1997

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Abstract

This study was conducted to determine if there is a teaching method that could help non-native adult learners of sign language acquire it in a more native-like fashion. Two training methods were used. The experimental group imitated only parts of signs during training; the control group imitated the entire signs. At test, all subjects produced both the learned signs, and novel signs consisting of novel combinations of components of the learned signs. The first experiment used signs with simultaneously produced morphemes. The second experiment used signs with both simultaneous and sequentially produced morphemes. Results showed that the experimental groups were no more accurate in the type and number of morphemes that they produced in the novel signs than were the control group. The experimental groups, however, were better able to break signs up into morphological components. The experimental groups also made more native types of errors.

Whole Versus Part Training of ASL Verbs of Motion with Simultaneous and Sequential Morphemes

It is generally known that adult language learners acquire language in a much less efficient and less complete way then young children. The question as to why this is has yet to be completely answered and is not the purpose of the present research. This research attempts to answer the question: Is there a way to help adult language learners acquire language in a more "childlike" way?

Much of the current research on why adult language learning is less effective than that of young children is based on the idea of a "sensitive period" for language development due to maturational constraints. The "sensitive period" differs from the "critical period" in that it takes into account the fact that many of the changes are not absolute and abrupt (Long,1990).

One hypothesis that has been studied is that of Johnson and Newport's (as cited in Long, 1990) "maturational state hypothesis". The "maturational state hypothesis" holds that our capacity to develop language is on a biological schedule and is available for use during a certain period of time and after that time declines.

Most second language research has found a difference in adult ultimate attainment of language. Patkowski's study suggests that to attain the morphology and syntax of a second language with high long-term proficiency, exposure to the language has to occur before the age of 15 (as cited in Long, 1990).

A large amount of native versus non-native language acquisition research has been done using American Sign Language (ASL). ASL is a natural visual and spatial language. ASL has its own phonology, morphology and syntax just as all natural verbal languages do (Wilbur, 1987).

ASL offers a special opportunity to study a population with no native language. This is because most deaf children have hearing parents who do not know sign language. These children, therefore, are not exposed to a language at birth and most do not acquire ASL until late childhood. Most learn sign language, not from parents, but from their peers (Mayberry & Fisher, 1989).

The acquisition patterns of these non-native, deaf users of ASL are compared with the 3%-8% of deaf children who are native ASL users described in Schein and Delk's study (as cited in Mayberry & Fisher, 1989) These children have been exposed to ASL by their parents since birth.

As in all verbal natural languages, older children and adults who are not exposed to ASL from birth acquire the language in a less effective and less complete way. Examples of these differences are described next.

Several studies have shown the differences between natives and non-natives. In one such study by Emmorey, Bellugi, Friederici and Horn (1995), both native and non-native users of ASL were given a recognition task and told to press a key as soon as they recognized the target sign. In this study native signers were slower to recognize a target sign when it followed an error

suggesting that the error distracted them. The non-natives in this study were not slowed by the errors suggesting that they did not detect the error. In another such study by Emmorey and Corina (1990), both natives and non-native users of ASL were given a recognition task. The participants were presented with 30 signs, 10 signs matched for location of sign production, 10 signs matched for movement of the signs, and 10 signs matched for handshape and asked at what point they could tell what sign was being produced. The native users were faster at isolating the signs.

Another native versus non-native study describes the "inductive generalizations" made by learners of ASL (Newport, 1988). Newport (1988) described three types of generalizations ASL learners could make. Type one is "holistic iconicity", in which ASL learners could generalize ASL verbs of motion holistically and see them as mirrors of events of motion as they are in the real world. Type two is "holistic rote", in which ASL learners could generalize ASL verb of motion as one fixed lexical item that consists of only one morpheme, with no relationship to a real world event. Type three is "morphological analysis", in which the learner could generalize that ASL verbs of motion are formed from several small morpheme components.

For example, consider the sign for a person walking straight forward. The handshape of the sign is the index and middle fingers open and facing down. The handshape of the sign pertains

to the object, the person. The movement of the sign is that of the two fingers moving one at a time. The movement of the sign pertains to the movement of the object, walking. The motion of the sign is in a straight line. The motion of the sign pertains to the motion of the object, straight. The direction of the sign is moving forward. The direction of the sign pertains to the direction of the object's movement, forward. A learner of ASL making generalization type one would decide that the above sign is not a combination of four separate morphemes but would see the sign as a whole. They would also see the sign as a mirror of real world events of motion. A learner of ASL making generalization type two would see the sign as a whole also, but might not relate it to real world events. A learner of ASL making generalization type three would see the sign as a combination of four morphemes: handshape pertaining to the person, movement of the sign pertaining to walking, motion of the sign pertaining to straight movement, and direction of the sign as pertaining to the movement forward.

Newport's research found that only young children make type three generalization. In Newport's research, the young native children who were in the process of learning ASL made the error of omitting some morphemes while producing others. The children also made the error of producing simultaneous morphemes sequentially. This suggested, to Newport, organization of the signs in terms of the morphemic components

Newport's research found that older children and adults who

acquire ASL make generalization type two. In Newport's study the older learners made the error of producing a single sign with incorrect components rather then correctly altering the morpheme components. Newport found no learners who make type one generalization.

In the present research, we developed a teaching method to try and get older children and adults acquiring ASL to perform like younger learners by getting them to make generalization type three. The control and the experimental group were both presented with the same ASL signs. The control group practiced the signs in their entirety the way they were presented to them. The experimental group on the other hand practiced only parts of the signs never practicing the entire sign.

EXPERIMENT 1

In experiment one, the participants were taught ASL verbs of motion in which four morphemes were produced simultaneously. The first morpheme was a classifier morpheme. This morpheme is marked by the handshape of the sign and pertains to the object performing the action. The second morpheme was a manner of motion morpheme. This morpheme is marked by the movement of the sign and pertains to how the object is moving. The third morpheme was a path of motion morpheme. This morpheme is marked by the path of the sign in space and pertains to the path in which the object is moving. The fourth morpheme was a direction morpheme. This morpheme is marked by the direction of the sign and pertains to the direction of the objects movement.

For example, consider the sign for an animal running circularly uphill. The handshape of the sign is four fingers extended downward and pertains to the animal. The manner of motion of the sign is the movement of the four fingers and pertains to the running movement of the animal. The path of motion is the circular motion of the sign and pertains to the circular path in which the animal is moving. The direction of the sign is the upward movement of the sign and pertains to the uphill direction in which the animal is moving.

Method

Participants

The participants were 28 LSU undergraduate students, who were given extra credit points in their psychology class for their participation. Participants were all native English speakers, with no knowledge of American Sign Language, except for the alphabet. All participants were right handed. The participants were randomly assigned to either the control or the experimental group.

Subjects who did not meet the performance criterion of a minimum of four correct learned signs in the test were discarded. This encompassed eight subjects. The first 14 subjects in each group who met the performance criterion were included in the study.

Stimuli

The stimuli for experiment one were simultaneous verbs of motion containing four morpheme as shown in Table 1. The first

morpheme was a classifier morpheme. The three forms of the classifier morpheme were: person, animal and vehicle. The second morpheme was a manner of motion morpheme. The three forms of the motion morpheme were: walk, jump, and drive. The third morpheme was a path of motion morpheme. The two forms of the path of motion morpheme were: straight and zigzag. The fourth morpheme was a direction morpheme. The two forms of the direction morpheme were: forward and backward.

These signs were presented to the subjects in a story format. The story contained other signs that were not relevant for the research. None of the signs in the story except for the six study signs contained any of the above mentioned words.

Procedure

Each participant was told that they were going to view a video-tape of a story performed in sign language. They were told that there would be a verbal translation of the story as it was being performed.

The control group was told to practice the signs in their entirety along with the story for all four runs of the tape. The experimental group was instructed to practice only the handshape of each sign in the story for the first and third runs of the tape. They were told to keep their arms on the desk in which they were sitting, to have their hands hanging over the edge of the desk and not to pick their arms up off of the desk. The experimental group was instructed to use a fist as a neutral handshape and to do only the movement of the arms for the second

and fourth runs of the tape.

The signs that the participants learned were video-taped and edited using a Canon UC5S 8mm video camcorder. All participants were presented with the same video tape and all participants watched the tape four times. After viewing the video-tape, each participant was asked to perform simple multiplication problems for two minutes, as a distracter task. They were then asked to make several new signs that combine the previously learned morphemes in new ways as shown in Tables 1-3.

All signs made by the participants were video-taped to be analyzed latter. The video-taped novel signs were analyzed for the number of accurate morphemes they contained and for their error types.

Results

Analyses

Experiment one is a 2(training) x 2(old vs. new sign type) design. A two tiered analysis was used for experiment one. The first analysis examined the complete signs made by the participants in each group. The analysis required a 2x2 mixed model ANOVA that was conducted to compare the two independent variables. The first independent variable was the between groups training, part vs. whole. The second independent variable was the within group type of test item, learned vs. novel. The signs were analyzed of the total correct morphemes present.

The second analyses was an error analyses done only on novel signs. There were four types of errors made by the subjects.

The first was the use of inventions, or unlearned handshapes. The second was the use of substitutions, or the wrong use of a learned morpheme. The third was the omission of hand movement. The fourth was the use of additions, or the simultaneous production of two hand movement morphemes.

We compared the errors made by the participants in the two different training groups to determine whether a particular group was more likely to make a specific type of error. We also compared the errors made by the participants in the two groups to errors made by native and non-native American Sign Language users, as reported in the literature, to determine whether the part training group was more likely to make native types of errors.

Total Correct Morphemes

The analysis of the total correct morphemes performed in the test of both the old and the new signs revealed a main effect of condition $F(1,26)= 4.30$, $p< .05$. As shown by the means in Table 4, more correct morphemes were performed by the whole group. There was also a main effect of sign type $F(1,26)=13.03$, $p< .01$. As shown by the means in Table 4, there were more correct morphemes for the old signs.

Error Types

Inventions. For this research inventions were the use of any handshape that the subjects had not been taught. The analysis of the use of an invented handshape by the subjects revealed a marginally significant main effect of sign type $F(1,26)=4.01$,

$p<.10$. As shown by the means in Table 4, the subjects performed more wrong handshapes on the old signs. There was no main effect of condition for this error.

Substitutions. The analysis of the use of substitutions revealed a main effect of sign type $F(1,26)=16.31$, $p< .001$. As shown by Table 4, the effect was stronger for the new signs type.

Omitted Handmovement. The analysis of the omission of handmovement revealed a marginal effect for condition $F(1,26)=3.29$, $p< .10$. As shown by the means in Table 4, the effect was stronger for the part group.

Additions. For this research an addition error type involved the simultaneous production of two handmovements, jumping and walking, along with the other morphemes of the sign. The analysis of the production of two handmovements revealed no main effects.

Discussion

The results of experiment one showed that all subjects performed more invented handshape errors on the old signs. It also showed, not surprisingly, that the subjects made more substitutions on new signs. Neither group made any significant addition errors.

The results of experiment one did not show that the part training helped the subjects to make more correct morphemes. The results show that the whole group performed more correct morphemes. This may have been because the task was too simple. In pilot tests of this experiment, all subjects performed at

ceiling. Therefore the presentation of the signs was modified for the experiment. The six verbs of motion were put into a story context and the entire story was presented to the subjects with a verbal translation. The results from the experiment suggest that this new presentation may not have raised the difficulty level of the task sufficiently, because both groups still performed around the 91 % range when analyzed for the correct morphemes present in the new signs.

The results of experiment one did however show that the subjects who received the part training made more omission errors. These omission errors suggest that the part subjects are not making generalization type two. They would not leave out one morpheme if they generalized the ASL verb of motion as one fixed lexical item that consists of one morpheme. The omission error also suggests that the subjects are organizing their signs into morphological components, like native children learning ASL. This is consistent with the findings of Newport's research on native ASL learners.

EXPERIMENT 2

In experiment two, participants were taught verbs of motion with three morphemes. Some of these signs had the three morphemes articulated simultaneously while others were produced sequentially. Some of the morphemes in these latter verbs are produced sequentially, because of restrictions in the grammar of ASL, which states that manner of locomotion morphemes can not be simultaneously combined with path of motion morphemes when

representations of body parts rather than the whole person are used (Supalla, 1990).

The simultaneous verbs of motion contained a classifier morpheme, a manner of motion morpheme, and a path of motion morpheme. For example, in the sign for an animal running circular the classifier morpheme which is four fingers extended downward refers to the animal. The manner of motion morpheme which is the moving of the fingers refers to the running movement of the animal. The path of motion morpheme, which is the circular movement of the sign, refers to the circular movement of the animal. The path of motion morpheme is articulated at the same time as the classifier morpheme and the manner of motion morpheme.

The sequential verbs of motion contained a classifier morpheme, a manner of locomotion morpheme, and a path of motion morpheme. For example, consider the sign for feet stepping sideways. In this sign, the classifier morpheme refers to the feet and is expressed through a flat hand. The manner of locomotion morpheme refers to the stepping movement of the body part and is expressed through the up and down movement of the flat hands. The path of motion morpheme refers to the sideways movement of the body part and is expressed through the sideways movement of the up and down flat hand. This path of motion morpheme is articulated after the classifier morpheme and the manner of locomotion morpheme.

Method

Participants

The participants were 38 undergraduate LSU students, who were given extra credit points in their psychology class for their participation. Participants were all native English speakers, with no knowledge of American Sign Language, except for the alphabet. All participants were right handed, except for one left handed person who performed the signs right handed. The participants were randomly assigned to either the control or the experimental group.

One participant was discarded because in the debriefing he voluntarily revealed that he had a learning disability. Three other participants were discarded because they were in the experimental group and were instructed to perform only part of the sign shown but performed the entire sign. Three other participants were discarded because they did not meet the performance criterion of the minimum of four correct learned signs in the test. Three other subjects were discarded because some of their data was not scorable. The majority of the discarded subject came for the part trained group. The first 19 subjects in each group who met the performance criterion and were not discarded for any of the above stated reasons were included in the study.

Stimuli

The stimuli for experiment two were simultaneous verbs of motion (see table 2) and sequential verbs of motion (see table 3)

each containing three morphemes. The simultaneous verbs of motion contained a classifier, a manner of motion, and a path of motion morpheme. The three forms of the classifier morpheme were: person, animal, and vehicle. The three forms of the manner of motion morpheme were: walk, run, and drive. The three forms of the path of motion morpheme were: straight, circular and curved.

The sequential verbs of motion contained a classifier, a manner of locomotion, and a path of motion morpheme. The three forms of the classifier morpheme were: legs, feet, and arms. The three forms of the manner of locomotion morpheme were: limping, stepping and waving. The three forms of the path of motion morpheme were: zig zag, sideways, and backwards.

Procedure

The procedure for experiment two was the same as experiment one, except that the signs presented to the subjects were not in the form of a story. The signs were presented to the subjects individually. There was a verbal translation of each sign on the tape before the sign was presented twice. There was then a five second interval in with the subject was told on the tape to practice the sign only one time. Then the next sign was presented to the subject.

In the test, the subjects were asked to make signs that were novel combinations of the learned signs. There were four types of signs in the test. The first was a sign that asked the subject to perform a path of motion morpheme simultaneously that

had been learned simultaneously, this is a matched sign. The second was a sign that asked the subjects to perform a path of motion morpheme sequentially that had been learned sequentially, this also was a matched sign. The third type of sign asked the subject to perform a path of motion morpheme simultaneously that had been learned sequentially, this was a non-matched sign. The fourth type of sign asked the subject to perform a path of motion morpheme sequentially that had been learned simultaneously, this was also a non-matched sign.

Results

Analyses

The old and new signs were analyzed separately. The analyses for the old signs in experiment two was a 2(training) x 2(sign type). The analyses for the new signs in experiment two was a 2(training) x 2(simultaneous vs. sequential sign type) x 2(matching between training and test). The first independent variable is the same as in experiment one, the training. The second independent variable is simultaneous versus sequential sign type. The third independent variable is the simultaneous versus sequential verbs of motion. A three way ANOVA was performed on the data from this experiment.

Analyses of correct morphemes for both the old and new signs were split into two different analyses. First was an analyses of the signs made in the test without the path of motion morpheme; therefore, only the handshape and handmovement performed by the subjects were analyzed. Second was an analyses of just the

production of the path of motion morpheme.

In addition to the analyses of correct morphemes four types of error analyses were done on path of motion morphemes in new signs. The first was analyses of missing path of motion morphemes. The second error type was the production of two path of motion morphemes. The third was the simultaneous production of a sequential morpheme of the sequential production of a simultaneous morpheme. The fourth error type was the use of frozen signs, this error showed the subjects inability to break down the learned signs into morphemes.

Old Signs

Non-Path Morphemes. All subjects performed almost at ceiling when analyzed for the handshape and handmovement morphemes present in the test of the old signs, (see Table 5).

Path Morphemes. All subjects performed almost at ceiling when analyzed for the path morpheme production in the test of old signs, (see Table 5).

Novel Signs

Non-Path Morphemes. The analysis of the test signs revealed a main effect of sign type $F(1,36)=35.02$, $p< .0001$. As shown by the means in Table 6, the performance was better for the simultaneous signs. There was also a main effect of matching. The subject performed more morphemes correctly when asked to perform the path of the new sign in the same manner as it had been learned (matching) $F(1,36)=237.14$, $p< .0001$. There was also an interaction between sign type and matching $F(1,36)=67.61$, $p<$

.0001. As shown by the means in Table 6, the performance was lowest for the sequential non-matched signs.

Correct Morphemes. The results of the analysis of the correct production sequence for path of motion morphemes revealed a main effect of sign type $F(1,36)=8.57$, $p<.01$. The subjects performed better on the signs produced sequentially on the test as shown by the means in Table 6. This main effect is qualified by a marginally significant interaction with study condition $F(1,36)=3.23$, $p<.10$. As shown by the means in Table 6, the effect was strongest for the whole group when they performed sequential signs.

There is also a main effect of matching $F(1,36)=119.09$, $p<.0001$. The subjects performed better on the matched signs as shown by the means in Table 6. This main effect is qualified by an interaction with the study condition $F(1,36)=13.72$, $p<.001$. As shown by the means in Table 6, the effect was the strongest for the part group when performing matched signs. The part group showed the greatest difference between their performance on matched and non-matched signs, as shown by the means in Table 6.

There was also an interaction between sign type and matching $F(1,36)=4.61$, $p<.05$. As shown in Table 6 the performance was the strongest for sequential matched signs and weakest for simultaneous non-matched signs.

Path Morpheme - Missing. The results of the error analysis on missing path of motion morphemes revealed a main effect of sign type $F(1,36)=47.87$, $p< .0001$ with the subjects omitting more

sequentially produced morphemes as shown by the means in Table 6. This main effect is qualified by a marginally significant interaction with study condition $F(1,36)=3.71$, $p<.10$. As shown by the means in Table 6 , the effect was strongest for the part group when performing sequential signs.

There was also a main effect for matched signs $F(1,36)=26.08$, $p< .0001$. The subjects omitted more paths when performing non-matched signs as shown in Table 6. This main effect was qualified by a marginal interaction with study condition $F(1,36)=3.98$, $p<.10$. As shown by the means in Table 6, the effect was strongest for the part group when performing non-matched signs.

There was also an interaction between sign type and matching $F(1,36)=32.64$, $p<.0001$. As shown by the means in Table 6, the omission was highest for the sequentially produced non-matched signs.

Path Morpheme - 2 Path. The result of error analysis on the production of two path of motion morphemes revealed a main effect of sign type $F(1,36)=48.34$, $p< .0001$. The subjects performed more two path errors for simultaneous signs as shown in Table 6.

There was also a main effect of matching $F(1,36)=59.58$, $p<.0001$. The subjects performed more two path errors for nonmatching signs as shown by the means in Table 6. This main effect is qualified by a marginally significant interaction with study condition $F(1,36)=3.82$, $p<.10$. As shown by the means in Table 6, the effect was the strongest for the part group.

There was also and interaction between sign type and matching $F(1,36)=56.16$, $p<.0001$. The two path production was the highest when the subjects performed simultaneous nonmatched signs as shown by the means in Table 6.

Path Error - Simultaneous Production of Sequential Morphemes or Sequential Production of Simultaneous Morphemes. Error analyses were performed on simultaneous performance of a path that should have been sequential or the sequential production of a path that should have been simultaneously, hereafter abbreviated as PTHQ or S. The results of the error analysis revealed a main effect of matching $F(1,36)=44.16$, $p<.0001$. The subjects made more PTHQ or S errors on non-matched signs as shown by the means in Table 6. This main effect is qualified by an interaction with study condition $F(1,36)=4.91$, $p<.05$. This effect was the strongest of the part group.

Path Error - Frozen. The last type of error that we analyzed was the use of frozen signs. There were three opportunities for the subjects to show that they had failed to break signs down into their component parts. When the subject was asked to perform a sign simultaneously and that path had been taught to them simultaneously, they were given their first opportunity to make a frozen sign. The subject could simultaneously perform a simultaneously learned sign in its entirety as the first part of the sign. For example, the subject was asked to perform the sign for a person walking backwards and they perform the learned sign for a person walking forward and then point backward. The first

part of that sign is frozen. The second opportunity for the subject to make a frozen sign is the same as above only it is the second part of the novel sign that they keep frozen. For example the subject is asked to perform the sign for a person running in circles and they perform the handshape for person then add the learned sign for an animal running in circles. The second part of that sign is frozen. When a subject was asked to perform a sign sequentially with a path that they had been taught simultaneously, they are given their third opportunity to perform a frozen sign. The subject could perform as the second part of their sign the entire sign that they learned with that path. For example, the subject is asked to perform the sign for feet marching straight and they perform the handshape and handmovement for the feet marching and then add the learned sign for a person walking straight. The second part of that sign is frozen.

In the analyses of this last error type, there was a marginally significant effect of condition $F(1,36)=3.60$, $p<.10$. As shown in Table 7, the effect was stronger for the whole group. There was also a main effect of the opportunity to make a frozen sign $F(2,72)=3.99$, $p<.05$, with the second opportunity to make a frozen sign least likely.

Discussion

The results of experiment two showed that all subject performed more correct handshapes and handmovements on simultaneous signs and on matched signs. All subjects performed more correct path of motion morphemes on sequential signs and on

matched signs. Subjects also performed more correct path of motion morphemes on sequentially matched signs.

The results of the error analyses on experiment two show that all subjects omitted more path of motion morphemes when performing sequential signs and non-matched signs. Subjects also performed more omission errors on sequentially produced non-matched signs. Subjects performed more two path errors for simultaneous signs and non-matched signs. Subjects performed more PTHQ or S errors for non-matched signs.

The results of experiment two showed that the whole training helped the subjects to perform more correct path morphemes for sequential signs, at a mean of .81. The part training helped the subjects to perform more correct path morphemes for matched signs, at a mean of .86. Therefore neither training helped the groups consistently produce more correct path morphemes than the other group.

The results of experiment two also showed that the subjects who received the part training performed more missing morpheme errors. This result is consistent with Newport's findings, native ASL learners make more omission errors. The part group consistently performed more missing path of motion morpheme errors. They performed more of such errors for both sequential signs and non-matched signs.

The results of experiment two also showed that the whole group performed more two path of motion errors. This error is essentially another way of making a sign sequential. Most

subjects made this mistake by performing all four morphemes of a sign simultaneously and then adding a sequential path. For example if the subject is asked to perform the sign for an animal running backwards, the majority of subjects who made two path errors performed the simultaneously learned sign for an animal running in circles and then added the sequentially learned path for backwards. The whole group performed this error at a mean of .24 for simultaneous signs.

The analyses of the subjects who received the part training showed that they were more likely to make the PTHQ or S error on non-matched signs. This error shows that the part subjects were organizing the signs into morphological components and not as one morpheme, as in generalization type two. These subjects were able to perform a path simultaneously that they had been taught sequentially. They were also able to perform a path sequentially that they had been taught simultaneously. This suggests that the subjects saw the path as a separate morpheme.

The part group made PTHQ or S errors at a mean level of .33 for sequential signs. This is evidence for a pattern seen in the data for experiment two. The part group tended to make signs simultaneously. Another pattern in the data is the whole group tended to make signs sequentially. This is shown by the interaction of study condition and sign type in the analyses of path morphemes. This pattern is also shown by the error analyses of two path errors that found that the whole group performed more two path errors.

This pattern of data for experiment two is inconsistent with Newport's findings that native learners of ASL produce simultaneous morphemes sequentially. The young native learners of ASL in Newport's study made the error of producing simultaneous signs sequentially because these children were producing each of the morphemes of the sign separately. Therefore they were making generalization type three and were therefore seeing each morpheme individually. This however is not what the whole group in this experiment was doing. The subjects who were given the whole training were not performing each individual morpheme of the sign sequentially. Instead, they were making more two path errors, and adding a sequential path morpheme onto one of the signs they had learned simultaneously. They were therefore also making the first type of frozen error. Therefore these subjects were not performing the same type of sequential error that the natives in Newport's study were performing.

The whole group also performed better overall on signs produced sequentially on the test. One reason for this could be their tendency to perform the signs sequentially. The reason of why they preferred to perform signs sequentially is not presently clear and would be a good area for future research.

There is an advantage in real-life learning of ASL to producing more signs simultaneously as the part group had a tendency to do. Most of the verbs of motion in ASL are produced simultaneously. The few sequential ones used in this research

were based on a grammatical rule, as stated earlier, that states that the manner of locomotion morphemes can not be simultaneously combined with path of motion morphemes when representations of body parts rather than the whole person are used. These types of signs are not the norm in every day ASL usage. Therefore, there was an advantage of part training leading to more simultaneously produced signs.

The last error analyses of experiment two was that of the frozen error type. The whole group performed more frozen errors. This result implies that the subjects failed to break the signs into their morphological components. The whole group performed more frozen errors. This error is consistent with Newport's frozen forms error produced more by adult late learners in her study.

The results of experiment two were consistent with the findings of experiment one. The part training did not help the subjects to perform more correct morphemes than the whole group, as we had originally hypothesized. The subjects who received the part training did however make more omission errors, as the young native learners of ASL did in Newport's study. The part training seems to have prevented the subjects from making generalization type two, "holistic rote".

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Table 1

Simultaneous Verbs of Motion Stimuli for Experiment One

	Classifier	Manner of Motion	Path of Motion	Direction
	Learned			
1	Person	Walk	Straight	Forward
2	Person	Walk	Zig Zag	Backward
3	Animal	Jump	Straight	Forward
4	Animal	Jump	Zig Zag	Backward
5	Vehicle	Drive	Straight	Forward
6	Vehicle	Drive	Zig Zag	Backward
	Novel			
1	Person	Walk	Straight	Backward
2	Person	Walk	Zig Zag	Forward
3	Person	Jump	Straight	Forward
4	Person	Jump	Zig Zag	Backward
5	Person	Jump	Straight	Backward
6	Person	Jump	Zig Zag	Forward
7	Animal	Jump	Straight	Backward
8	Animal	Jump	Zig Zag	Forward
9	Animal	Walk	Straight	Forward
10	Animal	Walk	Zig Zag	Backward
11	Animal	Walk	Straight	Backward
12	Animal	Walk	Zig Zag	Forward
13	Vehicle	Drive	Zig Zag	Forward
14	Vehicle	Drive	Straight	Backward

Table 2

Means for Experiment One

	Old Signs	New Signs	Means
	Correct Morphemes		
Part	.93	.89	.91
Whole	.98	.93	.96
Mean	.96	.91	.94
	Inventions		
Part	.11	.07	.09
Whole	.05	.02	.04
Mean	.08	.05	.07
	Omitted Handshape		
Part	.10	.10	.10
Whole	.01	.04	.02
Mean	.06	.07	.06
	Additions		
Part	.00	.005	.003
Whole	.00	.02	.01
Means	.00	.01	.01
	Substitutions		
Part	.02	.06	.04
Whole	.01	.06	.03
Mean	.02	.06	.04

Table 3

Simultaneous Verbs of Motion Stimuli for Experiment Two

	Classifier Learned	Manner of Motion	Path of Motion
1	Person	Walk	Straight
2	Animal	Run	Circular
3	Vehicle	Drive	Curved
	Novel		
1	Person	Walk	Circular
2	Person	Walk	Curved
3	Person	Walk	Sideways
4	Person	Walk	Zig Zag
5	Person	Walk	Backward
6	Animal	Run	Straight
7	Animal	Run	Curved
8	Animal	Run	Sideways
9	Animal	Run	Zig Zag
10	Animal	Run	Backward
11	Vehicle	Drive	Straight
12	Vehicle	Drive	Circular
13	Vehicle	Drive	Sideways
14	Vehicle	Drive	Zig Zag
15	Vehicle	Drive	Backward

Table 4

Sequential Verbs of Motion Stimuli for Experiment Two

	Classifier	Manner of Locomotion	Path of Motion
	Learned		
1	Legs	Limping	Zig Zag
2	Feet	Marching	Sideways
3	Arms	Waving	Backwards
	Novel		
1	Legs	Limping	Sideways
2	Legs	Limping	Backwards
3	Legs	Limping	Straight
4	Legs	Limping	Circular
5	Legs	Limping	Curved
6	Feet	Marching	Zig Zag
7	Feet	Marching	Backwards
8	Feet	Marching	Straight
9	Feet	Marching	Circular
10	Feet	Marching	Curved
11	Arms	Waving	Sideways
12	Arms	Waving	Zig Zag
13	Arms	Waving	Straight
14	Arms	Waving	Circular
15	Arms	Waving	Curved

Table 5

Means of Old Signs Experiment 2

	Simultaneous Signs	Sequential Signs
	Non-Path Morphemes	
Part Group	.91	.94
Whole Group	.93	.96
	Path Morphemes	
Part Group	.91	.94
Whole Group	.93	.96

Table 6

Means for Experiment Two

	Simultaneous Sign	Sequential Sign	Mean
No Path			
Part			
Matched	.90	.85	.88
Non-matched	.87	.57	.72
Mean	.89	.71	.80
Whole			
Matched	.89	.86	.88
Non-matched	.85	.61	.73
Mean	.87	.73	.80
Path Morphemes			
Part			
Matched	.85	.87	.86
Non-matched	.37	.49	.43
Mean	.61	.68	.65
Whole			
Matched	.65	.89	.77
Non-matched	.38	.73	.56
Mean	.52	.81	.67
Missing Path of Motion Morpheme			
Part			
Matched	.00	.02	.01
Non-Matched	.00	.16	.08
Mean	.00	.09	.04

Whole			
Matched	.001	.02	.01
Non-matched	.00	.09	.05
Mean	.00	.06	.03
Two Path of Motion Morphemes			
Part			
Matched	.04	.00	.02
Non-matched	.32	.01	.17
Mean	.18	.01	.09
Whole			
Matched	.14	.03	.08
Non-matched	.34	.00	.17
Mean	.24	.01	.13
QPTHQ or S			
Part			
Matched	.07	.09	.08
Non-matched	.28	.33	.31
Mean	.18	.21	.20
Whole			
Matched	.13	.05	.09
Non-matched	.26	.15	.21
Mean	.20	.10	.15

Table 7

Means for Experiment Two's Frozen Error Analyses

	First Part of Sign	Second Part of Sign
Part Group		
Simultaneous Signs	.06	.02
Sequential Signs	*	.06
Whole Group		
Simultaneous Signs	.19	.09
Sequential Signs	*	.15

* This category does not exist