A "Rank vs. Cluster" Conflict: Or, Is It Just an Artifact?

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Abstract
This study[1] reports on conflicting outcomes the authors have obtained, and discusses their significance and implications for the SLA research.
As part of their ongoing joint research, the authors have developed sets of grammaticality judgment tasks and have accumulated data from university-level Japanese EFL learners. One of the features examined was the unergative/unaccusative distinction. Both the conventional ANOVA and the IRT-based analysis had revealed a stable difficulty order (Yamakawa et al., 2003, 2008). Further analysis (Yamakawa et al., 2010) employing Neural Test Theory (NTT; Shojima, 2009a, 2009b) confirmed this finding, and also indicated that this order was observed across the four latent ranks into which the learners were categorized.
However, another analysis applying self-organizing map (SOM; Kohonen, 1997) to the identical data depicted somewhat different picture (Sugino et al., 2010). The learners were categorized into four clusters, but the response patterns the learner clusters displayed did not share similarities with those observed in the latent ranks. In addition, unlike the results of the NTT analysis, the SOM analysis did not yield clear indication of the learners differentiating the unaccusatives and the unergatives. In this poster presentation, after detailing the two studies further, results of the reanalysis using SOM will be reported.

Keywords
unergative/unaccusative, NTT (Neural Test Theory), SOM (Self-organizing map)

Introduction
The present study is carried out as part of the authors' joint research which aims at elucidating the development of grammatical competence across several linguistic features. Many previous studies in SLA have focused on a particular linguistic feature, and have assumed that interrelations among different features are fixed by the linguistic theory that the study is based on. However, direct comparisons of the findings from different studies, even when they are based on the same linguistic theory, are difficult, because the data obtained are sample- and test-dependent. As a consequence, it remains obscure to determine the developmental stage in the acquisition of, say, dative alternation of a hypothetical learner who has attained full mastery of the unergative/unaccusative distinction. This, in turn, is a serious drawback in grasping the overall picture of the SLA process.

In order to overcome this defect, the authors have developed several sets of grammaticality judgment tasks, each focusing on a linguistic feature, and *Measure of English Grammar* (MEG), an overall grammatical proficiency test (Shimizu et al, 2003, 2006), and administered the tests to Japanese EFL learners. Although the participant bodies varied among the grammaticality judgment tests, all participants took MEG. Using the MEG items as anchors, the authors employed IRT (Item Response Theory), equated the data from the grammaticality judgment tests, and placed all items in the grammaticality judgment tests onto a single

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difficulty scale (Yamakawa et al., 2008). This enabled the authors to directly compare the difficulty parameters of the items from different grammaticality judgment tests. One of the major findings of this IRT-based analysis was that the items in the verb-related grammaticality judgment tests were categorized into three levels of difficulty, which roughly corresponded to the difficulty order of the items that examined the learners' cue dependency in comprehension.

Although the authors believe that this IRT-based analysis shed new light into understanding of the SLA process, the study had some drawbacks. One is that distinctions among the three levels were somewhat arbitrary; although the authors observed concentration of categories in each levels, there was also wide variety of difficulty parameter values within a category. Another is that, in the equating process, since the data contained both binary data and polytomous data, the polytomous data were converted into binary in order to avoid distortion of difficulty parameter values. Thus, those subtle differences among the learners' responses were discarded in the equating process.

The authors have attempted to avoid these difficulties by exploring the applicability of two new analytical procedures. In one approach, instead of placing learners on a continuous ability scale as in IRT, NTT (Shojima, 2009a, 2009b) was employed in which learners were categorized according to their latent ranks on an ordinal scale (Yamakawa et al., 2010). The other approach (Sugino et al., 2010) was to categorize the learners according to their response patterns by utilizing SOM (Kohonen, 1997). Before detailing the outcomes of these two approaches, the results of the conventional analysis will be outlined below.

1 The Study

The two analytical procedures were applied to the same set of data from 369 university-level Japanese EFL learners on the unergative/unaccusative distinction, obtained from the authors' previous study (Yamakawa et al., 2003).

1.1 Theoretical background

The Unaccusative Hypothesis (Perlmutter, 1978) claims that there are two distinct classes of intransitive verbs known as unergatives and unaccusatives, which exhibit different argument structures:

(1) a. Unergatives: [NP_1 [$_{VP}$ V]]
(e.g., [Mary [$_{VP}$ danced]])
b. Unaccusatives: [empty [$_{VP}$ V NP_2]]
(e.g., [empty [$_{VP}$ happen the accident]])
c. The accident happened 15 years ago.

The unergatives (e.g., *cry*, *dance*, *laugh*) originally have a logical subject (NP_1) as an external argument (i.e., an argument outside the VP), which bears the participant role AGENT (the instigator of an event) (1a). The unaccusatives (e.g., *die*, *fall*, *happen*), on the other hand, originally lack a logical subject (i.e., "empty"), and have only a logical object (NP_2) as an internal argument, which assumes the participant role THEME (a participant affected by an event) (1b). The internal argument (NP_2), then, is moved to the surface subject position in order to satisfy the English syntactic requirement which stipulates that the subject position must be filled with a lexical item (1c). As a result, the grammatical subject of the unaccusative verb originates as the logical object. At first sight it becomes difficult to make the unergative/ unaccusative distinction on the surface level because both have the same surface structure (i.e., NP + V).

Many researchers have noted that L2 learners of English often extend passive formation rules to unaccusatives and produce the following types of ungrammatical sentence (Zobl, 1989: 204):

(2) a. *Most of people are fallen in love and marry with somebody. (Japanese L1)
b. *My mother was died when I was just a baby. (Thai L1)

Unlike unaccusatives, unergatives rarely undergo this inappropriate passivization process. In addition, these nontarget sentences are observed in L2 English with various L1 backgrounds, and are particularly noticeable among intermediate/ advanced learners.

Two major accounts of the nontarget phenomena have been advanced so far: the NP movement account and the lexical causativization account. The former account points out that the argument structures of an unaccusative (1b) and a passive construction (3a) are almost identical in that both lack an external argument (logical subject) and that an internal argument (logical object) is moved to the surface subject position. One difference is that only the passive construction can take the *be* + *p.p.* marker to signal the NP movement (cf. 1c and 3b):

(3) a. [empty [$_{VP}$ V NP2]]
(e.g., [empty [$_{VP}$ be spoken English]]
b. English is spoken in many countries.

However, some learners notice the similarity of the two and also apply the passive formation rules to

unaccusatives in order to signal NP movement, which results in inappropriate passives as in (2).

According to the lexical causativization account, on the other hand, L2 learners treat an unaccusative verb as transitive and temporarily create a causer of the event (4a). Then the verb is passivized with the suppression of the nonce causer (4b):

(4) a. *The driver happened the accident 15 years ago.
b. *The accident was happened 15 years ago.

With the use of the Longman Learners' Corpus, Oshita (2000) examined these two accounts and demonstrated the superiority of the NP movement account over the lexical causativization account. In addition, Oshita (2001) proposed the Unaccusative Trap Hypothesis in order to explain various nontarget phenomena observed with unaccusatives in L2 contexts. The hypothesis states that the acquisition of unaccusatives exhibits a U-shaped curve with three developmental stages. At the first stage, learners fail to syntactically distinguish unaccusatives from unergatives and they derive both classes of intransitives from the same underlying representation (i.e., 1a). This misinterpretation leads to seemingly grammatical uses of unaccusatives.

At the second stage, as their English proficiency develops, learners start to sense the different argument structures of unaccusatives and unergatives (i.e., 1a and 1b) and apply nontarget passive formation to unaccusatives (the NP movement account). It is at this second stage that inappropriate passives with unaccusatives as in (2a) and (2b) emerge. The transition to the final stage is achieved by the expulsion of the second-stage misanalysis from the L2 grammar. Learners at the third stage can both attain the correct representation of unaccusatives (i.e., 1b) and move the postverbal NP to the surface subject position without passivization. In this way the Unaccusative Trap Hypothesis accounts for unaccusative-related phenomena such as the fact that nontarget passives with unaccusatives can often be observed among intermediate/advanced learners, and the fact that unergatives are rarely passivized.

1.2 Yamakawa et al., 2003

1.2.1 Target sentence structures

In order to investigate Japanese EFL learners' acquisition of this unergative/unaccusative distinction, the following six categories of target sentences were prepared.

Category A: NP+V (unaccusative)
Your letter arrived yesterday.
Category B: NP+V (unergative)
Her father cried at her wedding ceremony.
Category C: *NP+be+p.p. (unaccusative)
**Because of the rain, the train was arrived late.*
Category D: *NP+be+p.p. (unergative)
**He was cried when he heard of his mother's death.*
Category E: *NP+V+NP (unaccusative)
**Finally the waitress arrived the salad to us.*
Category F: *NP+V+NP (unergative)
**The boy hit his little sister and cried her.*

1.2.2 Scoring procedure

The participants were instructed to judge the grammaticality of each sentence on a 5-point scale. The participants' responses were converted into scores by subtracting the differences from the correct response from the maximum score of 4. Thus, if a participant responded 4 ("definitely possible") to a well-formed target sentence, s/he will receive 4 points; if the response is 2 ("probably impossible") to a grammatical sentence, s/he will get 1 point.

1.2.3 Findings

By utilizing conventional ANOVA, Yamakawa et al. (2003) reported that the following implicational hierarchy among the categories was observed, where Category B was the easiest and Category C was the most difficult.

Table 1: The Implicational Hierarchy among Categories

Categories
Category B: NP+V (unergative)
Category A: NP+V (unaccusative)
Category F: *NP+V+NP (unergative)
Category E: *NP+V+NP (unaccusative)
Category D: *NP+be+p.p. (unergative)
Category C: *NP+be+p.p. (unaccusative)

1.3 IRT-based analysis

This order of difficulty was further supported by the IRT-based analysis (Yamakawa et al., 2008). The average *b*-parameter values of the categories, i.e., indices of the items' difficulty, followed the same order: Category B (-1.48) < A (-1.12) < F (-0.64) < E (-0.49) < D (-0.25) < C (0.26), indicating that the difficulty order was stable with a larger participant body.

2 A "rank vs. cluster" conflict

2.1 Results of the NTT analysis

Tables 2 and 3 summarize the results of the NTT analysis. As is shown by Table 2, the participants were categorized into four latent ranks, and those who were categorized into Rank 4 had successfully judged the grammaticality of the items, while those in Rank 1 had significantly lower scores, misjudged in most of the items. Table 3 indicates the same difficulty order among the categories as was obtained in the previous studies, although the difficulty orders among the verbs within a category varied.

2.2 Results of the SOM analysis

Figure 1 below shows the cluster of the participants categorized by the similarities of their response patterns to the items in the grammaticality judgment test. The SOM analysis yielded four participant clusters, and their responses to each item is displayed in Table 4.

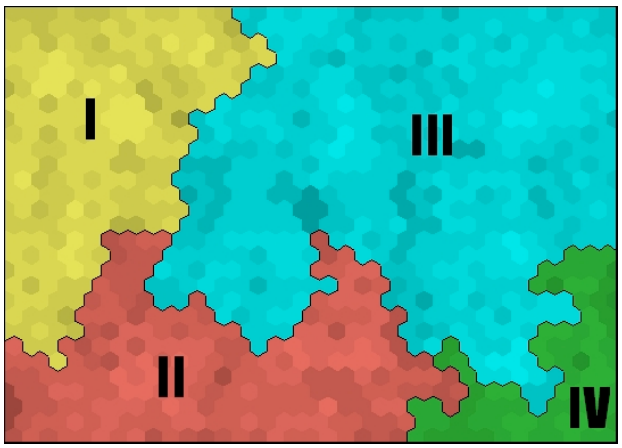

Figure 1: The Clusters of the Participants

As is shown in Table 4, Cluster IV learners consistently and correctly judged the grammaticality of the items, regardless of the unergative/unaccusative distinction. The other clusters of learners do not appear to differentiate the two categories either, although their response patterns differ from each other.

3 Discussion

The conventional analysis using ANOVA, or relatively new approaches employing IRT and NTT all revealed a stable difficulty order between the two verb classes (the unaccusatives are always more difficult than the unergatives), and among the target sentence structures (correctly judging ungrammatical passives as ungrammatical is more difficult than ungrammatical transitives as ungrammatical, or grammatical intransitives as grammatical), but such tendency did not appear to be obtained from the SOM analysis.

The SOM analysis differs from the other analytical procedures in that it does not presuppose any differences among the learners nor among the categories. As is the case with the NTT analysis, the participant groups, be it latent ranks or clusters, are the resulting outcomes of the analyses. Another difference between the SOM analysis and other procedures is that the converted scores were not used in the SOM analysis. This does not, however, seem to pose any serious difficulty, since the SOM clusters would be formed according to the similarities among the response or score patterns.

In the poster presentation, the result of the reanalysis applying the SOM analysis to the "scores" will be reported, and implications of the findings will be discussed.

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Table 2: Item Reference Profiles of the Unergative/Unaccusative Verbs (by Items)

Item No.	Category	Verb	Item Reference Profile (IRP) Rank 1 n=88	Rank 2 n=99	Rank 3 n=95	Rank 4 n=87
Y46	B	sing	2.991	3.365	3.672	3.822
Y42	B	cry	2.890	3.232	3.475	3.592
Y32	B	dance	2.830	3.203	3.380	3.517
Y06	A	die	2.949	3.086	3.299	3.460
Y23	B	laugh	2.817	3.123	3.367	3.383
Y04	E	arrive	2.813	3.013	3.217	3.282
Y36	A	happen	2.674	2.946	3.137	3.278
Y26	F	work	2.549	2.865	3.143	3.236
Y09	B	work	2.621	2.696	2.808	3.010
Y24	E	die	2.571	2.706	2.915	*2.931
Y03	B	play	2.405	2.554	2.888	3.169
Y16	A	appear	*2.539	2.607	2.775	3.048
Y18	D	sing	2.414	2.661	2.819	3.005
Y28	A	exist	2.324	*2.477	2.846	3.142
Y08	F	sing	*2.566	2.637	2.601	2.745
Y31	F	cry	2.416	2.525	2.688	2.907
Y20	A	arrive	2.421	2.613	2.805	2.751
Y13	A	fall	2.409	2.583	2.675	2.799
Y10	E	happen	2.345	2.524	2.755	2.818
Y17	F	dance	2.348	2.423	2.678	2.936
Y07	C	exist	2.358	*2.582	2.694	2.804
Y48	F	play	2.268	2.395	2.643	2.858
Y34	C	arrive	2.243	2.328	2.627	2.866
Y45	E	appear	2.310	*2.521	2.612	2.661
Y35	E	exist	2.126	2.380	2.594	2.841
Y29	D	play	2.125	2.293	2.627	2.874
Y14	D	cry	2.209	2.315	2.561	2.588
Y47	D	work	2.206	2.287	2.442	2.665
Y38	D	dance	2.152	2.214	2.367	2.581
Y39	F	laugh	2.270	2.347	2.316	2.300
Y12	D	laugh	1.937	1.982	2.073	2.171
Y02	C	appear	1.822	1.899	2.041	2.343
Y41	E	fall	1.933	1.938	1.873	2.085
Y43	C	die	1.790	1.780	1.916	2.116
Y27	C	fall	1.928	1.831	1.841	1.847
Y22	C	happen	1.736	1.623	1.685	1.848

…scores above 3.0
…scores between 2.5 and 3.0
…scores between 2.0 and 2.5
…scores below 2.0

Table 3: Difficulty Orders of the Categories and the Verbs

Category	Difficulty order	Rank 1	Rank 2	Rank 3	Rank 4
B (unerg.) (NP+V)	1	sing	sing	sing	sing
	2	cry	cry	cry	cry
	3	dance	dance	dance	dance
	4	laugh	laugh	laugh	laugh
	5	work	work	play	play
	6	play	play	work	work
A (unacc.) (NP+V)	1	die	die	die	die
	2	happen	happen	happen	happen
	3	appear	arrive	exist	exist
	4	exist	appear	arrive	appear
	5	arrive	fall	appear	fall
	6	fall	exist	fall	arrive
F (unerg.) (*NP+V+NP)	1	sing	work	work	work
	2	work	sing	cry	dance
	3	cry	cry	dance	cry
	4	dance	dance	play	play
	5	play	play	sing	sing
	6	laugh	laugh	laugh	laugh
E (unacc.) (*NP+V+NP)	1	arrive	arrive	arrive	arrive
	2	die	die	die	die
	3	happen	happen	happen	exist
	4	appear	appear	appear	happen
	5	exist	exist	exist	appear
	6	fall	fall	fall	fall
D (unerg.) (*NP+be+p.p.)	1	sing	sing	sing	sing
	2	cry	cry	play	play
	3	work	play	cry	work
	4	dance	work	work	cry
	5	play	dance	dance	dance
	6	laugh	laugh	laugh	laugh
C (unacc.) (*NP+be+p.p.)	1	exist	exist	exist	arrive
	2	arrive	arrive	arrive	exist
	3	fall	appear	appear	appear
	4	appear	fall	die	die
	5	die	die	fall	happen
	6	happen	happen	happen	fall

…scores above 3.0
…scores between 2.5 and 3.0
…scores between 2.0 and 2.5
…scores below 2.0

Table 4: Average Responses to Each Item by Clusters

		I	II	III	IV
	Category	n=151	n=83	n=91	n=44
appear_1	A	3.582	3.313	3.914	4.364
appear_2	C	3.615	3.072	2.914	1.614
appear_3	E	2.890	2.542	2.490	1.500
arrive_1	A	3.769	2.928	3.848	3.955
arrive_2	C	3.363	2.590	2.278	1.136
arrive_3	E	2.385	2.133	1.709	1.341
die_1	A	4.418	3.084	4.523	4.727
die_2	C	3.626	3.157	3.199	1.500
die_3	E	2.538	2.747	1.993	1.386
exist_1	A	3.352	3.205	3.987	4.386
exist_2	C	3.231	2.530	2.172	1.205
exist_3	E	3.088	2.771	2.338	1.477
fall_1	A	3.264	2.952	4.106	3.886
fall_2	C	3.440	2.916	3.219	2.614
fall_3	E	3.176	2.964	3.205	2.273
happen_1	A	3.308	3.578	4.523	4.432
happen_2	C	3.670	3.265	3.550	1.455
happen_3	E	2.758	2.578	2.311	1.591
cry_1	B	4.022	3.639	4.656	4.773
cry_2	D	3.648	2.434	2.364	1.455
cry_3	F	3.077	2.325	2.219	1.455
dance_1	B	4.275	3.072	4.649	4.795
dance_2	D	3.593	2.373	2.570	1.636
dance_3	F	2.978	2.349	2.377	1.341
laugh_1	B	4.440	3.120	4.503	4.341
laugh_2	D	4.022	2.783	2.695	2.000
laugh_3	F	3.473	2.325	2.788	1.477
play_1	B	3.769	3.133	3.974	4.182
play_2	D	3.473	2.458	2.338	1.295
play_3	F	3.165	2.530	2.364	1.159
sing_1	B	4.286	3.880	4.755	4.818
sing_2	D	3.275	2.458	1.854	1.364
sing_3	F	2.604	2.518	2.040	2.636
work_1	B	3.791	3.241	3.921	4.364
work_2	D	3.440	2.470	2.411	1.727
work_3	F	2.747	2.313	1.662	1.568

Note: verb_1: NP+V; verb_2: *NP+be+p.p.; verb_3: *NP+V+NP