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Skill Learning as a Concept in Life-Span Developmental Psychology: An Action Theoretic Analysis

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Abstract. An action theoretic account of skill learning and skill use is offered as a useful heuristic for life-span developmental psychology. It is suggested that analyses of the tasks confronting an individual and of the structure of action, as well as of the interplay of these two, have implications for the understanding of development across the life span. In particular, these analyses have implications for the disuse hypothesis, the issue of stability and cross-situational consistency of behavioral dispositions, the issue of the degree of awareness of action strategies, and the understanding of so-called skill traps. Furthermore, the concept of stage can be conceptualized differently within this framework. Finally, action theory, with its emphasis on the task structure, is able to circumvent the subjectivistic concepts which plague analyses of behavior, without giving up the principle that individuals actively structure their cognitions and their environments.

In this article we present a specific version of action theory which is particularly prominent in industrial psychology in the German-speaking countries [*Hacker,* 1978, 1984; *Volpert,* 1973]. Action theory, as conceptualized here, was greatly influenced by the book 'Plans and the structure of behavior' by *Miller* et al. [1960]. Our goals in this paper are twofold: (1) to describe some ideas from within the theoretical context of action theory which may be useful when applied to life-span developmental psychology, and (2) to emphasize the importance of looking at the task structure of the environment when investigating development over the life span, either in naturalistic or laboratory settings. The goals go hand-in-hand as will be clear after a brief review of the theoretical constructs of action theory which we present below.

It should be emphasized that action theory is offered as a useful heuristic for viewing development across the life span. It is not a fully worked-out theory of behavior. Its merits lie in the equal emphasis which it places on the analysis of the individual's behavior

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and on the task situation itself, as well as on the interaction of the two. So, for example, in analyzing the skilled performance of an action, not only would the action theorist discuss the process of skill acquisition, in terms of goals, plans to reach goals, and automatization of those plans, but the task, itself, would be analyzed. The task analysis would describe the decision points of the task, the number of decision points, and the degree to which the actor is able to automatize the actions because of the regularity of the task situation [*Hacker,* 1978]. After such an analysis of both the actor and the task, the interaction can be described within one theoretical framework.

Briefly, action theory is based on the notion that goal-directed behavior is cognitively regulated through hierarchically structured plans. It is hypothesized that there is an internal model of the action which when executed will attain some goal. The internal model that regulates action has to develop some kind of plan for approaching the goal. This plan may be detailed or sketchy, focused on the goal or relatively non-focused; it may result from the adaptation of an old plan or the generation of a new plan, or some combination of old and new plans. The plan is hierarchically structured, and the action guided by the plan is modified by feedback. With this type of theory, it is possible to bridge the gap between cognition and action since the plan outlines the action and is completed while the individual is acting. Of course, more than one plan can be generated, and will often be generated, before one actually acts.

In summary, an action consists of the following steps: (1) the development of goals and the decision of which goal to pursue; (2) the generation of a plan or various plans; (3) a selection from among the available plans; (4) the execution of the plan, and, thereby, also the completion of the plan, and (5) the processing of feedback, which can change or stop the execution of the plan and which facilitates the learning of the types of plans which can be most successfully and efficiently used in the future in similar situations. It is important to note that these actions are situationally specific. That is, the task at hand requires the actions. On the other hand, the structure, namely, how the goals and plans are developed and carried out, may differ across individuals and may be less situationally specific.

Five aspects of the theory stand out as particularly useful: (1) the focus on the interactive nature of the image/plan/action/world system; (2) the account of thought/action processes as hierarchical; (3) the focus on different levels of functioning, such as the difference between automatized behaviors and intellectually regulated action; (4) the stress on the importance of feedback for successful action and control, and thus, the impact of the real world on the action, the plan, and the model of the world. To clarify why these aspects are of importance we shall turn to a discussion of the concept of skills, focusing on the acquisition and use of the skill of typewriting. In a second step, we shall consider the usefulness of such an approach in life-span developmental psychology.

The Concept of Skills

We are using a broad conceptualization of skills. Social skills, cognitive skills, and sensory-motor skills are all included in our treatment. We think of skills as being practiced procedures for completing complex tasks. We

turn now to a description of the skill of typewriting to illustrate the type of analysis which action theory allows. At first the individual has a global picture of how to go about typewriting from having seen other people typing. The first clumsy attempts to write on the typewriter are guided by this kind of mental image. But obviously, the mental image does not completely guide the individual's actions because mistakes are being made which are not part of the mental image. This is an important general point. The mental image does not have to be connected to action, rather, there may be action-irrelevant cognitions as well as action-relevant cognitions contained in it. In many cases educational and therapeutic interventions are based on the conversion of action-irrelevant cognitions into action-relevant cognitions by providing the necessary practice and developing the necessary skills that are then connected with the mental image [*Semmer and Frese,* 1984]. A similar process goes on in everyday learning.

In the process of learning how to use the typewriter, three aspects are important. First, one must get to know the position of each character on the keyboard. Second, the learner must coordinate this knowledge with the appropriate muscle movements, for example, striking the desired key with the appropriate strength. Third, the various movements must be coordinated to allow for rapid, smooth and correct typing. Feedback from the environment is necessary to accomplish these three aspects of skill learning. The learner receives two types of feedback, information as to the correctness of the completed action and process feedback, such as kinesthetic feedback. Thus, through feedback the mental image is completed and the connection between the mental image and the actual physical movements of the individual is forged. The global picture is changed in this way to an 'operative image system', operative because it now guides the individual's actions in a coherent manner. This operative image system must be hierarchically organized. That is, not only is one character after another typed into the machine, but the typist reads a whole word and transforms this into subunits, corresponding to the characters, and transforms these subunits then into muscular movements, a process which implies hierarchical structure.

These muscular activities are by no means completely regular. Even when the typist types the same letter, the muscular activity is different depending on the location of the previous letters typed. So, apparently, one does not learn a series of discrete muscular movements [*Schmidt,* 1975]. Rather the operative image generates the appropriate movements and the typist has to have a system that is able to generate sub-programs from this operative image. Since the movements are generated, and not simply stored, they do not have to be alike. One of the most well-known examples is probably the following: one is able to sign one's name on a blackboard as well as on a piece of paper with essentially equal skill, despite the fact that completely different muscle movements are involved in these two processes. Similarly, one is able to type on a different typewriter, or computer terminal, which has different spaces between the keys than the keyboard which is normally used with little decrease in typing skill. The operative image is specific but also flexible.

At this stage the typist cannot yet be called 'expert'. Through practice the typist learns to chunk together letters and words. The action becomes 'automatic', such that the typist is

able to do other things while typing, for example, thinking about the next sentence which should be typed in the manuscript. This automatization has advantages, but it also has disadvantages. For example, if the typist is called upon to learn a different pattern of an oft-typed group of letters, the experienced typist will have a great deal more difficulty learning to type such a pattern than would a completely novice typist. One of the most well-known examples of this is the difficulty of typing 'hte' instead of 'the' for the experienced typist [*Miller* et al., 1960]. It would also be difficult to type blindly at this stage if the typist had learned to type with visual feedback.

Finally, there appears to be a certain master plan of how to learn a skill as well. This plan may be a very sketchy plan that one draws for oneself or it may be an elaborate plan provided by a teacher. This plan is not completely arbitrary, for example, the learner must learn certain objective features of the process, such as the position of the keys before being able to type a word. But the 'skill-learning' plan is highly flexible in terms of the process of the learner progressing from a global to an operative image, and from an abstract to a sensory-motor level of regulation.

This example has sketched out some of the most important features of an action theoretic conceptualization of a skill. First, an action is dependent on a goal and on an operative image system that generates the plans and the sub-programs which are necessary for the execution of the action. Second, the operative image system develops from a global picture to a more systematic and differentiated plan of action. Third, this development is fostered by feedback. This feedback is an objective feedback from the environment that has to be processed by the individual. This does not mean that every type of feedback can be processed. One can only handle that feedback that is not too far away from the mental image to be able to either change the mental image or be assimilated to the already existing plan, as *Piaget* has repeatedly noted. This would imply that the types of feedback which are useful for the individual learner would change as the acquisition process proceeds to the extent that the mental image has changed. Fourth, the action is hierarchically organized [compare also *Carver and Scheier,* 1982].

One can differentiate four different levels of regulation in a hierarchically organized action [*Hacker,* 1978; *Semmer and Frese,* 1984]. First, the abstract level: at this level the heuristic functions of how to go about a certain problem or some class of problems in a certain area are being regulated. In more cognitive terms, this might well correspond to a metacognitive level, one at which the individual has general procedures available, for example, a person's general strategy for going about playing games, for example, tennis. Second, the intellectual level: at this level the object-oriented procedures that involve thought processes are regulated. Contrary to the abstract level, it is the more concrete object-oriented level of intellectual regulation. Continuing with our example of the tennis player, the plans for a specific tennis game with a particular partner would serve as an example of this level of regulation. Another example at this level comes from developmental psychology in the form of *Karmiloff-Smith's* [1979] work on the progressive refinement and increasing metaprocedural knowledge which evolves during the child's mastery of tasks within various domains. Third, the level of flexible action patterns:

here relatively specific programs are regulated that have to be flexibly adjusted. For example, the action of hitting a tennis ball can be executed by hitting either a forehanded or a backhanded stroke. Actions at this level of regulation are consistently typical programs which can be generated as a whole, but which are also adjustable in a flexible way. Fourth, the sensory-motor level of regulation: here the highly automatized action programs are being regulated, although even here feedback can lead to a certain adjustment of the action despite the fact that programs at this level are somewhat rigid. They are rigid in the sense that the component steps of the action program are organized in specific, stable patterns, which will be executed in similar fashion regardless of the environmental conditions. They are not rigid in the degree to which accommodations can be made to environmental feedback. For example, driving a manual shift automobile demands a particular sequence of finely meshed movements of the driver's feet and hands, thus the rigidity. However, the movements can be done either slowly or quickly, with greater or lesser smoothness, depending upon the environmental conditions, thus the flexibility.

These levels of regulation reflect a dimension ranging from a highly conscious level of regulation to a more automatized level of regulation. As the process becomes more automatic and thus is more and more under the third and fourth levels of regulation, that is, as the skill becomes well-learned, the more it tends to have the following characteristics: (1) it becomes more situationally specific; (2) less effort has to be expended in orienting to the right signals; (3) less effort is necessary for the development of plans; (4) there will be more overlap between different operations, for example, one will already flex the muscles of one finger in preparation while still striking another key with another finger; (5) fewer decisions will need to be made; (6) less feedback from the environment is needed for the proper execution of the skill, and (7) the movements take on a more parsimonious form.

In summary, action theory is an approach to describing behavior which has as its most prominent characteristics the principles of hierarchical organization and its concomitant concept, automatization, the emphasis on the role of feedback at all levels of the organization and the role which it plays in the creation of that organization, and the focus on the interactive nature of the image or plan for the action with the actual situation of task requirements.

Implications for Life-Span Developmental Psychology

We now turn to the application of some of the concepts of action theory to life-span developmental psychology. First, we argue for the importance of task analysis, action analysis, and an analysis of the interaction of these two components. And second, we examine some particular cases which occur over the life span which can be readily and parsimoniously described by action theory.

The Analysis of the Task

Action theory has, as one of its main tenets, a strong task orientation. An individual's functioning, that is, the behavior we observe, is seen as occurring within some task environment. It is our belief that action theory provides a reasonable method for describing the situation as well as the action within one

theoretical system. The task as well as the action structure can be described within an action theoretic framework. Task analyses done in the industrial realm [*Hacker,* 1978] typically focus on four points. First, the task is analyzed for its content. The analysis asks what the end result of the action must look like, what the expected quality of the 'product' is, and what length of time the individual has to complete the task.

Second, the task is analyzed for the number of decision points and their location in the task execution. Such decision points may be differentiated in objective and subjective degrees of freedom. It is clear that the two may not be identical in that, for example, the individual may believe that there is no decision point where, in fact, there is one. Or the individual may assume the equal importance of all decision points when, in fact, they are differentially important or nested in such a way that only one decision point is the relevant one, with all other decisions following naturally from the decision made at that main point. *Seligman* [1975] has done research which bears on this issue of the disjunction of objective and subjective assessments of control.

Third, the task is analyzed for the signals which elicit or allow its execution. The analysis asks about the ease of recognizing the signals, about the number of signals, and about their predictive value. Again, *Seligman* [1975] has studied the notion of predictability in his work on anxiety.

Fourth, the task is analyzed for its redundancy. The analysis looks at the ease with which one can delegate control of action programs to lower levels of regulation, in other words, how readily automatic or unconscious processing can handle the execution of the task. Obviously, the number of decision points and the ease of recognition of the relevant signals are intimately related to this issue. The more decision points there are in performing a task, the longer it will take to automatize the action program. The more difficult it is to recognize the signals, and the more non-redundant signals there are, the more conscious vigilance will be necessary for the successful execution of a task.

The application of the concept of task to life-span developmental psychology is not a completely new idea. However, it is generally the case that there is very little research dealing with the concept directly, with task analysis more often ignored than systematically discussed. The work of *Havighurst* [1948] is one exception. He has discussed the concept of 'developmental task'. He sees developmental tasks as arising in certain situations in the course of development of the individual which tend to determine the adequate functioning of the person in the society. In his classic book, the developmental tasks for each 'stage' in the life span are described and the biological, psychological, and cultural bases of the stages, as well as the educational implications of such tasks, are discussed. The developmental tasks can, of course, be conveniently grouped into three classes, normative age-graded, normative history-graded, and non-normative tasks [*Baltes* et al., 1980].

Discussing the impact of the environment in terms of 'tasks' implies that the tasks, and therefore the environment, have an objective impact on the person. This does not mean that the individual's concept of the task is a simple 'mirror' of the objective task structure. The individual may not accept the task and, thus, not do anything about its execution, or the task may be redefined by the individual [*Hacker,* 1984]. Very often such a re-

definition of the task may produce innovations in task execution. The individual may also distort the task to a certain extent, even though over time the objective or necessary task structure makes itself known to the individual via feedback from the environment. Action theory holds that an unlimited number of subjective versions of the task do not exist, but rather that the subjective versions of the task are constrained by the objective task structure. Thus, there is an objectivistic orientation in an action theoretic analysis of life-span developmental tasks.

The Analysis of Action

In the analysis of action, we focus on the individual. Such an analysis investigates the individual's knowledge and action strategies, as they pertain to the selection of a goal, the formation of a plan, the decision to execute this plan, and so on. In one sense, the individual's action strategies are directly related to the 'leeway' or flexibility a person has in approaching and executing a certain task. However, these strategies should not be seen as unconstrained by the task structure, since the manifestation of the strategy is, of course, modified by the task structure. Following this analysis of action, we can turn to a discussion of the interaction of the task and the action which the individual takes to execute the task.

In analyzing an action one would first like to have an understanding of the knowledge on which the development of aims and subgoals, as well as plans, is based. This would include an analysis of the type of knowledge which the person has available and its relevance to the task domain, if even in the sense of general problem-solving skills. This assessment of knowledge would also include a determination of the degree to which the individual was aware of and sensitive to the signals which elicit execution of tasks in the task domain. A most important aspect to establishing the individual's knowledge base is an assessment of the degree to which the knowledge is integrated into some organized body and the extent to which it has been abstractly developed. It is assumed that the greater the degree of abstract development of some body of knowledge, the more likely it could be used in a flexible manner. The importance of these aspects of the individual's knowledge is felt throughout the action sequence, from the ability to assume a reasonable goal to the ability to efficiently execute the plan with the necessary sensitivity to feedback.

Second, the analysis of the action focuses on the development of goals. Several questions arise in this area. The analysis would ask how important the goal is to the individual, and how clearly the goal was formalized in the person's mind. Further, it is of interest whether the goal is short- or long-term. It is clear that there is no easy way of relating importance to temporal extent. Another variable is the degree to which the individual builds a rich hierarchically structured plan, with multiple levels of embedded sub-goals and sub-sub-goals. Individuals also differ in the relative emphasis placed on end-state versus process goals. In other words, is the goal formulated such that only with the completion of the entire task will the goal be satisfied, or is the goal such that it is reached 'in the doing' of the task.

Third, the analysis of action focuses on the plan which the individual develops to attain the goal. We present only a sampling of the many questions which can be asked at this level. One question of extreme importance is the issue of the degree of detail of the

plan. Degree of detail can have ramifications throughout the action sequence. The number of different kinds of plans which the individual develops for the attainment of one goal can affect the flexibility with which the action is executed and is probably an indication of the depth of knowledge which the individual can utilize in formulating a set of paths to the goal. Of course, related to this last point is the issue of how realistically focused these plans actually are on the attainment of the goal. A rather serious problem might arise if the individual produces many plans which are only loosely tied to the goal in any realistically attainable way. Another area of interest which relates to the importance of the goal is the range of the plan. It is clear that plans can be short- or long-range, and that the range of the plan can greatly affect the likelihood of the goal's attainment. Many of these last points pertain to the problem of strategies and strategy use in action planning. Some strategies take into account the many unknown variables which can often arise in the attainment of a goal. As is clear, the number of unknown variables increases with the range of the plan, as well as with the degree of detail of the plan. Thus, the individual faces a trade-off between detailedness, range of the plan, and the flexibility of the plan. Strategy changes may, in fact, also be closely related to the degree of the individual's skill in the task domain.

Fourth, we will want to focus the analysis of the action sequence on the decision process which is involved in selecting which plan to execute. Of course, this process is dependent on the number of plans which were developed in the first place. But also the simple speed with which the individual can decide will greatly affect the concrete action, and may further be related to the need for multiple and non-overlapping plans. The reasoning here is simply that the chance of using one plan may disappear if the individual is slow in deciding to execute that plan, and it may be well worth the effort to have other suitable plans developed to guarantee the attainment of the goal.

Fifth, the action must be assessed as the plan is actually being executed. Such issues as proficiency and speed are, of course, of interest. However, more interesting for our eventual goal of applying these concepts to life-span developmental psychology is the process of refinement which the plans seem to undergo as they are used for the actual guiding of the action program. The degree of refinement is, of course, related to the degree of detail and goal relevance in the initial plans. A second aspect to this refinement is that which results from the use of feedback, both process feedback and feedback which informs about the correctness of the action.

The relevance of feedback and the way in which the individual makes use of the feedback cannot be overemphasized. It relates to all of the points of analysis which we have reviewed above. For example, the range of relevant feedback can be greatly limited with increased and refined knowledge of the task domain. Plans can be formed which are more finely tuned to goal attainment if feedback is used in an efficient way. On the other hand, the individual must be sensitive enough to feedback that the action sequence will be modified or stopped if negative feedback occurs.

The different strategies discussed above will have an impact on the way a person approaches a task, the ease with which the task will be mastered, and the specific errors which are committed in the execution of the task. Furthermore, the strategies influence

the course of development across the life span. An illustration of this would be the differential effects of long-term versus short-term planning and goal setting. The long-term planner will be able to actively structure more situations in accordance with his or her own plan, rather than accommodating to successive, subjectively unrelated tasks, for example, as in the area of one's career. This strategy may turn out to be disadvantageous, however, when the environment is very unstable and does not allow for long-term planning. In this case, the long-term plans would interfere with accommodation to the successive objectively unrelated tasks. Such cases point to the need for a discussion of the interplay between tasks and action strategies. Since we could not possibly discuss all the implications of the interplay between the task structure and the action structure, we shall concentrate on the issue of the hierarchical structure and the level of regulation, and then turn to a discussion of two metaproblems which can also be discussed in terms of this interplay, namely, the concept of stage and the relation between subjective views of individuals and the objective environment as they are discussed in life-span developmental psychology.

The Hierarchical Organization of Action and Its Implications

Several effects follow from the hierarchical structure of action and its automatization which serve well to elucidate the contributions an action theoretical analysis can provide for life-span developmental psychology. First, the disuse hypothesis has been used widely in explaining some of the changes in intellectual functioning which occur with age. An action theoretic approach modifies the disuse hypothesis. The disuse hypothesis basically asserts that impaired functioning is the result of fewer intellectual demands being placed on the individual by the environment. An action theoretic assessment of such impairment would add a second possible cause for the impaired performance. The disuse of intellectual levels of regulation might also come about because the person has more skills in the entire skill repertoire, and, therefore, would have less need to develop completely new plans for some task situation. Such reasoning implies that disuse may often come about if one is very well-adjusted to a somewhat limited environment. Furthermore, one would hypothesize that the lower the level of regulation for a certain action is, the less important the lack of use of the skill becomes. For example, sensory-motor skills that have been highly overpracticed will be very quickly at the individual's disposal even after long periods of disuse. If one has not ridden on a bicycle for about 10 years there will be relatively little difficulty when one attempts to ride a bicycle again. However, a task which has been mastered at a higher level of regulation will show much more dramatic results of disuse, for example, doing calculus problems or playing a strategic game of tennis after many years of disuse.

Second, an action theoretic perspective can put the hotly debated issues of stability and consistency of an individual's behavior in a different light from that in which they normally appear [*Kenrick and Stringfield,* 1980; *Mischel and Peake,* 1982]. Perhaps both parties in the controversy are correct, the party which suggests that dispositions to act are cross-situationally stable and the one which says that they are not. Again, this is done by making reference to the concept of the level of regulation at which a skill is executed. The lower levels of regulation have an

extremely high stability over time. Once a certain action pattern is automatized there is a tendency to apply this automatized skill in a relatively stable manner. At the same time, lower levels of regulation are situationally specific, which means that there is little consistency across situations in the use of the same type of action.

Higher levels of regulation are associated with problem solving. The abstract and intellectual levels of regulation are less automatized than the lower levels of regulation, and should be seen as more like heuristics and, thus, more flexible and general in application than the more rigid, algorithmic plans one finds at lower levels of regulations. This may very well mean that the individual will try to use the same type of intellectual or abstract level plans in a heuristic fashion for quite different situations, at least across one task area. This means further that there may be a higher degree of consistency if the action sequence is regulated at higher levels. However, this consistency is more prevalent when confronted with a new situation for the first time because action sequences which are under the higher levels of regulation are more sensitive to feedback from the environment, and will consequently cause the action to be changed in accord to the information provided by analysis of the feedback. An illustration of this is provided by the case of a person who usually approaches new tasks with a very detailed plan. This will also be done in a new situation. But after finding out that the task is not very well suited to detailed planning, because unexpected feedback has to be dealt with continually, the person will adjust and adopt a less detailed procedure. It is interesting to ask whether even these higher level strategies can be automatized and will be used consistently across time and situations. Examples of the overuse of abstract heuristics include the young child's overgeneralization of newly learned grammatical forms or the scientist's use of a newly developed concept in many different and, at times, inappropriate arenas.

Third, the principle of automatization is relevant to the issue of the degree of awareness which we have into the causes of our own behavior. It is assumed that when some skill is automatized any action program which is used in the execution of the skill will be unavailable to conscious awareness. In fact, one approach to automatization speaks of the 'freeing of resources' as the result of the automatization of a skill [*Hacker,* 1978; *Shiffrin and Dumais,* 1981; *Posner and Synder,* 1975]. This does not mean that one cannot be aware of it, but rather that one does not have to be aware of the action program during the execution of the program. Obviously, this leads to the possibility that there may be a discrepancy between what one says one does and what one really does. The paper by *Nisbett and Wilson* [1977] contains descriptions of just such discrepancies. These authors try to show that knowledge about an action is rather incidental and not correlated with the action. They give many convincing cases. However, there is also the literature on metacognition [*Brown and Smiley,* 1977; *Brown and DeLoache,* 1978; *Gleitman and Gleitman,* 1979] which seems to imply that the individual can be completely aware of what and why certain actions are being taken, and can further change those actions by conscious thought about the most promising way to carry out some task, that is, some action. From the metacognition literature we seem to find no discrepancy between what one says one does and what one does. We think that an action theoretic approach can accommo-

date and explain the appropriate arena for each view. From our description of the higher levels of regulation it is clear that when some task is under such regulation the action program, in a sense, will be available to conscious awareness. In fact, the behaviors studied by researchers interested in metacognition have been in the area of problem solving or linguistic skills. By definition metacognition is taken to be a reflection on one's knowledge and problem-solving strategies. On the other hand, the tasks which made up the majority of the examples used by *Nisbett and Wilson* [1977] were highly automatized and, therefore in terms of action theory, not necessarily consciously represented. This does not mean that there has never been a conscious cognitive plan which has guided these actions, rather that the appropriate actions have been automatized and are regulated by a lower level.

Further, the principle of hierarchy also applies here. It is clear that, even for a particular task, the individual may be able to change the level of regulation depending upon environmental demands. Thus, the same action may be available to conscious awareness and intellectual or abstract control if it is necessary for the individual to change the action sequence. One way that a person could do this is through conscious reflection, or metacognition, on the behaviors which are usually produced. However, in an environment which demands smooth performance and which supports the action sequence as it is automatized, no such conscious awareness is necessary. A good example of this, and one which fits both the data of *Nisbett and Wilson* [1977] and *Gleitman and Gleitman* [1979] in being both social and linguistic, would be one's differential greeting behavior in two cultures. Our daily greeting interchanges are highly automatized. We say 'hello' and 'how are you?' with little or no thought as we meet co-workers and friends during the day. However, when we visit a culture different from our own, we must bring the level of regulation for this task back to a higher level, because quite often we find that particular linguistic forms are required for particular individuals and that it is inappropriate to ask casually about someone's state ('how are you?'), particularly with the wrong linguistic form. It may be no accident that most of the work in metacognition has been done with children, in whom we assume there has been little automatization of behaviors, but who are old enough to engage in conscious intellectual work.

Fourth, the level at which a skill is regulated will affect the way in which an individual responds to changes in already well-learned tasks. If a task which is usually met by an automatized action sequence is modified in some way, it is very difficult for the individual to adjust immediately to the new task at hand. It is difficult for the individual to modify the existing action sequence because it is automatized, and, further, the automatized skill will interfere with the learning of a new action sequence by its occurrence in this new task domain. To return to our typing example, it is disturbing for an expert typist to confront a keyboard which has a key pattern very different from a normal keyboard. This situation can be thought of as a skill trap, that is, a skill which is no longer adequate because of changing circumstances within a domain in which the individual must still perform in a skilled manner. An analysis of such skill traps is of particular importance to life-span developmental psychology since such skill traps occur very often throughout the life span. A familiar example

is that of an undergraduate who goes to graduate school and finds that the highly developed skill of pure memorization of material is no longer functional in this new school setting where original ideas are expected from students.

The transitions from school to work and from work to retirement and other major life transitions can typically present such skill traps. We suggest that such transitions and life crises in general can be analyzed by this approach [*Frese,* 1983]. If an individual is caught in a skill trap because some highly automatized task has to be changed and adjusted to the new circumstances, a renewed intellectualization of the skill has to occur. The action has to be dealt with at higher levels of regulation. Such a situation in which old skills are no longer reliable can create a great deal of stress. Under stress conditions individuals favor automatized actions over actions which rely more on intellectual level plans, and stress research has shown that under stress conditions the more automatized kinds of responses come forward again [*Semmer and Pfäfflin,* 1978; *Poulton,* 1971]. One explanation of this is that stress decreases the overall capacity of the individual, and since automatized skills take less capacity than do skills which are still regulated at the intellectual level, there will be a greater tendency for the automatized skill to be executed. This may explain why wrong responses are maintained in many skill-trap situations and why interference from prior well-learned skills will be particularly apparent in stressful situations.

A final point about skill traps is related to the acquisition of the action sequence and the hierarchical structure which has been developed during acquisition. That is, if the skill was learned as a flexible pattern originally, before automatization of the skill occurred, it should be easier for the individual to regain conscious control of the action and to modify the task behavior to fit the new environmental conditions. This flexibility is, of course, enhanced if the objective task itself requires some type of flexible response and is not overly redundant. The rich interplay of objective task characteristics, such as the number of decision points and the redundancy of the task, and the structure of the action, including its level of regulation and the number of alternative plans which are generated for a particular goal-plan-execution sequence, is particularly apparent in this case.

Two Metaconcepts and Their Analysis in Action Theoretic Terms

First, we deal with the usefulness of action theory in explaining or describing apparent stages in development. Apparent stages, from an action theoretic point of view, may arise for several reasons. The person may have a certain life plan with specific goals and subgoals. After reaching one sub-goal, the person will address the new goal and will consequently change the relevant action and action programs. From the observer's point of view, this may appear to be a qualitative change, whereas from an action theoretic view this would also be a qualitative change but within the continuity produced by the overall goal. A related issue states that stages may be a reflection of the learning process itself. Because of the theoretical framework of action theory, we can take the entire life span as a continuing acquisition and modification of skills. Acquisition, as a process in action theory, has embedded in it the notion of hierarchy and apparent qualitative change. For ex-

ample, performance at an abstract level of regulation will look qualitatively different from performance at an automatized level. A description of stages based on this type of observed change is quite different from one which posits qualitative, and apparently discrete, stages with little or no commonality of function between tasks performed at the different stages.

These prior two points have shown how the structure of action sequences could create stages in development across the life span. However, the tasks themselves may also create apparent stages by the type of demands which they place on the individual [*Havighurst,* 1948]. So, for example, certain tasks may have to be done before other tasks can be done. In the learning process one has to learn to perform a certain set of tasks before moving on to another set. Society may have certain constraints which establish an order to the acquisition of skills, not because of any necessary ordering for the acquisition of different skills, but rather because of conventional orders of acquisition. Returning to our earlier example, one could conceive of the memorization in undergraduate school followed by the more original work expected in graduate school as one of these conventional orderings, one which has a plausible rationale behind it, but not a necessarily organic or natural ordering. A related issue is that stages may also be purely a reflection of the fact that the tasks of a society change for the individual as a function of age and position. For example, we find that concrete-operational thought seems correlated with the time of entry of children into a formal school setting, although apparent precursors of the full concrete operational capacity are present earlier [*Gelman,* 1982]. Further, children and adults of non-Western traditional cultures do not spontaneously show concrete operational thought on the Piagetian-type conservation tasks, although individuals of such cultures who have had formal Western-style schooling do show such thought [*Cole and Scribner,* 1974]. Finally, familiarity with the materials of a task, such as the potter's child's familiarity with mass, can affect the appearance of concrete operational thought [*Cole and Scribner,* 1974], reinforcing the importance of the structuring of the environment by society for the apparent appearance of stages of thought. *Schaie* [1977] has proposed a model of cognitive stages which relates to this last point. The stages in the model are closely connected to the demands of the society as a function of their change with the age of the individual. For example, he talks of an inquisitive phase in childhood and adolescence and an achieving phase in young adulthood. Society, in other words, demands that the individual learns in childhood and adolescence and that the individual shows what has been learned and how it can be used in young adulthood. This might well translate into a greater emphasis on intellectual levels of regulation in childhood and adolescence, but with more reliance on flexible action patterns and automatized skills in young adulthood. This would parallel our discussion of the study of metacognition. *Flavell* [1982] points to the same differentiation in typical mental attitude. He asks when people are likeliest to show the least homogeneity in their thinking. His answer is that the likely period is 'between early infancy and whenever formal schooling or other systematic training ends – usually around the beginning of young adulthood ...' [p. 13]. He goes on to discuss the fact that during this period of seeming heterogeneity, people are constantly applying themselves to tasks and situations which they only

partly but do not fully understand; 'they are commonly somewhere in the middle game of one learning enterprise or another' [p. 13].

The second area of our discussion of metaconcepts implicated in development over the life span, for which an action theoretic framework might be helpful, is that of the relationship between the objective world and the individual's subjective knowledge and responses to this world. According to an action theoretic account there are certain objective demand characteristics in the world. This does not mean that there may not be a certain leeway of interpretation, but the number of avenues for solving a certain problem and working on some task is finite. This means that through negative feedback the individual approaches some approximation to the reality of the objective task [*von Hofsten,* 1984]. This is the reason that action theory is oriented toward an active model of the individual. This model assumes that the person actively structures the situation when in the process of developing a cognitive model of the task, that the plans which guide the actions involved are actively developed by the individual, that the situation is changed through the process of redefinition and the acquisition of greater knowledge even while the individual is engaged in the task, that the individual is task-oriented, and that the person changes strategies when interference or confusion occur in the process of reaching the goal. Such a view opposes the dichotomy which arises when we assume that subjective experience must be either the result of naive realism or purely constructivist thinking. In this way, action theory is closely related to the recent work of *Neisser* [1976].

Neisser has argued against this dichotomy with arguments very similar to those raised by action theory. He assumes that we first have a certain set of expectations about the real world. These expectations are constantly undergoing change as the result of the perceptual cycle which unites the perceiver and the world, and result in a constant development toward some 'realistic' perception. What he describes is a type of active reconstruction of the world, which may involve misconceptions on the part of the perceiver. But it is something which is systematically and intimately anchored in the objective environment, as long as the perceiver continues to engage in the perceptual cycle. *Neisser* does not discuss breakdowns in the perceptual cycle in any detail, although the potential is clearly there. In certain cases, action theory would predict that this finely meshed relationship between the individual and the world, which is mediated by the perceptual cycle, would break down. First, if a person has the power to define a situation, particularly a social situation, then there will be little influence of the situation on the individual. A familiar example of this is when an old and powerful professor dominates every discussion and demands 'respect' rather than free interchange of ideas. Second, if the feedback which the perceiver receives is not very concrete or is uninformative the perception of reality will decrease. Third, if the task is not salient or relevant to the individual, the perceptual cycle will essentially not take place in the way in which an engaged individual would experience it, and the task will not be executed in the expected manner. Action theory would expect this to be of particular importance when the individual fails to accept the task as defined by the task-giver, be it a teacher or the society at large. The misunderstanding of experimental instructions by young children is a prime example of this failure. An experiment by *Markman* [1977]

may exemplify this point. *Markman* found that first graders had more difficulty realizing that they did not have enough information to understand how to do a task than did older children of third grade age. *Markman* concluded that the children appeared to be processing material at a relatively superficial level and that they had to be induced to repeat an instruction or to execute the action before they realized that anything was wrong with the very sketchy and poorly written instructions. The reason why they failed to process the instructions for feasibility may well be that they are never called upon to perform such a task of judging the adequacy of instructions and, therefore, do not accept such a task without a directive to judge the goodness of the instructions. Further, the younger child may have adopted the intellectual heuristic of processing the instructions only when actually engaged in the task, so that the concrete characteristics of the task can minimize the intellectual load as the child engages in the task. This is not to deny that the children are displaying less than optimal intellectual strategies, just that it may be due to their non-acceptance of the task and not to a general tendency to avoid metacognitive activity.

Action Theory and Other Approaches to Life-Span Development

In conclusion, we turn to a brief comparison of action theory and other approaches which one encounters in developmental and life-span developmental psychology. We will not engage in any lengthy comparison in a point-to-point manner between action theory and other theories of developmental and life-span developmental psychology. Rather, we try to show the heuristic value of the action theoretic approach when applied to the area of development across the life span. Already, in our discussion of stages and the individual's relationship to objective reality, we have pointed out the usefulness of taking an action theoretic approach to issues which are dealt with in a very different manner by other theories of life-span and developmental psychology. In general, theories of life-span developmental psychology, as of most psychology, can be seen to fall within three frameworks. The three frameworks will be labeled reactive, active, and interactive. In discussing their differences we will tend to exaggerate, for expository purposes, drawing our examples broadly. The reactive approach to behavior posits a responsive, situationally dependent individual. The focus of research in this area is on situational conditions which elicit particular behaviors and which facilitate certain actions. It is clear that the individual must have certain sensory and mental equipment to be able to benefit from interchange with the environment. However, these are basic and do not define or predict the behavior or abilities of the organism. *J.J. Gibson's* [1979] and *E.J. Gibson's* [1982] work on affordances is a good example of what we mean by a reactive framework. They claim that certain invariant information in the stimulus provides information directly to the perceiver as to the functional qualities of an object or a situation.

The active approach, on the other hand, posits an individual who creates the situation in the process of emitting some behavior. A strongly active approach would take a radical nativist position, which assumes that the structure of the organism's mind and its sensory and mental abilities play a large role in shaping the environment which it sees. A

rather strong example of this approach would be the language acquisition position taken by *Chomsky* [1975]. And, as we discussed earlier, the constructivists also belong to this framework.

The interactive framework is not a compromise between the other two, but rather a synthesis of components of each. It comes in many versions with greater or lesser emphasis on the individual or the environment. Such a framework does not force one to side with either the environment or the individual as the primary instigator of action, since action is seen as arising from the interplay of the two. Because of this, different approaches to interactionism emphasize the environment and the individual differentially, and posit different means for bringing the two into synchrony. *Piaget* [1952], of course, is the primary example of interactionism within developmental psychology. His concept of the reciprocal processes of accommodation and assimilation which allow for development through the individual's continuingly greater mastery of the environment captures one type of interactionism. However, other approaches are readily available which have different emphasizes. *Fischer's* [1980] theory of development as skill acquisition is one such approach. His theory is based on the idea that cognitive growth is the sequential development of more and more complex skills. *Fischer* claims that 'the development of skills must be induced by the environment, and only the skills induced most consistently will typically be at the highest level that the individual is capable of' achieving [p. 480]. He makes strong claims about cognitive developmental sequences. He asserts that the development of skills in all domains is formally similar, and that there is a rich interrelationship between skills at different cognitive developmental levels (in *Fischer's* terms 'tiers'), in that the highest level of one tier constitutes the first level of its successor. In other words, cognitive development in *Fischer's* theory consists of a sequence of tiers which contain the same sub-sequences of levels. This is quite different from the type of developmental process which one finds in *Piaget*. *Piaget* hypothesizes stages of development which occur through the very active manipulation of the environment by the individual. The source of learning comes from the individual and the actions taken by the individual on the environment. The assumption is that there are clearly describable stages of acquisition which are qualitatively different from one another, both in the acquisition pattern and in the end result.

Action theory is also an interactive theory. It shares some common features with *Fischer's* work and some with *Piaget's* work. With *Fischer* there is the shared belief in a hierarchical structure of cognitive acquisitions, as well as the general belief in a similarity of skills across various domains. With *Piaget* there is the shared belief in an active individual who accommodates and assimilates the environmental feedback in the course of executing an action. However, action theory focuses not only on the acquisition of cognitive structures, which can often lead to a subjectivistic view of the individual's construction of the task, but action theory also provides a framework to facilitate the integration of cognitive structural views of the active individual with an emphasis on the objective task structure. It is this focus which clearly sets action theory apart from most other theories of life-span developmental psychology. In most of these theories, even the interactive ones, there is a great emphasis on the acquired structures rather

than on the task factors which can affect the development and execution of the skill. It is this aspect which brings us to offer action theory as a useful and, from this point of view, novel heuristic for the investigation of life-span developmental psychology.

Flavell [1982], in a discussion of the state of theories of development, compares structures, stages, and sequences. He concludes that the evidence for stage-like development in the horizontal-structure, high-homogeneity meaning of the term is unconvincing. In turning to sequences, he points out that 'there is considerable structure in human cognitive growth, and that much of it is the "vertical structure" that sequences provide' [p. 18]. He discusses sequences in the following way: 'We are accustomed to regarding sequences as descriptions rather than explanations of development. They are descriptions, of course; they describe what develops first, what develops next, and so forth. However, a careful analysis of sequences may give us hints about possible developmental mechanisms or processes that produce these sequential changes' [p. 22]. Action theoretic analyses are, by definition, analyses of sequences of skill learning. We suggest that an action theory approach, with its emphasis on the importance of task and action analysis, and the analysis of their interaction would, therefore, provide hints about possible developmental processes across the life span of the individual.

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