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Academic Performance as a Perceived Function of Ability and Effort[1]

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Subjects made predictions of the grade point averages of hypothetical students who varied over complete continua of scholastic ability and effort. Subjects in Study 1 made their predictions on the implicit assumption that target students were drawn from a student body chosen via selective admissions criteria. Study 2 subjects assumed that the ability range was one resulting from a "first-come, first-served" open-admissions policy. Although the ability assumption inductions, as intended, led to performance level predictions that were differently dispersed, the basic patterns of subjects' predictions were essentially the same in both studies: For the overwhelming majority of subjects, ability and effort were perceived to affect scholastic performance additively rather than multiplicatively, thus contradicting the suggestions of previous theory. In addition, students with high ability were anticipated to perform reasonably well even when exerting practically no effort. Theoretical interpretations and practical implications of these results are introduced and discussed.

What accounts for the amount of effort a student devotes to his/her studies? According to intuition and contemporary cognitive theories of motivation (cf. Weiner, 1972, 1974; Lawler, 1973; Korman, 1974), the relationship between effort and academic performance as perceived by the student surely has a role in the determination of his/her scholastic motivation. It seems that the student's perception of his/her ability should affect

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the vigor of his/her efforts also. Just how *do* students conceive of the contributions of effort and ability to scholastic performance and what are the potential implications of those perceptions? These are the issues addressed by the present studies.

It has generally been assumed (and partially demonstrated) that ability and effort combine multiplicatively to determine actual performance level at a task (Vroom, 1964; Lawler, 1973). Some observers have also maintained that the *perceived* relationship among ability, effort, and performance should have a similar form (Heider, 1958; Anderson, 1974b). The thrust of the argument is rather compelling, too. If a person has no ability for a task, no amount of effort should permit him/her to be at all productive at the task. Similarly, if the person devotes no effort, there is "obviously" no chance that he/she can achieve any measure of success at anything. As reasonable as these notions seem, do students really believe them? Do these principles apply in realistic scholastic settings? If so, they have a great deal of practical significance, as illustrated by Figure 1. If a student has essentially no ability for a task, it would be a waste of time for him/her to devote any effort to it; no amount of effort would prove to be fruitful. The higher his/her ability level is, however, the more profitable it is to invest relatively large amounts of effort.

Now, the actual amount of effort a student allocates to his/her scholastic endeavors probably depends on a variety of things, including the perceived consequences of good and bad performance as well as the "costs" of effort, e.g., enjoyable activities forgone for the sake of study. Nevertheless, it is clear that a "proper" allocation of effort is facilitated by the student having an accurate anticipation of the performance consequences of his/her potential motivational investments.

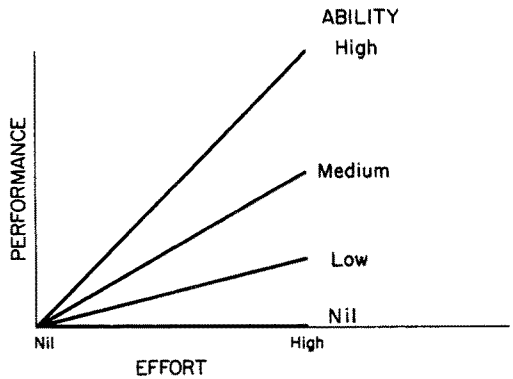

Fig. 1. Hypothetical effort–performance relationships for differing ability levels.

The approach of the present studies was straightforward. Subjects were presented with representations of hypothetical students described in terms of their ability levels and the extent to which they applied themselves to their academic work in the university with which the subjects were familiar. The task of the subjects was simply to anticipate the grade point average the hypothetical student in each scenario would be most likely to receive. The resulting response patterns could then be subjected to appropriate analyses to infer perceptions of ability, effort, and performance relationships.

STUDY 1

Method

Subjects. All subjects in Study 1 were students at the University of Michigan who had completed at least one term of studies. They were recruited through the Human Performance Center's paid subject pool and received $3.75 for their participation in the study. The sample of 20 subjects was evenly divided between males and females. Their self-reported grade point averages (4-point scale) ranged from 1.9 to 3.8.

Stimuli. The 98 stimuli to which each subject was exposed were displays of ability–effort profiles of hypothetical University of Michigan students. Each student could assume any one of seven levels of ability and any one of seven levels of effort. There were thus 49 distinct ability–effort combinations represented in the stimulus set. Each of those combinations was duplicated, thus accounting for the entire collection of 98 displays. The stimuli were presented to each subject in a distinct random order.

Apparatus. Hypothetical student ability–effort profiles were displayed to subjects on 30.5-cm diagonal Ball Miratell cathode ray tubes. As many as three subjects could be run simultaneously and independently on separate tubes contained in semienclosed booths. Each profile display consisted of two vertical Likert-type scales, one of which represented Effort and was bounded by anchors symbolizing No Effort and Greatest Possible Effort. The other vertical scale was labeled Ability and had anchors representing Minimum Ability and Maximum Ability. On any one trial, each scale contained an X at any one of seven equally spaced locations from the top to the bottom of the scale. Appearing beneath the vertical effort and ability scales was a horizontal grade point average (GPA) scale, extending from .0 (grade of E, failing performance) through 4.0 (grade of A/A+, excellent performance).

Each subject was provided with a response button panel to control the presentation of profiles and to record the GPA he/she anticipated for the hypothetical student represented by each profile. The GPA scale accompanying each profile contained an arrow that could point to any one of 41 equally spaced positions along the scale, i.e., corresponding to all GPAs in tenths of points from .0 through 4.0. Each trial began with this cursor located at the middle of the GPA scale, at 2.0. The control panel contained buttons that allowed the subject to move the cursor back and forth along the scale as often as he/she desired. When the cursor was located at a point corresponding to the GPA the subject anticipated for the student represented by a given profile, he/she could have this judgment recorded by pushing a rating response button on the panel. Recording of an anticipated GPA resulted in the display of the next profile in the sequence. The apparatus also included a button that allowed the subject to repeat a trial in the event he/she accidentally depressed the rating response button. The entire apparatus was under the control of an IBM 1800 data-processing system.

Procedure. The subject was told that the study concerned "how students perceive effort and ability to affect performance in school." He/she was told that he/she was to predict the GPAs earned for a given term by hypothetical undergraduate sutdents enrolled in the university's arts and sciences college. The subject was to assume that each student was taking a "normal load of 15 credit hours in courses that are of average difficulty" in the college.

The subject was then acquainted with the profile format. Care was taken to establish the appropriate psychological scales for effort and ability. So, the subject was asked to "bring to mind the range of effort levels a student could conceivably devote to his or her studies." He/she was then to imagine that range to be divided into seven equally spaced levels of effort, with 1 representing No Effort and 7 symbolizing Greatest Possible Effort. The subject was provided with an exemplar of the kind of graphical representation of his/her psychological effort scale that would be used later in the procedure. The subject was asked to construct a similar psychological scale for ability, extending from 1 for Minimum Ability to 7 for Maximum Ability. Minimum Ability was defined as "the ability of the *least* academically able student you can imagine in the university." The subject was to interpret Maximum Ability as "the ability of the *most* academically capable student you can imagine in the university."

The subject then made practice GPA predictions for four hypothetical students using a paper-and-pencil display and response format. After instruction and five practice trials using the computer-controlled display and response apparatus, the subject made predictions of GPAs for all 98 of

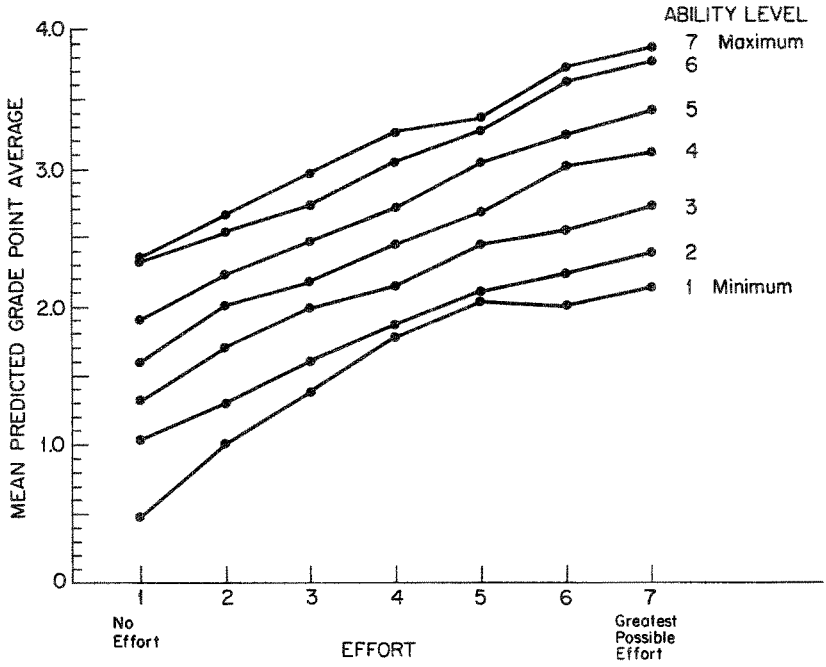

Fig. 2. Mean predicted grade point averages as functions of effort for various ability levels, Study 1 (current-admissions policy).

the hypothetical students represented by the stimuli. When this task was finished, the subject completed a postexperimental questionnaire inquiring as to the subject's personal conceptions of what ability and effort mean in the context of academic work. The end of the questionnaire also contained additional items not relevant to the present investigation. Subjects generally completed the entire procedure within 1 to 1½ hours.

Results and Discussion

Because individual differences are at the heart of motivation and decision processes, the appropriate level of analyis for the data provided by subjects is individual. Nevertheless, the graph of mean responses across subjects contained in Figure 2 is quite representative of the individual results.

There are two particularly noteworthy aspects of the results as illustrated by Figure 2. Perhaps the most striking feature of the display is that the graph does not exhibit the diverging fan effect consistent with the

hypothesis that performance level is a multiplicative function of effort and ability. Analyses of variance applied to individual subjects' responses are compatible with the impression conveyed by the graph. Not surprisingly, in all cases the main effects of effort and ability on performance judgments were significant statistically ($p \ll .01$ for 37 of 40 effects, $p < .05$ for the remaining effects). For 12 of the 20 subjects there was a statistically significant effort X ability interaction ($p < .05$). Anderson (1974a) has described a suitable convention for testing for the diverging fan required by a multiplicative model. One decomposes significant interactions into linear X linear and residual components. If the linear X linear component is statistically significant, while the residual is not, it is concluded that the linear X linear component adequately "accounts" for the interaction. These conditions were satisfied in 5 of the 12 cases of significant interactions found in the present results. In one of those instances, however, graphical analyses indicated that the linear X linear component was due to a converging rather than a diverging fan. Thus, overall, there is rather scant evidence that subjects perceived the joint effects of effort and ability on academic performance in their university to be multiplicative in form.

The second observation to be made about the pattern of results is partly implicit in the first. It concerns expected performance levels when students were described as devoting "No Effort" to their school work. Not only was No Effort seen to result in nonnegligible performance for all students, the most able students were expected to get along rather decently under those conditions (grades of C or better).

STUDY 2

Subjects' responses at the No Effort level in Study 1 were so curious that Study 2 was undertaken to pursue the matter. In particular, it was conjectured that perhaps this part of the results might be due to ambiguities in subjects' interpretations of the term "No Effort." The results might also have reflected the subjects' beliefs that selective admissions policies make the University of Michigan student body unrepresentative of the entire range of possible academic ability levels.

Method

The method of Study 2 was essentially the same as that of Study 1, with the following exceptions. Only 10 subjects were included rather than 20. Since they were not required to complete the auxiliary part of the post-

experimental questionnaire completed by Study 1 subjects, Study 2 subjects were paid $3.00 rather than $3.75 for their participation.

The critical differences in method concerned the inductions of psychological scales for ability and effort. In Study 2 subjects were asked to imagine a hypothetical experiment in which the university admitted a cohort of undergraduates to the arts and sciences college on an open-admissions, "first-come, first-served" basis. Students were thus to be assumed to "range in scholastic ability all the way from no aptitude to the greatest possible aptitude." A student with "Minimum Ability" was to be assumed to have "absolutely no aptitude for academic work," while a student with "Maximum Ability" was to be thought of as having the ability of the "*most* academically capable student you can imagine in the university." Effort inductions were similarly specific. The subject was urged to interpret No Effort to imply that all the student does is "show up to take the required exams." Greatest Possible Effort was defined as the most effort the subject could imagine any student in the University devoting to academic work.

In addition to his/her personal conceptions of what the terms *ability* and *effort* mean in the academic domain, the postexperimental questionnaire requested that the subject describe in words how he/she thought ability and effort influence one's scholastic performance in the university.

Results and Discussion

Figure 3 displays the mean responses for the subjects in Study 2. As a comparison with Figure 2 will verify, the basic pattern of results remains the same. There is essentially no evidence of a diverging fan as required by a multiplicative effort–ability performance model. Individual analyses of variance yielded only one instance in which there was a statistically significant ($p < .01$) linear X linear interaction component for a diverging fan pattern of responses with no accompanying significant residual term. It appears that the effort and ability scale inductions that distinguished Study 2 from Study 1 did indeed have effects on subjects' responses. As one might expect, given the scenario of a student body that is more heterogeneous with respect to ability, the effort–performance curves for various ability levels are more widely separated than before. Also, the No Effort performance level of least able students is closer to the .0 GPA one might anticipate on intuitive grounds. However, the basic result that No Effort typically is seen as resulting in nonnegligible performance is replicated. Moreover, the similarity of the No Effort responses in Studies 1 and 2 also suggests the obvious: Subjects in Study 1 did not interpret No Effort literally, but rather

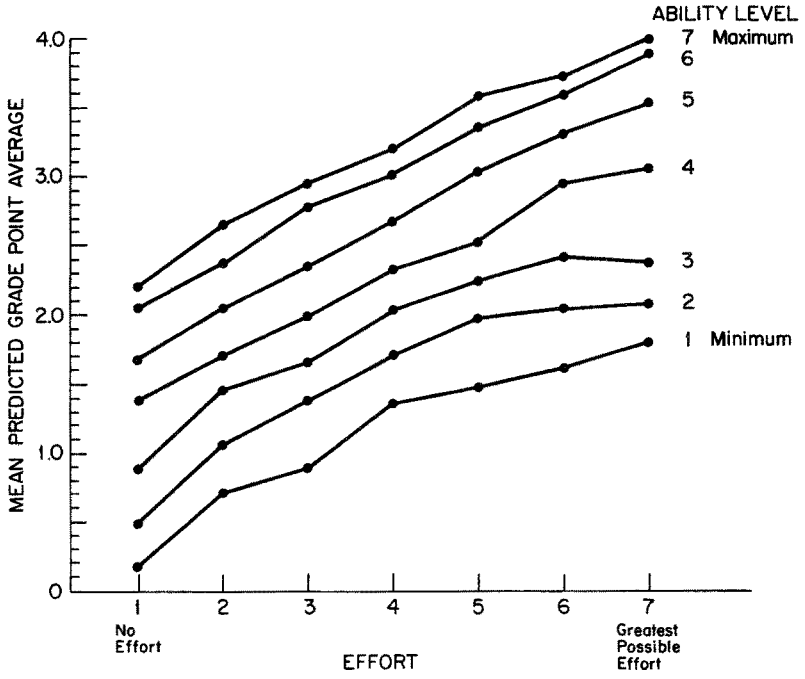

Fig. 3. Mean predicted grade point averages as functions of effort for various ability levels, Study 2 (open-admissions policy).

as something of a nonzero lower threshold of effort (cf. Yates & Kulick, 1977).

GENERAL DISCUSSION

In summary, the results of the present studies are consistent with the following conclusions. First, while on occasion subjects perceive scholastic ability and effort to affect academic performance in a multiplicative fashion, they ordinarily do not. The perceived relationship is much more akin to a simple additive function. Second, the responses of subjects in the present studies suggest that scholastic performance is typically expected to always improve when increasing amounts of effort are applied. Yates and Kulick (1977), in a different context, have also found the perceived relationship between effort and performance to be monotone increasing. Finally, as the nonmultiplicative relationship described previously implies, academic ability is perceived by subjects to be such that it can effectively compensate for an almost total lack of investment of effort on a student's part.

The first question one might raise about the results is how much they should be believed. That is, do the subjects' responses reflect the interrelationships that generally characterize students' true judgments about ability, effort, and performance? Anderson and Butzin (1974) have reported a study quite similar in method to the present studies. One major difference in approach is that Anderson and Butzin used fewer levels of ability and effort than were employed in the present studies. They also defined cues in a standard functional measurement verbal fashion and not in terms of the complete underlying psychological continua of ability and effort. Anderson and Butzin's analyses of variance were more consistent with a multiplicative ability X effort performance model than were those reported here. Although their graph of performance as a function of ability and effort suggests a small fan effect as required by a multiplicative model, that effect is very slight indeed. So, although the linear X linear component of their interaction is statistically significant, its practical significance is suspect; the basic pattern of results is quite similar to that evidenced in the present investigations.

While one generally cannot rely too strongly on people's reports of their judgment processes (cf. Nisbett & Wilson, 1977), subjects' verbal explanations of the roles of ability and effort in the determination of performance suggest that the results probably do reflect their true beliefs. Numerous of the subjects' comments are compatible with the additive model implicit in their pattern of GPA predictions as functions of ability and effort, e.g., statements that ability (or effort) is more heavily "weighted" than is effort (or ability).

What do the results mean? How might they be explained? Perhaps the most interesting feature of the results to which these questions might be addressed is the pattern of parallel effort–performance curves, which necessarily implies nonnegligible anticipated performance at minimal effort levels for most levels of ability. This pattern has a clear interpretation in terms of subject's conceptions of what scholastic "ability" means. To the subjects, one's knowledge base has more significance in school than one's capacity to learn. As corroborated by several subjects' explicit remarks, ability was often thought of as being acquirable, as "having already learned something." If the subjects thought of ability primarily in terms of aptitude for learning, then there should have been more evidence than there was of perceived effort–performance lines increasing in slope as a function of ability.

The subjects' perceptions of no meaningful differences in facility at learning new things is almost surely in error. People do seem to vary in the ease with which they can acquire knowledge; some seem to benefit greatly from exposure to new material, others practically not at all. So, how might such misperceptions have arisen? One possibility might be that it is difficult

to imagine that a person can really have *no* ability to learn. Closely related to this could be a cultural bias about the virtues of effort. As the work of Weiner and others suggests (Weiner & Kukla, 1970; Nicholls, 1976), in Western culture at least, effort is encouraged and valued. An assumption thereby implied is that effort will be rewarded ultimately by good performance. Thus well-socialized and generally successful subjects like those employed in this and other university-based research indicate that anyone ought to be able to learn something from a university experience, even if it is not enough to survive rigorous standards. But is this realistic? Would subjects from other backgrounds hold similar beliefs?

There are practical implications of the present results. These implications can be viewed from the perspective of either a student or an advisor of students, i.e., teacher, counselor, peer, or parent. If, as the results suggest, our perceptions of the effects of effort and ability on performance are sometimes (often?) discrepant from reality, effort misallocations and erroneous advice about effort allocations to scholastic work should be rather common. There is, unfortunately, no generally acceptable theory of scholastic motivation. However, one simplified cost-benefit model of motivation with some intuitive appeal can be used to illustrate the potential consequences of the types of misperceptions reported here.

Figure 4 suggests a variety of circumstances that might arise. In each panel of the figure the horizontal dotted line represents the student's aspiration level (e.g., required GPA for continuation in the university or admission to medical school). The solid curve is the true function relating the student's effort and scholastic performance levels. It is a peculiar fact of the state of motivation research that the precise nature of the true effort–performance function is not really known, although there are plausible speculations (cf. Kahneman, 1973). For convenience of discussion, we have made all the curves slightly concave and increasing. The increasing dotted line in each figure represents the student's conception of what the relationship is between effort and grade point average for him/her. That perceived function undoubtedly has a variety of bases. As suggested above, its form is probably affected strongly by culturally conditioned expectations about the merits of effort. Perhaps the primary basis for such speculations, however, is the person's experience with similar tasks in the past. So, to the extent that the student perceives his/her present courses to be similar to courses he/she has taken previously, he/she will conclude that the currently effective effort–performance relationship will be similar. Yet another basis for judging the relationship between effort and performance is the apparent complexity of the courses; more complex tasks should require greater effort. Just as culturally induced notions about effort–performance relationships can be misleading, so can the student's perceptions of courses' complexity and their similarity to his/her previous experiences.

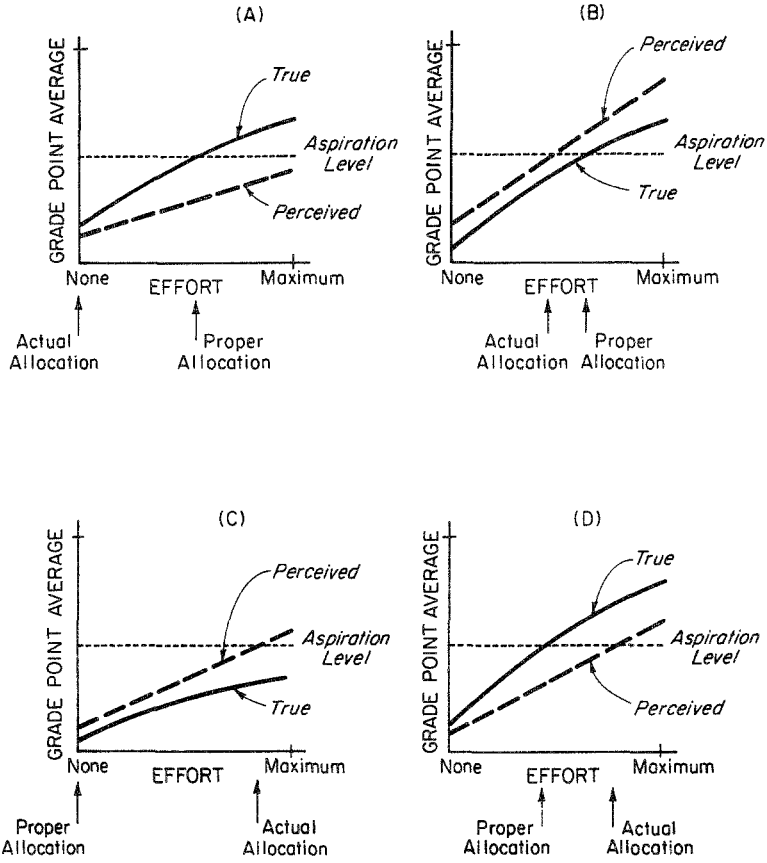

Fig. 4. Hypothetical true and perceived effort–performance relationships leading to effort misallocations, per a simplified scholastic motivation model.

Consider panel A of Figure 4. The student anticipates that even were he/she to expend maximum effort, he/she still would not be able to achieve an adequate GPA. Consequently, he/she "leaves the field" and allocates no effort to his/her studies at all, whereas a more accurate perception of his/her effort–performance function would have led to a quite different action. Panel B represents a situation in which the student has overestimated his/her abilities. So, he/she allocates or plans to allocate a lower amount of effort than is required. Of course, given the scenario as constructed, the student could conceivably make the appropriate adjustment and devote the additional effort needed. This is not necessarily so. The costs of that additional effort may not be affordable. For example, the additional effort may be obtainable only at the expense of the student's job or family responsibilities. Panel C depicts a situation in which it would be in

the student's best interests to leave the field and devote his/her energies to something different; no amount of effort (given his/her current capabilities, at least) would result in adequate performance. Finally, the person represented in panel D finds himself/herself in the seemingly enviable position of being more able than he/she thinks. So, he/she overallocates effort and does much better than anticipated, assuming he/she does not reduce effort when his/her judgment error becomes apparent. Even this set of circumstances is not necessarily all good. In establishing his/her initial effort allocation, the student may have come to the conclusion that achieving a GPA above his/her aspiration level was not especially valuable, particularly in relation to other things his/her efforts might bring, e.g., money earned in a part-time job.

REFERENCES

Anderson, N. H. Algebraic models for information integration. *Technical Report No. CHIP 45,* Center for Human Information Processing, University of California, San Diego, June 1974. (a)

Anderson, N. H. Cognitive algebra: Integration theory applied to social attribution. In L. Berkowitz (Ed.), *Advances in experimental social psychology.* New York: Academic Press, 1974. Pp. 1-101. (b)

Anderson, N. H., & Butzin, C. A. Performance = motivation X ability. *Journal of Personality and Social Psychology,* 1974, *30,* 598-604.

Heider, F. *The psychology of interpersonal relations.* New York: Wiley, 1958.

Kahneman, D. *Attention and effort.* Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

Korman, A. K. *The psychology of motivation.* Englewood Cliffs, New Jersey: Prentice-Hall, 1974.

Lawler, E. E. *Motivation in work organizations.* Monterey, California: Brooks/Cole, 1973.

Nicholls, J. G. Effort is virtuous, but it's better to have ability: Evaluative responses to perceptions of effort and ability. *Journal of Research in Personality,* 1976, *10,* 306-315.

Nisbett, R. E., & Wilson, T. D. Telling more than we can know: Verbal reports on mental processes. *Psychological Review,* 1977, *84,* 231-259.

Vroom, V. H. *Work and motivation.* New York: Wiley, 1964.

Weiner, B. *Theories of motivation.* Chicago: Markham, 1972.

Weiner, B. (Ed.). *Cognitive views of human motivation.* New York: Academic Press, 1974.

Weiner, B., & Kukla, A. An attributional analysis of achievement motivation. *Journal of Personality and Social Psychology,* 1970, *15,* 1-20.

Yates, J. F., & Kulick, R. M. Effort control and judgments. *Organizational Behavior and Human Performance,* 1977, *20,* 54-65.