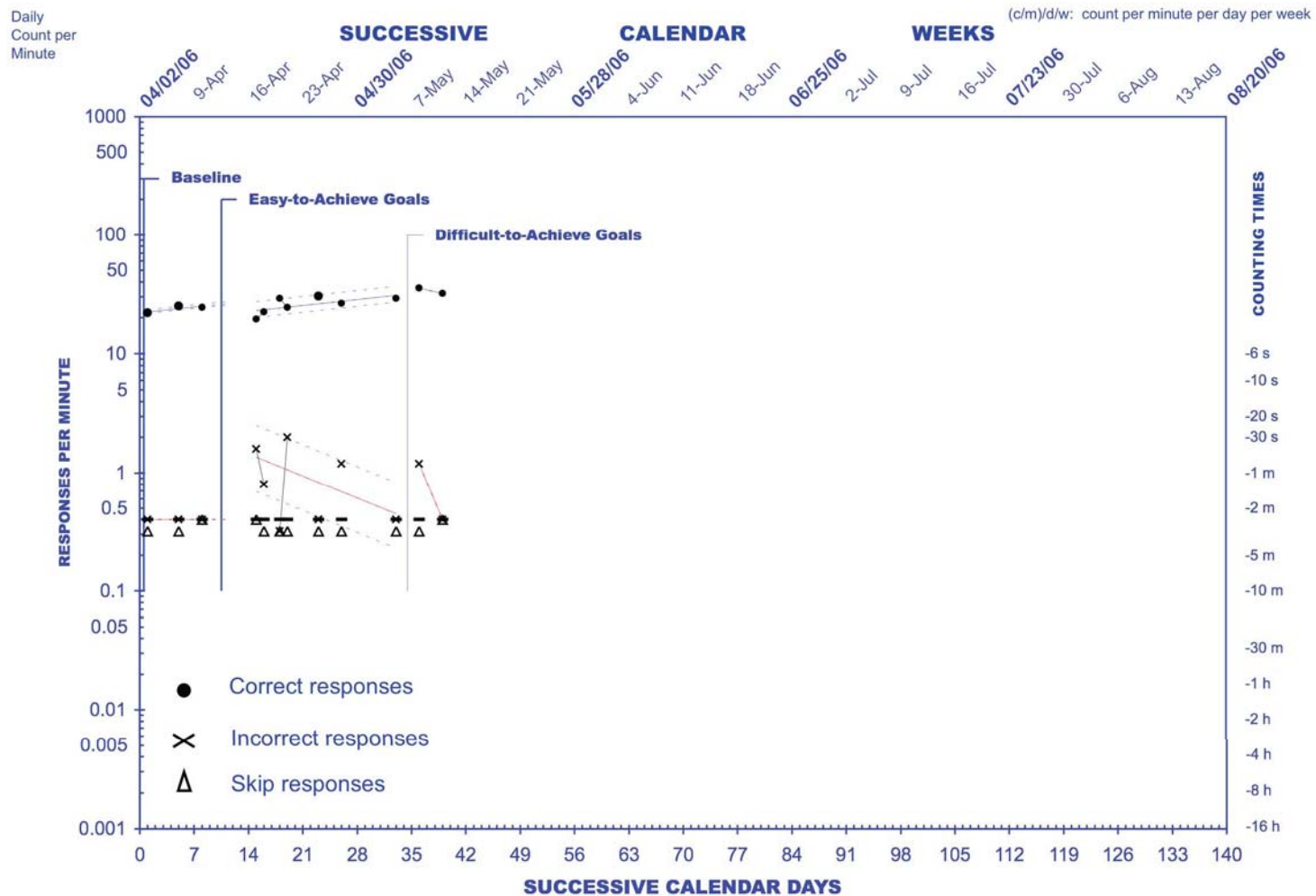
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Figure 2. The daily rates of correct, incorrect, and skip responses recorded each session across 5 30-s timings for division facts for Participant 2. Correct responses are represented by a closed circle, incorrect responses are represented by an X and skip responses are represented by an open triangle.

In baseline the trend of correct responses increased slightly from a beginning level of 3.6 to and ending level of 5.2 per minute. The trend of incorrect responses decreased slightly with a beginning level of 5.2 and an ending level of 4.4 per minute. The trend of skip responses was steeper than both trends of correct and incorrect responses. The level of skip responses doubled in a week from 1.6 to 3.6 with an ending level of 4.4 per minute.

The vertical line labeled difficult-to-achieve goals indicates when this condition began for Participant 1. In the difficult-to-achieve goals condition the level of correct responses immediately increased from 5.2 per minute in baseline to 9.2 per minute but then decreased to an ending level of 7.6 per minute. The level of incorrect responses immediately decreased from 4.4 per minute in baseline to 2.0 per minute but then increased to 3 per minute. The variability nearly tripled from baseline to the difficult-to-achieve goals condition. As for the skip responses, there were no changes effects in level; the only effects were a decrease in trend and in variability as a function of moving from baseline to the difficult-to-achieve goals condition.

The vertical line labeled Baseline indicates when the difficult-to-achieve goals condition ended. The return to baseline condition produced an increase in level and a decrease in the trend of the correct responses. For the incorrect responses, the effect was an increase in trend and a decrease in variability. For the skip responses there were no change effects in level or variability; the only effect was a rapid decrease in trend.

For both participants, levels of 1 or more alternative responses increased within conditions. The results show that for Participant 1 goal setting primarily affected the

level of skip responses (Figure 1). In baseline, the level of skip responses ranged from 1.6 to 4.4 per minute. In the difficult-to-achieve condition, levels of skip responses increased from 5.2 to 14.4 per minute. In a return to baseline, levels of skip responses decreased from 6.8 to 4 per minute.

The results show that for Participant 2 goal setting primarily affected levels of incorrect responses (Figure 2). In baseline, incorrect responses were at near zero levels. In the easier-to-achieve goals condition, levels of incorrect responses ranged from 0 to 2 per minute. In the difficult goals condition levels of incorrect responses ranged from 0.4 to 1.2 per minute.

To summarize the change effects across participants, experimental tasks, and dependent measures produced by manipulating the two levels of the independent variable, summary data are presented in tabular form. The data in Table 2 show the change effects in level, trend, and variability of correct, incorrect and skip responses for all treatment conditions for the experimental tasks (subtraction and division problems) for both participants in Experiment 1. The results suggest that daily improvement goals may have produced some weak but positive change in levels of correct responses for both participants. Participant 1's level of correct responses increased in 2 out of 3 treatment conditions whereas Participant 2's level of correct responses increased in only 1 out of 3 treatment conditions. However there were no consistent change effects in the level of correct responses across goals, participants, or tasks.

Table 2

Change Effects for Correct, Incorrect, and Skip Responses for All Treatment Conditions for Participants 1 and 2

Condition Changes	Task	Participant	Correct Responses			Incorrect Responses			Skip Responses		
			Level	Trend	Variability	Level	Trend	Variability	Level	Trend	Variability
From Baseline to Difficult-to-Achieve Goals	-	1	Increase X1.8	Decrease /1.5	No Effect	Decrease /2	Increase X1.5	Increase X2.7	No Effect	No Effect	Decrease /1.6
		2	No Effect	Decrease /1.3	No Effect	No Effect	Decrease /4.3	Increase X1.3	No Effect	No Effect	No Effect
From Easier-to-Achieve Goals to Difficult-to-Achieve Goals	/	1	No Effect	No Effect	No Effect	Increase X1.43	Decrease /1.7	No Effect	No Effect	No Effect	No Effect
		2	No Effect	No Effect	Decrease /1.3	Increase X1.79	No Effect	Decrease /3.3	No Effect	No Effect	No Effect
From Baseline to Easier-to-Achieve Goals	/	1	No Effect	No Effect	Decrease /1.3	Decrease /1.5	No Effect	Decrease /1.8	No Effect	Decrease /1.5	Decrease /1.7
		2	No Effect	No Effect	Increase X1.3	Increase X3	Decrease /1.5	Increase X3.1	No Effect	No Effect	No Effect
From Difficult-to-Achieve Goals to Baseline	-	1	Increase X1.5	Decrease /1.5	No Effect	No Effect	Increase X2	Decrease /3	No Effect	Decrease /5	No Effect
		2	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect

Note. The change effects in level, trend, and variability of correct, incorrect, and skip responses for all treatment conditions for subtraction and division math problems for both participants. The independent variables (difficult-to-achieve goals and easy-to-achieve goals) and the conditions that preceded them are listed under the heading Conditions. Under the heading Task, the division problems are represented by (/) and the subtraction problems are represented by (-).

The main change effects for both participants involved a decrease in the trend of correct responses and an increase in the level and variability of incorrect responses in the difficult-to-achieve condition. These effects were replicated across subtraction and division problems.

To quantify how often given change effects occurred (that is, a decreasing effect, an increasing effect, or no effect) across changes in experimental conditions, I calculated the number of times a particular change effect occurred across participants as each participant moved from one experimental condition to another and categorized those possible effects as either proportional increases or proportional decreases in each of the dependent measures across participants, tasks, and responses. Table 3 shows those calculations of repetition of effect across the dependent variables.

Table 3

Number of Times a Change Effect was Replicated across Participants

Condition S	Correct Responses						Incorrect Responses						Skip Responses					
	Level		Trend		Variability		Level		Trend		Variability		Level		Trend		Variability	
	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	/
Difficult-to-Achieve *n*=4	1	0	0	2	0	1	2	1	1	2	2	1	0	0	0	0	0	1
Easy-to-Achieve *n*=2	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0	1	0	1

Note. The two independent variables (difficult-to-achieve goals and easy-to-achieve goals) are listed under the heading Conditions. An increasing effect in level, trend, variability is represented by (↑), and a decreasing effect is represented by (↓).

The difficult-to-achieve goals condition was implemented 4 times across 2 participants, and two tasks. In this condition, the level of correct responses increased once, however the trend of correct responses did not increase in any of the four replications. The difficult-to-achieve goals condition also produced varying effects on the participants' incorrect responding. In the difficult-to-achieve goals condition, incorrect responses increased in level 2 times, decreased in trend 2 times, and increased in variability 2 times.

The easier-to-achieve goals condition was implemented 2 times across 2 participants and one task. In this condition, no change effect was replicated in level, trend, or variability of correct, incorrect, or skip responses across participants or tasks.

Discussion

The results of Experiment 1 showed that goal setting had differential effects on performance within and across participants. Goal setting increased the level and trend of 2 of the 3 measured responses: incorrect responses and skip responses, but goal setting did not affect the level or trend of correct responses. For Participant 1 skip responses increased in level and trend within both goal conditions, whereas for Participant 2 incorrect responses increased in level in both goal conditions. This is important because from the standpoint of a teacher, coach, or corporate manager these effects are far from desirable.

Performance managers typically set goals to increase both the level and trend of student or employee performance because they want to achieve outcomes such as accelerating student progress through a curriculum or boosting company earnings. Such contingency arrangers typically do not set goals aimed at increasing the number of times students fail to finish their homework (an analogue of the skip response used here) or the number of times their employees send a product to the wrong customer (an analogue of an incorrect response) and yet it appears from the data collected through Experiment 1 that goal setting produced just such effects.

The effects of goal setting on levels of correct responses were less consistent and robust in this experiment than in the findings reported by Locke et al (1981).

According to Locke and his colleagues, "48 studies partly or wholly supported the hypothesis that difficult goals lead to better performance than medium or easy goals." "Better performance" may be described in terms of data paths as an increase in the level of correct responses, a decrease in the level of incorrect responses, or possibly a decrease in the variability of correct and incorrect responses.

In this study goal setting only lead to "better performance" 1 out of 6 times it was implemented. Although the level of correct and incorrect responses changed in the predicted direction in the difficult-to-achieve goals condition for one participant, the variability of incorrect responses also increased, which is not a change that would indicate "better performance." Furthermore, the level and variability of incorrect responses actually increased 3 times, and the variability of correct responses increased 1 time in the goal setting conditions.

To ensure that the results from this experiment were not due to my failure to implement goal setting appropriately, I conducted a second experiment in which I increased the level of goal difficulty, and used a SCC as a way of showing participants their progress to provide them with more feedback. I increased the level of goal difficulty because to my knowledge, the specific goal difficulty levels that will increase the level and trend of correct responding (improve performance) for math problems printed on flash cards is unknown. Therefore, since research has shown that difficult goals lead to 'better performance' and 'better performance" was not observed in this study, I increased the goal difficulty level in Experiment 2 to see what effects would be observed if the value of both levels of the independent variables increased.

I elected also to increase the amount of feedback the participants received,

based on results from two previously published studies showing feedback amount to be a potentially important component of effective goal setting. In a 1996 meta-analysis Locke concluded that goal setting is most effective when progress feedback is given. Similarly, Vance and Colella compared two types of feedback and found that when individuals where far from reaching their goals, goals were abandoned. However, when individuals where given feedback about their performance in relation to (a) their best performance from the last session, and (b) their most current goal, they shifted their goals to exceeding past performance, rather than achieving the more difficult current goal.

Beyond increasing the values of both levels of the independent variable and increasing the amount of feedback that participants received, I added two new math tasks to increase the number of times each level of the independent variable was replicated, so that the nature of the relationship between the levels of the independent variable and the change effects could be more clearly observed.

EXPERIMENT 2

General Procedures

Some procedural changes from those employed in Experiment 1 were made to

the general procedures for Experiment 2. In each session for Experiment 2, the

participants completed 12 30-s timings (3 timings per task, 4 tasks). After each 30-s

timing, the experimenter graphed the results on a standard celeration timings chart

(SCC).[*] Each task was charted on a separate timings chart for all participants. After

the data were charted, the experimenter reported the number of correct, incorrect, and

skip responses to the participant while pointing to the symbol on the chart. Sessions

ended when the participants completed 3 30-sec timings each for addition, subtraction,

multiplication, and division.

Independent and Dependent Variables for Experiment 2

As with Experiment 1, the independent variable for Experiment 2 was the

difficulty of daily improvement goals set for each participant. However, in Experiment 2,

both the difficult-to-achieve and the easier-to-achieve goals were harder to achieve than

those used in Experiment 1.   In Experiment 2, the difficult-to-achieve daily improvement

goals were set using a goal line reflecting a rate of improvement where participants

doubled their level of performance from the previous session within 4 days (compared

to 7 days in Experiment 1's difficult-to-achieve condition), and the easier-to-achieve

daily improvement goals were set using a goal line reflecting a rate of improvement

where participants doubled their last performance in the previous session in one week

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[*] Standard celebration charts can be purchased from Behavior Research Company,
www.behaviorresearchcompany.com

(rather than doubling their performance in just under 4 weeks in Experiment 1's easier-to-achieve condition). The dependent variables for Experiment 2 were the same as Experiment 1.

Baseline

The only change made to the baseline procedures for Experiment 2 involved showing the participants their performance on a SCC after they completed each 30-s timing.

Feedback during the Difficult-to-Achieve Goals Condition
and the Easy-to-Achieve Goals Condition

There were two changes made to the way participants received feedback during the difficult-to-achieve and the easier-to-achieve goals conditions following Experiment 1. First, a goal box was drawn on the chart at the number of correct responses criterion each participant needed to achieve. This goal box provided participants with a visual referent of the criterion performance level they needed to achieve to meet the goal and showed them their progress towards reaching that criterion performance level as they completed each timing.

In the difficult-to-achieve goals condition a goal box was drawn for each day that a participant completed timed practices, whereas in the easier-to-achieve goals condition a goal box was drawn for each third day of participation. I elected to employ this procedure because in some instructional arrangements that use precision teaching, participants are given a specific number weekly goal and then instructed to keep their performance on or above an aim line drawn on the daily per minute SCC from their

baseline performance to the goal box. In the difficult-to-achieve goals condition a goal line was drawn on the graph from the participants' level of correct responses achieved in the first timing to the goal box. In the easier-to-achieve goals condition a goal line was drawn from the participants' level of correct responses achieved in the first timing of the condition across three sessions on a timings chart to the goal box.

The second change to the way participants received feedback in Experiment 2 involved the explicitness of the directions the experimenter gave them. Before timings began for each day, the experimenter showed the participants their graphs with the goal boxes drawn at the criterion performance level and said, "Your goal for (mathematical operation) for this week is (x) correct per minute. Try to keep your level of performance on or above the goal line and that will ensure that you will reach your goal of (x) correct per minute by next week."

Experimental Design

A counterbalanced parametric design element was used to evaluate the effects of difficult- and easy-to-achieve goals on the level, trend, and variability of correct, incorrect, and skip responses. A parametric design element is a within-series design in which levels of an independent variable are varied and each level is replicated within-subjects to determine the relationship between the levels of the independent variable (here, easier-to-achieve and difficult-to-achieve goals) and the effects on some dimension of behavior. In this study, the two levels of the independent variable were counterbalanced across times of the day and tasks order across participants.

Results

As with Experiment 1, because of the large number of individual graphs produced by the experiment I elected to show one participant's graphs for one of the experimental tasks in Experiment 2. Figure 3 shows correct, incorrect, and skip responses for subtraction problems for Participant 3.

The horizontal lines drawn on 0.7 correspond to the total time the participant participated in timed-practice for subtraction problems each day (1 min and 30 s). A closed circle represents rate of correct responses; an X represents rate of incorrect responses, and a triangle represents rate of skip responses.

In baseline, the trend of correct responses decreased slightly with a beginning level of 8.7 and an ending level of 6.7 per minute. The trend of incorrect responses increased steadily with a beginning level of 1.3 and an ending level of 2.3 per minute. There was very little variability within the correct or incorrect responses. The skip responses remained at zero levels for the first two sessions and then increased in level to 1.3 per minute in the final session of baseline.

The vertical line labeled difficult-to-achieve goals indicates when this level of the independent variable was implemented for Participant 3. In the difficult-to-achieve goals condition the correct responses increased in level from 6.7 per minute in baseline to 10.7 per minute and remained close to this level for 6 more sessions. The trend in correct responding showed almost no increase. Incorrect responding decreased in level and trend but increased in variability by more than three times that of baseline performance.
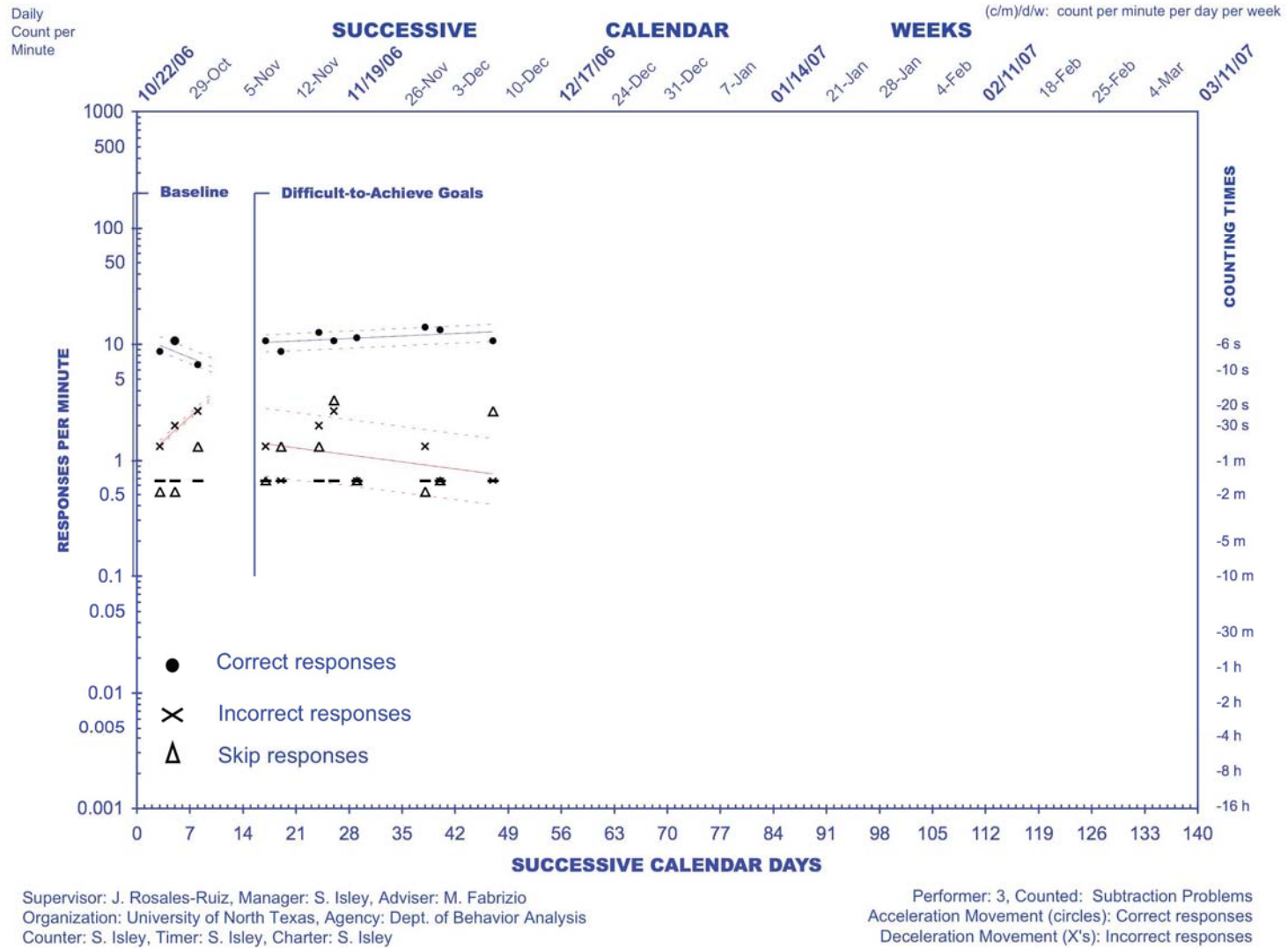
Figure 3. The daily rates of correct, incorrect, and skip responses recorded each session across 3 30-s timings for subtraction problems for Participant 3. Correct responses are represented by a closed circle, incorrect responses are represented by an X and skip responses are represented by an open triangle.

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The data in Table 4 summarize the change effects in level, trend, and variability of correct, incorrect and skip responses for all treatment conditions for addition, subtraction, multiplication, and division problems across the 3 participants in Experiment 2. The results show that levels of both correct and incorrect responding increased in the difficult-to-achieve goals condition for all participants and both decreased for Participants 3 and 4 in the easy-to-achieve goals condition. Additionally, the trend of correct responding only increased in the difficult-to-achieve goals condition for Participant 5 on multiplication problems.

To quantify how often a given effect (that is, a decreasing effect, an increasing effect, or no effect) occurred across changes in experimental conditions, I calculated the number of times a particular change effect occurred across participants as each participant moved from one experimental condition to another as in Experiment 1. Table 5 shows those calculations of repetition of effect across the dependent variables for Experiment 2.

The difficult-to-achieve goals condition was implemented 11 times across 3 participants, and four tasks. In this condition, the level of correct responding increased 4 times, the trend of correct responding increased 1 time, and the variability increased 1 time. The level and variability of incorrect responses increased 5 times, and also decreased 5 times.

The easier-to-achieve goals condition was implemented 5 times across 3 participants and 2 tasks and appeared to produce little effect on the participants' performance. In this condition, the only change effects replicated involved the level of correct and incorrect responses, both of which increased 2 out of 5 possible times.

Table 4

Change Effects of Correct, Incorrect, and Skip Responses for All Treatment Conditions for All 3 Participants

Condition Changes	Task	Participant	Correct Responses			Incorrect Responses			Skip Responses		
			Level	Trend	Variability	Level	Trend	Variability	Level	Trend	Variability
From Baseline to Difficult-to-Achieve Goals	+	3	No Effect	No Effect	Decrease /1.6	No Effect	Increase X1.3	Decrease /1.5	No Effect	No Effect	No Effect
		4	Increase X1.3	No Effect	No Effect	No Effect	No Effect	Decrease /1.5	Increase X2.3	Decrease /1.9	Decrease /2.5
	-	3	Increase X2	No Effect	No Effect	Decrease /2	Decrease /2	Increase X4	No Effect	No Effect	Increase X3.4
		5	No Effect	No Effect	Decrease /2	No Effect	No Effect	Decrease /4	No Effect	No Effect	No Effect
	X	3	No Effect	No Effect	No Effect	Increase X1.6	Increase X1.4	No Effect	No Effect	Increase X13.8	Decrease /3
		5	Increase X1.8	Increase X1.8	No Effect	Decrease /1.6	Decrease /2.7	Increase X2.9	No Effect	No Effect	Decrease /1.4
	/	4	No Effect	No Effect	No Effect	Increase X1.5	No Effect	Increase X2.9	Increase X4	Decrease /1.4	Increase X2.9
		5	Increase X1.5	No Effect	Decrease /2	Increase X1.6	Decrease /1.8	Decrease /2.1	Decrease /5	Increase X6.8	Decrease /3
From Easier-to-Achieve Goals to Difficult-to-Achieve Goals	+	4	No Effect	No Effect	No Effect	Decrease /1.3	No Effect	Decrease /1.7	Increase X1.6	Increase X2.4	No Effect
		5	No Effect	No Effect	No Effect	Increase X2	No Effect	Increase X2	No Effect	No Effect	No Effect
	/	3	No Effect	No Effect	Increase X1.3	Increase X1.7	Increase X2.8	Increase X2.8	No Effect	No Effect	No Effect
From Baseline to Easier-to-Achieve Goals	+	4	Increase X1.3	Decrease /1.8	No Effect	Increase X2.4	Increase X2.5	Increase X1.6	Increase X2	Increase X3	No Effect
		5	No Effect	No Effect	No Effect	No Effects	No Effect	Decrease /1.3	No Effect	No Effect	No Effect
	/	3	Increase X1.3	No Effect	No Effect	Increase X.1.7	No Effect	No Effect	No Effect	Decrease /2	No Effect

Note. The change effects in level, trend, and variability of correct, incorrect, and skip responses for all treatment conditions for addition, subtraction, multiplication and division problems for all 3 participants. The independent variables (difficult-to-achieve goals and easy-to-achieve goals) and the conditions that preceded them are listed under the heading Conditions. Under the heading Task, the addition problems are represented by (+), the subtraction problems are represented by (-), the multiplication problems are represented by (X), and division problems are represented by (/).

Table 5

Number of Times a Change Effect was Replicated across Participants

Conditon	Corrects						Incorrects						Skips					
	Level		Trend		Variability		Level		Trend		Variability		Level		Trend		Variability	
	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓
Difficult-to-Achieve *n*=11	4	0	1	0	1	3	5	3	3	3	5	5	3	1	3	2	2	4
Easier-to-Achieve *n*=5	2	0	0	1	0	0	2	0	1	0	1	1	1	0	1	1	0	0

Note. The two independent variables (difficult-to-achieve goals and easier-to-achieve goals) are listed under the heading Conditions.

Discussion

Similar to Experiment 1, the results of Experiment 2 showed that while some positive change was observed in the participants' level of correct responding, goal setting based on those correct responses primarily affected the level of incorrect responses and the level and trend of skip responses. One difference that occurred in Experiment 2 was that the most difficult goal condition had a slight positive influence on the trend of correct responses for one participant.

In Experiment 1 the effects of goal setting on levels of correct responses were less consistent and robust compared to findings reported by Locke, *et al* (1981). Because of this contrary finding, in Experiment 2 I increased the difficulty level of goals. Furthermore, I increased the amount of feedback participants received. Although past research demonstrated that showing participants their progress in relation to the goal influences the effectiveness of goal setting (cf., Locke et al. 1981), it is likely that increasing the goal difficulty level produced the slight positive effect on the level of correct responses in Experiment 2 rather than that effect being attributable to the

increased feedback because participants very rarely achieved their goals in Experiment 2, thus potentially masking the reinforcement effects of seeing their progress in relation to the goal. During each session in the difficult-to-achieve goals condition the experimenter multiplied the value of the participants' level of correct responses from the previous session by 1.25, thus the goal difficulty level was often increased even though participants rarely achieved their daily improvement goals in the previous session, thus never coming in contact with the potentially reinforcing effects associated with goal attainment. As a result, participants rarely received visual feedback showing they achieved the daily improvement goal.

GENERAL DISCUSSION

Overall, the results of both experiments show that goal setting had differential effects on different aspects (level, trend, or variability) of the participants' performance, both within and across participants. Although some positive change was observed in the level of correct responding of all participants, goal setting primarily increased the level of incorrect responses and both the level and trend of skip responses. These findings are important for practical reasons because, as mentioned earlier, contingency arrangers such as teachers and corporate managers typically set goals that seek to increase the correct responding of their students or employees, not goals that seek to increase other types of responses such as skips or errors.

Although no previous research has directly investigated the effects of goal setting on correct, incorrect and skip responses separately, these findings can be discussed in the context of one mediating variable of goal effects—task complexity. According to Locke and Latham (2002) as the complexity of tasks increase, goal effects will depend on individuals' ability to discover appropriate new task strategies to complete the task if they do not have the prerequisite skills necessary to do so. For example, let us assume that a student decides that their goal for their research methods class is to make an A+ grade. The entire grade for the class is based on one research paper, however the student cannot write proficiently. In this case, the effects of goal setting will depend on whether the student chooses an appropriate topic, reads extensively through the literature, manages their time well (for example, writing a small portion each day), and solicits frequent feedback about their writing from a skilled writer. In addition, because

individual repertoires vary greatly "the effect size for goal setting is smaller on complex [tasks] than on simple tasks" (Locke & Latham).

Although participants in these studies completed no assessment prior to either experiment to determine if they had the necessary prerequisite skills in their repertoire to complete the math tasks, the findings suggest that the preparation of the materials may have restricted the participants from achieving their goals by requiring them to solve computation math problems without a pen or pencil or calculator resulting in effects similar to those observed with more complex tasks. For example, in Experiment 1 Participant 2's level of correct responses while solving subtraction problems only increased from 7.2 to 14 per minute in eight sessions in the difficult-to-achieve goals condition. Similarly, in Experiment 2 Participant 3's level of correct responses while solving subtraction problems only increased from 10.7 to 14 per minute in 8 sessions in the difficult-to-achieve goals condition. These results affirm that if there is too large of a gap between the expected level of performance and the individual's current level of performance, the gap cannot be reduced solely by setting difficult-to-achieve goals.

Following Experiment 1, I increased the level of goal difficulty because the findings were inconsistent with those from goal setting literature; and to my knowledge the specific goal difficulty levels that would improve performance for math problems printed on flash cards was unknown. Beyond just increasing the difficulty level of the goals set, I also used a standard celeration chart (SCC) as a way of showing participants their progress as an additional means of providing them with feedback based on findings by Locke (1996) that goal setting is most effective when progress feedback is given. The procedural changes made following Experiment 1 had little effect

on the participants' levels of correct responses. The only differences that were observed following the procedural changes involved a slight increase in the trend of correct responses and a slight decrease in the variability of correct responses in the difficult-to-achieve goals condition in Experiment 2.

<center>The Current Findings within the Context of
Previous Research on Goal Setting</center>

To compare the findings from these experiments to the findings reported in the research from the area of organizational/industrial psychology, I divided the findings into themes similar to Locke and his colleagues (1981). These themes related to (a) the effects of setting various types of goals on task performance; and (b) the variables that influence the effectiveness of goal setting. The main finding within the extant literature relating to setting various types of goals indicates that setting specific goals that are difficult to achieve leads to better performance than easy-to-achieve goals, do-your-best goals, or setting no goals at all. In the data reported here, the slope of correct responses (one indicator of better performance across time) increased for some participants in the most aggressive goal condition, which is partially consistent with Lock et al.' (1981) findings. In addition, the reduction in variability of correct responses for some participants was consistent with Locke and Latham's (2002) findings that setting specific goals reduces variation in performance, thus producing what may be better performance under some conditions.

In relation to the variables that influence the effectiveness of goals, Locke et al. (1981) concluded that goal setting will most likely improve performance when participants receive specially arranged programmed consequences (such as money)

<center>43</center>

related to achieving the goals and when the participants see their progress in relation to their goal. However, the results of this study show that goal setting increased the level of correct responding across participants, tasks, and conditions when no programmed consequences were delivered for achieving the goals and that the increased feedback participants received in Experiment 2 produced no concomitant improvements in performance. From a practical standpoint, these results are important because in terms of time and costs it would be nearly impossible for teachers, coaches, and corporate managers to deliver programmed consequences each time their students, athletes, or employees achieved every goal set for them, and it appears that at least under some conditions such specially arranged consequences may be unnecessary. It still remains unknown how often programmed consequences (such as money) must be delivered to improve performance with goal setting and what specific goal difficulty levels will improve performance for similar tasks. Ultimately, the fact that the participants' levels of correct responding increased in the absence of programmed consequences related to achieving the goals demonstrates the need for more fine-grained parametric analyses around goals setting.

From a theoretical standpoint, these results are consistent with those researchers who suggest that setting goals may affect performance similarly to the way verbal stimuli affect verbally mediated behavior (rule governed behavior) (Fellner & Sulzer-Azaroff, 1984; Malott, 1992; O'Hara & Maglieri, 2006). For example, in Experiment 2 when the experimenter told the participants their daily improvement goal and then instructed them to keep their level of performance on or above the goal line to ensure that they will achieve the goal in the desired amount of time, those verbal stimuli

may have begun to mediate the participants' problem solving behavior on the experimental tasks.

The results of Experiment 2, which show that goal setting primarily affected the level, trend, and variability of skip responses, producing only minimal change in the level and trend of correct responses, may be explained by at least 2 possibilities. First, the participants may have reached a performance ceiling in completing their math problems, which they could not have surpassed with practice alone. A performance ceiling is a term used to describe conditions in which the level or trend of an individual's graphed performance flattens because the behavior is complex and requires a mastery of several simpler responses or because the procedures and materials used prevent the participant's performance from increasing.

Potential Methodological Limitations, Their Possible Effects,
and Recommendations for Future Research

Some participants' correct responding may have contacted extinction conditions as a result of two potential methodological limitations. It is possible that some participants' correct responding leveled off because the types of math problems used in these experiments are typically presented on a worksheet requiring people to write answers rather than on flash cards requiring answering aloud. This change in contingencies may have slowed the participants' rate of progress because instead of responding overtly and producing a permanent product on paper, which may have occasioned the next response in the chain, their responding was constrained to a subvocal level, which produced no permanent product and fewer occasioning stimuli.

Furthermore, the measures used in this study (correct answers) may not have

been as sensitive to changes in the independent variables as they could have been had

the unit of measurement been more closely calibrated. An example of a unit of

measurement that is more closely calibrated for computation problems is movements

per minute (such as crossing out a number and writing a number) or digits per minute.

Rather than employing such smaller, more closely calibrated measures, this study

employed broader measures of larger units of behavior (correct answers). Because of

this reliance of measurement on larger units of behavior the effect size of goal setting

may have been smaller and more similar to performance on complex tasks, even

though relatively simple mathematics tasks were used. For example, in Experiment 1

Participant 1 achieved the daily improvement goal for subtraction problems in each of

the first 3 sessions in the difficult-to-achieve goals condition, but then did not achieve

the daily improvement goal once in the following 4 sessions. Similarly, in Experiment 2

Participant 5 achieved the daily improvement goal for addition problems in 2 out of the 3

sessions in the easier-to-achieve goals condition, but then after the experimental

conditions changed to the difficult-to-achieve goals condition, they did not meet the daily

improvement goal once in the following 5 sessions.

As an example of changes that I might have seen had the measures been more

closely calibrated, consider Participant 1's correct responding while solving subtraction

problems. Had the measures employed been more closely calibrated, Participant 1's

level of correct responses for subtraction problems might have continued to increase in

the difficult-to-achieve goals condition. In the third session of the difficult-to-achieve

goals condition Participant 1 achieved the daily improvement goal, which was 12 correct

responses per minute for the third consecutive time. In the next session the goal

difficulty level was increased to 14 correct responses per minute. In the following 4 sessions Participant 1 did not achieve that goal, and they only answered 12 subtraction problems correctly once in 25 timings. Considering that up to 7 movements can be made to answer 1 subtraction problem it is likely that Participant 1's level of correct responses decreased from 12 to 6 per minute as a result of ratio strain, an effect that might have been avoided if the measures were calibrated more closely.

The addition, subtraction, and multiplication problems required carrying and borrowing numbers and the answers to these problems were, for the most part, two or three digits, rather than simple math fact sentences such as "5 X 3 = 15." Because of this difference between simple math fact sentences and the multiple-step computation required of the participants, results may have shown more increases in performance levels as a function of goal setting if the math problems were presented on a worksheet requiring respondents to write answers, and the goals were based on each correct step in a multiple step solution or if the goals were based on digits rather than correct whole answers. For example, up to 7 steps may be taken to solve the problem 45 – 29. The 7 steps include: (1) cross out the number four, (2) write the number three over the crossed out number four, (3) write the number one next to the number five (4) subtract nine from fifteen, (5) write the number 6 in the ones column of the answer, (6) subtract two from three, and (7) write the number 1 in the tens column of the answer. These 7 steps would have produced at least 5 different written responses for this problem (steps number 1, 2, 3, 5, and 7). This is important from a sensitivity standpoint because the more sensitive is the measures employed the easier it is to identify changes in the dependent variable as a function of the independent variable. Furthermore, if the goals

were based on digits for the same problem and the participant answered, "11", 2 correct responses would be scored. As anecdotal support for the possibility that the measures I employed may not have been sensitive enough to detect small changes in the dependent variables, some participants used their fingers to cross out and borrow numbers, while others skipped numerous problems during timings to find those they could answer correctly without borrowing or carrying numbers.

In addition to not reinforcing these alternative responses, the extinction contingencies (not achieving the goal) also may have produced some observed emotional responding such as cursing and uttering self-deprecating statements, (such as "I suck at math" "I'll never meet my goal") and a decreasing trend in correct responding. Furthermore, the following statement was written in an email sent by a participant in Experiment 2 to the first author: "Your research is having a major negative effect on my self-esteem." In 2 out of the 4 goal conditions implemented with Participant 3, a decreasing trend occurred in correct responding and in the other 2 goal conditions (addition and subtraction); functionally, no increasing trend emerged for correct responses for Participant 3.

As further evidence of the need to revise the behavior counted towards goal attainment in future research for these type of math exercises, although the division problems were printed on flash cards and the goals were based on the number of correct responses, these problems did not require carrying and borrowing numbers and as a result all participants' reached the highest levels of correct responding in this task.

Practical Implications of the Current Study
for Goal Setting in Applied Settings

The findings from Experiments 1 and 2 indicate that goal setting must implemented carefully in treatment packages that contingency arrangers put into place to improve participants' performance in academic tasks. If treatment packages with goal setting are not closely monitored they can have adverse effects on performance as mentioned above including increases in the level and trend of skip responses and increases in level, trend, and variability of incorrect responding when goals are not put in place carefully. For example, if kindergarten teachers set difficult-to-achieve reading goals for their entire class and then fail to monitor each student's progress individually towards those goals, some students may avoid reading tasks by engaging in other, less desirable behaviors such as refusing to respond or engaging in disruptive behavior. If corporate managers set difficult-to-achieve goals for only a few departments and fail to monitor the change effects within the organization, some employees may make costly errors or avoid work.

The authors recommend that teachers, managers, coaches, and any other professionals whose primary responsibility is to improve performance follow these 4 guidelines when implementing goal setting to improve performance. First, conduct an assessment to identify if the students have the prerequisite skills to complete the task for which goals will be used. One way to do this is to set low goals for the target task and deliver reinforcers contingent on meeting or exceeding the goals. If the students' performance does not improve, then it is likely they are missing the prerequisite skills or that the measures being used are not sensitive enough to detect small changes in performance. Second, when setting performance goals, use daily (proximal)

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improvement goals and weekly or monthly (distal) improvement goals in combination. For example, a biology professor may set a goal for her students for the semester: "By the end of the semester everyone is expected to write the definitions for these 50 terms." She may also set incremental improvement goals for her students: "By next class everyone is expected to write the definitions for these three terms."

Third, set the daily improvement goals based on the students, employees, or athletes' previous best performance rather than based on some pre-determined rate of improvement. For example, if after drawing a trend line on a graph reflecting a rate of improvement based on a performer's previous performance one observes a deviation from the trend, draw a new line that more closely reflects the performer's changing rate of improvement. This is recommended because trends of performance can increase, decrease, or flatten fairly rapidly. To maximize progress, goals should always be set based on the most current performance measures. For example a corporate manager may set an improvement goal for each one of her sales representatives based on their individual previous best monthly performance such as: "Given your previous best performance was $4,100.00, your goal for this month to sell $5,000.00 worth of merchandise."

Fourth, measure the level, trend, and variability of the participants' performance within and across time periods.

Recommendations for Future Research

Based on my review of the extant literature, one account for the inconsistencies in findings between disciplines has been a general lack of methodological rigor (Burton

et al., 2001). One of the many strengths of behavior analysis involves the methodological rigor with which behavior analysts study the effects of independent variables on dependent variables. Behavior analysts may play a significant role in extending the parametric analysis of the variables that influence goal setting by bringing experimental rigor to bear in a collaborative partnership with other practitioners such as sport psychologists.

I recommend that future research employ single case design elements (such as parametric design elements) to evaluate the effects of goals on performance and the variables that influence the effectiveness of goal setting (such as feedback, programmed consequences, goal commitment, task complexity, self efficacy, participant selected goals). Based on the number of variables that have been shown to influence the effectiveness of goal setting I suggest that researchers begin by simplifying their procedures. Using the Skinner box as a model I recommend that researchers (a) develop an operandum that permits more free operant responding, (b) select and define a target behavior, (c) establish baselines without thresholds that do not constrain the response. Based on the inconsistent findings among the different disciplines, it is clear that standard procedures for investigating the effects of goal setting need to be established. So maybe the first step toward a functional approach to goal setting may be for researchers to explicitly and thoroughly describe their experimental procedures in hopes that other researchers will replicate them in their own laboratories.

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