EQUIVALENCE IN PHONOLOGY: THE CASE OF FINNISH STOPS VS. ENGLISH STOPS

KARI SUOMI

University of Turku

In this paper[1] some methodological issues of contrastive phonology are discussed, mainly in connection with the problem of stating equivalence between phonemes. More specifically, an argument is made both for a rather concrete (or natural) phonology and for data-based, experimental phonetics as indispensable components of the contrastive analysis of sound systems, especially for pedagogical applications (which were the original *raison d'etre* of contrastive studies). To illustrate the general points discussed reference is made to the contrastive analysis of the stop systems of Finnish (as the source language) and English (as the target language), the emphasis being on the treatment of the /voiceless/-/voiced/ distinction. The terms and concepts used are mainly those of classical structuralist theory, used because of their practicality in stating surface contrasts, not as a token of commitment to that theory.

0

As an introduction, a brief account of the stop system of Finnish might be in order for theose readers who are not familiar with the language. For the majority of speakers of Finnish the stop system consists of four phonemes, viz. /ptdk/. [3] Among these /d/ has a marginal status: [2] in native vocabulary

[1] This is a slightly revised version of the papor presented at the 14th international conference of contrastive linguistics at Boszkowo, December 7 - 10.1977. I wish to thank the participants of the conferenco as well as Fred Karlsson, Jaakko Lehtonen and Kalevi Wiik for valuable comments and criticism.

[2] For an account of the segmental phonemes of Finnish see Karlsson 1969.

[3] Historically, /d/ (realized as a stop) entered the language as a result of a spelling pronunciation, due to the early scribes' practice of using the corresponding letter for writing down the then existing dental spirant. On the whole, the many complexities involved here are another indication of the artificiality of such monolithic notions as "*the* sound system of Finnish" (cf. the treatment of *b* and *g* below and in Suomi 1978).

and in fully integrated (older) loanwords it has a limited distribution (occurring only in certain word medial positions and even there, in contradistinction to the other stops, only /single/), it does not occur at all in some dialects, and in some further dialects it is realized as a flap rather than a stop. Neither is it, in a generative description, included among the Finnish lexical consonant segments, since its surface representations can be regarded as the product of easily statable morphophonological rules (cf. Karlsson 1971 : 32). Yet, as /t/ and /d/ are distinctive in Standard Finnish (e.g. *katon* gen. sg. of *katto* 'roof' vs. *kadon* gen. sg. of *kato* 'dearth') it is not *a priori* impossible, even in the light of the limited distribution of the latter, that the distinction would be essentially one of voicing, in which case the lack of /b/ and /g/ would be interpreted as an instance of two paradigmatic gaps. The *phonetic* differences between Finnish /t/ and /d/, however, do not seem to favour such an interpretation. The two stops (in the kind of educated speech where also /d/ is realized as a stop) differ from each other in the following ways: /d/ has a more retracted (or retroflex) place of production (Sovijärvi 1963 : 47; Wiik 1965 : 24) resulting acoustically to a higher F2 locus, and it has a shorter duration (Wiik 1965 : 24; Lehtonen 1970 : 71). As regards voicing, and this is the crucial point, /d/ is usually fully voiced between vowels and varies freely between voiced and voiceless when next to /h/ (see e.g. Lehtonen 1970 : 52ff.), /t/ being (when/single/) in voiced environments either voiceless or voiced (Hakulinen 1968 : 20). Thus, with regard to voicing, there is a possibility of complete overlapping in word pairs of the type *katon/kadon*. This state of affairs would seem to suggest that in these instances listeners have to rely on the other cues signalling the distinction, i.e., the acoustical consequences of the difference in the place of production as well as duration. It can be argued that the frequent total voicing of /d/ is a secondary, concomitant result of favourable aerodynamic conditions prevailing across the glottis due to the short duration of the occlusion and the influence of the adjacent segments (of which at least the following one is always a vowel, i.e. a naturally voiced sound). A /voice/ correlation, moreover, would presuppose context-independent control of voicing in stops: as the above discussion indicates this does not seem to exist (cf. also Hakulinen 1968 : 20 - 21). Thus phonetic considerations, too, suggest the rejection of the hypothesis of a /voice/ distinction. As for Finnish /ptk/, they are seldom aspirated but often, especially medially when occurring /single/ between naturally voiced sounds (i.e. vowels and sonorants), partly and occasionally even fully voiced (not surprisingly, voicing having no distinctive function in the Finnish stop system). In fact there seem to be strong grounds for regarding the Finnish stops as being produced in an essentially "neutral" mode with regard to voicing: the voicelessness or voicedness of these sounds seems to be an automatic response of the vocal apparatus to the context-dependent prevailing aerodynamic conditions, a single glottal configuration (one appropriate for speaking) being invariably employed for segmental purposes (for details see Suomi 1976 : : 73 - 75). [4]

It seems reasonable, then, to accept the view (expressed e.g. by Karlsson 1969 : 358) that /d/ is isolated and that there is thus no stop correlation in Finnish. This accepted, it follows that there is basically one series of stops in the language, all /unmarked/ (in the sense of Chomsky-Halle 1968) for voice. From the point of view of the system it is clear that it is /d/ that is "extra" (this view is also diachronically supported, cf. footnote 3) rather than /b/ and /g/ being paradigmatic gaps. How the classificatory feature distinguishing /t/ and /d/ should be labelled is a question of secondary importance; it is likely that the distinction is identified by listeners on the basis of all the concomitant phonetic differences.

The picture of the stop system of Finnish is, however, made more complex by the ever-growing adoption of new loanwords to the language, particularly from English. The new loanwords usually enter the language through the printed word, and consequently there are recent loanwords featuring the letters *b* and *g* such as *bussi* 'bus' and *bingo* 'bingo' as against *pussi* 'bag' and *pinko* 'swot' of the native stock. However, for the majority of Finns such word pairs are simply homophones as indicated, among other things, by their frequent misspellings. [5] Thus, for the majority of speakers of Finnish the pronunciations of words like *pussi* and *bussi* are non-distinct. There is, admittedly, a group of educated speakers who, under the influence of the foreign languages they have learnt, do maintain this distiction also in speaking Finnish. Yet there are indications that even among this educated group the distinction is far from being fully integrated and stable; the selection between the system /ptdk/ and the evolving system /pbtdkg/ is for most members of this group connected with the sociolinguistic phenomenon of register of sociolect, i.e. a matter of choice between informal and formal modes of speech communication. All this indicates that the Finnish stop system is presently in a period of restructuring, [6] and in the current state of transition caution must be observed e.g., in the

[4] It is here assumed, in accordance with the so-called aerodynamic-myoelastic theory of phonation, that two conditions must be met for voicing to occur, namely that the vocal cords be appropriately positioned and a sufficient transglottal flow of air be provided (for details see e.g. van den Berg 1968).

[5] It is to be noted that with regard to native vocabulary the Finnish ortography, with some minor predictable exceptions, is phonemic, i.e. there is a two-ways one-to-one correspondence between graphemes and segmental phonemes. The adoption of new loanwords of the type discussed of course violates this principle.

[6] I have discussed the problem of *b* and *g* in Finnish and the other related issues touched upon here in more detail in Suomi 1978.

selection of informants in contrastive analyses. If an elegant and simple description is necessarily insisted upon, however, it can, for most practical purposes, be assumed that the Finnish language has a stop system of /ptdk/, the distinction /t/-/d/ being based on phonetic differences only partially similar to those usually (e.g. in English or Polish) accompanying a fully integrated /voiceless/-/voiced/ one. Alternatively, and this seems a better solution, appropriate measures should be resorted to to assess, for each group of Finnish informants, whether and to what extent they are in command of the more complex system /pbtdkg/.

1

In contrastive analysis equivalent entities of two or more languages are compared, often for the purpose of predicting and/or explaining sources of interference. According to Lehtonen (1977 : 33) the following criteria have been used in various works to state the equivalence of phonemes in the languages compared:

(1) cogency of similar letters in spelling;
(2) similarity of phonetic descriptions and of conventions of transcription;
(3) use of phonological criteria; and
(4) perceptual similarity.

Let us examine the kind of results obtainable by the respective application of each of the criteria mentioned to the contrastive analysis of the stop systems of Finnish and English. The use of similar letters in spelling could conceivably, under a pretence to pedagogical simplicity, be taken as a point of departure in the case of Finnish being the source language, because of its almost perfect two-way one-to-one correspondence between graphemes and segmental phonemes (cf. footnote 5). However, the possible pros are far overruled by the cons inevitably resulting from the adoption of such an approach to the problem, even if rigorously applied. To be convinced, consider the following "transfer rules" necessary (although probably not even sufficient) to convert the phonological information deducible from the letter *g* in Finnish to that deducible from its counterpart in English: [7]

The letter *g* "is pronounced in English in two different ways:
(a) before *a*, *o* and *u* it is pronounced normally; "(sic!) "examples: *gang*, *goat*...;
(b) when *e*, *i* or *y* follows it is usually pronounced like the English *j*: this sound, which a Finn has to learn by practice, could perhaps best be represented by the transcript dž. The word *ginger* would have to be transcribed as džindžor, the word *German* similarly as džörmän. However, there are numerous exceptions to this rule. Although *gem* and *gelatin* are pronounced džem and dželoltin, the words *gelding* and *get* are pronounced gelding and get. When the letter *i* follows *g* the latter is pronounced *g* in almost as many words as it is pronounced dž: consequently the word *giant* is pronounced džaiont, but *giggle* as gigll; *gin* is pronounced as džin but *gingham* as gingom; *giraffe* is pronounced as džiräf', whereas *girl* as gerl. When followed by *y*, *g* is almost invariably pronounced as dž; the only exception to this rule is the word *gynecology* which is usually pronounced gainekol'odzi; also in this word, however, the first *g* is sometimes pronounced as dž, consequently: džainekol'ədzi (sometimes also: džinəkol'ədzi). It is also to be noted that *g* is not at all pronounced if followed by the letter *n* either word initially or medially, cf. the consonant cluster gn below." (Alanne 1968) [8]

[7] The letter *g* occurs in Finnish (apart from loanwords) also in the spelling *-ng-* for /ŋŋ/, this being a major exception to the one-to-one principle mentioned in footnote 5. However, the spelling does not violate the two-way correspondence as the relation is recoverable in both directions.

I have ventured to strain the reader's patience on the grounds that a normal user of the dictionary is clearly expected to read such instructions and, moreover, to remember what he has read. Thus, especially with English as the target language, the learner would have to memorize myriads of *ad hoc* rules in exchange for not having to become explicitly aware of the non-interchangeability of the notions "phoneme" and "letter", little practical difference as they may seem to make in his native tongue. In coming across such "instructions" one is forced to ask whether it would not, after all, be more economical to give the spelling *and* phonological structure (i.e., "the pronunciation") as the two distinct items to be learned for each English word (which, in fact, is the usual practice in textbooks of English for Finnish learners). [9]

It remains an open question how much the use of similar letters in the two languages interferes with the correct learning of the English stops by speakers of Finnish; one would think that the influence could be great only at the very initial stages of learning. We can conclude, then, that the application of the first criterion does not even produce viable practical solutions, not to mention its theoretical inattractiveness.

2

The second criterion, similarity of phonetic transcriptions and conventions of transcription, can, if inadvertently applied, lead to much more harmful misinterpretations as, due to the higher degree of sophistication involved, the

[8] Translation mine, KS.

[9] Thus, despite the fact that, for practical purposes, letters and phonemes can often be regarded mutually interchangeable entities in teaching various aspects of Finnish to native speakers, the concept of the phoneme must, implicitly or explicitly, form the basis of the description of the sound structure of the target language in foreign language teaching. Usually, of course, this is done implicitly, e.g. "*poika* in Finnish corresponds to *boy*, pronounced as /boi/, in English." This type of description can also cope with allophonic variation, e.g. by statements like" /b/, /d/ and /g/ in English, when word initial or final, are less voiced than in the word medial position." It is difficult to imagine how similar statements could profitably be incorporated into a comparison of spelling systems.

flaws are more difficult to detect. Among the shortcomings of traditional phonetic transcription (such as the phonetic categories of the IPA) Lehtonen (1977 : 34) mentions the dependence on categories predetermined by traditional classification, ambiguity in the evaluation of the phonetic characteristics (because the phonetic description is based on subjective, non-empirical impressions), and, thirdly, attention to vague and immaterial physical characteristics of the speech sounds. A case in point is the treatment of Finnish and English plosives by Moisio and Valento (1976). In discussing the physical differences between the stops of the two languages the authors state:

"It would seem that the Finnish plosives /pdk/ are fully acceptable as the corresponding English phonemes and /t/ can be used as a substitute for the English /t/ in spite of a slight difference in the place of articulation. Thus learning to hear and produce English /ptdk/ should not be too difficult for Finns. There are also two new plosives that must be learnt. They are /b/ and /g/. These may occur as sounds in loan-words in Finnish (e.g. *bussi* 'bus', *laboratorio* 'laboratory', *gallona* 'gallon', *agentti* 'agent', *Haag* 'the Hague'). Therefore one might assume that learning the English plosives is not difficult for a Finn. However, the picture is obscured by the fact that word-initially and at the beginning of a stressed syllable the fortis plosives /ptk/ are aspirated in English, whereas in Finnish they are unaspirated. This difference should not cause any hearing problem, because Finns probably identify English /ptk/ correctly whether they are aspirated or not. In production there may arise a difficulty, because Finns tend to pronounce their fortis plosives too laxly and without aspiration so that native speakers of English may hear them as /bdg/." (Moisio and Valento 1976: 15 - 16)

As regards the claim that /b/ and /g/ "may occur as sounds" (=phonemes!) in Finnish the authors state earlier (1976 : 14) that they interpret the Finnish stop system to consist of /ptdk/: clearly their position fluctuates on this point. However, on the basis of the discussion in section (0) above and the empirical data obtained by the authors themselves (cf. below) it can be inferred that, at least for the group of Finnish speakers used as their informants, the native stop system consists of /ptdk/ (this position is again subsequently taken by Moisio and Valento (1976 : 22 - 23) when they review the learning problems implied by their contrastive analysis).

Although discussing the physical characteristics of the stops the authors give no physical evidence which would justify the postulated correspondence or substitution relationship between Finnish /ptk/ and English /ptk/; on the contrary, they state (quite correctly) that there is a difference with regard to aspiration. The existence of a physical correspondence is further made questionable by the fact (mentioned by the authors) that Finnish /ptk/ are often identified as /bdg/ by native speakers of English. The results of their own listening tests are also far from indicating that speakers of Finnish identify English /ptk/ correctly (which would be the case if a physical correspondence

existed): English (E) /p/ is identified by Finns as /p/ in 28 per cent of the cases and as /b/ in 27 per cent, E /t/ is identified as /t/ in 43 per cent of the cases vs. 32 per cent as /d/, and E /k/ as /k/ in 58 per cent as against 14 per cent as /g/ (p. 33).

The use of the terms "forits" and "lax" (as *physical* attributes of stop sounds, i.e. as attributes meant to refer to some objectively observable phonetic feature of these sounds (and different, for example, from the objectively definable dimension of voicing), remains an instance of "attention to vague and immaterial physical characteristic of speech sounds" (Lehtonen 1977 : 34) until their referents in the physical world are indicated. To my knowledge this has not been done.[10] As regards the use of e.g. the terms "fortis" and "lenis" in a phonological, classificatory function, for example to refer to (or used as a label for) the English sets of stops (ptk) and (bdg),[11] they are, from a strictly formal point of view, as good as any provided that the two sets are systematically kept apart.

Thus, Moisio and Valento fail to give a phonetically motivated justification for the assumed correspondence between Fininsh /ptk/ and English (ptk) (in favour of English (bdg)), and the situation is indeed "obscure" in view of the obvious discrepancy between data and predictions.

What, then, could be the basis of Moisio and Valento's choice of correspondence? It seems that the second criterion mentioned by Lehtonen, viz. similarity of phonetic transcriptions and, particularly, conventions of transcription can give the answer as both the (voiceless) set of English stops and the basic triplet of Finnish stops are traditionally transcribed as /ptk/ (for historical reasons that need not concern us here). Given such a situation, it is tempting to transcend the similarity beyond the merely graphic one, i.e. to regard the stops also phonetically equivalent. (That they are not phonologically equivalent will be shown in more detail in section (3) below). Thus, looking up the transcripts *ptk* in an IPA chart, for example, one finds that

[10] The same terms *fortis-lenis* are, admittedly, used e.g. by Ladefoged (1971), but with reference to differences in the degree of respiratory activity resulting to variations of subglottal air pressure significant on the segmental level, as is the case e.g. in Luganda (see Ladefoged (1971: 24 - 29; 95ff.) for data and a detailed discussion). In English no such differences are associated with the /ptk/-/bdg/ distinction (see Suomi (1976: 55 - 56) and the references therein).

[11] As was done deliberately by the present writer in Suomi (1976) in order to reserve the terms *voiced* and *voiceless* for the phonetic dimension (i.e. presence vs. absence of glottal pulsing). It was explicitly stated that no material content was implied by the terms *fortis* and *lenis* (1976: 3 - 4).

they are defined, among other things, by the feature *voiceless* (while *bdg* are characterized by the feature *voiced*). In principle the IPA transcription system is a phonetic one, i.e., it enables a classification of speech sounds independently of their phonological function in the languages described. In practice, however, even the very construction of the system has been greatly influenced by the phonological structure of a number of languages, notably English. As a result, for English, the classificatory and narrow (phonetic) transciptions usually coincide, i.e. the same transcripts are used in both, and usually without doing injustice to either. For Finnish, on the contrary, the choice between the transcripts *ptk* and *bdg* is more arbitrary in a phonological (classificatory) transcription as the /voiceless/-/voiced/ distinction does not exist in Finnish. Now, in an attempt to capture the essential *phonetic* characteristics of Finnish stops one is in principle free to choose the transcripts that best seem to describe the essential features of these sounds, and in practice *ptk* have traditionally been chosen. However, it is erroneous to assume, after the choice has been made, that the same transcripts now stand for phonetically non-distinct sounds in the two languages. Or, to adapt Lehtonen's (1977 : 34) expression, one must avoid "dependence on categories predetermined by traditional classification". Yet it seems that this is exactly the pitfall Moisio and Valento have tumbled over and when, contrary to their assuption, the stops of the two languages exhibit clear phonetic differences they are forced to state that "in production there may arise a difficulty, because *Finns tend to pronounce their fortis plosives too laxly and without aspiration*..." (1976 : 16, italics mine, KS). That the pronunctiation of Finnish follows its own regularities and is different from English pronunciation should not be regarded as a tendency to deviate from a norm (dictated here, it seems, by the IPA classification). The crucial (albeit unintentional) point of the above quotation, however, is that it lends further support to the present writer's contention that the distinction *fortis/lenis* (or *voiceless/voiced*) is completely vacuous in the *systematic* description of (the) Finnish (stops), both phonologically and phonetically, i.e., it cannot be used as a basis for establishing natural classes of sounds beyond the primary distinction between obstruents and sonorants (voicing, as a phonetic parameter, being primarily dependent on physiological/aerodynamic and coarticulatory effects (cf. section (0) above and Suomi 1976 : 73 - 74).

As a corollary of the postulated correspondence between Finnish /ptk/ and English /ptk/ in their contrastive analysis Moisio and Valento are forced to predict (1976 : 22 - 23) that, while English /ptk/ cause no great problems, it is the English stops /b/ and /g/ that are difficult for Finns to produce and to identify. Below is a graphic representation of their argumentation (as a slightly modified but factually true reconstruction of the relevant parts of their chart (1976 : 19) of the Finnish system complemented by a parallel description of

part of the English system, also according to Moisio and Valento's own interpretation):

Finnish:	
/p/	/k/
[b]	[g]

English:	
/p/	/k/
/b/	/g/

On the basis of such a chart it is indeed very tempting to conclude that Finnish /ptk/ correspond to English /ptk/. The descriptions of the two languages do not, however, observe the basic principles of contrastive analysis, i.e. they are not of an identical status: for English, only phonological information is given whereas the description of Finnish includes also allophonic information. I will return to the use of such graphic representations below; to conclude the present section it is sufficient to note that again the predictions of Moisio and Valento are invalidated by their own results: the percentage of correct identifications of English /bdg/ by Finnish subjects is considerably *higher* than that of English /ptk/, viz. 56, 76 and 74 per cent for /bdg/, respectively, against 27, 43 and 58 per cent for /ptk/, respectively (Moisio and Valento 1976 : 33).

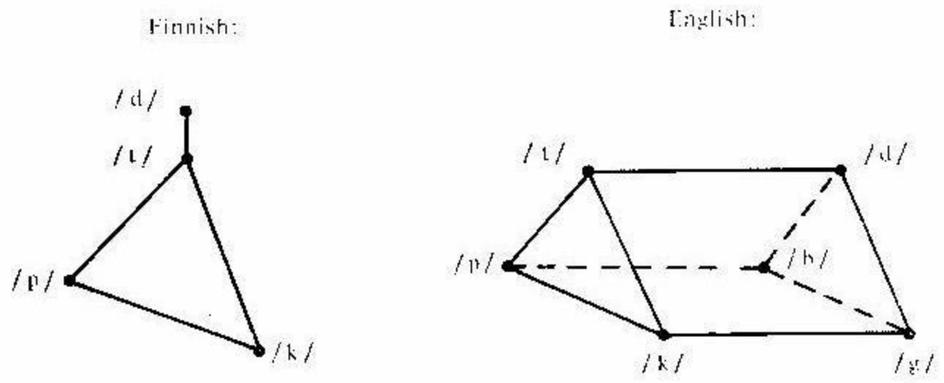
3

The third principle for stating equivalence between phonemes of different languages mentioned by Lehtonen is the use of phonological arguments. I will attempt to show in this section that substantively, i.e. phonetically motivated phonological considerations,[12] although unable to answer the question of equivalence positively, can at least help us to avoid the kind of false conclusions exemplified in the preceding section. The atomistic concept of the phoneme as an indivisible, abstract entity existing only through its distinctive oppositions to the other phonemes of the language, the basic tenet of taxonomic phonology, viz. the idea that each language is a system of its own right, describable only by the language-specific network of oppositions, the denial of a universal basis for the description of speech sounds and their interrelationships, all these are, of course, irreconcilable with the demand in contrastive analysis for parallel descriptions of the languages contrasted. Consequently, the idea of universal categories, of a "common platform", is inextricably inherent in contrastive analysis if it is to make sense. In accordance with this conviction, then, we must assume the existence of universal features that somehow reflect

[12] Thus extremely abstract, substance-independent theories of phonology like glossematic (see e.g. Hjelmslev 1943) are not considered here very useful for the purposes of contrastive analysis, for reasons that should become clear on the basis of the subsequent discussion.

our categorization of the phonic substance of speech. For the features to be universal they must be based on (or derived from) the general (or, more likely, speech-specific) cognitive capabilities of man as a speaking animal, using his vocal apparatus to produce the speech sounds. The more abstract phonological, classificatory (or "distinctive") features must, in accordance with the above considerations, be based on the universal, lower-level phonetic features. From a contrastive point of view, then, the situation is this: each language has at its disposal the same articulatory and perceptual possibilities, delimited by the species-specific anatomical, physiological and cognitive characteristics of man. In this perspective specific applied contrastive studies (cf. Fisiak 1973) of sound systems are faced with two obvious tasks: first, to find out the differences in the utilization of these potentials for functional[13] purposes in different languages, and second, to investigate the phonetic means by which the functional information is conveyed in these languages and the similarities and differences between them. It is a fragment of the first task that we are concerned with in the present section.

If the stop systems of Finnish and English are described in terms of classificatory features and notice is taken only of the minimal distinctions *within* the stop system in each language then the differences between the two systems can be visualized by the following graphic representations where each line corresponds to a distinction maintained by a difference in the specification of a single feature (/place of articulation/ being regarded as a single, multivalued feature in accordance with e.g. Ladefoged 1971 : 91ff.):

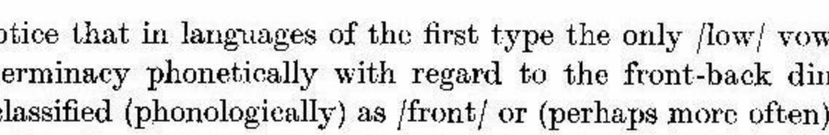


From the graphs it can be seen that Finnish /pk/ both participate in a two-way minimal opposition in the system, Finnish /t/ and /d/ taking part in a three-way and one-way minimal opposition, respectively. As regards English, each of the six stops stands in a three-way minimal opposition within the system. Now, disregarding Finnish /d/ for a moment, it can be seen that similar interrelationships exist within the sets Finnish /ptk/, English /ptk/ and English /bdg/ with regard to the feature /place of articulation/. As for the distinction represented by the horizontal lines it can be seen that it only exists in the English system. Now it is one of the major claims of this paper that there are no purely formal criteria that would enable one to equate the Finnish set with either one of the English sets as there are no such features as are shared by the Finnish set and only *one* but not the other of the English sets, the horizontally represented dimension being vacuous in Finnish. Rather, we would have to conclude that both of the English sets *together* correspond to the Finnish one. This conclusion prevents us from making the kind of wrong predictions discussed in the preceding section (i.e. from equating Finnish /ptk/ with English /ptk/, an equation clearly inconsistent with empirical data) but, as was anticipated at the beginning of the present section, it fails to give a positive answer to the problem of equivalence. For we cannot be content with a laconic statement that Finnish /ptk/ are equivalent to as it were the sum total of English /ptk/ and /bdg/ as it is precisely the difficulty of Finns to differentiate between the two English sets that gives contrastive analyses of this kind a practical motivation in addition to the more theoretical ones. The interim conclusion gives us no hint whatsoever, for example, as to how a speaker of Finnish should alter his native habits of stop articulation to arrive at acceptable pronunciations of the English ones.

There is one further step, however, that might conceivably be taken towards a solution of the problem without resorting to the methods of empirical, experimental phonetics, namely the recognition and use of certain well-known general phonetic tendencies (the knowledge of which ultimately derives from the accumulation of data from direct observation). To illustrate the point it is sufficient here to refer to one such principle, viz. the tendency observable in languages to avoid making use of extreme articulatory configurations in the absence of a phonological motivation (or, the principle of least effort). Given that a maximally voiced stop and a maximally aspirated stop represent the two extremes on the voicing continuum (see e.g. Suomi 1976 : 65 - 68), the first tendency would predict that the stops of a language like Finnish would tend to be situated somewhere in between the two extremes. A direct parallel is offered by the dimension /front/-/back/ in /low/ vowels: in languages with a single /low/ vowel its phonetic realizations are usually more or less indeterminate with regard to the articulatory dimension front-back (e.g. German, Italian, Polish, Russian) whereas in languages with two /low/ vowels the distinction is (of course) maintained also phonetically, the vowels having distinct front and back articulations (e.g. English, Finnish and Swe-

[13] The word "functional" could be given different scopes; in this paper it is interpreted to refer to the (phonologically) distinctive function.

dish). Notice that in languages of the first type the only /low/ vowel, despite its indeterminacy phonetically with regard to the front-back dimension, is usually classified (phonologically) as /front/ or (perhaps more often) as /back/. Analogically, then, we would predict that the two sets of English stops are situated, with respect to the voicing dimension, towards the voiceless and voiced extremes, respectively, away from the "neutral" position predicted for the Finnish stops. Or, to return to the graphic representation above, it could be assumed that the non-horizontal lines delimit the articulatory possibilities exploited in the two languages with regard to the place of production of stops and that the horizontal dimension reflects the scope of variation along the voicing dimension. The space delimited by the faces of the three-dimensional body could then be argued to encompass all the possible stop realizations in the two languages. Now the fact that each English stop stands in a three-way opposition to the others causes the stop realizations to tend to be located towards the corners of the body as both horizontal and non-horizontal distinctions must be maintained. In Finnish, on the other hand, the horizontal dimension being vacuous, there are no formal criteria that would help us predict anything about the location of the realizations of the Finnish stops on the horizontal dimension. To push the point even further, we could concentrate our whole attention on the core of the problem and depict the situation (disregarding the both theoretically and pedagogically non-problematic /place of production/ aspect) in the following way:



In this graph the horizontal line *in toto* reflects the potentials available (at least in principle) in both languages with regard to differentiation on the voicing continuum, the vertical line indicating its division for distinctive purposes (in English). Again, even such an utterly simplified description would prevent us from equating Finnish /ptk/ with English /ptk/. The (non-formally, i.e. substantively motivated) tendency just discussed, however, predicts that the Finnish stops tend to be scattered approximately half-way between the two extremes on the horizontal dimension. But here, again, we would be confronted by the same dilemma as before: we could not decide which of the two English sets of stops are equivalent to the Finnish one. And, to see the problem in its entirety, consider the fact that the /voiced/-/voiceless/ distinction is signalled by a wide variety of phonetic mechanisms in different languages. In Mandarin Chinese, for example, the /voiceless/ set is signalled by extensive aspiration, while the /voiced/ set is in fact usually phonetically

voiceless.[11] In a language like Polish, on the other hand, the former are realized as voiceless non-aspirates and the latter as extensively voiced stops, the two sets occupying positions on the voicing dimension clearly different from those of the English sets (for experimental data see e.g. Kopczyński 1977 : : 72 - 76). Thus different languages occupy different positions on the voicing continuum, obeying at the same time the principle of minimal effort to produce sufficient (but not maximal) separation of the two categories (cf. Suomi 1976 : 70 - 72).

It seems that we cannot proceed further in our analysis without resorting to an experimental phonetic analysis of the processes of production and perception in the two languages because otherwise, and this is the basic problem of contrastive analyses of sound systems performed in an arm-chair, we are always, at most, left with just predictions.

4

The last principle for stating equivalence of phonemes in different languages mentioned by Lehtonen is perceptual similarity.[15] In other words, to (in) validate our hypotheses we "must go to the very outskirts of linguistic processing, to the mechanism which is used by the speaker to transform the linguistic information of the phonological segment string into the actual speech signal, and to the mechanism which is used by the listener to detect the corresponding phonological information" (Lehtonen 1977 : 35). An attempt in such a direction was the present writer's analysis of the production of English stops by native and Finnish speakers (Suomi 1976). The results of the study, although preliminary and planned to be followed by a more detailed investigation of the articulatory and acoustic phenomena involved, indicate, among other things, the inability of the kind of contrastive analysis sketched in the preceding sections to predict many interesting and important characteristics of the interlanguage employed by a language learner. Thus, for example, it was found that advanced native Finnish learners of English exhibited extensive voicing of English /bdg/ irrespective of their position in the word, in contradistinction to the less advanced learners who, under the influence of interference from the mother tongue, showed only moderate (and more random) voicing, and, what is more important, also in contradistinction to the

[14] The present situation being an outcome of earlier interplay between tonal and /voice/ features.

[15] The term "perceptual similarity" might be interpreted (although this does not seem to be Lehtonen's intention) to exclude studies of speech perception in favour of perceptual studies proper; to avoid this connotation the simple term "phonetic similarity" could be adopted.

native speakers who, conforming to the allophonic regularities of English, exhibited only moderate or no voicing in the word initial and final positions while having fully voiced stops only in the word medial position (for details see Suomi 1976 : 17 - 48).[16] Needless to say, these differences between the behaviour of the Finnish groups could not have been predicted *a priori*. An even more striking indication of the necessity of empirical validation is the fact that confusions in the perception of English by Finnish speakers occur not only between the stops (i.e. not only *within* the category /pbtdkg/) but also e.g., between stops and consonant clusters. Thus, for example, Finns often confuse English /t/ and /tr/, especially in a pre-stress position (as in the words *tie* and *try*) (Lehtonen, personal communication. The data come from a thesis study by R. Hänninen, to be published in Jyväskylä Contrastive Studies no 6.). The ability to predict such patterns of interference are far beoynd the scope of a contrastive analysis based on phonological considerations only, and, moreover, they are easily overlooked even in empirical investigations if, for example, the subjects in an identification test are given a choice of possible answers predetermined, very often, by the intuitions of the researcher.

It may well turn out that the special problem discussed in this paper, the question whether Finnish /ptk/ are equivalent[17] to English /ptk/ or English /bdg/, remains unsettled even after the application of the fourth criteria. The results of Moisio and Valento (1976) and Suomi (1976), although perhaps showing a weak tendency in favour of English /bdg/, certainly do not justify us to give an unequivocal answer in one direction or the other. It is possible, in other words, that we have to be content with the answer arrived at in section (*d*) above, viz. that Finnish /ptk/ are equivalent to *both* English /ptk/ *and* English /bdg/. In this future situation, however, having performed detailed investigations of the phonetics of the stops of the two languages, we are on a much firmer ground than before as we then have empirical data to support our contentions. This deepened knowledge can also be expected to serve as a basis for constructing better pedagogical techniques for Finnish learners of English.

To sum up, the main theses of this paper are: first, that phonology, to be useful for the purposes of contrastive analysis, must be phonetically based and not too abstract, and second, that the validity of the predictions arrived at

[16] The behaviour of the more advanced Finnish learners of English can be interpreted as an instance of overgeneralization of a TL rule.

[17] The reader may have noticed the rather free use of wordings like "correspond to", "are equal to", "are comparable" etc. in the earlier parts of this paper. These are the terms used in the studies quoted, and no need was felt to introduce the more technical term "equivalence" until an attempt had been made to elaborate its meaning more precisely.

a priori must be checked against empirical data about the actual speech behaviour in an actual language contact, e.g. in the speech of bilingual speakers (for similar demands for objective testing of contrastive analysis hypotheses see Dimitrijević 1977). What is propounded here is in fact an amalgam of traditional contrastive analysis and error analysis.

What are the ultimate criteria of equivalence of phonemes? On the one hand, they can be said to be extralinguistic insofar as they are referable to the universal anatomical properties of the speech producing apparatus. On the other hand, it is evident that some kind of categorization takes place in speech perception. It is very difficult and may even turn out to be impossible to assess whether the perceptual features used as a basis for this categorization are linguistic or not: due to the constant interplay between and mutual interdependency of form and substance in the evolution of language as a means of communication the linguistic and non-linguistic aspects of speech perception are inextricably interwoven (for a somewhat different view of the nature of the features see Lehtonen 1977 : 36 - 37). Phonetics is a branch of linguistics studying the one end where language (as a system of rule-governed behaviour) is in contact with the objective world, connecting linguistic entities with physical phenomena, both physiological and acoustic (which again are clearly non-linguistic in nature). Consider a parallel, by now well-agreed-upon case from the opposite end of the language system: code-particular, system-internal (structural) criteria cannot be used for stating equivalence between utterances in different languages. The *tertium comparationis*, the universal frame of reference must be sought from outside the particular codes of the languages compared, from semantics, the other point of direct contact between language and the objective world (although here, too, it is difficult to draw a sharp demarcation line between linguistic and extralinguistic features used by us to categorize the world, consider e.g. the Whorf hypothesis). Thus, given the fact that languages are different codes capable of expressing the same contents by using the same channel, we cannot expect to find equivalence in the codes themselves but from the two "sames" connected by the codes.

Finally, I should like to stress the fact that the kind of contrastive analysis of sound systems outlined above is not a new idea: for an early example of an analysis on similar lines see the comparison of Finnish and English vowels by Wiik (1965).

REFERENCES

Alanne, V. S. 1968. *Finnish-English general dictionary*. Helsinki: WSOY.

Alhoniemi, A. (ed.). 1978. *Rakenteita. Juhlakirja Osmo Ikolan 60-vuotispäiväksi 6.2. 1978*. Turku: Departemnt of Finnish and General Linguistics of the University of Turku.

Berg, Jw. van den. 1968. "Mechanism of the larynx and the laryngeal vibrations". In Malmberg, B. (ed.). 1968. 278 - 308.
Chomsky, N. and Halle, H. 1968. *The sound pattern of English*. New York: Harper and Row.
Dimitrijević, N. R. 1977. "Testing and contrastive analysis". *PSiCL 7*. 121 - 131.
Fisiak, J. 1973. "The Polish-English Contrastive Project". *PSiCL 1*. 7 - 13.
Hakulinen, L. 1968³. *Suomen kielen rakenne ja kehitys*. Helsinki: Otava.
Hjelmslev, L. 1943. "Omkring sprogteoriens grundlaeggelse". *Festskrift udgivet at Kobenhavns Universitet i anledning af Universitetets Aarsfest, November 1942*. Copenhagen: University of Copenhagen. 3 - 113.
Karlsson, F. 1969. "Suomen yleiskielen segentaalifoneemien paradigma". *Virittäjä 73*. 351 - 362.
Karlsson, F. 1971. *Finskans rotmorfemstruktur: en generaitv besrivning*. Publications of the Phonetics Department of the University of Turku 10. Turku: Department of Phonetics.
Kopczyński, A. 1977. *Polish and American English phonemes. A contrastive study*. Warsaw: Państwowe Wydawnictwo Naukowo.
Ladefoged, P. 1971. *Preliminaries to linguistic phonetics*. Chicago and London: The University of Chicago Press.
Lehtonen, J. 1970. *Aspects of quantity in standard Finnish*. Studia Philologica Jyväskyäensia 6. Jyväskylä: University of Jyväskylä.
Lehtonen, J. 1977. "Contrastive phonetics and the analysis of speech communication". *JyOS 4*. 31 - 44.
Malmberg, B. (ed.). 1968. *Manual of phonetics*. Amsterdam: North-Holland.
Moisio, R. and Valento, E. 1976. *Testing Finnish schoolchildren's learning of English consonants*. JyCS 3. Jyväskylä: Department of English.
Sovijärvi, A. 1963. *Suomen kielen äännekuvasto*. Jyväskylä: Gummerus.
Suomi, K. 1976. *English voiceless and voiced stops as produced by native and Finnish speakers*. JyCS 2. Jyväskylä: Department of English.
Suomi, K. 1978. "Onko suomen kielessä p/b ja k/g-oppositio?". In Alhoniemi, A. (ed.). 1978. 66 - 74.
Wiik, K. 1965. *Finnish and English vowels*. Annales Universitatis Turkuensis B: 94. Turku: University of Turku.