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Contents

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Acquisition of new speech perception in second language (L2) learning is the result of a learning process. Such speech perception learning not only has particular features as a specific learning process, but it has many essential characteristics universal to a variety of learning processes. In this paper, several problems on experiments of L2 speech perception training were discussed from the viewpoints of current learning studies. In addition, it was suggested that findings on such individual learning processes can contribute to reconstruction of general learning theories. Before discussing the limited problems to L2 speech perception training, it is necessary to sum up the new viewpoints and methodologies in current learning studies.

1) Nature of learning

Learning is one of the adaptation processes to new environments, in which organisms ontogenetically acquire new behavior patterns. In the evolutionary process, higher species have evolved to acquire more learning abilities. As a result, these species can adapt to variously changing and individually specialized environments even after birth, and this makes these animals highly adaptive. The ability to learn is one of the essential characteristics of human beings. In humans, most behaviors are learned on species-specific genetic bases and truly innate behaviors are rare. A human is born as an entirely powerless existence without having sufficient behaviors to survive alone. In addition, it takes a couple of decades to mature. However, on the contrary, such characteristics of human development can give individual structure of learned behaviors many qualities; such as complexity and variability; and plasticity and individuality.

After 1960s and 1970s, "grand theories of learning", such as Hull's theory (1943) , Tolman's theory (1967) , Skinner's theory (1938, 1953) , were criticized seriously from biological sciences (cf. Lorenz, 1972) and cognitive sciences (cf. Chomsky, 1959) because of their oversimplified premises. In these controversies, learning studies acquired new viewpoints and methodologies. First, the strategies of the studies changed to being more inductive; the more desirable goal at that time was not to construct inclusive and integrative general theories of learning (and/or behavior), but to analyze concrete and specialized learning mechanisms and/or processes, that is, to clarify "mini theories" on each specific phenomenon. In future, the general theory of learning may be constructed by integrating numerous "mini theories". However, such integration should be completed after sufficient accumulation of concrete data. Second, the objects of the studies were extended; they were not only simple stimulus-response learning. More complicated cognitive learning has also been regarded as an essential object. As processes in such learning are complicated and their constituents can interact with each other, they should be described to have hierarchical and sequential structures. Third, the viewpoint on learning processes was changed; learning was not conceived as a process in which a new behavior is strengthened on *tabula rasa* (cf. Skinner, 1948) , but rather as a process in which various factors of behavioral variation and selection interact on a given initial state (cf. Staddon & Simmelhag, 1971; Staddon, 1983) . The initial state in each subject is decided by biological predispositions, development processes, previous experiences and so on. Organisms, not only humans but many animals, learn new behavior on such biological bases and individual histories, not on *tabula rasa*. In studying acquisition processes, it is essential to describe the initial state in each subject and to clarify the differences among them. As Skinner recognized intrinsic meaning of individual variability in learning studies, he advocated that within-subject design is one of the essential methods to study learning processes (Skinner, 1938; cf. "single-subject designs", Barlow & Hersen, 1984).

By acquiring such new viewpoints and methodologies, in addition to operationalism and methodological behaviorism, current learning studies can have a more common basis with other natural sciences and can share more data with the related sciences. Each learning process is established on a specific background and has a characteristic hierarchical and sequential structure. Therefore, a necessary strategy in current learning studies is to describe the changes of such structure successively from each initial state (*the descriptive paradigm on learning processes*).

2) Characteristics of L2 speech perception training as a learning process

L2 speech perception training is one of the particular processes of learning, and it has several desirable characteristics as a material for current learning studies. First, significance of the initial state in L2 learning is theoretically obvious and it can be operationally clarified. In this case, the initial state is described as each subject's perceptual characteristics on training sounds and their neighbors. The initial state of each subject is primarily determined by the native language (L1) . According to Best's Assimilation Model (Best & Strange, 1992) and Flege's Speech Learning Model (Flege, 1990) , the phonetic similarity between L1 and L2 phoneme categories is an important factor of L2 learnability. However, such initial state is also modified with the subject's dialect, individual history of other foreign language learning and so on. Even if their native language is identical, it is probable to find some differences among individuals in their initial states. As it was found in many training studies on L2 speech perception, if subjects are not naive to trained L2 and have any training experience, initial states will be dramatically changed with their achievement levels (Yamada & Tohkura, 1992b; Strange, 1992; Best & Strange, 1992) . In studies using such subjects with various initial states, it is unreasonable to draw a conclusion from group data without considering differences in their initial states. It may be especially dangerous if the number of subjects in each group is small. For example, if visitors and students from foreign countries are used for subjects, it is necessary to note such differences in the initial states. In addition, even if training methods are identical, starting from different initial states may result in different learning processes. In the studies on L2 speech perception training, it is effective to compare each progressing state with the initial state using a within-subjects design and to get conclusions based on individual changes in training. This method also coincides ideally with the current paradigm in learning studies. By sharing this methodology, training experiments by L2 learners can not only clarify the mechanisms of one particular phenomenon, but also propose one instance of typical learning processes to current learning theories.

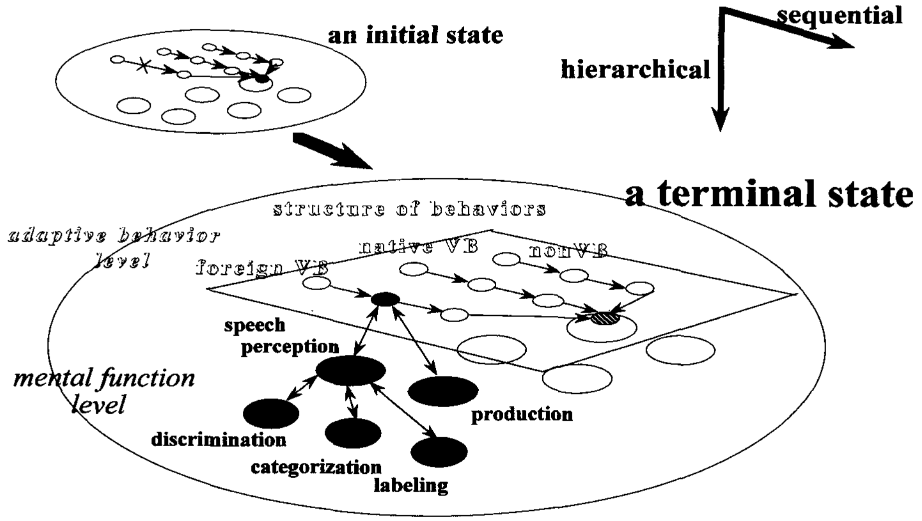

Figure 1. Hierarchical and sequential structures of learning in second language (L2) speech perception training.

In L2 speech perception training, various learning processes progress in different hierarchical levels, and they can interact with each other simultaneously and sequentially. At the adaptive behavior level, an organism has structures of adaptive behaviors for various goals. For example, when they need food intake (a consummatory behavior), they can not only collect or hunt in non-social contexts (non-verbal behaviors; non-VB), but can demand or purchase in social contexts using the native language (native VB) and foreign languages (foreign VB). However, to realize such structures, various functions in mental function level are necessary. In acquiring a foreign speech sound, functions of speech perception and production are indispensable; furthermore, to realize such speech perception, various functions at a different level, such as discrimination, categorization, labeling, will be necessary. In addition, each structure of learning has been shaped on the given initial state, not on *tabula rasa.* At present, as we don't have any complete methods that can describe and control such structure of learning inclusively, development of new methods is indispensable.

Second, as many other learning phenomena, L2 speech perception training has hierarchical structures of learning (Figure 1) . On each training task, in order to adapt the given circumstance as an individual, that is, to get efficiently more rewards (high score, social praise, money, self-satisfaction, shortening of experiment period and so on), subjects try to acquire a new behavior or to reallocate their own structures of behaviors (learning processes at the adaptive behavior level). On the other hand, in acquiring a new behavior, acquisition of new mental functions or reorganization of such functions may be indispensable (learning processes at the mental function level). When acquire a L2 and adapt the community in which the L2 are spoken, new mental functions for perceiving and producing the L2 utterances are necessary. Learning behavior at the adaptive behavior level is shaped and maintained with various factors. For example, it is shaped with several factors that were classified as principles of behavioral variation and those of reinforcement (cf. Staddon & Simmelhag, 1971) , and is maintained with several schedules of reinforcements (cf. Ferster & Skinner, 1957) . Motivation and drive also play an important role at this level. At the mental function level, learning processes on various psychological and physiological functions progress in interacting with each other. Necessary functions in L2 speech perception training are speech perception and production, and/or discrimination, categorization and labeling, and so on; therefore, such interactive processes are those between perceptual learning and motor learning, those between simple discriminative learning and concept formation learning, and/or those between learning at the linguistic level and learning at the auditory level. The learning processes at the mental function level are controlled with various factors; for instance, structure of discriminative stimuli such as variability of talkers and phonetic environments (Logan, Lively & Pisoni, 1991; Lively, Pisoni & Logan, 1992) , structure of training procedures (Jamieson & Morosan, 1986, 1989; Strange & Dittmann, 1984) and structure of feedback operations (on the former two factors; cf. Tetrahedral Model of Cross-language Perception; Strange & Jenkins, 1978; Jenkins, 1979; Polka, 1989; Strange, 1992) . However, learning processes at this level also depend on performance of learning behaviors at the adaptive behavior level. Learning of a poor performer not only needs more sessions comparing with one of high performers, but may have an entirely different process in quality. If the purpose of the experiment is only on the learning processes at the mental function level, performance at the adaptive behavior level should be kept constant between and within subjects as possible by controlling with reinforcements and motivation. On the other hand, from the standpoint that interactions between different levels are essential on learning processes, such interactions themselves are an object of experimental operations and description.

Third, L2 speech perception training has also acquisition processes and maintenance processes. Acquisition is a learning process in which new response patterns are acquired; maintenance is a learning process in which acquired response patterns are kept. In the learning processes at the adaptive behavior level, acquisition and maintenance of behaviors can be controlled with different principles. For example, pigeons' key-peck responses, which have been shaped with a Pavlovian stimulus contingency ("autoshaping"; cf. Brown & Jenkins, 1968; Locurto, Terrace & Gibbon, 1981) , can be maintained with an Operant response contingency. In most experiments on L2 speech perception training, learning behaviors at the adaptive behavior level, such as communicative behaviors with experimenters or key-pressing responses, had been acquired in advance and maintained in steady states. Rather, in these studies, comparison between acquisition and maintenance is interesting in the learning processes at the mental function level. Yamada & Tohkura (1992a) showed that, in perception of English /r/-/l/, perceptual cues used by native listeners of American English were different from those used by Japanese learners. While native listeners used the third formant (F3) , most of Japanese learners used all clues, that is, F3, F2 and F1. It is an essential question

whether these differences were caused by differences between different acquisition processes or by those between an
acquisition process and a maintenance process.

In L2 speech perception training, various learning processes can progress simultaneously in different hierarchical levels interacting with each other, and differences in initial states can be critical for later learning processes. L2 speech perception training has originally the framework that is adequate for the *descriptive paradigm on learning processes.* In addition, speech sounds, which are the objects of this learning, are a constituent of language and the use of language is one of the essential characteristics of *Homo sapiens.* Therefore, human speech learning is an indispensable material for reconstruction of learning theories and should be studied more systematically from the standpoint of learning theories.

3) Problems in previous studies on L2 speech perception training

From such standpoints of learning studies as discussed in the former, it was clarified that previous researches on L2 speech perception training had several theoretical and technical problems. A theoretical problem was the lack of a viewpoint which regards a speech perception training as an acquisition and/or maintenance process of speech perception, that is, *the learning paradigm in speech perception studies.* In addition, some experiments had several questions in their training methods, such as training procedures, training stimuli, feedback operations and error correction operations.

Necessity of a new paradigm in speech perception studies

Although it has innate backgrounds, speech perception in each individual is originally shaped in the development process. Therefore, speech perception has not only static and fixed aspects as a result of learning, but dynamic and plastic aspects as a learning process in essence. In speech perception studies, the paradigm to describe such learning processes is also indispensable as a basic methodology. By this learning paradigm, the dynamics and mechanisms of speech perception can be examined from different angles. In developmental studies using techniques of infant psychophysics (Eimas et al., 1971; Kuhl, 1979; 1983; Lasky, Syrdal-Lasky & Klein, 1975; Streeter, 1976) , innate characteristics of speech perception and their developmental changes under various linguistic environments were clarified. However, such studies have methodological and ethical restrictions and have the limits to control various experimental factors precisely or to describe the whole processes inclusively. On the other hand, in speech perception training using adult L2 learners, such restrictions are less severe and, if influences of their past experience and L1 are described and controlled, it can be one of the adequate materials for the learning paradigm in speech perception studies.

In previous studies on L2 speech perception training, there are no viewpoints that try to describe the process of speech perception training as an acquisition process of speech perception. From this viewpoint, the purpose of speech training studies is not merely to compare the effectiveness between several training conditions, but to describe each learning process objectively. In this paradigm, what is described is not learning curves of each experimental group, but perceptual characteristics of each learner at each learning stage. Pretest-posttest design (Strange & Dittmann, 1984) is an excellent experimental design. However, if measurements on pretests and posttests are limited only to the correct response ratio for the evaluation of training effects, it is not sufficient. Combinations of various tests should be prepared to investigate characteristics of speech perception and other mental functions. An actual combination of tests depends on the purposes and hypotheses of each research. One of those can be a categorical perception test using synthesized sounds (cf. Harnad, 1987), a generalization test using novel natural sounds (cf. Logan, Lively & Pisoni, 1991), a goodness rating test using synthesized sounds (Kuhl, 1991, 1992), a goodness-of-fit rating test using natural sounds (cf. Strange et al., 1993) or a production test spoken by subjects themselves. In addition, in order to clarify the acquisition process in detail, not only the pretest-posttest design but the *interim test design* are effective (Yamada, Yamada & Strange, 1994, 1995). In the *interim test design,* multiple interim tests, which consist of a full set or a subset of the achievement test, are carried out regularly between training sessions. The primary purpose in this learning paradigm is to describe learning processes, not to compare the effectiveness between training techniques. However, with the progress in such descriptive analysis of learning processes, optimal techniques for L2 speech perception training will be available.

Confusions on functions of various training procedures

The goal of speech perception training is to identify each phoneme correctly in various contexts. To reach the final goal, the trainee must acquire several behaviors and mental functions as prerequisites; he/she needs to discriminate unfamiliar and/or undistinguished sounds, to categorize them into appropriate classes and to label them with correct names in given language. In current studies of L2 speech perception training, both optimal structures of training procedures and those of training stimuli are the main issues, and the effectiveness of several training methods was compared and discussed (cf. Flege, 1989; Logan, Lively & Pisoni, 1991; Strange, 1992). Identification training is a comprehensive procedure because the purpose of this training is identification, that is, the final goal of speech perception training itself and because this training requests all prerequisites of the trainee. Therefore, this procedure is suitable to describe a whole process of speech perception learning. However, identification training is less analytic on the individual learning processes. It is difficult to control each learning process with this training procedure and various processes can occur even under the identical operations. In learning experiments, ideally, each experimental operation should correspond to a specified process. However, actually, multiple processes can exist to an experimental operation (Catania, 1979) . For more analytic studies, some discrimination training will be necessary. If the trainee cannot discriminate differences on a critical acoustic feature, discriminative learning on the given acoustic dimension may be effective (cf. Repp, 1984) . If labeling is a burden for the trainee and such difficulties interfere with the whole learning process, Categorial AX discrimination training (Strange, Polka & Aguilar, 1989; Pruitt, Strange, Polka & Aguilar, 1990) may be effective at least in some stages. However, if the functions of labeling (naming) in categorization are essential (cf. Pisoni, Aslin, Perey & Hennessy, 1982) , the process of Categorial AX discrimination training itself must be clarified. From the viewpoints of learning studies, some of orthographical problems in speech perception studies contain such difficult labeling processes. The first case is failures in corresponding each sound category to one of labels, which is those in the just essential process of labeling. The second is failures in discriminating between labels. For example, it is difficult for most of American listeners to discriminate between Japanese phonetic characters ("kana"). The third is the interfering effects mediated by labels. Failure of perceiving Japanese flap (/ ɾ /) is sometimes caused by labeling it "r" in the Romanized characters.

The purposes and objects of each training procedure are different. In addition, as speech perception training is a discriminative learning, it is impossible to examine separately both structures of training procedures and those of training stimuli. Actually, comparison of the effectiveness between different training procedures, that is, identification versus discrimination, is a difficult task. Therefore, it is more productive to describe and analyze the learning processes in each training method.

Essential operations on the structure of discriminative stimuli

In current studies of L2 speech perception training, optimal structure of training stimuli also is one of the main issues. A structure of training stimuli can be described and controlled with variability and typicalness in various attributes. In Logan, Lively & Pisoni (1991) and Lively, Pisoni & Logan (1992) , variability of talkers and phonetic environments was manipulated with natural speech tokens. On the other hand, synthesized stimulus continua were also used as a set of training stimuli. In Strange & Dittmann (1984) , they consisted of typical stimuli (endpoints), which had actual parameters of natural speech sounds, and intermediate stimuli, which generated by interpolating between endpoint parameter values. Jamieson & Morosan (1986, 1989) also used synthesized stimuli and manipulated the number of kinds of stimuli and their locations on the continua; that is, the entire set or one prototypic pair. In such studies, stimulus variability and typicalness must be operated on the essential attributes for the speech perception. In the experiments using synthesized sounds, while such stimulus structure can be clearly controlled by synthesizing stimuli with given parameters, it is necessary to clarify in advance which attributes are essential. On the other hand, in the experiments using natural tokens, while it is impossible to operate such parameters regularly, distributions of stimuli can be described in an adequate space of several attributes as a result of acoustic analyses, and their variability can be operated by preparing various tokens sufficiently. Though each method has its merits and demerits, the latter is more effective if it is not clear which attributes are essential for the speech perception.

In most of previous studies, such attributes were only discussed on physical characteristics that training stimuli have universally as a speech sound of the language. However, optimality of each stimulus structure is also dependent on each trainee's perceptual characteristics. If perceptual characteristics in the initial state are different, optimal structure of training stimuli may be different between trainees. Therefore, it is also necessary to locate such stimulus structure in each trainee's initial perceptual space. Interactions of such stimulus structure with initial perceptual characteristics of the trainee are essential as a learning process.

Stimulus structure also can be controlled temporally. In discriminative learning studies, *fading* method (Terrace, 1963ab, 1974) and blocked-trials method are frequently used. Both methods are techniques for *non-error learning* (cf. Rilling, 1977) . One of the important determinants of errors is the physical similarity between stimulus contrasts. In a *fading* method, clearly discriminable stimuli, for example, interdimensional stimulus pairs, are used at the beginning. When differences between stimulus contrasts are reduced gradually in training, the step is small enough to keep error levels low. As a result, comparing with ordinary methods, total number of errors can be reduced by such a *fading* method. This method was applied to L2 speech perception training by Jamieson & Morosan (1986) . In blocked-trials methods, while trials with identical or similar stimuli are grouped into several blocks at the beginning, the size of blocks is gradually reduced with the progress of the training and, in the final stage, trials are arranged randomly (cf. Yamada & Yamada, in preparation). If there are multiple and functionally different stages in speech perception learning, different operations will be effective at each stage.

In the studies of L2 speech perception training, it is productive to describe the structure of training stimuli not only in acoustic and linguistic space of speech sounds, but also in perceptual space of each trainee. In addition, it is also important to describe sequentially the interactions between the structure of training stimuli and the progressed states of speech perception in each trainee.

Ambiguous feedback operations

In learning experiments, a feedback to subject's response can have multiple functions. In human discriminative learning, the following functions are suggested; one is a cue for the error correction. By using together with the correction method (discussed later), adequate feedback can facilitate acquisition of the correct behavior. If actual stimulus sounds are used as a part of such feedback, it can give additional opportunities to listen to stimulus sounds and consequently may facilitate the extraction of new features or the reconstruction of their feature extracting system. Another important function is reinforcement to learning behavior in the adaptive behavior level. If they are operant behaviors, learning behaviors are maintained with reinforcers. In human experiments, various stimuli were used as a reinforcer; food (Ayllon & Haughton, 1962) , visual stimuli (Benton & Mefferd, 1967) , social praise (Azrin et al., 1961) , auditory stimuli (Kapostins, 1963) and so on. However, in many experiments, generalized reinforcers such as coins and tokens were utilized because primary reinforcers have often physical and/or ethical limits. Effects of each reinforcer are influenced with various factors; for instance, motivation, drive level and individual differences. As generalized reinforcers are exchangeable with various goods or services according to each subject's demand, they can keep reinforcing effects constant between and within subjects (Davey, 1981) . Generally speaking, effects of reinforcers are also decided in the relations with gross supplies in an economic system, i. e., in the relations with the total amounts of the given stimuli which were supplied as a reinforcer and/or a non-experimental operation (cf., "open economy"; Hursh, 1980, 1984) . Therefore, ratio of total amounts of reinforcers to gross supplies should be kept at the adequate level. Partial reinforcement using schedules of reinforcements is effective to keep rate of responding constant (Ferster & Skinner, 1957) . Especially, partial reinforcement is indispensable in some experiments using a probe test. In probe test trials, any discriminative responses should not be reinforced differentially. As absence of feedback is less salient, stable learning behaviors can be maintained more easily with a partial reinforcement than with a continuous reinforcement.

In the experiments on L2 speech perception training, as feedback operations were originally prepared for the error correction (questions on this function will be discussed in the following section), their effects on learning behaviors in the adaptive behavior level were not clear. On the other hand, in these experiments, learning behaviors in the adaptive behavior level were not operationally controlled. They were not reinforced with clear reinforcing stimuli nor punished with clear aversive stimuli. In Logan, Lively & Pisoni (1991), the feedback to a correct response was non-delayed initiation of the next trial and the feedback to an incorrect response was a series of operations; "response boxes remained on the CRT screen and a light on the response box corresponding to the correct response was illuminated followed by a second presentation of the sound stimulus." In Strange & Dittmann (1984), both feedback to a correct response and feedback to an incorrect response were identical and they were "given by lights that were illuminated over the correct response button." In addition, Strange and Dittmann gave each subject's progress as another feedback after each session. In Jamieson & Morosan (1989), "accuracy feedback was provided by illuminating a small white light to identify each error". Such feedback operations were originally planned to provide subjects with the information on their accuracy. However, as a process, such feedback might have function of a reinforcer or that of a punisher to learning behaviors in the adaptive behavior level. On the other hand, in these experiments, subjects were paid for participation only; for example, $5.00 for each session (Logan, Lively & Pisoni, 1991) or $12.00 for participation (Jamieson & Morosan, 1989). Under such gross incomes, if subjects were motivated only with money, their performance in training may have been poor because they never got money as a reinforcer. However, if learning behaviors were maintained highly even under such conditions, it suggests that the feedback of their accuracy may have been very effective reinforcers/punishers to these subjects or that their learning behaviors may have been maintained with other uncontrolled, individual processes. In experiments of speech perception training, performance of learning behaviors in the adaptive behavior level should be kept constant between and within subjects in order to avoid its unbalanced influences on the processes in lower levels. Such differences of the influences will be amplified in cross-linguistic studies because they have also various cross-cultural differences in motivation and learning. Reinforcement with generalized reinforcers is one of the effective operations for this problem (cf. Lively, Pisoni, Yamada, Tohkura & Yamada, 1994).

Effectiveness of error correction operations

In studies on discriminative learning, the *correction method* is one of the effective techniques for error correction. In the *correction method,* the identical trial is repeated until the subject responds correctly (cf. Blough & Blough, 1977). This method has several merits for learning experiments. The number of stimulus presentations is a critical factor in discriminative learning. In this method, repetitions of stimulus sounds are controlled and described, while correcting errors, confirming response of subjects and keeping the structure of each training task. On the other hand, the number of stimulus sounds can be also operated by playing them repeatedly in a trial. Trainees need more stimulus presentations in the beginning. Using this method together with the correction method, stimulus presentation can be controlled more efficiently but still without changing the structure of each training task. Needless to say, even in this method, the number of repetitions should be limited within a given range to decrease variance between subjects and between sessions.

In the previous experiments of L2 speech perception training, some feedbacks were presented to inform error responses to subjects (Jamieson & Morosan, 1986, 1989; Logan, Lively & Pisoni, 1991) or to inform what is the correct answer (Strange & Dittmann, 1984; Logan, Lively & Pisoni, 1991) . However, in their experiments, functions of such operations and their effectiveness were not clear. It was not confirmed whether the feedback was noticed by trainees or not and what kinds of functions it could have for trainees. On the other hand, by using the *correction method* and requesting trainees to confirm the correct response, feedback for the error correction should be clarified not only as an operation but as a process (Lively, Pisoni, Yamada, Tohkura & Yamada, 1994) . Furthermore, in the *correction method,* actual training sounds can be presented easily as a part of the feedback (cf. Logan, Lively & Pisoni, 1991) . The *correction method* is one of the most suitable and effective error-correction operations in L2 speech perception training.

4) Conclusions

Although it is also under the biological constraints, speech perception is originally to be learned in an individual linguistic environment selectively. Therefore, it is not sufficient if speech perception is analyzed merely as a static state. The viewpoint that speech perception has dynamic and plastic aspects as an acquisition process, that is, *the learning paradigm in speech perception studies,* is also necessary. Researches on L2 speech perception training can provide the most suitable materials for this paradigm. However, methodologies used in previous studies were not effective for the new paradigm. It is because such methodologies were for comparing the effectiveness between several training methods, not for describing each learning process comprehensively. Speech perception training has hierarchical and sequential structures of learning; and various interactions can occur between different hierarchical levels and between different mental functions. To describe each acquisition process appropriately, it is necessary to define training methods as a clear operation and to clarify their effects on the various processes of behavior and mental functions. In *the learning paradigm in speech perception studies,* while controlling the influences of hierarchical and sequential interactions, a learning process of speech perception must be described successively from the initial state to the terminal state. At present, development of such descriptive methods is indispensable.

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A Review on Experimental Studies of Second Language Speech Perception Training: Necessity of the Learning Paradigm in Speech Perception Studies

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Second language (L2) speech perception training is one of learning processes, and it has adequate characteristics for a new paradigm in learning studies, that is, the descriptive paradigm on learning processes. In this paper, theoretical and technical problems in the experimental studies of L2 speech perception training were discussed from the viewpoints of current learning studies. As a theoretical problem, the necessity of *the learning paradigm in speech perception studies* was clarified; it is the viewpoint that speech perception has dynamic and plastic aspects as an acquisition process. Experimental studies on L2 speech perception training can provide one of the most suitable materials for this paradigm. In addition, several technical questions on the training methods, such as, training procedures, training stimuli, feedback operations and error correction operations, were examined.