

The well-formedness and the ill-formedness of the JSL type-III syllable
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The purpose of this study is to try to find the rules that function to distinguish the well-formed and ill-formed syllables of Japanese Sign Language (JSL). To find out what makes syllables well-formed or ill-formed, we have adopted two methodological approaches to this problem: one is a conventional linguistic, i.e., descriptive, observation, and the other is a kind of new approach of using machine learning algorithms, in which the authors make a computer learn differences between the well-formed and the ill-formed JSL syllables and find features effective to distinguish them. Our presentation will be a progress report of our study from the linguistic side.

This presentation will focus on so-called type-III syllables, where the non-dominant hand remains still while the dominant hand moves, and show some of the well-formedness conditions of the type-III syllable of JSL in the light of syllable constituents. The JSL syllable is composed of one or two handshapes, one location, one or two movements, palm and finger orientations, and some others, but not all the mathematically possible combinations are unattested. Among the unattested combinations, some are accidental gaps whereas the others are systematic gaps: the latter do not exist because they violate the phonotactics of JSL. Here, we call those combinations that observe it well-formed syllables (WFS's) regardless of whether their existence is attested or not. Combinations that violate it, on the other hand, are called ill-formed syllables (IFS's).

To find out the rules involved in the distinction of WFS's and IFS's, we have collected both types of syllables.

1. Collecting of WFS's: to collect WFS's, we have specified the *Japanese-and-JSL Dictionary* as a corpus. All signs listed there (except ones the well-formedness of which the native speaker of JSL has denied) have been decomposed into about 2,500 syllables, which have been in turn analyzed into syllable-constituting elements such as the handshape, location, and movement. Syllables thus decomposed have been recorded in Excel as a sequence of symbols representing syllable constituents.
2. Collecting of IFS's: we have specified a series of dictionaries named *New Signs* as a corpus for the IFS's because it has been widely known that it includes a certain percentage (which is about 15% shown by Hara elsewhere) of IFS's. We have extracted from them and have videotaped about 600 syllables, and then asked ten JSL native signers to watch the videos and judge their ill- and well-formedness. This has resulted in about 400 IFS's (Figure 1), which, after being decomposed into constituents, have been recorded in Excel in the same way as we did for the well-formed ones.

We have compared the well-formed with the ill-formed syllables in terms of combination of constituents, and found that both hands of the type-III syllable must be specified for the identical location, which is either NS (neutral space: space in front of the signer) or TK (trunk). If the location is NS, mutual hand-contact is optional (Figures 2a, b). But, if TK, both hands must contact (Figure 2c). For instance, the syllable in Figure 1a is ill-formed because two hands are in different locations, the one in Figure 1b is ill-formed because the hands are neither in NS nor TK although they are both in the same location, and the one in Figure 1c is ill-formed because the hands are both in TK but not in contact with each other.

In the course of trying to find characteristics of IFS's of JSL, we have also found what

the typical well-formed type-III syllable of JSL is like by using the corpus of the WFS's. The statistics show that of about 2,500 syllables listed, there are 464 type-III syllables. Of 464 type-III syllables, 405 (87%) have one of Battison's seven handshapes (B, A, S, C, O, 5, and 1)*¹ on the nondominant hand, 405 (87%) have at least one path movement (they may have a path movement only or a path movement with another type of movement), 438 (94%) have neutral space (NS), and 317 (68%) have the dominant hand contact to the other hand. More than half of the type-III syllables (i.e., 238) consist of all together one of the seven nondominant handshape, path movement, neutral space and hand contact, the combinations of which we call **prototypes of the type-III syllable**. If any one of these elements is replaced with a different type of handshape, movement, location, or no hand-contact, then the number of the prototypical type-III syllables will be 159 (34%), if any two are replaced, then the number will be 34 (7%), and if any three, then only 2 (almost 0%).

In our presentation, referring to the statics and protoypicality above mentioned, we will discuss the well-formedness and the ill-formedness of the JSL type-III syllables.

Figure 1: Three Examples of IFS's

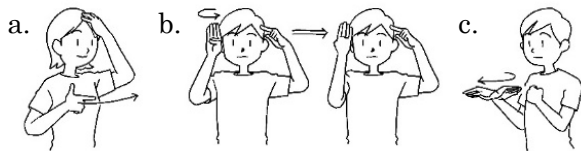
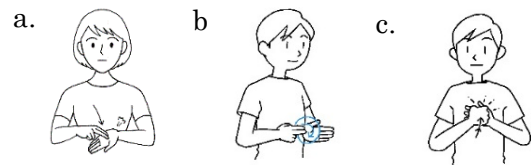


Figure 2: Three Examples of WFS's



*1. 25 kinds of handshapes appear on the nondominant hand in JSL. The most frequent to the 7th most frequent handshapes (Top 7 HS's) are the same as Battison's seven handshapes.(See the table.)

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TYPE-III Nondominant Handshape				
Rank	Handshape	Frequency	Percentage	Accumulation
1	b	257	55.39%	55.39%
2	s	38	8.19%	63.58%
3	a	36	7.76%	71.34%
4	c	33	7.11%	78.45%
5	1	16	3.45%	81.90%
6	o	13	2.80%	84.70%
7	5	12	2.59%	87.28%
8	i	6	1.29%	88.58%
9	v	6	1.29%	89.87%
10	y	6	1.29%	91.16%
11	5-b	5	1.08%	92.24%
12	b-f(q)	5	1.08%	93.32%
13	f	5	1.08%	94.40%
14	L-b	5	1.08%	95.47%
15	u	4	0.86%	96.34%
16	L-f	3	0.65%	96.98%
17	L-f(q)	3	0.65%	97.63%
18	7	2	0.43%	98.06%
19	b-b	2	0.43%	98.49%
20	L	2	0.43%	98.92%
21	4	1	0.22%	99.14%
22	1-b	1	0.22%	99.35%
23	b-f	1	0.22%	99.57%
24	ko	1	0.22%	99.78%
25	w	1	0.22%	100.00%