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# Pessimism in educational psychology : In the case of ATI research

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Based on a presentation made by the author at two universities in West Germany, he discussed following topics in this article : *Zeitgeist* of psychology in Japan at the beginning of 1960s ; Basic concept of Aptitude-Treatment Interaction, or ATI ; Experimental findings ; Limitation and utility of ATI ; The status quo of ATI study at Stanford : Pessimism in educational psychology from ATI point of view.

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It is a great pleasure and honor to be offered a chance to make a presentation to you today. I would like to express my heartfelt gratitude to Professor Kornadt of Saarland University and Professor Trommsdorff of Konstanz University for taking the trouble of inviting me as your guest and arranging this presentation in the busiest time of an academic year in Germany. Professors Kornadt and Trommsdorff, as you already know, stayed at my university Keio as Visiting Professors last year totally for about five months. During their stay, Professor Kornadt gave us a special lecture entitled "Psychology in Germany and its relation to Japan", and in it he introduced to us the overview of German psychology up to today relating it to Japanese psychology. Professor Trommsdorff had a class for graduate students on crosscultural socialization study. Both of them were very exciting and instructive. In addition, a project of crosscultural study on socialization has started from this year, and exchange of students are being done. I hope the tie between Saarland and Konstanz on Germany side and Keio on Japan side will be tightened from now on year by year.

I would like to talk to you today under the title "Pessimism in educational psychology", with a subtitle "In the case of ATI research". My research interest has been diverse including developmental study of cognition and moral judgment, study of achievement motivation, etc. But today I would limit the topic to ATI study in which I have been engaged these fifteen years or so. I prepared totally six headings in my presentation. (1) Background of my start as a psychologist : Here I would like to introduce to you the *Zeitgeist* of psychology in Japan at the beginning of 1960s, and at the same time, Professors of psychology at Keio University in those days. (2) ATI : its outline. Here I would like to talk about the basic concept of ATI, its educational relevance, and its relationship to a later theory of Gestalt psychology. (3) Experimental findings : Here I would like to show several results of my own research. (4) Practical utility of

ATI: Here I will point to the utility of ATI paradigm in educational settings, and then, its limitation due to instability. (5) What is go ing on at Stanford: Here I would like to show recent works done by Professor Snow at Stanford University. (6) Pessimistic view points: Here I will point out that ATI viewpoint itself is pessimistic, citing an article in this connection. Finally, I would reconsider the educational relevance and significance ATI paradigm still has.

## Background of my start as a psychologist

When I entered undergraduate course of psychology at Keio University in 1959, the main teaching staffs were as follows. Professor Matsusaburo Yokoyama, who got his Ph. D. at Clark University in USA in 1921, was former President of Japanese Psychological Association, and specialized in perception. Professor Takashi Ogawa, who got his Ph. D. from Tokyo University, was a translator of Lewin's *Dynamic Theory of Personality*, also a pioneer researcher of behavior analysis, and had just begun to use so-called Skinner-Box. Professor Tarow Indow, who got his Ph. D. from Keio University, is currently teaching at University of California, Irvine, and was my adviser when I finished the undergraduate course. He specialized in mathematical psychology and psychometrics. Professor Kendo Nishitani, who studied psychology in Leipzig at the beginning of 1930s, specialized in educational psychology, and introduced German psychology to us, for example, by using German text books for graduate classes. Professor Minoru Murai, who got his Ph. D. from Hiroshima University and specialized in philosophy of education, just returned from Harvard carring back a prototype model of teaching machine presented from Professor B. F. Skinner himself. Several years later, he established an institute at Keio mainly for studies of programmed instruction. Lastly, let me make mention of my cousin Professor Yasufumi Kataguchi. He obtained his Ph. D. from Tokyo

University and also Ph. D. in medicine from Juntendo Medical College. He specialized in clinical psychology and taught at Chukyo University. A voluminous handbook of Rorschach Test he wrote is being used widely still today. And he was a great influence on me in making up my mind to become a psychologist.

I have mentioned above Professors to let you know the *Zeitgeist* of psychology in Japan in those days. In retrospect, I can characterize it as the beginning of a strong influence of American psychology. Thanks to the academic climate where I was raised up as a psychologist, I myself have never forgotten respect for the original German psychology ever since.

## ATI : Its outline

Professor L. J. Cronbach, now retired and Emeritus of Stanford, proposed the basic concept of Aptitude-Treatment Interaction, or ATI in abbreviation, in his presidential address at an annual conference of American Psychological Association about three decades ago entitled *The two disciplines of scientific psychology* (Cronbach, 1957). In it he eloquently persuaded the necessity of unifying two streams of psychology, namely, experimental psychology and psychology of individual differences. By this unification, he insisted, a new vista of psychology could be opened up. And ATI is exactly this unification. Psychology of individual differences has long been engaged in developping theories and methods to tap traits of individuals including aptitudes. On the other hand, the main interest of experimental psychology has been to mainpulate experimental conditions or treatments in experimental settings to change or form behavior of organisms. Typically ATI has a shape as shown in Fig. 1. If we take an aptitude as abscissa and payoff or the result of treatment as ordinate, and prepare two kinds of treatments, A and B, then we may obtain such pattern as Fig. 1. These two lines are regression
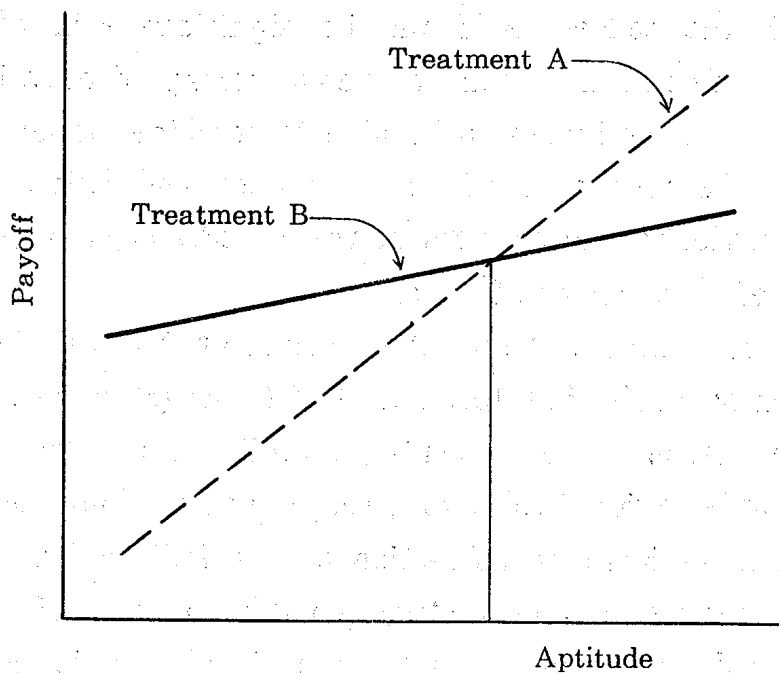
Fig. 1 Typical ATI with one aptitude, payoff, and two treat-
ments (with an intersection between two regression lines).

lines of payoff onto aptitude corresponding to each treatment. We call this non-parallel pattern an interaction (ordinal or disordinal) in the sense of statistics. The reason why such an interaction can occur is that responsiveness of invdiduals to treatments differs depending on their position on aptitude dimension.

At first, Professor Cronbach did not especially point to educational relevance of ATI, but later he did so by emphasizing the possibility of optimizing instructional methods based on ATI, i. e. by switching to the other treatment at the intersection, we can adapt teaching methods to individual differences, and expect much better payoff for much more persons.

Professor Cronbach stayed in Japan as Fulbright Professor in 1965, and once visited Keio to deliver a special lecture held in honor of Professor Yokoyama. My Research interest had already turned from more basic psychology to educational psychology by that time, but was still searching in the dark to know "What is, and should be, educational psychology?" Listening to his lecture, I was deeply im-

pressed with the concept ATI and its significance in educational psychology. I felt as if I found a thema worthy of devoting whole of my life. I was delighted to be able to combine under the banner of ATI the technique of psychometrics and Skinnerian technology of behavior formation, both of them I had been taught at the Department of Psychology of Keio.

According to Professor Hunt, the concept of ATI can be seen as a specification of K. Lewin's formula : B=f (P, E) (Hunt and Sullivan, 1974). Here person P corresponds to aptitude, environment E to treatment, and behavior B to payoff, respectively. And then, payoff, the dependent variable, is a function of two independent variables, aptitude and treatments, and the function takes a form of, for example, a statistical structural model with a linear combination of two main effects of these two independent variables, interaction term between them, error term, and grand mean.

## Experimental findings

Since Professor Cronbach advocated the concept of ATI, many experimental studies have been done during these three decades. The voluminous handbook by Cronbach and Snow (1977) entitled *Aptitudes and instructional methods : A handbook for research on interactions* was a monumental work on ATI study until the end of 1970s. The development of the study after the publication of the handbook up to now has recently reviewed by Professor Snow in one chapter of a book entitled *Aptitude-Treatment Interaction as a framework for research on individual differences in learninng* (Snow, 1989).

I have been engaged in ATI research these fifteen years or more, and tried to increase the generality of ATI paradigm by taking two aptitude dimensions and multiple treatments into account simultaneously (Namiki and Hayashi, 1977). In this case, we can calculate
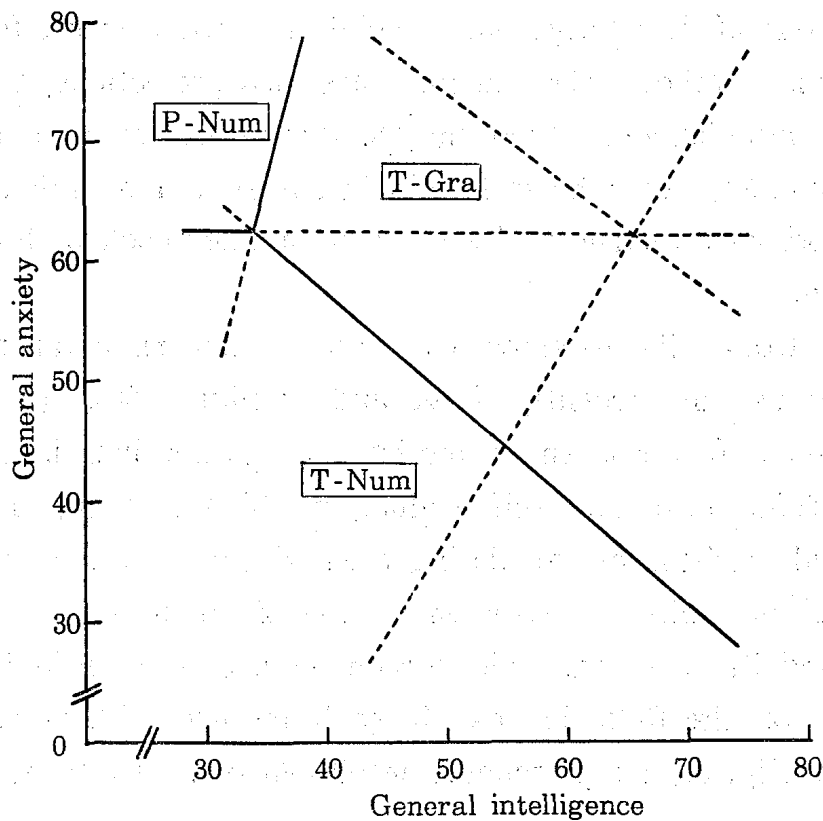
Fig. 2 Regions of optimal treatments when general intelligence
and general anxiety are used as aptitudes. Solid lines are
boundaries of optimal treatment. Dotted lines are also or-
thogonal projections of intersections among regression planes,
but not relevant to optimization. T: textbook; P: pro-
grammed book; Num : numerical expression; Gra : graphical
expression. (Namiki and Hayashi, 1977).

regression plane for each treatment in a three dimensional space
defined by two aptitudes and one payoff. For example, in the case
of Fig. 2, the learning task was understanding and application of a
formula for arithmetic progression, using junior high school students
as subjects, and the two aptitude dimensions were standard scores
of general intelligence and general anxiety. Four kinds of instruc-
tional methods were prepared by combining two factors, textbook or
programmed book format, and numerical or graphical expression.
Five lines (one line was outside of this sphere, and omitted here) in
the figure are orthogonal projections of intersections obtained by the

combinations of four treatments. Solid lines are boarders for optimal instructional methods. Dotted lines are also projections, but not relevant to optimization. According to this figure, or, an optimization chart, a student, say, who is low in intelligence and high in anxiety can be optimally instructed by the programmed book with numerical expression.

Next, I would like to show you another experimental result obtained by us only recently (Kage and Namiki, 1990). In this case, the treatment factor is three methods of evaluation, i. e., relative, criterion-referenced, and self evaluation. The learning task was to understand methods of calculating area of figures, and sixth graders were used as subjects. After each class, a small quiz was administered, and its score was told to each pupil at the beginning of the next class on the following day in each method of evaluation. As shown in Fig. 3, using general intelligence as aptitude, and self-
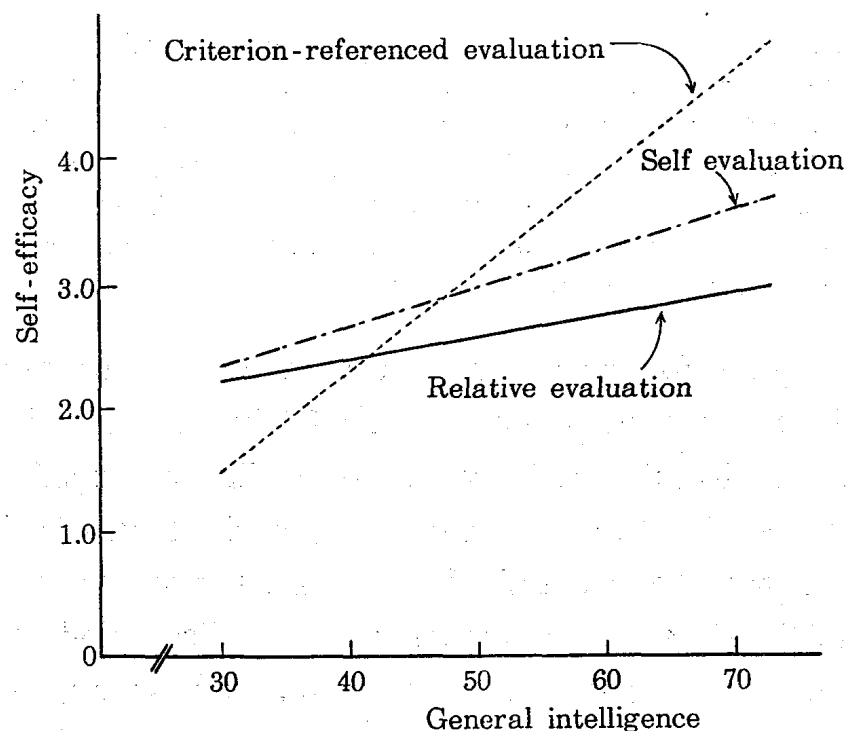


Fig. 3 Interaction between general intelligence and three methods of evaluation with self-efficacy as payoff (Kage and Namiki, 1990).

efficacy as payoff, we obtained a significant interaction between intelligence and three methods of evaluation. It may safely be said from this result that one method of evaluation can not be best for students of all intelligence levels. Also in this experiment, a significant interaction was obtained between test anxiety and evaluation methods when feeling of pressure was the payoff.

These results altogether suggest that any result of school learning is a function of a complex of cognitive, conative, and affective factors and instructional methods in a very subtle way, and consequently, any all-purpose, best-for-all or with strong main effect enough to cancell out interaction effect, or panacealike method of pedagogy has not been available until today.

## Practical utility of ATI

If a large amount of ATI experiments have been done and a substantial body of knowledge on disordinal interaction has been accumulated, prescription for each student will become possible to place him in the best and optimal pedagogical method correponding to his unique pattern of aptitudes. As an extention from the concept of optimization based on ATI, Professor R. Glaser proposed models of Adaptive Education (Glaser, 1977). Some of the models are in a sense more active than optimization by ATI, because they are furnished with a remedial loop to compensate for an insufficient aptitude in addition to alternative instructional methods leading to one educational goal. Anyway, optimization in terms of ATI is made possible only when stable disordinal ATI patterns are available. In fact, many authors, except for a small number of proponents of ATI who themselves do conduct ATI experiments, are critical even about the existence of ATI effect mainly because of the instability of the phenomena.

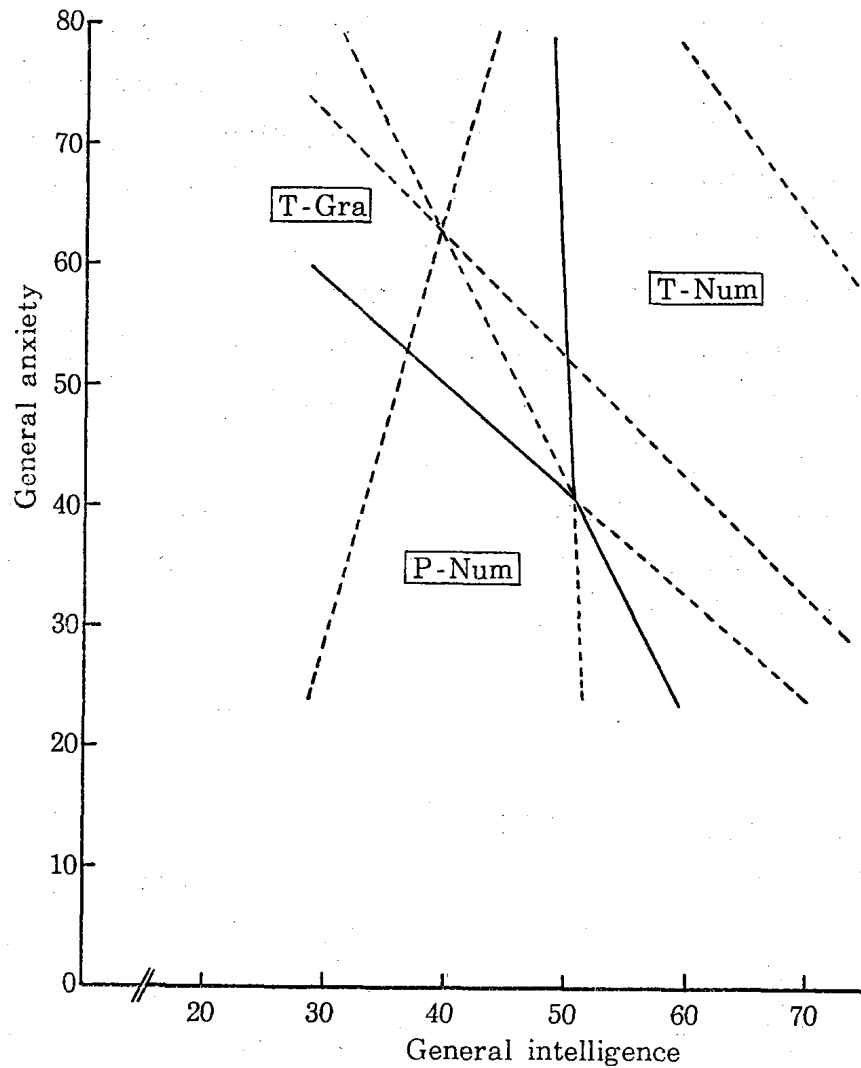Next, I would like to show you a replication of the experiment

Fig. 4  Regions of opitimal treatments obtained by a replication
experiment. Cf. Fig. 2  (Namiki, et al., 1977).

shown in Fig. 2. The replication experiment was originally planned
to examine the effectiveness of optimization chart in Fig. 2 on a
new sample of students in the following year at the same school,
with the same eight grade, and at the same time of an academic
year (Namiki, et al., 1978). As shown in Fig. 4, the ATI pattern
in the three dimensional space is so different from that of Fig. 2.
Judging from this comparison, this kind of ATI effect can not stand
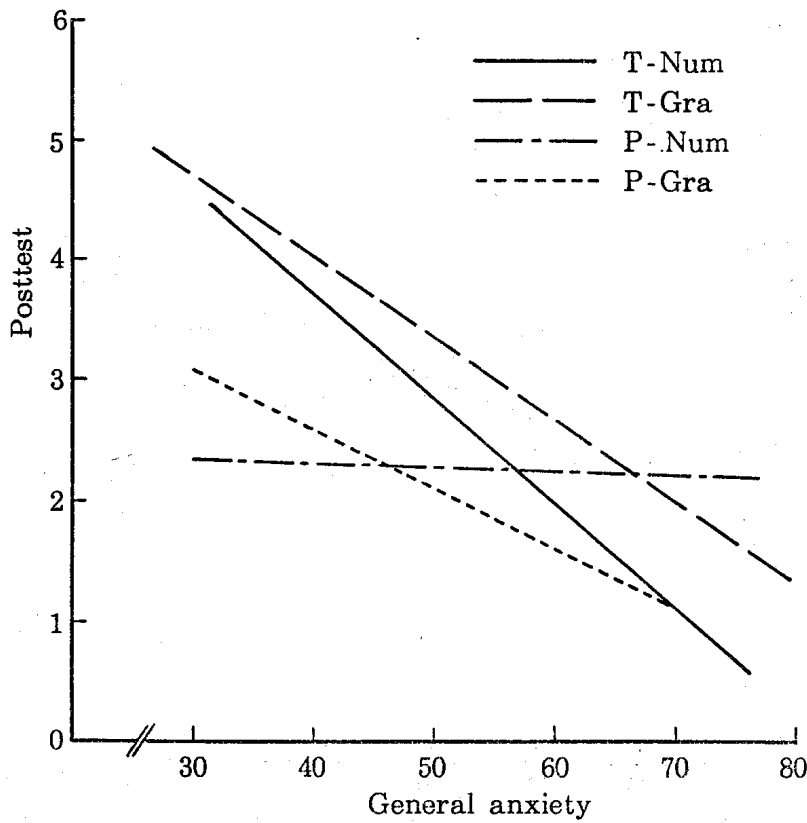replication, even though each ATI pattern is statistically significant.

Fig. 5　Regression lines of four instructional treatments when general anxiety is used as aptitude and posttest as payoff. (Namiki and Hayashi, 1977).

Therefore, I must reluctantly admit that the conception of optimization in terms of this kind of complex ATI pattern is far from practical utility.

I should now try to examine the possible causes of instability characteristic of this type of ATI. Fig. 5 and 6 are ATI patterns on General Anxiety in the two experiments, and we notice that regression slopes are mostly negative in Fig. 5, and mostly positive (except for Program-Numerical) in Fig. 6.* As for ATI patterns on

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\* The scales of payoff in Fig. 5 and 6 have different units because the scoring rule and the number of items were slightly modified in the replication experiment in Fig. 6, but the content of the items in the two experiments is the same and specific domain of arithmetic progression, and so these two scales are comparable.
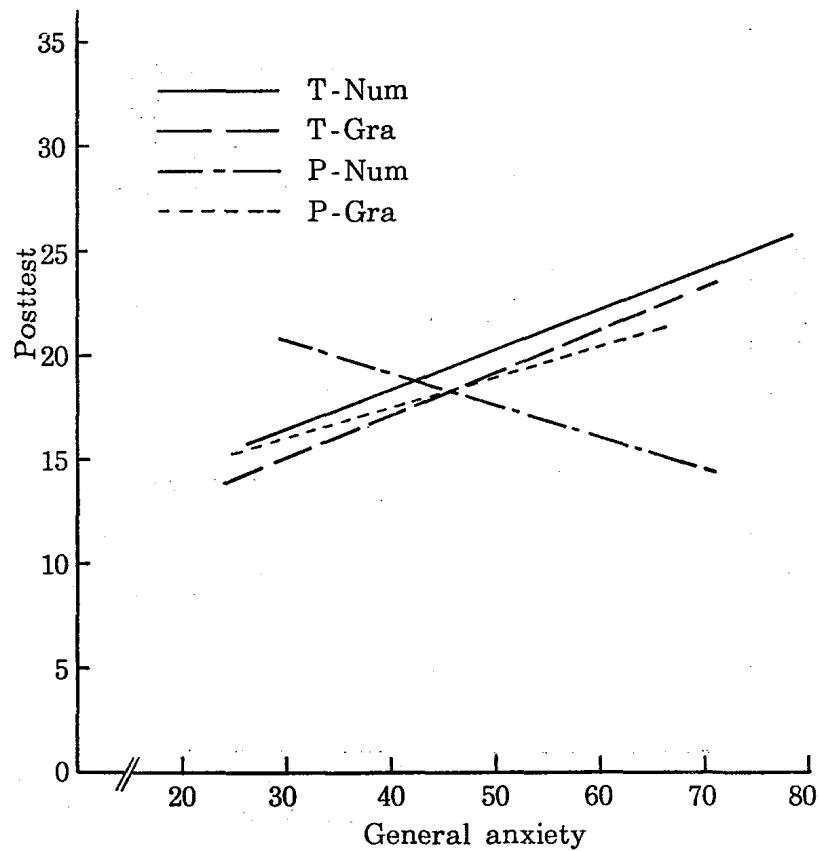
Fig. 6　A replication experiment of Fig. 5 (Namiki, et al., 1979).

intelligence, there is not so large discrepancy between two experiments as is often the case with general intelligence. From these results, it may safely be said that the discrepancy between Fig. 2 and Fig. 4 can be ascribed to the instability in the relation of General Anxiety measure to payoff under each instructional condition. And, if so, we can reasonably doubt the construct validity of General Anxiety measure notwithstanding its naming of "General".

By the way, if we pick up each regression line separately from ATI pattern, it represents predictive validity of an aptitude measure for a criterion, in this case payoff, under each instructional condition. As is well-known, measures of general intelligence always have high predictive validity, especially at primary education level. The reason why ATI is so unstable, and in contrast, predictive validity is so high and stable even though the same kind of aptitude measure is

concerned is that in the former the regression line is obtained on a single sample of a specific and special instructional condition, but in the latter it is obtained as an average of all possible educational conditions over a long period of time. In short, my interpretation about the cause of instability in ATI is twofold: low construct validity of an aptitude measure and sampling fluctuation of a specific pedagogical condition (Namiki, 1977).

## What is going on at Stanford

I stayed at School of Education, Stanford University, for one full year in 1978 to know what was going on there. In the preceeding year, the handbook on ATI that I already mentioned had been published. Professor Cronbach was still teaching at the Graduate School, but he himself said that his own research interest had turned to other areas, for example, evaluation. Professor Snow was energetically conducting experiments using an eye-camera. " Aptitude Process " was his own terminology at that time to the effect that ATI phenomenon should be analysed at the level of information processing between aptitude and treatment. For example, he examined eye-movement while a subject was solving an intelligence test item, and tried to relate this process to his level of general intelligence. Many of the staffs and graduate students out there had been raised up under the strong influence of these two Professors, and the Graduate School looked like a mecca of ATI study in those days. Since then Professor Snow edited a series of books entitled *Aptitude, learning, and instruction* (Vol. 1-3) (Snow, et al., 1980, 1980, 1987). In these books he tried to extend the analysis of aptitude process to many facets of aptitude including cognition, conation, and affection. And only recently he published a historical review of ATI study as a framework for research on individual differences in learning as I already mentioned. After leaving Germany soon, I will visit Stanford again

after ten years interval, and I am looking foward to seeing what is going on there today.

## Pessimistic viewpoints

Positivistic researches in education, especially experimental ones, have been done for nearly a century on a firm belief that empirical methods are so effective that they will surely bring about fruitful results enough to reform and improve educational practices. Educational psychologists have been expected to give clear and constructive answers for the solution and betterment of urgent educational problems. The concept of optimization in terms of ATI paradigm is a good example. Yes, the model is appealing to educators offering a scientific method to realize education for individuality. But the experimental results, as I frankly admitted, are so unstable that they are far short of practical application.

I would like to refer to a seemingly simpler example of empirical research in education. Professor Snow mentioned Schramm's review of comparisons of televised versus live classroom teaching (Schramm, 1962; Snow and Yalow, 1982). Schramm collected totally four hundreds cases of comparison, and TV method was better than traditional class in 83 cases, TV method was worse than traditional in 55 cases, and no significant difference between these two in 255 cases. To our regret, no clear-cut conclusion is available even though so many scientific studies have been conducted and accumulated. One interpretation of these results is that in these four hundred cases only comparison of averages, or main effect was taken into account, and possible interaction, for example, between ability and instructional methods was neglected. During the last decade, methods of integrating similar research results and drawing more valid conclusion have been developped by the name of Meta-analysis (Hedges and Olkin, 1985; Mullen and Rosenthal, 1985; Whitener, 1989). These

methods pay attention to the metrics of effect in each experimental result instead of counting the number of positive and negative cases, or a voting rule, and may contribute to draw conclusions from conflicting experimental findings (Light, 1979).

Only recently I happened to read an article by Cziko (1989) that appeared in *Educational Researcher*. He exhaustively listed the possible sources of "unpredictability and indeterminism in human behavior". I was deeply impressed with his augument and would like to introduce its outline to you, relating it to my own experimental results. According to his article, there are two arguments from a deterministic perspective: (a) individual differences. (b) chaos. In addition, there are three arguments from an indeterministic perspective: (c) the evolutionary nature of learning and development. (d) the role of consciousness and free will in human behavior. (e) the implications of quantum mechanics. He concluded that "educational research that attempts to predict and control educational outcomes cannot be successful and that educational research should focus on providing descriptions and interpretations of educational phenomena to provide findings that can be used to improve our understanding of learning, development, and education and to fascilitate their evolution".

Here I would like to restrict my discussion on (a) individual differences. This argument is based on higher order interaction of educational phenomena including ATI. From this argument, the cause of the discrepancy between the two ATI patterns in Fig. 2 and 4 can be ascribed to an interaction with time or occasion. Here again I quote Cziko's words in his argument in connection with ATI: "Cronbach and Snow conclude that comprehensive and definitive experiments in the social sciences are not possible and that the most we can ever realistically hope to achieve in educational research is not prediction and control but rather only temporary understanding".

Thus, if we go too far to the extreme of interactional viewpoint,

the only thing we can say is " It depends— ". But, as Professor Cziko also acknowledged in his article, Cronbach and Snow do not reject the lawfulness itself in human behavior. Rather, from their interactional point of view, only local lawfulness can be established, and more general lawfulness is hard to attain. Therefore, we should not expect too much from an experimental study in education, and should not overgeneralize from its result. Consequently, the ATI viewpoint can be characterized as moderately pessimistic, and located just between both extremities of scientific optimism from where today's educational experimentation started and radical pessimism where human behavior is seen, for example, as a chaos by nature. In other words, ATI viewpoint is always eclectic, and even the concept of optimization by means of ATI is a compromise between tutorial lesson for the individual and group lesson with uniform regimentation.

Now, I would like to touch upon two examples of inconsistent and problematic findings from other areas of science. The first example I mention is a vaccine therapy invented by Professor Maruyama in Japan about twenty years ago. We hear that it is a sort of tubercular vaccine, and activates the immunity mechanism of human body against cancer. But the effectiveness of the substance has not been proved yet by usual methods of biochemical scrutiny. On the other hand, tens of thousands cancer patients are on injections of the vaccine throughout Japan because, people say, it is sometimes in fact effective. The vaccine, however, is not approved as a legal medicine by Ministry of Health and Welfare still today.

Another example I mention is the phenomenon of nucler fusion at low temperature. Since the discovery was reported at Utah University and Brighum Young University in USA nearly at the same time, many reexaminations have been done world-widely including Japan, but any decisive conclusion has not been reached. These two examples I have taken notice of, one from medical science and the

other from physics, seem to give us some relief. Even in more advanced sciences, inconsistency is no exception at one stage of their progress, and gives an impetus to the next stage.

Finally, I would like to tell you an interesting argument I happened to hear at Stanford during my last stay. The argument was set forth in a class for graduate students, and two discussants were Professor Gage known for a thick handbook on educational research and Professor Snow who was my Host Professor at that time. Professor Gage addressed to Professor Snow excitedly: "ATI researchers look like sticking to the hole of a doughnut. If one method is better than the other and most of the students get better results, it suffices. It means a strong main effect, or a substantial body of doughnut. It is of no use to warry about the hole!" Professor Snow calmly replied: "Yes, the percentage of interaction effect is usually small. But, say, penicillin has a strong effectiveness or main effect. Only rarely, however, it can cause a penicillin shock. It is an interaction between the predisposition and the medical substance. Even if such a fatal case occurs only once out of tens of thousands, we must prevent it by all means. The same thing holds true for education, that is, even if a method yields good result for most of students, we must not forget a small number of possible victims by the method however small the number may be". I myself would rather prefer to stick to the hole of a doughnut yet.

I thank you so much for your kind attention.

### References

Cronbach, L. J., 1957, The two disciplines of scientific psychology. *American Psychologist*, 12, 671–684.

Cronbach, L. J., and Snow, R. E., 1977, *Aptitudes and instructional methods: A handbook for research on interactions.* Irvington.

Cziko, G. A., 1989, Unpredictability and indeterminism in human behavior: Arguments and implications for educational research. *Educational Researcher*, 18, 3, 17–25.

Glaser, R., 1977, *Adaptive education: Individual diversity and learning.* Holt, Rinehart and Winston.

Hedge, L. V. and Olkin, I., 1985, *Statistical methods for Meta-Analysis.* Academic Press.

Hunt, D. E. and Sullivan, E. V., 1974, *Between Psychology and Education.* Dryden Press.

Kage, M. and Namiki, H., 1990, The effect of evaluation structure on children's intrinsic motivation and learning. *Japanese Journal of Educational Psychology*, 38, 1, 36-45.

Light, R. J., 1979, Capitalizing on variation: How conflicting reseach findings can be helpful for policy. *Educational Researcher*, 8, 7-11.

Mullen, B. and Rosenthal, R., 1985, *Basic Meta-Analysis: Procedures and program.* L. E. A.

Namiki, H. 1977, Specificity-generality in ATI research: Some theoretical consideration and experimental evidences. *9th Report, Psychological Laboratory on Hiyoshi Campus*, Keio University, 87-98.

Namiki, H. and Hayashi, J., 1977, Determination of optimal instructional treatment in ATI of two aptitude dimensions and multiple treatments. *Japanese Psychological Research*, 19, 56-67.

Namiki, H., Hayashi, J. and Shibata, T., 1978, Specificity-generality of aptitude information in the Aptitude-Treatment Interaction: An experimental evidence. *Philosophy*, Keio University, 68, 145-162.

Schramm, W., 1962, Learning from instructional television. *Review of Educational Research*, 32, 156-157.

Snow, R. E., Federico, P-A. and Montague, W. E. (Eds.), 1980, *Aptitude, learning and instruction, Vol. 1: Congnitive process analyses of aptitude.* LEA.

Snow, R. E., Federico, P-A. and Montague, W. E. (Eds.), 1980, *Aptitude, learning and instruction, Vol. 2: Congnitive process analyses of learning and problem solving.* LEA. ‘

Snow, R. E. and Yalow, E., 1982, Education and intelligence. In R. J. Sternberg (Ed.) *Handbaok of human intelligence.* Cambridge University Press.

Snow, R. E. and Farr, M. J. (Eds.), 1987, *Aptitude, learning and instruction, Vol. 3: Cognitive and affective process analyses.* LEA.

Snow, R. E., 1989, Aptitude-Treatment Interaction as a framework for research on individual differences in learning. In P. L. Ackerman, R. J. Sternberg and R. Glaser (Eds.), *Learning and individual differences: Advances in theory and research.* Freeman.

Whitener, E. M., 1989, A Meta-Analytic review of the effect on learning of the interaction between prior achievement and instructional support. *Review of Educational Research*, 59, 1, 65-86.