6 Implicational Scales

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Implicational scales represent an important device for revealing structure in variability, and for demonstrating that what some linguists might dismiss as random or free variation is significantly constrained.[1] Introduced to linguistics in 1968 by David DeCamp for the analysis of the Jamaican Creole continuum, they have since been used for studying sociolinguistic variation and change in a wide spectrum of language varieties (including American sign language), for understanding linguistic intuitions, and for modeling second language acquisition (SLA).

In recent years, it is primarily variationists engaged in the study of SLA who have continued to make active use of implicational scales – for instance, Pienemann and Mackey (1993), Nagy et al. (1996), and Bayley (1999). But because of their potential utility, all students of linguistic variation and change should know how to interpret and use them. Variationists should also be familiar with some of the theoretical and descriptive issues involved in the use of implicational scales in the literature, including the role that scaling and its associated "dynamic" paradigm played in the development of variation theory.

The use of implicational scales in sociolinguistics has declined after an auspicious start. At the 29th annual conference on New Ways of Analyzing Variation (NWAV 29) in October, 2000, the only significant references to implicational scales occurred in a workshop on multidimensional scaling and correspondence analysis. By contrast, at the very first NWAV conference in October, 1972 (Bailey and Shuy 1973), there were at least ten papers that referred to implicational scales. One such paper was Derek Bickerton's "Quantitative versus dynamic paradigms: the case of Montreal *que*" (1973a) whose very title drew attention to differences between the quantitative and implicationalist or dynamic approaches. Sankoff (1973) and Labov (1973), leaders of the quantitative paradigm, included implicational scales as models of the facts of Montreal French and the possible relations between dialects, respectively. Anshen (1973), Fasold (1973) and Robson (1973) discussed problems with assumptions or methods of the implicationalist approach, while DeCamp (1973) attempted to provide solutions to two earlier critiques of implicational scales. The syntactic squishes of Albury (1973), Sag (1973) and Ross (1973), though far removed from the "dynamic" approach that C. J. Bailey and Derek Bickerton were advocating for implicational patterns, all used implicational arrays to demonstrate that their synchronic syntactic "dialects" were well-ordered. Clearly, then, implicational scales were a central element in the early days of variation theory.

What are implicational scales? In linguistics – this qualification is necessary because similar scales are widely used in the social sciences for the measurement of attitudes and other constructs (see Gorden 1977) – implicational scales depict hierarchical co-occurrence patterns in the acquisition or use of linguistic variables by individuals or groups, such that *x* implies *y* but not the reverse. When linguistic variables are distributed in implicational patterns, the scope of variability is significantly constrained. For instance, suppose that dialects in a community differ with respect to whether they have or do not have each of three rules, A, B, and C. If the variation is random, there are a total of *eight* possible dialect patterns (2^3, or in general, k to the n, where k = the number of values or variants of each variable, and n = the number of variables). But if the variation forms a perfect implicational pattern, there are only *four* possible dialect patterns or scale types ($n + 1$, for a binary variable), for instance, those shown in table 6.1a. The four excluded patterns are shown in table 6.1b. Because the data form a linear, unidimensional scale, we are able to reduce

Table 6.1a Implicational scale of four lects in relation to use of three hypothetical rules

Scale types or lects	Rule A	Rule B	Rule C
1	+	+	+
2	+	+	–
3	+	–	–
4	–	–	–

Table 6.1b Patterns or lects excluded by the scale model underlying table 6.1a

Excluded patterns	Rule A	Rule B	Rule C
5	–	+	–
6	–	+	+
7	–	–	+
8	+	–	+

the number of possible patterns by half, and to make very precise predictions. If a dialect has only one of these rules, for instance, we can predict that the rule in question is A (not B or C); if it has only two, that the second rule is B (not C), and so on. As the number of items increases, the constraining effect and predictive power of scaling are even more dramatic. For example, with nine binary variables – and several scales in the variation literature have at least this many – there are 512 (or 2^9) possible arrangements of + and –, but only 10 (or 9 + 1) scale types actually occur.

1 In the Beginning: DeCamp's Scale for the Jamaican Creole Continuum

As noted above, David DeCamp is credited with introducing implicational scales to linguistics, in a paper presented at a 1968 creole conference in Jamaica whose proceedings (Hymes 1971) were highly influential both in pidgin-creole studies and variation theory.[2] This credit is fully deserved, but there are three curious things about it from a history of science perspective. First of all, the scaling technique itself had been invented earlier by Guttman (1944) for the measurement of social attitudes, and it is known among statisticians and social scientists as Guttman scaling or scalogram analysis (see for instance, Torgerson 1958, Dunn-Rankin 1983). As DeCamp later noted (1971: 369), he did not realize he had been "anticipated" by Guttman until after the 1968 Jamaica conference; he had independently developed the scaling technique in 1959 and had been presenting it at professional meetings and in public lectures as his own innovation. Second, although DeCamp used them in a somewhat different way, it was Greenberg (1963: 73), studying language universals and typology, who first discovered the existence of implicational relationships in language (see Politzer 1976: 123): given *x* in a language, we always find *y*. Thirdly, while DeCamp (1971: 355–7) outlined a method for constructing an implicational scale based on the usage of six features and seven Jamaican speakers, and told us what the resultant orderings would be, he did not actually present the completed scale.

The only tabular array DeCamp provided in relation to his six features and seven speakers is the unordered array shown as table 6.2a, but since this is closer to the point at which the work of the variation analyst actually begins, it is excellent for pedagogical purposes. Most statistical packages (SPSS, SYSTAT, and so on) include programs for Guttman or scalogram analysis, but it is helpful to know how to construct one by hand. I do not recommend following the procedure DeCamp himself outlined (1971: 356) – which does not result in anything looking like a conventional implicational scale. What I will present instead is a modified version of the procedure outlined in McIver and Carmines (1981: 44–6).

Table 6.2a The unordered array of Jamaican speakers and features in DeCamp (1971: 355)

			Features			
Speakers	A	B	C	D	E	F
1	+	+	+	–	+	+
2	–	+	–	–	+	+
3	–	+	–	–	–	–
4	–	–	–	–	–	–
5	+	+	+	+	+	+
6	+	+	–	–	+	+
7	–	+	–	–	+	–

Key:

A	B	C	D	E	F
+ = child	+ = eat	+ = /th~t/	+ = /dh~d/	+ = granny	+ = didn't
– = pikni	– = nyam	– = /t/	– = /d/	– = nana	– = no ben

Table 6.2b Reordering or "translating" the columns of table 6.2a in terms of number of plusses

			Features			
Speakers	B	E	F	A	C	D
1	+	+	+	+	+	–
2	+	+	+	–	–	–
3	+	–	–	–	–	–
4	–	–	–	–	–	–
5	+	+	+	+	+	+
6	+	+	+	+	–	–
7	+	+	–	–	–	–
Plusses:	6	5	4	3	2	1

Beginning with unordered data, you first compute the number of plusses for each column, and then reorder or "translate" the columns (McIver and Carmines 1981: 45) in descending order from left to right with respect to the number of plusses they contain, as in table 6.2b. You then compute the number of plusses per row, and reorder those so that they form a descending series from top to bottom, as in table 6.2c. Alternatively, you could reorder the rows first and then the columns, but in each case the output of the first operation

Table 6.2c Reordering or "translating" the rows of table 6.2b to yield a perfect implicational scale

	Features						
Speakers	B	E	F	A	C	D	plusses
5	+	+	+	+	+	+	6
1	+	+	+	+	+	–	5
6	+	+	+	+	–	–	4
2	+	+	+	–	–	–	3
7	+	+	–	–	–	–	2
3	+	–	–	–	–	–	1
4	–	–	–	–	–	–	0

Key:

B	E	F	A	C	D
+ = eat	+ = granny	+ = didn't	+ = child	+ = /th~t/	+ = /dh~d/
– = nyam	– = nana	– = no ben	– = pikni	– = /t/	– = /d/

serves as input to the second. The cumulative result of both operations is the perfect scale shown in table 6.2c, which we can now use to make several observations about implicational scales, their interpretation and use, and their significance in variation theory.[3]

1.1 *Interpreting the scales*

Table 6.2c provides an implicational ordering both horizontally (from left to right), in terms of linguistic features, and vertically (up and down), in terms of speaker outputs. The *horizontal* implicational relations – the ones to which variationists usually give pride of place – can be stated as follows: a plus anywhere in the matrix implies plusses to the left; a minus anywhere implies minuses to the right. Minuses in this scale represent Creole features, and plusses represent English features,[4] or in the case of columns C and D, variable use of English features. To translate the abstract implicational pattern into linguistic reality, let us focus on just one feature, A. Speakers (like 5, 1, and 6) who have a plus for feature A (saying *child* instead of *pikni*) will also have plusses for features F, E, and B (using *didn't* instead of *no ben*, *granny* instead of *nana*, and *eat* instead of *nyam*). By contrast, speakers (like 2, 7, 3, and 4) who have a minus for feature A (saying *pikni*), will have minuses for features C and D as well (using voiceless and voiced stops instead of interdental fricatives).

Scaling, as Gorden (1977: 1) reminds us, is a means of measuring a common underlying property, and an implicational scale, as Pavone (1980: 64–5) observes, is a sophisticated ordinal scale, simultaneously ordering subjects and items with respect to that underlying property. In the case of table 6.2c, and most creole continuum scales, the property is relative ordering on a Creole-to-English continuum, which we could conceptualize as relative "Creoleness." What the horizontal ordering of features in this table reveals is that while *nyam*, *nana*, *no ben* and so on are all Creole variants, some are more markedly Creole than others; *nyam*, for instance, is the most markedly Creole variant, and using it predicts use of Creole variants for each of the other features. To the extent that one thinks of table 6.2c as depicting a continuum produced by a diachronic process of decreolization – a point on which we will elaborate below – it is in this most marked environment (note the plethora of plusses for column B) that the process would be assumed to have begun. Alternatively, one could conceptualize the underlying property that table 6.2c measures as "Englishness" – treating the variable use of the voiced interdental fricative as the most marked feature, the one that predicts use of English variants (or decreolization) in every other linguistic category. Regardless of how we conceptualize it (in terms of the plus values, or relative "Englishness," or in terms of the minus values, or relative "Creoleness"), table 6.2c represents one underlying dimension (as is usually the case with implicational scales), not two.[5]

Vertically, a plus anywhere in table 6.2c implies plusses above, and a minus anywhere implies minuses below. It is not clear what the vertical ordering in any one column means, at the level of individual cognition and use. Presumably speakers like 1 who use a plus for feature E might be aware that there are more speakers like them who have plus values for this feature than there are who have plus values for feature C, but this has never really been considered or investigated. In terms of the overall ordering of speaker outputs or lects, defined by Bailey (1973a: 11) as "a completely noncommital term for any bundling together of linguistic phenomena,"[6] lect 5 is the acrolect (most English or least Creole variety), and lect 4 the basilect (least English or most Creole). The intervening varieties are mesolects, or intermediate varieties, illustrating DeCamp's more general point that the Jamaican Creole continuum does not simply consist of two discrete varieties. At the same time, recognition of a continuum does not open the door to chaos; for a six-variable (n) two-valued (k) scale like this one, scaling limits the number of possible lects or scale types to seven ($n + 1$) instead of 64 (k^n).

More importantly, once speakers' outputs are ordered on purely linguistic grounds, they can be given social interpretations. DeCamp notes, for instance, that

> informant 5, at one end . . . , is a young and well-educated proprietor of a successful radio and appliance shop in Montego Bay; that informant 4, at the other end . . . , is an elderly and illiterate peasant farmer in an isolated mountain village; and that the social and economic facts on the other informants are roughly (not exactly) proportional to these informants' positions on the continuum. (DeCamp 1971: 358)

DeCamp (1971) and Bickerton (1971, 1973a: 40) both emphasized the importance of ordering individuals on the basis of their linguistic usage and then looking at their social characteristics in terms of socioeconomic class, network and the like, and they were critical of the quantitativists for beginning with social categories and presenting group means that might obscure or distort individual patterns. In this respect, they were followed by variationists such as LePage and Tabouret-Keller (1985: 137ff), who although using statistical clustering techniques instead of implicational scales, also began by clustering their speakers in terms of common linguistic behavior rather than in terms of social categories. Quantitativists never followed the implicationalists in this regard – Sankoff (1974) explicitly defended the practice of beginning with social categories in order to have results that "correspond to socially or culturally meaningful categories." However, as a result of the implicationalist critique, they began making more of an effort to show that individuals exemplified the constraint patterning postulated on the basis of group averages, and they began to address the relation of individual to group grammars as a theoretical and empirical issue (Guy 1980).

1.2 Scales, rules, and style-shifting

DeCamp suggested that the scalar ordering of features and varieties could be used to facilitate the writing of linguistic rules for the entire community:

> it would be unnecessary to specify within each rule the entire list of speech varieties (i.e. points on the continuum) which activate or block that rule. It would be sufficient to identify the point on the continuum beyond which the rule does or does not operate. (DeCamp 1971: 353)

For instance, for the hypothetical data set in table 6.1a, one could add to rule A the notation [≤3], to show that it applies to lect 3, and to all lower numbered lects (2, 1). As DeCamp observed (1971: 353), "this approach thus provides a very economical and meaningful way of incorporating many linguistic varieties into one grammatical description." DeCamp's useful suggestion was never really taken up by subsequent researchers. This was partly perhaps because of practical difficulties (the number and composition of possible lects could vary from one area of the grammar to another, even from one set of constraints on a single rule to another), and partly perhaps because of theoretical or conceptual ones (a declining interest in community-wide "grammars," and in the mechanics of rule-writing itself).[7]

DeCamp also suggested that the lects of an implicational scale could be used for the study of style shifting, since individuals would not shift randomly, but only to implicationally ordered patterns already present in the community. That is, that socially or geographically defined "dialects" could also be alternative "stylelects" within the range of an individual speaker's repertoire. This proposal was endorsed by Stolz and Bills (1968: 21) and Bickerton (1973b), and it has intriguing parallels with the subsequent proposal of Bell (1984) that intra-speaker variation is in general later than and to some extent parasitic on inter-speaker variation.

There are several ways in which subsequent implicational scales in the literature differed from DeCamp's pioneering scale. For one thing, DeCamp's scale, like Stolz and Bill's (1968) scale for Central Texas English, covered a disparate set of linguistic features (phonological, lexical, and morpho-syntactic), but subsequent researchers preferred to scale closely related items in a single area of the phonology or grammar, or related environments of a single rule. Second, while the scales of both of these pioneering studies were restricted to binary values (+ and –), and arbitrary thresholds were sometimes set up to classify speakers' variable usage as belonging to one categorical extreme or another (see Stolz and Bills 1968: 13–14), subsequent researchers allowed for greater variation within each lect. In the simplest case, scales became three-valued, allowing for variable use of a feature or variable application in an environment (marked by "*x*" in table 6.3, for instance); in the most complicated case, they included frequencies themselves, permitting a level of precision in terms of implicational orderings which was initially considered to be difficult (cf. DeCamp 1973: 147) or to be excluded by the implicational paradigm (Fasold 1970). Third, subsequent scales based on speaker outputs often included a "scalability" measure of the goodness-of-fit between the actual data and the predictions of the scale model. Although table 6.2c was a perfect scale, in the sense that it included no cells deviating from the ideal scale pattern, DeCamp himself told James Pavone (see Pavone 1980: 120, 178) that the actual data were not error-free, and this was the experience of all later researchers. Finally, DeCamp offered no diachronic interpretations for the implicational patterns in his data, but Bailey (1971, 1973a, 1973b) and Bickerton (1971, 1973a, 1973b) linked such patterns to the effects of ongoing or completed change, leading to the characterization of the implicational approach as the "dynamic" paradigm. We will touch on these issues (and others) as we review the scales of other researchers below.

2 Dynamicizing and Elaborating the Model: Bailey and Bickerton

C. J. Bailey, in a series of papers (1969, 1970, 1973b) and an integrative book (1973a), built on DeCamp's "important paper of 1968" (Bailey 1970: 3) to construct a dynamic model of variation in which synchronic implicational patterns are seen as reflections of linguistic changes spreading in waves through linguistic and geographical/social space. Derek Bickerton, in a series of papers from the same period (1971, 1973a, 1973b, 1973c), articulated, exemplified, and extended Bailey's principles and the method of implicational scaling, primarily with data from the highly variable Guyanese Creole-English continuum. He also launched the most trenchant critiques of the quantitative, variable rule paradigm,[8] and the fact that these attacks were published in leading linguistics journals (*Language*, *Journal of Linguistics*) increased their impact.

Probably the clearest and most succinct statement of Bailey's dynamic interpretation of synchronic implicational patterns comes from Bickerton:

> implicational phenomena . . . arise as a result of waves of change spreading through a speech community (therefore moving in time as well as space) so that at any given time a particular change will not have 'passed' certain speakers but will not yet have 'reached' others, while those who it has 'passed' will also (anomalies apart) have experienced the change waves that preceded it. . . . In other words, a wave model, collapsing the synchronic–diachronic distinction, had dimensions of both space and time, and implicational relationships come about only because an original change, while it is being diffused through (in this case, social) space, is also being generalized through time in the place where it

Table 6.3 Schematized illustration of the change that raises the vowel nucleus of words like *ham* to that of *hem* in the different environments shown[a]

Following consonants:	m n	f θ s	d	b	ʃ	g	v z	p t k	l
Locales/lects	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
0 *	–	–	–	–	–	–	–	–	–
1 *	×	–	–	–	–	–	–	–	–
2 Birdsboro	+	×	–	–	–	–	–	–	–
3 Philadelphia	+	+	×	–	–	–	–	–	–
4 Mammouth Junction	+	+	+	×	–	–	–	–	–
5 Ringoes	+	+	+	+	×	–	–	–	–
6 Jackson	+	+	+	+	+	×	–	–	–
7 New York City	+	+	+	+	+	+	×	–	–
8 *	+	+	+	+	+	+	+	×	–
9 *	+	+	+	+	+	+	+	+	×
10 Buffalo	+	+	+	+	+	+	+	+	+

[a] "A minus denotes the categorical nonoperation of the rule for the change; x denotes the variable operation of the rule; a plus sign denotes its categorical operation. An asterisk denotes a thus far unattested, but presumably discoverable pattern. The change is presumed to originate in locale 10, where it is complete in the vernacular style of speaking – the style illustrated in this table" (Bailey 1973b: 158).

originated (i.e. it spreads to more and more environments until it is completely unconditioned). (Bickerton 1971: 476–81)

We can use this general statement and Bailey's principle 20 – "What is quantitatively less is slower and later; what is more is earlier and faster" (1973a: 82) – to interpret the implicational scale in table 6.2c as depicting a general process of decreolization. It is most advanced in lect 5 (the one with the most plusses), and at the other extreme, has not yet begun to affect lect 4 (which has no plusses). Again, from the more/less evidence of the columns, we might assume that, in terms of these six features at least, decreolization began with feature B and spread in waves to features E, F, A, C, and D. Of course, this depends on whether one believes in decreolization as a qualitative phenomenon, involving the progressive loss of basilectal features (see Mufwene 1999: 158ff) and whether one has independent evidence (from real or apparent time) that it has taken place or is taking place.[9] But the implicational scale, interpreted according to dynamic principles, provides a clear set of diachronic predictions which can be empirically investigated.

Table 6.3, described by Bailey as as "an idealization of [the] data" in Labov (1971: 427), illustrates two more of Bailey's dynamic principles: that linguistic change begins in a very restricted or marked environment (principle 8a in Bailey 1973a: 55–6) and spreads from there to less marked or more general environments; and that it begins variably before becoming categorical. The scale as a whole depicts the raising of /æ/ in a range of following phonological environments and geographic locales; a plus (categorical application) anywhere implies plusses to the right and below, and a minus (categorical non-application) implies minuses to the right and above. The scale is three-valued, with a single *x* (optional or variable usage) intervening between minuses and plusses. Following Bailey's principle 20, we would once more infer that the change originated in lect 10 (Buffalo) and before non-velar nasals, and spread outwards in linguistic and social space as depicted in table 6.3. Figure 6.1 (from Bailey 1973b: 159, 1973a: 68) is another way of representing the diachronic interpretation of table 6.3, in terms of the kinds of varieties (with respect to the tensing rule) that exist at each locale at successive time periods.

That Bailey was not averse to the incorporation of frequencies in models of the change process is clear from Figure 6.2, which depicts hypothetical frequencies for a linguistic change at a particular point in time. The synchronic implicational pattern – any frequency of rule application implies equivalent or higher frequencies to the left (and below) – is taken to be a reflection of the diachronic spread of the change in waves from the locale and environment at the lower left hand corner of the table (environment a, locale 0) outward and upward. If the change continues to completion, all the cells will eventually reach 100 percent.

Although his 1971 paper is better known for its "no holds barred" attack on the quantitative paradigm, Bickerton's (1973c) paper, dealing with three variables in the Guyanese Creole continuum, better exemplifies the substantive

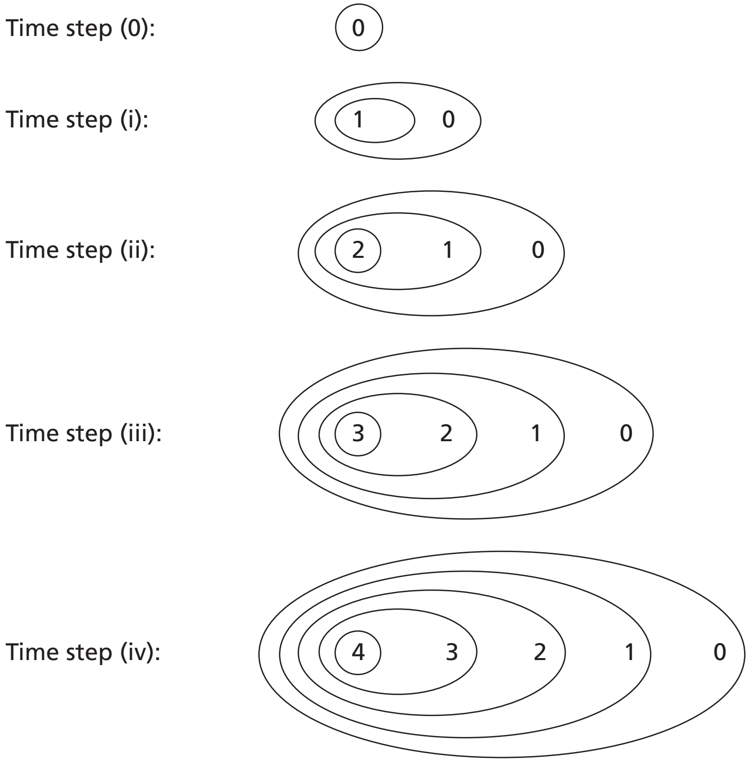

Figure 6.1 Wavelike propagation of the change shown in table 6.3. The arabic numerals represent the same varieties of the language here as in table 6.3. The time steps are defined by the changes themselves

Source: Bailey (1973b: 231)

Environment d	20%	10%	0	0
Environment c	80%	20%	10%	
Environment b	90%	80%	20%	10%
Environment a	100%	90%	80%	20%
Locales	0	1	2	3

Figure 6.2 Hypothetical frequencies, at one point in time, for a change spreading in waves to different locales and linguistic environments (point of origin: locale 0, environment a)

Source: Adapted from Bailey (1973a: 79)

Table 6.4 *Tu/fu* variation in the Guyanese Creole Continuum

Speaker	After non-inceptive, non-desiderative verbs (e.g. kom_)	After desiderative and "psychological" verbs (e.g. waan_)	After inceptive and modal verbs (e.g. staat_)
3	1	–	–
6	1	–	–
9	1	1	1
12	1	–	1
20	1	–	–
21	1	–	–
22	1	–	–
24	1	–	1
7	1	–	2
13	1	1	2
16	1	–	2
26	1	1	2
28	1	–	2
11	1	12	2
25	1	12	2
8	1	2	2
2	12	–	(1)
5	12	2	–
14	12	2	2
15	12	–	2
17	12	–	2
27	12	(1)	(1)2
1	2	2	2
4	2	–	2
10	2	–	–
19	2	2	2

1 = fu; 2 = tu. A dash indicates empty cells/no data; parentheses enclose deviant cells, ones which do not confirm to implicational patterning.

Source: Bickerton (1973c: 647) Scalability = 94.64 percent

contributions he made to the implicational scaling paradigm. Table 6.4 shows the implicational scale for variation between *fu* and *tu* as infinitival complementizers (as in *staat fu/tu go* 'start to go') which it contains (1973c: 647).[10] The scale is three-valued, allowing for alternation between basilectal and acrolectal variants (12) as well as categorical use of the basilectal (1) and acrolectal (2) variants, and the linguistic categories are three types of predicates in which these infinitival complementizers arise: I = after modal and inceptive verbs (e.g. staat 'start'), II = desiderative and other psychological verbs (e.g. waan 'want'), III = after verbs not in categories I or II (e.g. kom 'come'). The implicational relations are more complex than in previous scales in the literature, stated by Bickerton as follows:

> deviances apart, the presence of a basilectal index ALONE in a given column implies the presence of similar indices in all columns to the left; while the presence of a non-basilectal index, alone or otherwise, implies the presence of similar indices, alone or otherwise, in all columns to the right. (Bickerton 1973c: 646)

Deviations from this implicational prediction are enclosed in parentheses, and the scale is accompanied by a "scalability" figure of 94.64 percent, which represents the proportion of non-deviant cells (53) out of the total of filled cells (56). This is somewhat similar to Guttman's Index of Reproducibility (IR), which is:

$$IR = 1 - \frac{\text{Total number of errors}}{\text{Total number of opportunities for error}} = 1 - \frac{\text{Total number of errors}}{\text{No. cols.} \times \text{No. rows}}$$

except that Guttman's IR presumes completely filled cells, and almost one-third of the cells in table 6.4 are missing, a point to which we will return below.

Bickerton (1973c) also contains substantive implicational analyses of variation in the Guyanese copula system and the singular pronouns, and includes panlectal grids, showing the totality of possible isolects for each subsystem, (e.g. Table 6, 1973c: 664) whether attested or not. Such grids also allowed him to show the distribution of all his speakers on the continuum (e.g. in Figure 2, 1973c: 665), a useful innovation. Finally, in addition to providing information on the social correlates of individuals' placement on the continuum, Bickerton attempted to correlate the relative positions that individuals in one village occupied on implicational scales for the copula and the singular pronouns. He found such correlations weak, casting doubt on the value of seeking implicational relations across different areas of the grammar, as DeCamp (1971) had done. Bickerton also expressed the conviction that inter-subsystem correspondences would be found, "given time, patience, and knowledge of the principles on which they are based" (1973c: 666), but to date, there has been no progress on this front.

3 Other Uses of Implicational Scales

Given their initial use by DeCamp and Bickerton with creole data, it is no surprise that implicational scales have been popular in studies of variation and change in pidgin and creole continua. They have been exploited in the description of Tok Pisin (Woolford 1975), Providence Island Creole (Washabaugh 1977), Belizean Creole (Escure 1982), Hawaiian pidgin and creole (Day 1973, Bickerton and Odo 1976), Jamaica Creole (Akers 1981) and Guyanese Creole (Rickford 1979, 1987b), among others. Interestingly, most of these studies dealt with grammatical variables. By contrast with the quantitative model, which was originally applied to variation in phonology and only later extended to syntax and semantics, the implicational model received its early applications in syntax and the lexicon, and it was only later extended to the analysis of phonological problems (Bailey 1973a, Fasold 1975, Akers 1981).

Implicational scales have also been used for the analysis of linguistic intuitions with regard to syntactic phenomena (e.g. Elliot et al. 1969, Rickford 1975, Hindle and Sag 1975 in addition to the studies by Albury 1973, Ross 1973, and Day 1973 cited earlier). They have also been used to model variation in American sign-language (e.g. by Battison et al. 1975, Woodward 1975), and in a variety of North American and European language situations (Bickerton 1973a, Bailey 1973a, Napoli 1977). Gal's (1979) use of scaling to model the kinds of interlocutors to whom speakers in Oberwart, Austria, used either German or Hungarian, was particularly innovative. "God" was the context in which Hungarian was most highly favored, followed by "grandparents and their generation." At the other extreme, one's "doctor" was the interlocutor to whom German was reported to be most commonly used, followed by "grandchildren and their generation." The differential use of German and Hungarian was evidence of an evolving language shift from Hungarian to German.

However, since the mid-1970s and continuing to today, the subfield of variation studies that has been most favorable to the use of implicational scales, is, as noted above, the study of second language acquisition. Politzer (1976) used scaling to model mastery of the rules for five grammatical contrasts in French and English by San Francisco Bay Area students enroled in bilingual schools. Andersen (1978) used it to study the acquisition of 13 grammatical morphemes in English by Spanish-speaking students at the University of Puerto Rico. Trudgill (1986: 25), drawing on data in Nordenstam (1970), used it to model the order in which Swedes living in Norway acquire Norwegian pronouns. Implicational scales have also been used by Pienemann and Mackey (1993) to depict the acquisition of various English structures by child learners from a variety of language backgrounds; by Nagy et al. (1996) to illustrate the ordered acquisition of /l/-deletion in Montreal French by anglophone speakers, and by Bayley (1999) to model the use of the preterit and imperfect tense by aspectual class in Mexican-origin children's narratives. Using the implicational scale shown in table 6.5, Pienemann (1998: 178, drawing on work by M. Johnston) depicts the acquisition of twelve English grammatical structures in Australia by 16 adult immigrants from Polish and Vietnamese backgrounds. Speaking of this table, Pienemann notes that:

Table 6.5 Acquisition of English grammatical rules by 16 Vietnamese and Polish adult immigrants to Australia

	Stages											
	6	5		4		3				2		1
Structures	A	B	C	D	E	F	G	H	I	J	K	L
phuc	–	+	+	+	/	+	+	+	+	+	+	/
dung	–	+	+	+	/	+	+	+	+	+	+	/
ja	–	–	+	/	+	+	+	+	+	+	+	/
ij	–	–	+	/	+	+	+	+	+	+	+	/
es	–	–	–	+	+	+	+	+	+	+	+	/
ka	–	–	–	+	+	+	+	+	+	+	+	/
bb	–	–	–	+	+	+	+	+	+	+	+	/
sang	–	–	–	+	/	+	+	+	+	+	+	/
jr	–	–	–	–	+	+	+	+	+	+	+	/
vinh	–	–	–	–	+	+	+	+	+	+	+	/
long	–	–	–	–	+	+	/	+	+	+	+	/
tam	–	–	–	–	+	+	+	+	+	+	+	/
ks	–	–	–	–	–	+	+	+	+	+	+	/
my	–	–	–	–	–	–	+	+	+	+	+	/
IS	–	–	–	–	–	–	–	–	–	+	+	/
van	–	–	–	–	–	–	–	–	–	–	–	+

Key:
+ = acquired; – = not acquired; / = no context for an obligatory rule, or no tokens for an optional rule. A = Cancel inversion; B = Aux2nd/Do2nd; C = 3sg. –s; D = Y/N inversion; E = PS Inversion; F = Neg+V; G = Do Front.; H = Topi.; I = ADV; J = SVO; K = Plural; J = single words

Source: modified from Pienemann (1998: 178)

> The scalability . . . is 100 per cent. This means that there is not a single piece of evidence to contradict the hypothesized implicational pattern, and this means that Johnston's study strongly supports the English processability hierarchy.
>
> There are several factors which add to the strength of this support. First of all, five of the six levels of processability are documented . . . there is at least one speaker for whom the given level is the highest.
>
> The second contributing factor is the richness of the database. This is evident in the small number of slashes [= empty cells]. . . . Leaving aside one-constituent words [= the rightmost column], such gaps occur in merely 3.125 per cent of Johnson's corpus. In other words, in this corpus it hardly ever happens that it provides neither evidence for nor against the hypothesized hierarchy.
>
> (Pienemann 1998: 178)

4 Three Caveats about the Use of Implicational Scales

Useful though implicational scales have proven to be as an heuristic and data-ordering device, I must mention three caveats about their use.

4.1 *Avoid empty cells and weak goodness-of-fit measures*

The power of scaling lies in its ability to predict that data in the area of grammar under consideration will occur in highly constrained, non-random implicational patterns. In general, we want to make the strongest predictions consistent with the scaling model, but empty cells and sloppy tests of the goodness-of-fit between the scaling model and the actual data militate against the validity of the results.

Some of the earliest scales in the variationist literature are less than ideal in this regard (for instance, Bickerton's (1973c) *tu/fu* scale, in which 28.2 percent of the cells are empty – see table 6.4), and some of the most recent are equally wanting (for instance, the ESL scale in Pienemann and Mackey 1993, in which 24 percent of the cells have no data). Referring to the gaps in the latter scale, Pienemann (1998: 181) claims that "this in no way disqualifies the hypothesis it highlights," but this is disputable. Ignoring empty cells in a table, and computing scalability figures only on the basis of filled cells, amounts to a leap of faith that if the empty cells were to be filled, they would pattern in accord with the implicational predictions of the scale model. This is clearly not a valid procedure. To avoid it, we simply have to continue collecting data until our scales contain no empty cells, or devise procedures for filling the empty cells by other means, for instance, reproducing the proportions of attested deviations (see Pavone 1980: 111–19).

Second, the statistically accepted rate for scalability or the Index of Reproducibility (IR) is 90 percent, not the 85 percent figure that has been accepted in a number of linguistic studies. As Dunn-Rankin (1983: 107) notes, Guttman has stated that a scale with an IR less than 90 percent "cannot be considered an adequate approximation to a perfect scale," and an IR of .93 approximates the .05 level of significance. To be sure of the validity of our findings we should probably accept 93 percent as the minimum "scalability" figure.

Third, as observed and exemplified by Pavone (1980) – the most statistically sophisticated study of linguistic scaling available – there are more demanding tests of the goodness-of-fit between scale models and actual data than IR, the one which virtually all linguists use. For instance, Pavone's implementation of Jackson's (1949) "Plus Percentage Ratio" and Green's (1956) "Index of Consistency," results in the rejection of several classic scales in the variationist literature that would otherwise pass muster with IR.[11]

4.2 Attempt frequency-valued (instead of binary) scales where possible

In the early literature on implicational scales, binary (+, −) or at best, trinary (+, −, x) scales were the norm. To the extent that one's data came in that format (as, for instance, where informants either accepted, rejected, or were uncertain about the grammaticality of a sentence), this made perfect sense. Sometimes data could scale only when converted from frequencies to plusses and minuses, although such conversions invariably involved arbitrary procedures and the resultant order could conceal vast extremes of variability. A case in point is Day's (1973: 98) copula scale, whose application symbol (*x*) covered frequencies from 2.1 percent to 100 percent and virtually everything in between, as shown by his subsequent percentage use array for the same variable (1973: 106). As Pavone (1980: 146–7) points out, the real problem with this is that Day goes on to write variable rules for his data, which make unmotivated predictions about speakers' knowledge of more or less relations between the relevant environments when only either/or relations are justified.

Of course, implicationalists like Bickerton (e.g. in 1973a: 24–5) explicitly eschewed the incorporation of frequencies in implicational scales, and the use of variable rules, on the grounds that they require unorthodox and overly strong assumptions about the cognitive linguistic capacity of human beings. However, as quantitativists have often emphasized, it is not the statistics, but the relationships between environments they represent which humans are assumed to have as part of human competence. And, as Fasold (1970: 558) shows convincingly, attention to frequency relationships leads to the discovery of linguistic patterning where implicational analysis with only binary- or trinary-valued scales does not.

Although a number of researchers have incorporated frequencies into their implicational scales, they are usually hypothetical (e.g. the frequencies in figure 6.2 above, from Bailey 1973a), or based on the data of social classes rather than individuals (e.g. Tables 5 and 6 in Fasold 1970, based on Wolfram's Detroit data). Aggregated social class data limit the number of outputs which have to be scaled and so provide a weaker test of the model than scales that use the data of individual speakers.

I know of only three frequency-valued scales in the literature that pass the IR: Fasold's (1975: 53) scale of Sankoff's que-deletion data from Quebec,[12] Andersen's (1978: 226) scale for the acquisition of four grammatical features, and my own (Rickford 1979: 261) scale for vowel-laxing by pronoun form, shown as table 6.6. Note that in my case, the frequency-valued scale replaced an earlier binary scale (Rickford 1979: 255, 1991: 234), based on the same data. In both cases, the scales have an acceptably high IR,[13] but the frequency-valued scale makes a finer discrimination of the pronoun forms into four groups rather than two, and this discrimination is better supported on independent

Table 6.6 Frequency-valued scale for vowel laxing by pronoun form in Guyana

Lects	Speaker	Speaker	ju	de, shi	mi	wi
A	4	Reefer	1.00	0.89	0.84	0.08
	10	Ajah	1.00	0.89	0.80	0.00
B	12	Nani	0.96	0.94	0.76	0.00
	11	Darling	0.96	0.94	0.76	0.00
	2	James	0.96	0.88	0.76	0.00
	24	Granny	0.96	0.92	0.68	0.32
	6	Raj	(0.88)	0.89	0.80	0.00
	1	Derek	0.96	0.94	0.62	0.12
	5	Sultan	0.96	0.84	0.72	0.24
	7	Irene	0.96	0.84	0.72	0.00
	8	Rose	0.96	0.81	0.76	0.00
	9	Sari	0.96	0.85	0.72	0.12
	13	Mark	0.96	0.80	0.76	0.04
	3	Florine	0.92	0.90	0.60	0.04
C	17	Sheik	0.88	(0.68)	0.68	0.04
	20	Claire	0.88	(0.68)	0.68	0.04
	14	Magda	0.84	0.72	0.60	0.24
	19	Radika	0.84	0.63	0.52	0.00
D	18	Seymour	0.72	0.56	0.40	0.04
	16	Kishore	0.64	0.57	0.52	0.00
	23	Oxford	0.68	0.48	0.36	0.32
	15	Katherine	0.70	0.51	0.20	0.00
	22	Ustad	0.56	0.38	0.36	0.08
	21	Bonnette	0.76	0.60	0.20	0.00

Implicational pattern: Frequencies are higher in cells to the left, lower in cells to the right. Deviations parenthesized. IR = 96.9 percent (1–3/96). The solid step-like line running from lower left to upper right separates cells with 80 percent or more rule application from those with less; lects – demarcated by dotted lines – differ from each other in the number of pronoun forms they have with 80 percent or more rule application.

Source: adapted from Rickford (1979: 261)

linguistic (see below) and quantitative grounds.[14] The moral is that we should *not* be content with binary or trinary scales just because they scale successfully. To the extent that our data permit it, we should go for frequency-valued or more discriminatory scales, and the stronger predictions and alternative patternings they afford us.

4.3 Seek explanations for the implicational patterns

To my mind, a major flaw in the literature on linguistic variation is the tendency to be satisfied with the data orderings provided by our heuristic tools (frequencies, variable rule programs, implicational scales), without seeking to explain them in linguistic (or social) terms. Bickerton (1971) showed the danger of this with his spurious constraints on *tu/fu* variability which satisfied the constraints of the quantitative paradigm. But the problem afflicts implicationalists as well.

For instance, for all the vaunted regularity of the alpha scale in the implicationalist framework – DeCamp's (1971) scale of six features in the Jamaican Creole continuum – neither DeCamp nor anyone else ventured an explanation as to why *nyam* and *nanny* were the most marked creole features and earliest to decreolize, and why the nonstandard stop pronunciations for English interdental fricatives were the least marked. But as I have suggested elsewhere (1991: 238), it is because direct African loans like *nyam* and *nanny* (which unlike loan translations tend to be more obviously non-English in form or function) are for historical and sociological reasons (see Alleyne 1971: 181, Smith 1962: 41) particularly stigmatized in Caribbean societies, while nonstandard phonological variants like *t* and *d* are considerably less so. The fact that phonological features tend to be more gradient, and to function less frequently as ethnic and class barriers (see Rickford 1985) may also be related.

In the case of vowel-laxing by pro-form in the Guyanese continuum (table 6.6), justification for the more stringent frequency-valued ordering derives from the fact that an independent variable rule analysis of the data produces exactly the same ordering of the forms (with feature weights of .84 for *ju*, .68 for *de* and *shi*, .48 for *mi*, and .04 for *wi*), while Allsopp's (1958) study orders the forms similarly (*ju* .80, *de* .67, *shi* .59, *mi* .56, *wi* .32). Moreover, the independently established consonantal strength hierarchy (Hooper 1973, Jakobson and Halle 1956) provides a powerful explanation for this ordering. The generalization is that the stronger the preceding consonant (in this hierarchy), the greater the likelihood of vowel laxing: the /w/ in *wi* ranks lowest on this scale; nasals, as in *mi*, are ranked 3; and voiced stops and voiceless continuant, as in *de/shi* are ranked 5. The form *ju*, with a weak initial glide, should be ranked least with respect to vowel laxing, like *wi*. But it is the most recoverable by syntactic rules and therefore the most reducible and loseable of all.[15]

Whether our scales are for the variable use of linguistic features, for intuitions, or for patterns of language acquisition, we should not be satisfied to locate descriptive regularities without attempting to explain them.

The corollary of the injunction that implicational scales require interpretation is that they provide descriptions and orderings of data that invite interpretation. Clearly, attempts at arranging variable data as implicational scales can reveal regularities in that data hitherto hidden from the investigator's eye, and it is those regularities that may – indeed, should – invite the investigator to search further for explanations. The relative neglect of implicational scales by sociolinguists in recent years has removed one of the methods for organizing data from our active tool kit. I hope I have demonstrated in this chapter that the neglect did not follow from any inherent shortcomings of the method. Certainly we do not have so many methods that we can afford to neglect any of them. Implicational scales have served variationists well in the past, and should continue to do so in the future.

NOTES

1 This chapter incorporates some material from Rickford (1991).

2 Because of the widespread linguistic variability which they display, pidgin and creole speech communities have often been of interest to variationists, and creolists have often been contributors to and pioneers in the study of linguistic variation. See LePage and Tabouret-Keller (1985) and Rickford (1987a) for more discussion.

3 It is very important to note that the feature letters (A–F) and speaker numbers (1–7) in table 6.2c (and of course 6.2a and 6.2b) correspond exactly to those originally used by DeCamp (1971) and *not* to alternative versions of table 6.2c in Fasold (1970: 552), Pavone (1980: 32), or Rickford (1991: 227). In the latter works, the feature columns are relettered and the speaker rows renumbered so that they themselves form a neat series matching the ordering produced by the implicational scale. By contrast, I have chosen in this article to retain DeCamp's original designations even if the resultant orderings are messier (BEFACD, 5162734). I did so to permit easier comparison with DeCamp's original article, and to make the point that one does not start with a perfectly ordered implicational scale (or something close to it), but gets to it by reordering the rows and columns in which one's raw data come.

4 To avoid any implication that speaking Creole is a "minus" and English a "plus," one could represent the varieties respectively as x and y or 1 and 2, but I have chosen to follow DeCamp's designations in this as in other matters, and trust that readers will not attach any unintended sociopolitical interpretations to it.

5 Variationists (e.g. Bickerton 1973b: 20, LePage 1980: 127) sometimes use the term "bidimensional" for creole continua and the implicational scales used to describe them, when they clearly mean "unidimensional." The confusion perhaps arises because creole continua are bipolar, with the two poles English and creole, or acrolect and basilect.

6 The lects of table 6.2c and similar implicational scales actually represent *isolects*, "varieties of a language that differ only in a minimal way" (Bailey 1973a). Bailey did not seem to mind speaking of *idiolects* (individual speaker patterns, at least with respect to particular features or restricted sets of features), but he was chary about the utility of the notion of *dialects*, "mutually intelligible forms of a language delimited by isoglossic

bundles," on the grounds that "such dialects are rarely found" (Bailey 1973b: 161).

7 Witness the parallel decline in the writing of variable rules by quantitativists (see Fasold 1991, "The quiet demise of variable rules").

8 Bickerton (1971: 461) openly mocked the quantitativist tendency to focus on group means, using an absurd thought-experiment: "since the group figure is the crucial one . . . each individual must – if that group figure is to be maintained – keep track, not merely of his own environments and percentages, but also of those produced by all other members of his group; in other words, speaker B must continually be saying to himself things like: 'Good Lord! A's percentage of contractions in the environment +V __ + __ NP has fallen to 77! I'll have to step up mine to – let's see: A's production of this environment-type stands to mine in the ratio 65:35 over the last 100 token-occurrences, so I'd better compensate by shooting up to /// what? About 86 percent?' And, to crown it all, he must not only be able to perform all these highly sophisticated calculations – he must also . . . somehow continue to do so EVEN IN THE PHYSICAL ABSENCE OF ALL OTHER GROUP-MEMBERS!"

9 See Fasold (1973) for other critiques of Bailey's more = earlier/less = later assumptions, as likely to lead to wrong results in cases of rule acceleration, rule stagnation, and rule inhibition, and Bailey's response (1973a: 82–6).

10 Like his precursor DeCamp (1971), Bickerton had described this scale but not actually provided it in his (1971) article.

11 Attempting to explain these complex measures of goodness-of-fit would take us far afield. The reader is referred to Pavone (1980), Dunn-Rankin (1983), and Chilton (1969) for further discussion.

12 Fasold's scale barely passes (or fails), with an IR of 89.6 percent; Andersen's has an IR of 94 percent.

13 In earlier versions of table 6.6, the IR was reported as 99 percent instead of 96.9 percent, because the two occurrences of .68 in the *de/shi* columns for Sheik and Claire – equivalent to the .68 values to their immediate right – were not counted as deviations. However, requiring frequencies to the left to be everywhere higher (rather than higher or equivalent) than frequencies to the right is more in keeping with the predictions of a true frequency-valued scale. The one exception might be at the extreme categorical values of 0 or 100 percent where equivalence might be considered non-deviant (as in Andersen 1978: 226 – see Rickford 1991: 236–7).

14 The reason for selecting 80 percent as the basis for dividing the outputs in table 6.6 into lects is that this represents the final inflection point of Bailey's (1973a: 77) S-curve model of change and its associated principle 17: "A given change begins quite gradually; after reaching a certain point (say, 20 percent) it picks up momentum and proceeds at a much faster rate; and finally [around 80 percent as indicated in his S-curve] tails off slowly before reaching completion. The result is an S curve." To see the validity of this prediction in the data of Table 6.6, note that there are only 38 cells in the broad middle range of frequencies between .21 and .70, but there are more (58) in the

narrower .00–20 and .81–1.00 ranges, showing that individuals really do go through the middle range of frequencies more quickly than the extremes.

15 See Rickford (1979: 221–4) for details, and note that this discussion is related to unstressed syllables, and not to stressed syllables, which are categorically tense.

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