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Explorations Using Computer Simulation To Comprehend Thematic Apperceptive Measurement of Motivation[1]

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The new theory of motivation by Atkinson and Birch (1970), based on conceptual analysis of a change in activity, has been programmed to allow computer simulation of effects of differences in motivation on the stream of operant behavior. Simulation of conditions that exist when people who differ in strength of achievement motive write imaginative stories in response to a sequence of pictures shows that construct validity does not require internal consistency as traditionally supposed. The theoretically deduced differences in total time spent imagining achieving (instead of something else) can postdict input differences in motive strength (i.e., construct validity) even when there is little or no internal consistency reliability as indicated by Cronbach's (1951) alpha computed from theoretically deduced time spent imagining achievement in response to particular pictures. This general point has already been amply documented in 25 years of productive empirical research using TAT n *Achievement. Now a definitive theoretical refutation of the repeated psychometric criticism of the method is provided. Those who have been moved "to dispel fantasies about fantasy-based measures of achievement motivation" (Entwistle, 1972) are invited, instead, to examine the shallow theoretical foundation of our traditional myths of measurement.*

[1]This paper elaborates a report presented August 30, 1975, at the 83rd annual meeting of the American Psychological Association. The authors gratefully acknowledge early assistance by Mary M. Moffett, and financial support by a Rackham Faculty Research Grant (JWA), a National Science Foundation Fellowship (KB), and a Michigan Student Medical Research Grant (LHP). Intricate detail has been avoided in describing the several simulations for the sake of clarity in this overview of exploratory work.

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Systematic study of the behavioral effects of individual differences in achievement motivation has employed an experimentally validated method of measurement for a little over quarter of a century (McClelland, Atkinson, Clark, & Lowell, 1953). It has taken this long for the sustained program of research to reach a point in its theoretical development that allows a definitive reply to the frequent criticism that thematic apperceptive measures of *n* Achievement and other social motives (e.g., *n* Affiliation, *n* Power) cannot possibly be valid because they have such low internal consistency reliability. Our primary aim is to answer this criticism and to throw new light on the method of inferring motivational differences from content analysis of operant imaginative behavior emitted in the presence of pictures. This so-called projective technique is known as thematic apperception (Morgan & Murray, 1935). Some consider it no more than a vestige of an earlier era that was more tolerant of clinical intuition and general looseness in the study of personality and human motivation. We, among others who have taken a different view, are now more encouraged than ever concerning the promise of disciplined experimental and conceptual analysis of imaginative thought content. It is one of the virtually untapped resources for future development of the behavioral science of an animal distinguished by its unique competence for conceptual thought and language. This is much easier to say today, in an era generally characterized by a resurgence of interest in cognitive phenomena, than it was in the earlier heyday of S–R behavior theory (e.g., McClelland, 1955).

Of all the criticisms of empirical research on *n* Achievement and behavior that have appeared repeatedly over the years (most of which have been adequately answered if one knows the mainstream of the work), the argument voiced again most recently by Entwistle (1972), that inadequate internal consistency reliability puts a lid on any claims for the validity of a thematic apperceptive measure, has probably produced the most persistent skepticism regarding the scientific credibility of the method and of the results of the research program in which it has provided the integrative thread. By now that program of research has become a rather vast one, embracing other social motives and invading sociology, education, and industry, and extending into content analysis of literature to diagnose motivation in historical and comparative societal studies (e.g., McClelland et al., 1953; Atkinson, 1958; McClelland, 1961; Atkinson & Feather, 1966; Heckhausen, 1963; 1967; McClelland & Winter, 1969; Smith, 1969; Veroff & Feld, 1970; McClelland, Davis, Kahn, & Wanner, 1972; Atkinson & Raynor, 1974; Winter, 1973; Weiner, 1974).

True believers of classical test theory assert that reliability is the sine qua non of validity. To refute this assertion, we shall review what we are now learning about the psychometric properties of thematic apperception when a theory of motivation, instead of classical test theory, serves as the model of human behavior. The question of interest is: what happens when we simulate the conditions that exist when people who differ in strength of achievement motive, for example, are confronted with a series of pictures, each of which provides an occasion for emission of an imaginative story? It has become possible to do this because the conception of motivation evolved using TAT *n* Achievement in the face of chronic skepticism culminated in a reconstruction of the theory of motivation by Atkinson and Birch (1970). This development followed a landmark study of persistence in achievement-oriented action by Feather (1962) and recognition of its more general theoretical implications (Atkinson & Cartwright, 1964; Atkinson, 1964, pp. 298-314).

The new theory of motivation, the dynamics of action, recovers the basic empirical facts about effects of individual differences in achievement motivation on behavior (Atkinson & Birch, 1974) and well-known empirical generalizations about the subsequent motivational effects of reward and punishment. A computer program for the theory was initiated by Seltzer (1973) and is constantly being extended and refined (Seltzer & Sawusch, 1974; Bongort, 1974). So now we are able to undertake computer simulation of the effects of differential motivation on the stream of operant behavior under complex conditions (e.g., Atkinson & Birch, 1974), including now the stream of imaginative behavior that constitutes a thematic apperceptive test. In our work at Michigan, we are in the midst of computer-simulation analysis of problems that were literally unthinkable a decade ago. For example, Birch, Atkinson, and Bongort (1974) have recently demonstrated how the content of thought can control voluntary action without any prompting of the thought from the immediate environment or stimulus situation.

Given a computer program that *is* the theory of motivation, we can turn that theory around on the method of measurement used in the empirical research over the years to provide the main source of most of the inferences that guided construction of the theory. It comes as no great surprise to us that a coherent theory of motivation evolved in the course of using thematic apperception to study and explain behavioral expressions of individual differences in motivation should also finally explain the stream of imaginative behavior that constitutes the standard and controversial measuring instrument. We already have that model in physics. The theory of heat explains the behavior of mercury in a thermometer.

To date, our 25 computer simulations of thematic apperception have produced this rather unambiguous and important conclusion: *the construct validity of thematic apperceptive measures does not require internal consistency reliability as supposed by traditional test theory.* The theoretically deduced differences in the total amount of time various people will spend imagining achieving (instead of something else), on the occasion of being presented with a set of pictures, can postdict, with substantial accuracy, the differences in strength of motive that were fed as input to the computer among the antecedent conditions. This is so even when there is no internal consistency reliability as indicated by the coefficient alpha (α) (Cronbach, 1951), calculated from the theoretically deduced time spent imagining achieving in response to each of the several pictures in the simulated thematic apperceptive test. This means, very simply, that experimental research on human motivation, and conceptual analysis of motivation based on that research, has produced an alternative logic to substitute for the traditional a priori logic of test theory based on elaboration of the implications of the normal curve of distribution *concerning what happens from moment to moment in the temporal period of a TAT.* We present, to reiterate, an alternative to traditional test theory as the theoretical foundation of thematic apperception—a "psychologically" grounded theory as distinct from a "statistically" grounded theory.

Perhaps having the conclusion first will encourage broader interest in this new theory of motivation and a computer program for it, both of which are included in Atkinson and Raynor's *Motivation and Achievement* (1974), the most recent progress report of the program of research at Michigan.

THE DYNAMICS OF ACTION

The new conception, the dynamics of action, breaks with the traditional mode of thought that has always considered behavioral episodes as isolated events. It begins with a new premise: that an individual is already active in two senses before being exposed to the traditional stimulus situation that in the past has always been assumed to be needed to get things started. First, the individual is already doing something when a scientific observer initially takes notice. Second, the individual is already actively motivated to do many other things before the stimulus situation of traditional interest occurs. This was one of Freud's great insights: that wishes, inclinations, or tendencies, once aroused—whenever—persist until expressed in behavior directly or substitutively, long past the time of direct exposure to their initial instigating stimulus. And it is the idea that Hebb (1949) elaborated in calling attention to the sensory dominance of traditional psychological theory that is incompatible with what is known about an already active brain.

This means, in effect, that we have broken out of the traditional S–O–R mode of thought that considers behavioral episodes as separate, independent, isolated events. We now view the behavioral life of an individual as a continual stream (Barker's concept, 1963) that is characterized by change from one activity to another, even in a constant environment. The emphasis shifts from analysis of the initiation, instrumental striving, and termination of isolated activities to analysis of the continuity of behavior and *the continuity of its underlying motivational structure* as we focus attention on the joint or juncture between activities, a change from one to another (Birch, 1968, 1972; Atkinson, 1969).

In *The Dynamics of Action* (Atkinson & Birch, 1970, 1974), we conceive the impact on behavior of the immediate environment (or stimulus situation) to be the various instigating and inhibitory forces it produces. These influence the rate of arousal of an individual's tendencies to engage or not to engage in certain activities, including imaginative activities.

If a certain kind of activity has been intrinsically satisfying or previously rewarded in a particular situation, there will be an *instigating force* (F) for that activity, attributable in part to strength of motive in the person and in part to the magnitude of incentive for that activity in that situation. This will cause a more or less rapid arousal and increase in the strength of an inclination to engage in that activity, an *action tendency* (T), depending on the magnitude of the force. If a certain kind of activity has been frustrated or punished in the past, there will be an *inhibitory force* (I) and a more or less rapid growth in the strength of a disinclination to act. This is what we now call a *negaction tendency* (N) and conceive as a tendency *not* to do it. The duration of these forces will determine how strong the action tendency or negaction tendency becomes. The latter, the tendency not to do something, will produce *resistance* to the activity. It opposes, blocks, dampens; that is, it subtracts from the action tendency to determine the *resultant action tendency* ($\bar{T} = T - N$). The resultant action tendency competes with resultant action tendencies for other incompatible activities. The strongest of them is expressed in behavior. The expression of an action tendency in behavior is what reduces it. Engaging in activity produces a *consummatory force* (C), which depends in part on the *consummatory value* (c) of the particular activity and in part on the strength of tendency being expressed in the activity (i.e., $C = c\bar{T}$). Similarly, the resistance to an action tendency, produced by the opposition of a negaction tendency, constitutes an analogous *force of resistance* (R), which reduces, in a comparable way, the strength of the negaction tendency. The basic concepts are presented in Table I.

This, very briefly, outlines our conception of the causal factors involved in the continuous rise and decline in strength of tendencies

Table I. Analogous Concepts in the Treatment of Instigation of Action and Resistance to Action[a]

Instigation of action	Resistance to action
Instigating force, F	Inhibitory force, I
Action tendency, T	Negaction tendency, N
Action	Resistance
Consummatory force, C	Force of resistance, R

[a]From Atkinson and Birch (1970, p. 207).

illustrated in Figure 1. The changes in strength of competing motivational tendencies in turn account for the changes from one activity to another (x, y, z in the behavioral stream of Figure 1) and the particular sequence of activities that characterizes an individual's behavior, even in a constant environment.

Thematic Apperception

This sort of thing happens when a person is confronted with a particular picture in a thematic apperceptive test and asked to write an imaginative story. Figure 1 is one of our earliest computer simulations of what should be expected to happen if an individual were exposed to three

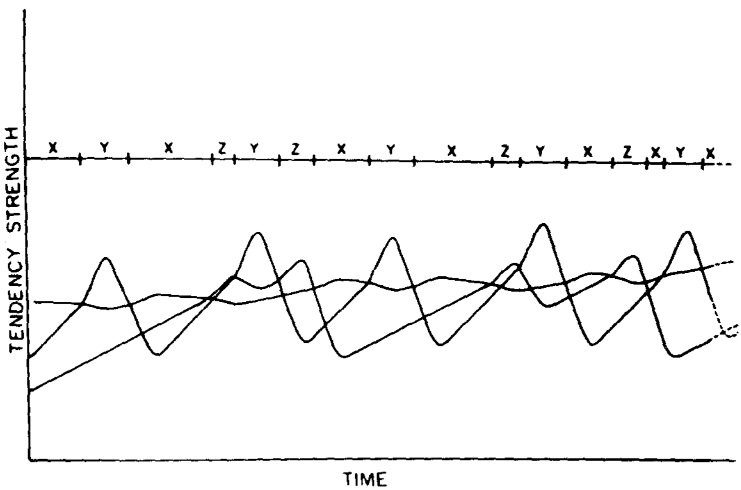

Fig. 1. An example of a stream of activity (x, y, z) and the systematic changes in strength of tendencies that produced it. Based on Seltzer (1973) and Birch et al. (1974).

instigating forces of different magnitudes with different consummatory values for these incompatible activities in the same environment for a period of time (Seltzer, 1973). One may therefore consider this a simple instance of the kind of thing that happens in our computer simulations of thematic apperception, except that the strength of the several motivational tendencies one sees would carry over and constitute the initial strength of those motivational tendencies when the person is immediately exposed to the next stimulus situation, or picture. It will produce forces that may differ in both kind and strength from those of the first picture, and so on.

The basic concepts of the dynamics of action presented in Table I should not seem totally unfamiliar to those acquainted with earlier theory of achievement motivation (Atkinson & Feather, 1966). In the framework of the new dynamics of action, the theory of achievement motivation—as recently elaborated and generalized by Raynor (1969, 1974)—is now to be considered a theory about the determinants of instigating forces to achieve success (F_S) and inhibitory forces to avoid failure (I_F) in various activities and not, as was heretofore assumed, about the determinants of the final strength of the tendencies to achieve success (T_S) and to avoid failure (N_F) in a particular situation.

We have made the same general distinction between the arousability (or rate of arousal) of a tendency, calling it the magnitude of force (F), and the level of arousal or strength of that tendency at a particular time (T) that Whalen (1966) proposed in an analysis of sexual motivation.

Considerations of both space and just how far along we are in computer simulations of operant behavior argue for limiting the present discussion to the fate of positive motivational tendencies. So we shall ignore inhibitory force, negaction tendencies, and resistance to action in further discussion, though the theory and its computer program do not. Systematic study of the effect of resistance on thematic apperception is already under way. We cannot conceive of the possibility that this further complication will change the conclusion, already stated, based on even more simple conditions.

The Integrative Principle of a Change in Activity

A single and fairly simple principle of change in activity has emerged in our analysis of the question of what is required in a theory to explain a simple change of activity. Several such changes are shown in Figure 2 (uncomplicated by inhibitory force, negaction tendency, and resistance).

What causes the change(s) in motivation implied by the observed change in activity in a constant environment? Why does the person stop writing about sex and start writing about achievement?

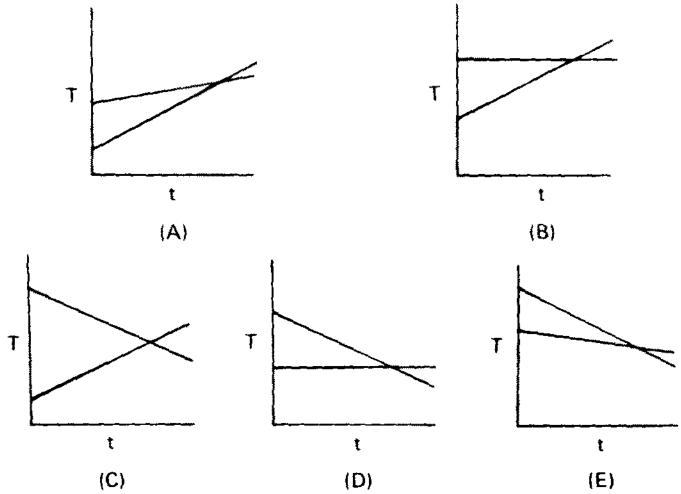

Fig. 2. Various ways in which a change in relative strength of two tendencies (T_A and T_B) can come about during an interval of time (t). From Atkinson and Birch (1970, 1974).

We began very conservatively, eschewing the idea that action tendencies change in strength spontaneously by mere random oscillation from moment to moment (as presumed in traditional theories). Freud argued that the wish persists until it is expressed. We sharpen that language somewhat. *A behavioral tendency, once aroused, will persist in its present state until acted upon by some psychological force that either increases or decreases its strength.* This explains why all the tendencies in the graphs of Figure 2 have some initial (or inertial) strength above zero at the beginning of the interval of observation. The person is active, already doing something (activity A) corresponding to the strongest tendency, and is already actively motivated to do something else (activity B) and certainly many other activities, should we care to complicate both our graphs and introductory discussion with a larger number of initially subordinate tendencies.

The algebraic statement of the principle of a change in activity says simply what the several graphs show. A subordinate tendency will become dominant and a change in activity will occur at a certain time, depending on the initial strength of the subordinate tendency (T_{B_i}); the magnitude of instigating force controlling the rate of arousal or further growth in its strength (F_B), which is attributable in part to strength of motive in the person and in part to the magnitude of incentive in the immediate environment; the strength of the dominant initial tendency (T_A) as it is affected by its instigating force (F_A) and the consummatory force of the activity being expressed, which derives in part from the consummatory value (c_A) of that activity; and, finally, the duration of exposure (t) to these several forces. The mathematical statement of the principle (ignoring resistance), accounting for the time it will take before the change from activity A to activity B occurs, is:

$$t = \frac{T_{A_f} - T_{B_i}}{F_B}, \text{ or } t = \frac{F_A/c_A - T_{B_i}}{F_B}$$

when the ongoing activity has approached the limit of its strength (F_A/c_A) in that situation (see Atkinson & Birch, 1970, Ch. 1; 1974).

Elaboration of the implications of the mathematical statement of the principle and its application to explanation of a sequence of changes in a stream of behavior (Birch, 1972) has yielded hypotheses about how the magnitude of instigating force (and therefore strength of motive, one of its determinants) will influence the initiation of an activity (i.e., latency of response), choice among alternatives, the duration or persistence of a particular activity, the proportion of total time spent in a given activity, the relative frequency of activities, and the operant level or rate of an activity in a given environment.

The dynamics of action purports to be a theory of operant behavior. And it provides the integrative logic or theoretical basis for expecting relationships among various measurable aspects of an activity in the study of personality.

The Stream of Behavior

In going beyond a simple change in activity to analysis of a sequence of changes in the stream of behavior, we have assumed that there is a temporal lag in the onset and cessation of the full consummatory force of an activity when a change occurs (Atkinson & Birch, 1970, pp. 96-101). The parameters of the lag in our computer programs are its duration and the shape of the ogive-like function that defines the rate of growth to, or decline from, full consummatory force during this interval.

In addition, we have found it meaningful to allow for a certain degree of selectivity in attention to the various cues (or discriminative stimuli) that are the sources of instigating forces for various activities (Atkinson & Birch, 1970, pp. 92-96). It is generally assumed that an individual will be systematically (i.e., constantly) exposed to instigating force for the activity that is occurring. But the degree of attention (or exposure) to cues that produce instigating forces that influence subordinate tendencies is another parameter of interest in simulation of streams of behavior.

COMPUTER SIMULATION OF THEMATIC APPERCEPTION

The mathematical elaboration of the theory for the simple case of two alternative activities suggested to Sawusch (1974) that the proportion of time spent in a given kind of activity, when there were many competing alternatives, would equal the ratio of the asymptotic strength of the critical tendency to the sum of the asymptotic strengths of all the competing action tendencies in that situation. It could not be proved mathematically, but it was nicely demonstrated in a series of computer simulations of streams of behavior that varied the magnitude of instigating force and consummatory value of the critical activity against a constant context of competing alternatives, as shown in Figure 3. The dashed-line curves represent the theoretically expected proportion of time spent in the critical activity; the points

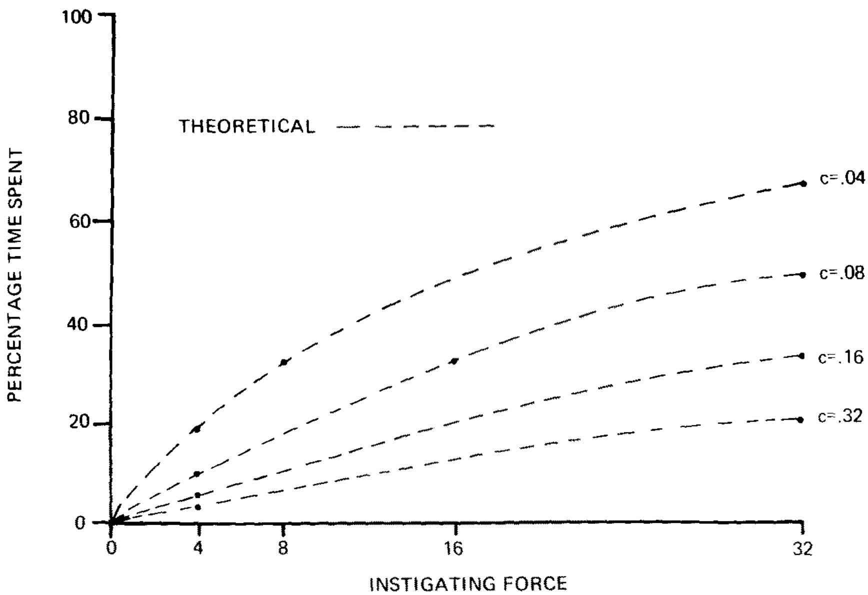

Fig. 3. Correspondence of simulated (•) and theoretical (---) percentage time spent in critical activity A assuming percentage time in A equals ratio of F_A/c_A to $F_A/c_A + F_B/c_B + F_n/c_n$ in that environment. (The simulation approximates the ideal case in not assuming selective attention and in minimizing effects of consummatory lags [interval = 1.0, σ = .8]. There are three competing alternatives, each having $F = 8$, $c = .08$, $F/c = 100$. Based on last 900 of time interval of 1000.)

represent the results for particular situations that were simulated. The fit is exact for our approximation of the ideal case, and it was exact when we varied the context provided by number and strength of competing alternatives.

It is a small step to ask: How long will the tendency to achieve be dominant and expressed in imaginative activity if the environmental stimulus, a TAT picture, produces instigating forces for a number of competing activities and the strength of motive to achieve (which influences the strength of instigating force to achieve) differs among a number of individuals? Then what will happen if, after an arbitrary interval of 100 units of time (corresponding to a 4-min story), we immediately confront these individuals, who differ in strength of motive, with a new picture that presents either more or less incentive to achieve than the first one and variation in the incentives that influence the competing tendencies? (We assume, as generally, that strength of motive and magnitude of incentive combine multiplicatively to determine magnitude of instigating force.) What happens if we continue to present a new TAT card, with a new pattern of instigating forces, every 100 time units?

This has been the pattern of 25 computer simulations involving, in each case, 18–30 hypothetical subjects who differ in strength of achievement motive. We have presented our simulated TAT pictures in Latin Square designs, following the procedure of the first study of internal consistency of *n* Achievement by Atkinson (1950), reported in McClelland et al. (1953, Ch. 7), and in a fixed order, following a fixed pattern of strongly and weakly cued pictures established by Haber and Alpert (1958). Both of these early studies had indicated enough internal consistency, even given conventional test theory, to justify research classifying subjects at the median or into thirds according to motive strength. So, for comparability with empirical data, we have classified subjects into thirds, according to computer input strength of motive, in our analysis of simulated results even when individual differences in motive were sampled from a distribution of magnitudes.

The computer program applies the principle of a change in activity given the strengths of a set of competing tendencies in the individual and forces produced by the first picture. Then, at the end of 100 time units, it applies the principle again, but now with a different set of forces operating on tendencies that have changed in strength and carry over from the end of one story to the beginning of the next, and so on. Here, instead of assuming isolated and completely independent tests, or behavioral episodes, the new theory emphasizes the continuity that characterizes both the stream of motivation and of behavior in real life.

At the end of each 100 units of time, the computer printout tells us how much time was spent imagining achievement and each of the other kinds of competing activities. By treating simulated time spent thinking about achievement as the theoretically expected or *true n* Achievement score (as if we had an empirical measure that corresponded to a perfect clock), we can compute the theoretically expected average split-half reliability, Cronbach's α, treating each story as a separate test or item, as, for example, Entwistle (1972) did. In addition, we can determine construct validity of the theoretically expected total time spent thinking about achievement in the set of four, five, or six stories by seeing how accurately this *total time* postdicts the differences in strength of achievement motive (High, Mid, and Low thirds) that were fed into the computer as input descriptive of our hypothetical subjects. The reader is reminded that *the theory represented by the computer program was not constructed to explain thematic apperceptive* n *Achievement but to explain behavioral phenomena related to individual differences in TAT* n *Achievement and other more generally known behavioral facts.*

In a review of quite a number of empirical studies, Entwistle (1972) concluded that the Cronbach α for TAT *n* Achievement scores must generally fall between .35 and .40—values rather too modest, given traditional test theory, to justify any "fantasies about fantasy-based measures of achievement motivation." We must keep in mind that these αs, obtained in actual empirical studies, are degraded versions of what a perfect clock would tell because *n* Achievement score, at best, is a rough index of time spent, how rough depending a good deal on the scoring reliability or skill of the investigator, which is too often, we know, very modest. Our data, here, represent time as measured by a nearly perfect clock.

The very first computer simulation of a TAT (Moffett, 1974) utilized a balanced Latin Square design with five different pictures, ten orders of presentation, for 30 hypothetical subjects who were High, Moderate, or Low in strength of achievement motive. The theoretically deduced time spent imagining achievement on each of five stories and total time for subjects rank-ordered by thirds on strength of motive, taken from the computer printout of the simulated event, are shown in Table II.

Here, with all other parameters of the theory held constant for each of the 30 subjects, including those influencing three activities incompatible with "achieving," the Cronbach α (internal consistency) based on time per story by picture was only .08; yet 87% of the subjects were correctly ordered into High, Mid, and Low thirds on motive strength in terms of the total time spent "achieving" in all five stories. One would expect 33% to be correctly placed by chance.

This earliest effort reproduced a number of other phenomena well known to those familiar with the literature on TAT *n* Achievement. Under certain limited conditions, there was an odd–even oscillation in mean time

Table II. Theoretically Deduced Time Spent Thinking about Achievement in First Computer Simulation of Thematic Apperception Involving Five Pictures in Balanced Latin Square Design[a]

Motive strength (defined by computer input)	Subject No.	Simulated time spent "achieving": By picture A	B	C	D	E	By order: Stories 1 and 2	Stories 4 and 5	Total 5 stories
High (1.5)	1	13	10	18	22	25	23√	40	88
	2	14	20	17	20	24	37	44	95
	3	5	15	10	21	25	31	30√	76√
	4	12	8	11	24	25	49	21√	80
	5	9	17	10	22	27	37	26√	85
	6	14	14	9	22	25	39	31√	84
	7	13	20	19	20	25	33	45	97
	8	10	18	10	20	24	28√	34√	82
	9	4	18	11	23	23	35	21√	79
	10	10	10	19	20	27	47	28√	86
Medium (1.0)	11	2	15	14	21	19	16√	35√	71
	12	9	14	9	18	19	23	37√	69
	13	11	15	11	12	19	23	30	68
	14	14	9	16	10	20	30√	23√	69
	15	0	16	9	19	22	22	26	66
	16	2	19	16	9	19	21	26	65
	17	12	13	10	16	21	25	37√	72
	18	0	7	11	21	20	18√	20√	59√
	19	21	15	17	10	20	27	36√	83√
	20	8	9	14	16	22	38√	23√	69
Low (0.5)	21	0	7	10	19	18	7	28√	54
	22	2	0	20	20	15	20	36√	57
	23	24	18	2	15	16	16	40√	75√
	24	15	9	9	14	10	23√	24	55
	25	0	10	25	18	11	11	35√	64
	26	0	0	18	9	18	18	27√	45
	27	9	0	27	10	18	8	29√	64
	28	0	17	2	24	13	19	13	56
	29	16	8	12	14	10	26√	24	60
	30	14	9	14	7	10	18	22	54
Percentage correctly placed into High, Medium, Low thirds:							73.3%	33%	86.7%

[a]Study No. 1, contributed by Moffett (1974). The text describes the conditions. Checks (√) indicate subjects incorrectly ordered by theoretically deduced and simulated time spent. Times for 1 and 2 versus 4 and 5 were computed to allow comparison with Reitman and Atkinson's (1958) results concerning predictive validity with a behavioral criterion. Alpha computed before rounding figures for table.

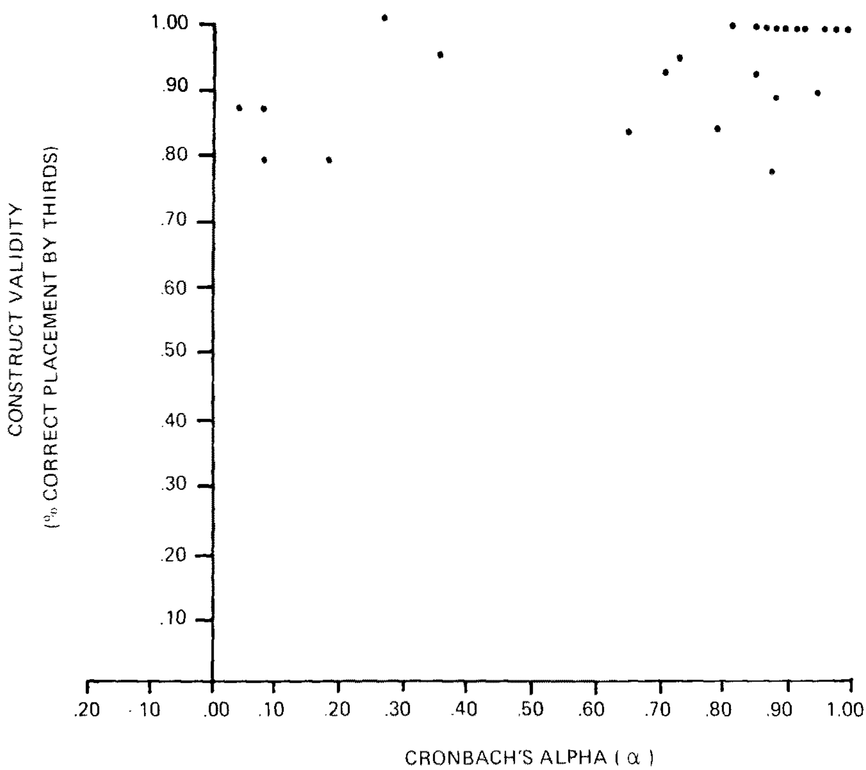

Fig. 4. Relationship of construct validity and internal consistency (α) in 25 simulations of TAT varying design and parameter values. (Construct validity refers to the percentage of subjects correctly placed by total time in achievement activity into rank-ordered thirds of true motive strength defined by computer input.)

spent achieving, as first noted in Atkinson (1950) and emphasized by Reitman and Atkinson (1958); stories early in the series have greater validity than those later in the series, a point documented with a behavioral criterion by Reitman and Atkinson (1958); the more strongly cued pictures (i.e., those producing relatively stronger instigating force to achieve) produce more time spent in achievement activity than less strongly cued pictures.

Since this pioneer effort, we have run a total of 25 simulations varying certain parameters of the theory known as *initiation* and *cessation lag* in consummatory force, *selective attention,* and *consummatory value* of the critical activity in response to different pictures. The overall summary of our effort covering a variety of conditions is clearly indicated in Figure 4. It shows the relationship between Cronbach's α, based on time spent thinking achievement in response to each picture, and construct validity, based simply on the percentage of subjects correctly placed into thirds (*as defined by the input motive strength*) according to the *true* or theoretically deduced total time spent thinking about achievement in the simulated test as a whole. The samples of hypothetical subjects were 18, 24, or 30, depending upon requirements of the study.

In 19 instances, the construct validity is 85% correctly ordered or better (when by chance one expects 33%), while a varies from .08 to 1.00. In five cases, the construct validity is 78% to 85%, again with a ranging from 08 to .90. Within this set of 24 simulations, the product moment correlation between positive internal consistency coefficients and construct validity is .49, not the traditionally expected 1.00. In only one instance in the 25 simulations of a TAT test of achievement motive does the truly expected construct validity really seem quite modest, only 60% correct placement into thirds (as compared with chance expectation of 33%). And this occurs when the value of Cronbach's α is $-.18$!

Our specific conclusion is that *construct validity does not require internal consistency reliability.* More generally, we are now prepared to argue, with a firm theoretical foundation, that *misleading myths of measurement* need to be identified and recognized as such, and not repeatedly taught as doctrine to students who lack theoretical sophistication.

A DESCRIPTIVE REVIEW OF SIMULATION STUDIES

Table III shows, for 25 simulations of measurement of TAT *n* Achievement, two indices of construct validity (e.g., the degree to which the theoretically deduced time spent in the critical imaginative activity correctly identified the motive strength of the hypothetical subjects) and the coefficient of internal consistency reliability, α, based on theoretically deduced time spent in the critical activity in each of five or six stories (by picture), depending on the design. Also listed are two of the several parameters of the theory shown to affect internal consistency, viz., selective attention, duration of consummatory lag, and σ of the ogivelike function for consummatory lag. The latter (not shown) defines the rate at which the full consummatory force will come on or go off, respectively, at the initiation and cessation of an activity during the interval. Finally, Table III shows the percentage of total time (100 units per story) in which the tendency for expression of the critical motive was dominant during the test as a whole. This might be taken as an indicator of what, in the empirical literature on TAT, is called a strongly cued picture (i.e., one that produces a high average *n* Achievement score) or a weakly cued picture (i.e., one that produces a low average *n* Achievement score). Haber and Alpert (1958), for example,

Table III. Summary of Major Parameters of Interest Allowing Comparison of Internal Consistency and Construct Validity in 25 Computer Simulations of Thematic Apperceptive Measurement of *n* Achievement with Pictures in Latin Square Design or Fixed Order of Presentation

Simulation No.	Selective attention[a]	Lag interval	% time spent	α	Construct validity: % correct[b]	Construct validity: Pearson r[c]
Latin square designs						
1	.5	10	14.2	.078	86.7	.854
2	1.0	1	10.5	.888	100.0	.995
2B	1.0	1	11.7	.825	100.0	.981
3	1.0	1	35.3	.981	100.0	.992
13	.5	10	13.5	.183	80.0	.895
14	.5	5	12.0	.751	93.3	.963
15	.75	5	14.2	.267	100.0	.934
16	.75	10	15.3	.067	86.7	.903
21	.5	7.5	12.6	.355	93.3	.928
22	1.0	5	14.9	.086	80.0	.852
23	1.0	10	16.9	–.182	60.0	.691
Fixed order of presentation						
4	1.0	1	37.3	.967	100.0	.998
5	1.0	1	38.1	.903	100.0	.997
6	1.0	1	36.8	.949	100.0	.998
7	1.0	5	33.1	.942	88.9	.996
8	1.0	10	32.3	.883	77.8	.986
8B	1.0	10	35.6	.821	83.3	.976
9	.5	1	38.7	.910	100.0	.996
11	.5	10	35.1	.89	88.9	.987
11B	.5	10	39.1	.730	91.7	.983
17	.5	10	39.0	.869	100.0	.994
18	.5	10	27.3	.652	83.3	.962
19	.5	10	40.1	.857	91.7	.991
20	.5	10	25.3	.843	91.7	.989
24	.5	10	14.9	.705	75.0	.955

[a] Percentage time subject is exposed to forces influencing subordinate tendencies.
[b] Percentage correctly ordered by total time spent achieving into High, Mid, and Low thirds on strength of motive defined by computer input.
[c] Correlations between total time spent achieving and actual magnitude of motive strength in computer input (number of subjects, 18–30).

reported more reliable measurement of individual differences in responses to strongly than to weakly cued pictures.[3]

In our initial simulation study (No. 1, conducted by Mary M. Moffett), the choice of parameter values was influenced by two primary considerations. First, we already had spent a couple of years exploring the

[3]The latter were found to be substantially more sensitive to prior experimental arousal of motivation, another fact that can be reconciled with the principles of the dynamics of action and results of computer simulation, but not of immediate interest.

effects of certain critical variables of the theory and had established certain conventions and guidelines concerning magnitudes for certain parameters (Seltzer, 1973; Atkinson & Birch, 1974; Birch et al., 1974). Second, our aim was quite explicitly to determine, by simple trial and check, whether or not it would be possible to produce a demonstration of the logical possibility of very substantial construct validity despite very low internal consistency reliability, *given the principles of the dynamics of action as the explanation of the content of the stream of operant imaginative behavior.*

In a preliminary simulation (not listed here) with a particular Latin Square involving five pictures, five sequences, and therefore 15 subjects, one designated High, Mid, and Low in achievement motive in each sequence, the magnitudes for strengths of motive (M) were arbitrarily selected as 3, 2, and 1. The incentive values of five pictures designated A, B, C, D, and E were, respectively, 2, 3, 4, 6, and 8. The product of motive (in the person) and incentive (in the picture) yielded instigating forces to achieve ranging in magnitude from 2 to 24, each of which was pitted against instigating forces for three incompatible activities, each having a magnitude of 12 in response to the various pictures. Coefficient α was .42 ($N = 15$).

The ordinal position effect for the five subjects classified Low (i.e., $M = 1$) showed the odd–even oscillation or "sawtooth" effect first noted by Atkinson (1950) and given some emphasis by Reitman and Atkinson (1958, p. 665). Here was evidence of something already familiar yet perplexing. Deliberately seeking to lower α, we decided to follow the lead of what looked familiar, so we made a change in the parameters. The motive strengths for High, Mid, and Low groups now became 1.5, 1.0, and 0.5 (half their original magnitudes), and Moffett felt it imperative to achieve a balanced Latin Square design, one in which each picture follows every other picture an equal number of times. Each of the ten new sequences of five pictures, shown in Table IV, was presented to three hypothetical subjects differing, as mentioned, in strength of motive. Cronbach's α, which describes the average of all possible split-half reliabilities, was calculated from printouts showing simulated time spent "achieving" by the 30 subjects *on each picture* (see, again, Table II). This yielded *what we were looking for,* an $\alpha = .08$ ($N = 30$), yet with 86.7% of the subjects correctly placed into thirds by total score (following the simple kind of trichotomization of the distribution recommended in reseach with *n* Achievement scores in the mainstream of the work, e.g., McClelland et al., 1953, pp. 187-194).

Within the framework of this same balanced Latin Square design, we then proceeded to determine the effect of certain variations. In Study No. 2 (as listed in Table III), we sought to approximate the ideal case of a sequence of changes in activity as summarized in the mathematical principle of a change in activity by minimizing the effect of the consummatory lag interval. It was set at 1 (instead of 10 time units) and a σ of .8 was chosen for

Table IV. Ten Sequences of Pictures (A to E) in Balanced Latin Square Design (Study No. 1) Also Employed in Subsequent Simulations Using This Design (N = 30)

Subject No.	Serial order of pictures				
	1	2	3	4	5
1	A	B	E	C	D
2	B	C	A	D	E
3	C	D	B	E	A
4	D	E	C	A	B
5	E	A	D	B	C
6	A	E	B	D	C
7	B	A	C	E	D
8	C	B	D	A	E
9	D	C	E	B	A
10	E	D	A	C	B
	Achievement incentive value in Study No. 1				
	A	B	C	D	E
	2	3	4	6	8

the ogive instead of .4. Furthermore, we made no assumption of differential or selective attention to cues instigating the dominant and subordinate tendencies. Thus, the magnitude of selective attention, which is always 1.00 for the force influencing ongoing activity, was now set at 1.00 for the three competing alternatives as well. Now α = .89 and the percentage correct placement, in terms of total time scores (construct validity), was 100%.

In both simulations No. 1 and No. 2, the percentage of 500 units of time spent thinking about achievement was low, 14.2% and 10.5%, respectively. In simulation No. 3, the strength of each of the three alternative instigating forces for activities x, y, and z was reduced from 12 to 2.5. This has an effect equivalent to greatly strengthening the relative achievement cue strength of all pictures. Now the percentage of time spent thinking of achieving increased to 35.3%, and α increased from .89 to .98.

We felt it to be a more realistic approximation of the ambiguity of the so-called projective test situation when the percentage time spent in the critical activity was lower, as in simulations No. 1 and No. 2, so we restored the magnitude of forces for each of the alternative activities x, y, z to 12 for all subsequent simulations in the balanced Latin Square designs.

In simulation No. 2B, we replicated No. 2 (the "ideal case"), but changed the σ from .8 to .4 so it would correspond to that of No. 1. The effect on α and construct validity was minimal.

Simulation No. 13 was a replication of No. 1 with one minor exception that had already been introduced from No. 2 onward as a simplification. The consummatory value of all activities (c) was set at .08 instead of .0833 as in No. 1. The effect of this small change was minor, α = .18 (N = 30) instead of .08, and the percentage correct placement based on total time score dropped from 86.7% (in No. 1) to 80% (in No. 13).

The effects of our subsequent efforts systematically to vary selective attention and the duration of the consummatory lag are summarized in Figure 5. It is obvious that when ongoing activity (whatever it is) is favored by greater attention to cues relevant to it, and therefore more systematic exposure to its instigating force than to the forces of subordinate competitors, there is greater internal consistency. Thus, when the lag is constant at 5.0, α = .75 when subjects are exposed only half as often (SEL = 0.5) to instigating forces influencing the subordinate tendencies for competing activities. When exposure to instigation for a nonoccurring competing

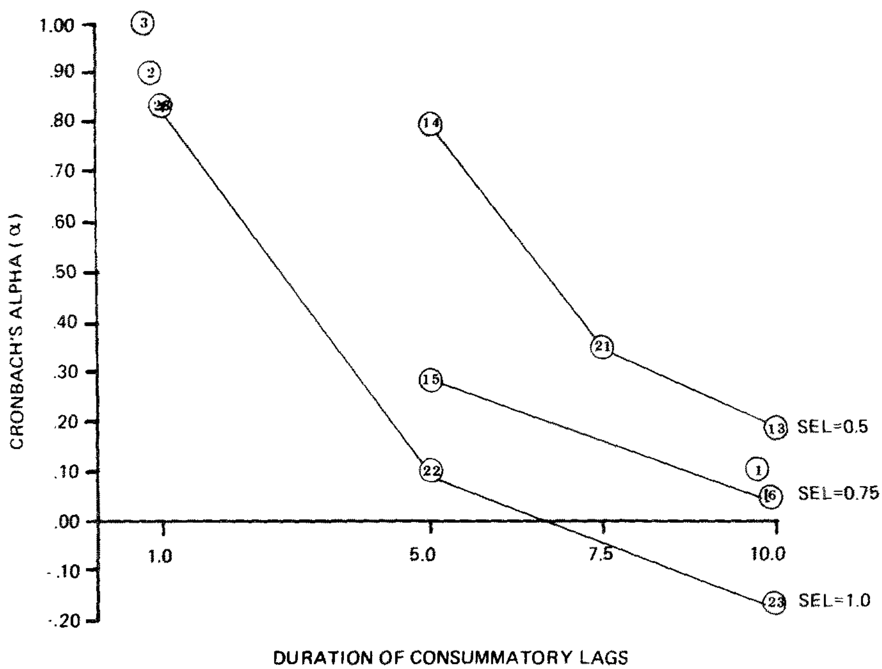

Fig. 5. Effects of duration of consummatory lags (σ = .4) and selective attention on internal consistency (α) of time spent achieving in simulations employing Latin Square designs. (Points are identified by study number in Table III. For each of three alternatives, F = 12, c = .08, σ = .4).

activity is equivalent to that of the dominant ongoing activity (SEL = 1.0), α drops to .09.

It is also obvious that the longer the temporal interval of the consummatory lag (1.0, 5.0, 7.5, or 10.0), the lower the internal consistency reliability, as indicated by α. The combination of the extremes of both parameters, in simulation No. 23, produced $\alpha = -.18$ ($N = 30$), yet 60% of the hypothetical subjects were still correctly ordered according to their motive strength in terms of the truly expected total score. The product moment correlation indicating construct validity in this case (No. 23) was .69 ($N = 30$).

Also identified in Figure 5 are points for simulations No. 3 and No. 2, which, when compared, show the effect of *strong* vs. *weak* cues for the critical variable. And simulation No. 2 in relation to No. 2B shows the effect of a σ for the ogive during the lag of .8 vs. .4. The point marked No. 1 near No. 16 shows the result of No. 1 (by Moffett) with $c = .0833$ instead of $c = .08$ and other differences (Table III).

So much for the Latin Square designs patterned after Atkinson (1950). Table III shows comparable simulations when the design involves a fixed order of presentation of pictures to all the hypothetical subjects. This corresponds closely, in terms of ordinal cue strength of six pictures, to the pattern established by Haber and Alpert's (1958) early empirical study of reliability.

In simulations No. 4 and No. 5, there were three magnitudes of achievement motive (.5, 1.0, and 1.5 in No. 4; .8, 1.0, and 1.2 in No. 5). There were six subjects of each type who differed in the permutations of strength of other motives (x, y, z) within the constraints: (1) that total strength of all motives of a subject always equaled 4; and (2) that the incentive values of pictures for x, y, and z had magnitudes of 1, 2, and 3, but varied from picture to picture. The impact of selective attention and consummatory lag was minimized. In both cases, internal consistency and construct validity are both very high.

In simulations No. 6, No. 7, and No. 8, all parameters were the same as in No. 5 except that now, in each case, the strength of achievement motive for each subject was based on random selection from a normal distribution. The respective sample means were .961, .886, .898; respective standard deviations were .266, .215, .226. The effect of increasing consummatory lag (σ of ogive constant at .8) appears to be some reduction in both internal consistency and construct validity.

In simulation No. 9, the same procedure is employed (mean achievement motive is .919, $SD = .227$), but selectivity of attention (0.5) is introduced. The effect is minimal.

The procedure in simulation No. 11 follows that in No. 9, but the consummatory lag is increased from 1 to 10 units of time. Again, very little effect is evident.

In simulation No. 8B, all procedures and parameters correspond to No. 8 except that N is increased from 18 to 24 (mean motive strength = 1.031, SD = .171). The same randomly selected initial strengths of tendencies of No. 8 are employed in this and subsequent studies. Simulation No. 11B corresponds in all respects (mean motive strength = 1.031, SD = .171), but selectivity in attention is changed from 1 in No. 8B to 0.5 in No. 11B and α drops from .82 to .73.

Perhaps the most interesting results are obtained by comparing simulations No. 17, No. 20, and No. 24, each involving N = 24 and a 12-picture TAT, a simple repetition of the order of six pictures differing in achievement incentive values, as established in No. 4 (i.e., 2 6 4 1 8 3 2 6 4 1 8 3). Here we return to the parameter values for selective attention (0.5) and lag interval (10) and σ (0.4) of No. 13, our standard experiment in the Latin Square designs. The results for this set of three are described in Table V. Here, with both selectivity in attention and consummatory lag having the kinds of effects we have tended to assume they do have on the stream of behavior, we have done the equivalent of changing the overall cue strength for achievement of the test as a whole by varying the strength of the competing tendencies. In simulation No. 17, the incentive values of pictures for the three alternative activities (x, y, and z) have magnitudes of 1, 2, and 3, varying from one picture to the next for a set of six pictures and then repeated. In No. 20, these competing incentives are doubled (2, 4, 6). In No. 24, they are quadrupled (4, 8, 12).

Table V. Effect of Varying the Incentive Values of Pictures for Alternative Activities x, y, and z on Percentage of Total Time Spent in Achievement Activity, Construct Validity, and Internal Consistency

Simulation Study No.	Stories considered	Incentives for x, y, z	% time spent achieving	α	% correct placement
17	1–12	1, 2, or 3	39.0	.87	100.00
	1–6		39.1	.68	91.7
	7–12		38.9	.76	91.7
20	1–12	2, 4, or 6	25.3	.84	91.7
	1–6		25.5	.69	91.7
	7–12		25.2	.66	83.3
24	1–12	4, 8, or 12	14.9	.71	75.0
	1–6		14.5	.35	75.0
	7–12		15.3	.52	41.7

The major effect of this diminution in the relative cue strength of pictures for achievement is an orderly reduction in the percentage of total time spent "thinking about achievement" from 39% to about 15%. And corresponding to this reduction in percentage of time spent in the critical activity (now down to what it was in the Latin Square designs) is a reduction in α from .87 to .71 when based on all 12 pictures, and from .68 to .35 when based only on *the first six pictures.* The latter corresponds more closely to the typical TAT used to measure individual differences in empirical research. Nevertheless, the percentage of persons correctly placed into thirds on the basis of total time for the test as a whole never falls below 75% for the first six pictures. It does, however, fall as low as 41.7% for the second six pictures in No. 24, perhaps a simulated confirmation of an early report by Reitman and Atkinson (1958) that in sets of eight pictures, a *n* Achievement score based on the first four pictures, but not the last four, had predictive validity when *n* Achievement was related to a behavioral criterion, viz., level of arithmetic performance of men working alone in a room.

THE COMMON FACTOR AFFECTING DEGREE OF INTERNAL CONSISTENCY

It is premature to attempt a very comprehensive discussion of how the several assumptions that constitute traditional test theory differ from those that constitute the theory of motivation applied here to thematic apperception. One simple point can be made to spark some critical discussion. Traditional test theory treats each story written in response to a picture as if it were a separate test of a person's motive to achieve (e.g., Entwistle, 1972) and assumes that the obtained *n* Achievement score on each test will equal the "true score" ± error. Furthermore, the errors across test items are assumed to be independent, identically and normally distributed, with mean zero. *Each test is treated as an isolated incident in the life of the person.*

In contrast, the dynamics of action emphasizes the streamlike character of behavior—change in behavior yet continuity (i.e., persistence) of the underlying motivational structure from one incident to the next. If the initial strengths of various competing motivational tendencies are not the same at the beginning of each incident (e.g., the presentation of a picture), the *true score, i.e., the theoretically-deduced time spent thinking about achievement, is not expected to be constant from one picture to the next.* That, in effect, is what these simulations have been about.

One might guess, and we did, that any factor that would increase the range of differences among competing motivational tendencies at the moment a TAT picture (the stimulus) is presented would lower the internal consistency (α) of the test as a whole. Why? Because sometimes the tendency of critical interest (in this case, tendency to achieve) would be the strongest of the competitors, but sometimes it would be the weakest. If there were no variation in the initial (or inertial) strengths of competing tendencies carried over from the preceding moment, then strength of instigating forces (motives) alone would determine the latency and duration of the critical activity in response to each picture.

Figure 6 shows that our guess, the kind of unconscious inference one begins to make when acquainted with the logic of a theory, is correct. For each of 20 simulations having different designs and parameter values, we calculated the range between the strongest and weakest tendency for each subject, and the mean for all subjects in that simulation immediately prior to presentation of picture C in Latin Square designs, and before the third picture when there was a single or fixed order of presentation. In each case, the magnitude of the incentive to achieve of the critical picture was 4 for the average subject. One can see (in Figure 6) that α decreases as the mean range of the initial strengths of four competing motivational tendencies increases.

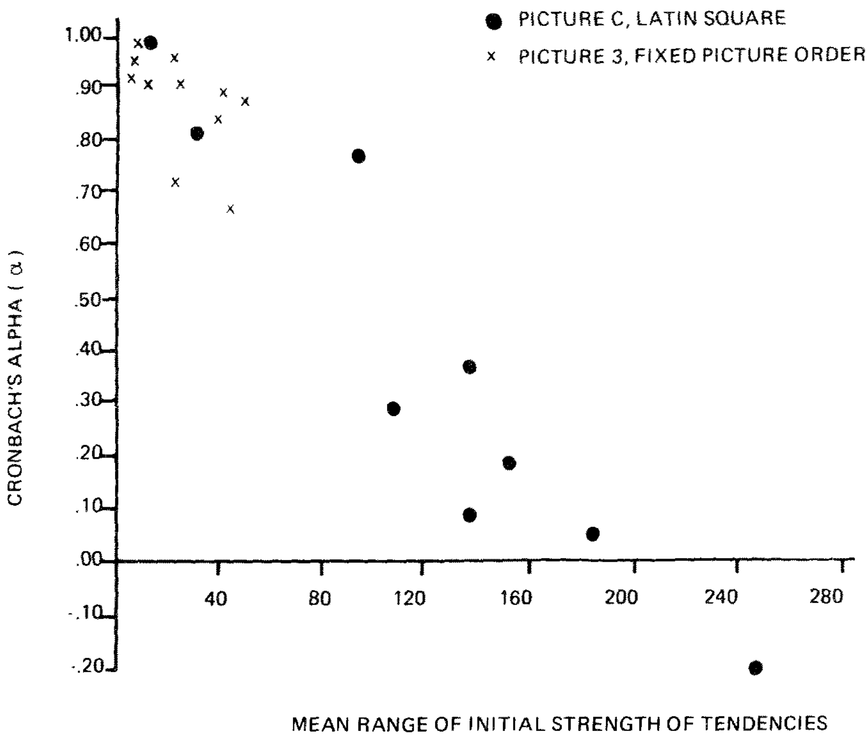

Fig. 6. Effect on internal consistency (α) of mean range in strength of action tendencies immediately prior to exposure to critical picture computed after 20 TAT simulations ($r = -.96$).

The product moment correlation between magnitude of α and mean tendency range is $-.96$ ($N = 20$). The mean range in strength of tendencies is consistently smaller when we are dealing with the third picture in a fixed order than the same picture in Latin Square designs, where it is preceded by a different sequence of events for different subjects. *If the several tests defined by presentation of a picture are independent incidents* (as presumed by traditional test theory), *should it make any difference where a particular picture occurs in the sequence?*

THEORY OF MOTIVATION AND MEASUREMENT THEORY

The theory of motivation specifies how a *stable* personality disposition, strength of motive, will be expressed behaviorally in *variable* amounts of time spent thinking and/or writing about achievement. It tells us specifically how, under various conditions, the "truly expected" time spent expressing the tendency to achieve will vary in a sequence of consecutive incidents. From our computer simulations, we conclude that the "truly expected" construct validity of a TAT test can be substantially high even when the "truly expected" internal consistency is nil!

Basic theory about the underlying psychological process is logically prior to any application of traditional test theory. One must, in other words, have some sound theoretical basis for expecting a certain "true score" on a given test before one introduces the whole logic of test theory, which has to do with the implications of random error in the effort to measure accurately. With thematic apperception, it has been a mistake to assume that the "true score" (some behavioral manifestation) should be constant just because the strength of the underlying trait (motive) is presumed constant. One needs a theory to get from personality to something measurable, viz., behavior.

In the present context, traditional test theory becomes a useful conceptual tool in getting to and from these theoretically deduced (and simulated) times spent thinking about achievement as we imagine them measured by a perfect clock to the fallible empirical index called *n* Achievement score. How good a clock is that 25-year-old experimentally validated and obviously heuristic index (McClelland, Clark, Roby, & Atkinson, 1949) when calculated by someone whose coding reliability is .95? Or only .70? Quite obviously, the very modest indices of internal consistency noted or estimated by constant critics of TAT methodology (e.g., an α around .30 to .40 estimated by Entwistle, 1972) must be degraded versions of some higher theoretically expected value of α. But that truly expected α is not necessarily 1.00 or very near to it.

In suggesting this relationship between basic psychological theory and traditional test theory, let us not lose sight of the main point and conclusion. *It is erroneous to conclude that a thematic apperceptive test lacks validity as a measure of individual differences in strength of achievement motive because internal consistency is low.* We have demonstrated the logical possibility of substantial construct validity even when there is no internal consistency reliability. The point has been made repeatedly in empirical research with TAT *n* Achievement since 1949, which yielded the general theory of motivation now turned on the TAT itself.

According to the dynamics of action, *one should expect high internal consistency reliability, as measured by* α, *when a person is engaged in one particular activity for a substantial length of time* (as, for example, when taking a 20-minute arithmetic test, or when trying to present an accurate picture of oneself in response to the structured items of a long objective test), or *when constantly engaged in the task of writing imaginative stories for 32 minutes without interruption.* According to the theory of motivation, the strength of a tendency should move toward its limit and become essentially stable when a given activity continues for a period of time (Atkinson & Birch, 1970, p. 18; 1974, pp. 276-278). Here is a sound theoretical basis for the *constant* true score presumed in traditional test theory. And we find substantial evidence in the literature of high internal consistency when the activity measured stretches uninterrupted through a period of time. We even have this new fact to present to illustrate the point. When α was recently calculated for *number of words per story* in the data of Atkinson's (1950) initial eight-picture Latin Square that had then been designed to check the reliability of TAT *n* Achievement, α was .96 ($N = 32$) for *number of words.* Individual differences in imaginative and verbal productivity were quite stable throughout the 32 minutes of writing imaginative stories. But the α for *n* Achievement score obtained from each of the eight pictures was lower, only .57 ($N = 32$), when calculated from actual scores of individual subjects (shown in the appendix of Atkinson, 1950), but not .37 as estimated by Entwistle (1972) from a later published table of cell means. Furthermore, the calculated α was .64 for *n* Achievement in six stories when two pictures lacking in validity were excluded now as in 1950. The scoring reliability was probably as high then, .95, as it ever has been.[4]

The difference between the internal consistency ($\alpha = .96$) of imaginative-verbal productivity, which went on continuously for 32 minutes, and $\alpha = .57$ of imaginative content having to do with achievement nicely illustrates the difference between *engaging in a particular activity for a period*

[4]See McClelland et al. (1953, Ch. 7) for further discussion of the usually overlooked evidence of the independence of *n* Achievement and length of protocol among college students.

of time (e.g., writing stories) and the typical change from one activity to another that characterizes the everyday stream of overt operant behavior and *the content* of the covert stream of imaginative thought.

This characteristic of an individual's imaginative behavior—the ability of the subject to change, when so inclined, from one kind of activity to another, and to encompass in the stream of thought anything that one is inclined to think about—makes it a great resource for future development of social psychology. For the stream of imaginative thought now has a sound theoretical foundation, something it lacked a quarter of a century ago. This general theory of motivation, the dynamics of action, provides a new, *empirically grounded,* conceptual scheme in terms of which to appraise the adequacy of the underlying premises of traditional test theory in the new era of behavioral science, the era of computer simulation of behavior.

REFERENCES

Atkinson, J. W. *Studies in projective measurement of achievement motivation.* Doctoral dissertation, University of Michigan, 1950. (Ann Arbor: University Microfilms, Publ. No. 1945, p. 145; also Microfilm Abstract, 10-14 (1950), pp. 290, 291.)

Atkinson, J. W. (Ed.). *Motives in fantasy, action, and society.* Princeton, New Jersey: Van Nostrand, 1958.

Atkinson, J. W. *An introduction to motivation.* Princeton, New Jersey: Van Nostrand, 1964.

Atkinson, J. W. Change of activity: A new focus for the theory of motivation. In T. Mischel (Ed.), *Human action.* New York: Academic Press, 1969.

Atkinson, J. W., & Birch, D. *The dynamics of action.* New York: Wiley, 1970.

Atkinson, J. W., & Birch, D. The dynamics of achievement-oriented activity. Ch. 15 in J. W. Atkinson & J. O. Raynor (Eds.), *Motivation and achievement.* Washington, D.C.: V. H. Winston & Sons (Halsted Press/Wiley), 1974. Pp. 271-326.

Atkinson, J. W., & Cartwright, D. Some neglected variables in contemporary conceptions of decision and performance. *Psychological Reports,* 1964, *14,* 575-590.

Atkinson, J. W., & Feather, N. T. (Eds.). *A theory of achievement motivation.* New York: Wiley, 1966.

Atkinson, J. W., & Raynor, J. O. *Motivation and achievement.* Washington, D.C.: V. H. Winston & Sons (Halsted Press/Wiley), 1974.

Barker, R. G. *The stream of behavior.* New York: Appleton-Century-Crofts, 1963.

Birch, D. Shift in activity and the concept of persisting tendency. In K. W. Spence & J. T. Spence (Eds.), *The psychology of learning and motivation: Advances in research and theory* (Vol. II). New York: Academic Press, 1968.

Birch, D. Measuring the stream of activity. *Michigan Mathematical Psychology Publication, MMPP 72-2,* Michigan Mathematical Psychology Program. Ann Arbor: University of Michigan, 1972.

Birch, D., Atkinson, J. W., & Bongort, K. Cognitive control of action. In B. Weiner (Ed.), *Cognitive views of human motivation.* New York: Academic Press, 1974. Pp. 71-84.

Bongort, K. *Revision of program by Seltzer and Sawusch: Computer program written to simulate the dynamics of action.* Unpublished program. University of Michigan, September 4, 1974.

Cronbach, L. J. Coefficient alpha and the internal structure of tests. *Psychometrika,* 1951, *16,* 297-334.

Entwistle, D. E. To dispel fantasies about fantasy-based measures of achievement motivation. *Psychological Bulletin,* 1972, *77,* 377-391.
Feather, N. T. The study of persistence. *Psychological Bulletin,* 1962, *59,* 94-115. Also in J. W. Atkinson & N. T. Feather (Eds.), *A theory of achievement motivation.* New York: Wiley, 1966.
Haber, R. N., & Alpert, R. The role of situation and picture cues in projective measurement of achievement motive. Ch. 45 in J. W. Atkinson (Eds.), *Motives in fantasy, action, and society.* Princeton, New Jersey: Van Nostrand, 1958. Pp. 644-663.
Hebb, D. O. *The organization of behavior.* New York: Wiley, 1949.
Heckhausen, H. *Hoffnung und Furcht in der Leistungsmotivation.* Meisenheim Glan: Verlag Anton Hain, 1963.
Heckhausen, H. *The anatomy of achievement motivation.* New York: Academic Press, 1967.
McClelland, D. C. The psychology of mental content reconsidered. *Psychological Review,* 1955, *62,* 292-302.
McClelland, D. C. *The achieving society.* Princeton, New Jersey: Van Nostrand, 1961.
McClelland, D. C., Atkinson, J. W., Clark, R. A., & Lowell, E. L. *The achievement motive.* New York: Appleton-Century-Crofts, 1953. (Reissue: New York: Irvington, 1976.)
McClelland, D. C., Clark, R. A., Roby, T. B., & Atkinson, J. W. The projective expression of needs. IV. The effect of need for achievement on thematic apperception. *Journal of Experimental Psychology,* 1949, *39,* 242-255.
McClelland, D. C., Davis, W. N., Kahn, R., & Wanner, E. *The drinking man: Alcohol and human motivation.* New York: The Free Press, 1972.
McClelland, D. C., & Winter, D. G. *Motivating economic achievement.* New York: The Free Press, 1969.
Moffett, Mary M. *Computer simulation of low split-half reliability of the thematic apperception test.* Unpublished term paper for Psychology 742, University of Michigan, Winter 1974.
Morgan, C. D., & Murray, H. A. A method for investigating fantasy. The Thematic Apperception Test. *Archives of Neurology and Psychiatry,* 1935, *34,* 289-306.
Raynor, J. O. Future orientation and motivation of immediate activity: An elaboration of the theory of achievement motivation. *Psychological Review,* 1969, *76,* 606-610. Reprinted with experiments and elaborations in J. W. Atkinson & J. O. Raynor (Eds.), *Motivation and achievement.* Washington, D.C.: V. H. Winston & Sons (Halsted Press/Wiley), 1974.
Raynor, J. O. Future orientation in the study of achievement motivation. Ch. 7 in J. W. Atkinson & J. O. Raynor (Eds.), *Motivation and achievement.* Washington, D.C.: V. H. Winston & Sons (Halsted Press/Wiley), 1974. Pp. 121-154.
Reitman, W. R., & Atkinson, J. W. Some methodological problems in the use of thematic apperceptive measures of human motives. Ch. 46 in J. W. Atkinson (Ed.), *Motives in fantasy, action, and society.* Princeton, New Jersey: Van Nostrand, 1958. Pp. 664-684.
Sawusch, J. R. Computer simulation of the influence of ability and motivation on test performance and cumulative achievement and the relation between them. Appendix B in J. W. Atkinson & J. O. Raynor (Eds.), *Motivation and achievement.* Washington, D.C.: V. H. Winston & Sons (Halsted Press/Wiley), 1974. Pp. 425-438.
Seltzer, R. A. Simulation of the dynamics of action. *Psychological Reports,* 1973, *32,* 859-872.
Seltzer, R. A., & Sawusch, J. R. A program for computer simulation of the dynamics of action. In J. W. Atkinson & J. O. Raynor (Eds.), *Motivation and achievement.* Washington, D.C.: V. H. Winston & Sons (Halsted Press/Wiley), 1974. Pp. 411-423.
Smith, C. P. (Ed.). *Achievement-related motives in children.* New York: Russell Sage Foundation, 1969.
Veroff, J., & Feld, S. *Marriage and work in America.* New York: Van Nostrand-Reinhold, 1970.
Weiner, B. *Achievement motivation and attribution theory.* Morristown, New Jersey: General Learning Press, 1974.
Whalen, R. E. Sexual motivation. *Psychological Review,* 1966, *73,* 151-163.
Winter, D. *The power motive.* New York: The Free Press, 1973.