Verbal Grammar Correlation Index (VGCI) method: a detailed description

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Abstract

Current paper is detailed description of Verbal Grammar Correlation Index that is a precise typological method of comparative linguistics. The method is intended to direct comparison of really existing/existed languages. The method is based on the following: language is determined by set of grammatical meanings and set of their positional distributions; degrees of correlations of both sets can be calculated. Tests of the method on the material of firmly assembled stocks (Indo-European; Sino-Tibetan; Austronesian) show the following: if value of VGCI is about 0.4 or more then languages are related; if value of VGCI is about 0.3 or less then languages are not related.

Key words: typology in comparative linguistics; Verbal Grammar Correlation Index; comparative linguistics

1. Verbal Grammar Correlation Index (VGCI) method background

As far as language is structure/grammar but not a heap of lexemes so conclusions about genetic relatedness of certain languages should be based on comparison of grammars.

Grammar is first of all positional distributions of grammatical means, i.e.: ordered pair of the following view: \(<A; \Omega>\) where \(A\) is set of grammatical meanings and \(\Omega\) is set of operations defined on \(A\) or positional distributions.

In order to understand whether two languages are genetically related we should analyze the degree of correlation of grammatical meanings sets and to estimate proximity of positional distributions of common grammatical meanings (i.e.: without any comparison of material implementations).

It is supposed that through comparison of grammatical meanings sets and positional distributions we can completely answer the question whether two randomly chosen languages are related and also can see the degree of relatedness.

2. Why the method is about verb?

Why it is possible to conclude about languages relatedness/unrelatedness\(^1\) considering only verbal grammar? Because there are many languages that have poor grammar of noun (or have almost no grammar of noun) while there is no language without verbal grammar, i.e.: there are languages which have no cases and genders (even language that are very close relatives can differ seriously in that case, for instance, English and German or Russian and Bulgarian), but

\(^{1}\) Possibility of proving of unrelatedness is proved in Akulov 2015b.
there are no languages without modalities, moods, tenses and aspects that’s why verb is backbone of any grammar and backbone of comparative method.

3. General scheme of VGCI calculation

As it has been said in (1) to estimate grammar correlation should be done the following:

1) Estimation of correlation of grammar meanings sets: first should be found intersection of two sets of grammatical meanings (those grammatical meanings that are represented in both sets), then should be found intersection ratio to each set and then should be taken arithmetical mean of both ratios; this is index of sets of grammatical meanings correlation.

I am specially to note that there is no need to have universal set (so called U) to compare two sets of grammatical meanings.

If we would have a U set of all possible grammatical meanings then we also finally have to compare prints of original sets and as far as original sets are different so prints also are different and so the problem remains the same, but as far as prints obviously are larger than original sets so we will have to spend much more efforts: anyone can take a look at the picture below (pic. 8) and imagine than we have to compare not ‘circles’ A and B but the spaces that are beside A and beside B, i.e.: ¬A and ¬B, that would be result of introduction of U upon current phase.

Pic. 1. Venn diagrams of intersected sets A and B and a universal set U.

There are two ways to estimate correlation of sets of grammatical meanings:

a) To estimate correlation of elementary meaning. Elementary meanings are those grammar meanings that can’t be decomposed into constituent parts, for instance: 1p.sg.sb. isn’t elementary meaning since it can be decomposed into the following meanings: first person, singular number and subject which are elementary meanings since they can’t be decomposed.

b) Stable clusters correlation.
At first sight way of elementary meanings seems to be more perspective and preferable since if we are going to compare languages that are supposed to be very distant relatives, i.e.: it would be difficult to estimate grammars correlation by comparison of their stable grammatical clusters as far as those clusters can differ seriously even in languages that aren’t distant relatives.

However, I am going to use a hybrid system, i.e.: use stable clusters comparing tense – aspect and modality – mood meanings and use more elementary meanings comparing such items as agent/patient/subject/number. Actually the system is very flexible and certain parameters can be more detailed if there is a particular need (if certain system is introduced it should not be modified within one consideration).

2) Just sets of meaning obviously don’t describe grammatical systems as far as positional distributions are of no less importance. That’s why estimation of correlation of positional distributions of common grammatical meanings is second step. Having got intersection of two sets of grammatical meanings we should estimate degree of positional correlation of meanings that belong to intersection.

3) In order to calculate values of VGCI we should take logical conjunction of degree of grammatical meanings correlation and degree of correlation of positional distributions of common grammatical meanings i.e.: VGCI is multiplication of two indexes.

4) It is rather obvious that languages which are closer genetically related demonstrate higher values of VGCI (as far as they have more alike sets of grammatical meanings, so intersection ratio to each set of grammatical meanings is higher, and due to the fact that common grammatical meanings are distributed in more alike positions) while languages that are distant relatives will demonstrate lower values of VGCI and those that are not related (i.e.: that belong to different stocks) will demonstrates much lower values of VGCI.

5) As a consequence of previous point it is supposed that there are some threshold values of VGCI that determine border of stocks, i.e.: if certain particular value is lower than threshold value then language evidently doesn’t belong to the stock. In order to see what values of VGCI show distant relatives I am going to compare distantly related languages of firmly assembled stocks (Indo-European; Sino-Tibetan; Austronesian); and also I am going to calculate VGCI of some evidently unrelated languages.

6) As far as there are many so called isolated languages so the method is intended to make direct comparison of languages that exist/existed in reality and which potentially are distant relatives, i.e.: it doesn’t suppose gradual comparison and use of any reconstructions that often are much alike constructed languages since they in many cases are determined by views of particular authors only and can’t be verified anyhow.

7) Also I am to note that the method doesn’t pay any attention to material exponents at all, i.e.: the method supposes comparison of meanings and their positional distributions only. It isn’t a response to radical megalocomapartivists who harshly ignore typological issues, but it just a matter of reality and practice since material correlation (regular phonetic correspondence) between languages that are distant relatives can be very complicated matter so the method is intended to prove genetic relationship/unrelatedness by pure typology.

4. VGCI illustration and searching for threshold values
In order to illustrate and test the method of VGCI I am going to compare some languages of undoubtedly established stocks.

Obviously I am especially interested in comparison of distant relatives since the aim of the testing is to find some threshold value of VGCI.

4.1. English and Russian

First of all we need to take the list of grammar meanings of both compared languages (in current case of English and Russian).

A principal note is that in current consideration I pay attention mostly to so called contensive grammatical meanings, but not to agreemental meanings, i.e.: not to, for instance, markers of transitivity but to such items as: markers of tenses, aspects, modalities and so on, i.e: to those grammar categories that have certain content that can be expressed by lexical means. (Actually if there is a need technical meanings also can become object of consideration.)

As far as it can be rather complicated task to distinguish obligatory features of certain verb from facultative so first of all attention should be paid to the following categories:

a) tenses and aspects;
b) mood and modalities;
c) voices;
d) agent, patient, object, subject, numbers.

Also there can be certain specific categories like, for instance: evidences (a kind of modality), or spatial orientation/versions (can be considered as a development of triggers system), so good descriptions of compared languages are matter of high importance (but sometimes same items can be described differently in different descriptions).

4.1.1. List of English forms

List of English forms has been compiled after (Barhkhudarov et al. 2000).

1. Active voice: zero marker
2. Agent: prp-/[prp-] + 6 -sfx²
3. Causative: prp-
4. Conditional mood: prp-
7. Future continuous: prp + prp + -sfx
8. Future perfect: prp- + prp- + inner fusion/prp- + prp+ -sfx
10. Future simple: prp-
11. Hortative: prp-
12. Imperative: R
13. Impossibility: prp-

² In such way of recording only syntagmatically different elements are taken into account so while elements that belong to the same paradigm are generally considered as variants of the same element: for instance prepositional way of expression of agent in English supposes an endless set of elements (personal pronouns, names, nouns) but from syntagmatic point of view they all are just realization of the same item.
4.1.2. List of Russian forms

List of Russian forms has been compiled after (Wade 2011).

1. Active voice: zero marker
2. Agent: [prp] +6 -sfx
3. Attemptive aspect/mood: prfx-
4. Causative: prp-
5. Deontic: prp-1/prp-2/prp-3
7. Feminine gender: -sfx
8. Future perfect: prfx-1 + 6 -sfx / prfx-2 + 6 -sfx / prfx-3 + 6 -sfx/prfx-4 + 6 -sfx /prfx-5 + 6 -sfx / prfx-6 +6 -sfx /prfx-7 +6 -sfx / prfx-8 +6 -sfx
9. Future simple: prp- + -sfx/prfx- +6 -sfx
10. Indicative: zero marker
11. Imperative1: -sfx1 / -sfx2 / -sfx3 / inner fusion + -sfx1
12. Imperative2: -sfx1 + -sfx/-sfx2 + -sfx/inner fusion + sfx1 + -sfx
13. Impossibility1 prp-
14. Impossibility2 prp-
15. Indicative mood: zero marker
16. Interrogative: prp-
17. Masculine gender: -sfx (zero suffix)
18. Negation: prp-
19. Neutral gender: -sfx
20. Passive voice: prp- + -sfx
22. Past perfect: prfx-1 + -sfx / prfx-2 + -sfx / prfx-3 + -sfx / prfx-4 + -sfx / prfx-5 + -sfx / prfx-6 + -sfx /prfx-7 + -sfx / prfx-8 + 6 -sfx / prfx-1 + suppletivism + -sfx / prfx-2 + suppletivism + -sfx / prfx-3 + suppletivism + -sfx / prfx-4 + suppletivism + -sfx / prfx-5 +
You can see that each grammatical meaning is followed by certain schemes of letters and signs. These are notations representing general schemes of positional implementation of certain grammatical meaning.

Notations of positional implementations are the following: prp- – preposition; prfx- – prefix; -infx- – infix; crfx- – circumfix; crp- – circumposition; -RR- – reduplication; inner fusion – any irregular changes inside the root; suppletivism; R – root; -sfx – suffix; -pp – post position.

If there are some different forms of same position (i.e. forms used in different contexts) they are numbered the following way: prp1/prp2/prp3 – and distinguished by slash; positional elements that are components of the same implementation are expressed in the following way: prp- + -sfx.

If certain positional element can optionally be omitted and isn’t obligatory then it is written in square brackets: [prp-].

4.1.3. Grammatical meanings intersection of English and Russian

1. Active voice
2. Agent
3. Causative
4. Deontic
5. Desiderative
6. Future perfect
7. Future simple
8. Imperative
9. Impossibility
10. Indicative
11. Interrogative
12. Negation
13. Passive voice
14. Past simple
In the case of English and Russian we haven’t met any serious problems with correlation of grammar meanings since both languages actually have rather alike grammatical systems, however, sometimes it can be rather complicated.

We have 24 common meanings (or relatively common, anyway we have to suppose some drift and backlash of meanings) so index of correlation of sets of grammatical meanings is the following:

\[
\frac{(24/33 + 24/33)}{2} = \frac{0.73 + 0.73}{2} = 0.73.
\]

Then we should estimate degree of correlation of positional implementation of these common grammatical meanings. Schemes of positional implementation will help us to do it: we take the schemes that have been drawn above and completely formally compare the set of positional schemes of each meanings; if there is no difference (positional schemes are the same or very close, for instance: prp- and prfx- is the same full correlation as prp- and prp-) then this point is counted as 1; if there is completely no correlation (for instance prp- and -pp) then we count it as 0, in other cases we estimate degree of correlation.

### 4.1.4. Estimation of positional correlation of grammatical meanings intersection of English and Russian

System of recording is the following: first is name of a grammatical meaning that is common for both of compared languages (or meanings that are correlated), then is abbreviation of name of the first of compared languages, then first language schemes of expressions of this grammatical meaning, then sign of correlation “~” or anti-correlation “≠”, then abbreviation of the name of second language, then second language ways of expressions of the grammatical meaning and then number that expresses degree of correlation. If certain meaning can be expressed by some ways in such case schemes representing these ways are separated by slash; if there are some similar items expressing the same meaning, for instance, some prepositions, then they are marked by lower index numbers.

1. Active voice: En: zero marker ~ Rs: zero marker 1
2. Agent: En: prp- / [prp-] +6 -sfx ~ Rs: [prp-] +6 -sfx 0.75
3. Causative: En prp- ~ Rs: prp- 1
5. Desiderative: En: prp-1/prp-2 ~ Rs: prp-1/prp-2 1
6. Future perfect: in En: prp- + prp- + -sfx/ prp- + prp- + inner fusion ≠ Rs: prfx-1 + 6 -sfx / prfx-2 + 6 -sfx / prfx-3 + 6 -sfx / prfx-4 + 6 -sfx / prfx-5 + 6 -sfx / prfx-6 + 6 -sfx / prfx-7 + 6 -sfx / prfx-8 +6 -sfx; so the intersection is 0.
7. Future simple: En: prp- ~ Rs: prp- + -sfx/prfx- +6 -sfx 0
   -sfx2 + -sfx/inner fusion + -sfx1 + -sfx 0
9. Impossibility: En: prp- ~ Rs: prp1/prp2+0.75
10. Indicative: En: zero marker ~ Rs: zero marker l
11. Interrogative: En: prp- ~ Rs: prp- 1
12. Negation: En: prp- ~ Rs: prp- 1
13. Passive voice: En: prp- + -sfx/prp- + inner fusion ~ Rs: prp- + -sfx 0.75
   (1/3 +1/2) /2 ≈ 0.41
15. Past perfect: En: prp + -sfx / prp + inner fusion while in Russian by the following:
   prfx-1 + -sfx / prfx-2 + -sfx / prfx-3 + -sfx / prfx-4 + -sfx / prfx-5 + -sfx / prfx-6 + -sfx
   prfx-7 + suppletivism + -sfx / prfx-8 + suppletivism + -sfx / prfx-9 + suppletivism + -sfx / prfx-10 + suppletivism + -sfx /
   prfx-11 + suppletivism + -sfx / prfx-12 + suppletivism + -sfx / prfx-13 + suppletivism + -sfx /
   prfx-14 + suppletivism + -sfx / prfx-15 + suppletivism + -sfx / prfx-16 + suppletivism + -sfx /
   prfx-17 + suppletivism + -sfx / prfx-18 + suppletivism + -sfx /
   prfx-19 + suppletivism + -sfx /
16. Patient: En: -pp ~ Rs: -pp 1
17. Plural number: En: prp-.[prp-] +3 -sfx; Rs: [prp-] +3 -sfx 0.75
18. Potential modality: En: prp- ~ Rs: prp- 1
19. Present perfect: E: prp + -sfx / prp + inner fusion ~ Rs:
   prfx-1 + -sfx / prfx-2 + -sfx / prfx-3 + -sfx / prfx-4 + -sfx /
   prfx-5 + -sfx / prfx-6 + -sfx / prfx-7 + -sfx / prfx-8 + -sfx
   prfx-9 + suppletivism + -sfx / prfx-10 + suppletivism + -sfx / prfx-11 + suppletivism + -sfx /
   prfx-12 + suppletivism + -sfx / prfx-13 + suppletivism + -sfx /
   prfx-14 + suppletivism + -sfx /
20. Present simple: in En: 6 -sfx ~ Rs 6 -sfx/ inner fusion + 6 -sfx 0.75
21. Prohibitive: En: prp1/prp2 ~ Rs: prp1/prp2 1
22. Singular number: En: prp-.[prp-] +3 -sfx ~ Rs: [prp-] +3 -sfx 0.75
23. Subject: En: prp-.[prp-] +6 -sfx ~ Rs: it is expressed as: [prp-] + 6 -sfx 0.75.
24. Subjunctive mood: En: prp- ~ Rs: prp- 1

Thus we have got the following indexes of positional correlation for each meaning of intersection:

1. Active voice: 1
2. Agent: 0.75
3. Causative: 1
4. Deontic: 0.87
5. Desiderative: 1
6. Future perfect: 0
7. Future simple: 0
8. Imperative: 0
9. Impossibility: 0.75
10. Indicative: 1
11. Interrogative 1
12. Negation: 1
13. Passive voice: 0.75
14. Past simple: 0.41
15. Past perfect: 0.28
16. Patient: 1
In order to get general index of positional correlation we have to take sum of all these indexes and then take their arithmetical mean:

\[(10 + 0.87 + 7 \times 0.75 + 0.41 + 2 \times 0.28) / 24 \approx 0.71.\]

### 4.1.5 VGCI of English and Russian

And finally we should multiply index of positional correlation of common meanings by index of meanings correlations since we want to know in what degree sets of meanings are correlated and in what degree intersection of sets of meaning is positionally correlated, i.e.: we need both indexes do intersection or conjunction, so we do the following: 0.71 * 0.73 ≈ 0.52.

### 4.2. English and Lithuanian

List of English forms can be seen in (4.1.1).

#### 4.2.1. List of Lithuanian forms

List of Lithuanian forms has been compiled after (Ambrazas et al. 2001).

1. Active voice: zero marker
2. Agent: [prp-] + 6 -sfx
3. Deontic: prp-
4. Desiderative: prp-
5. Female gender: -sfx
6. Future continuous: prp + prfx- + -sfx
7. Future perfect: prp- + -sfx
8. Future simple: -sfx
9. General tense: -sfx (zero suffix)
10. Hortative: inner fusion
11. Imperative: R/ prfx- + -sfx
12. Indicative: zero marker
13. Male gender: - sfx
14. Negation: prfx-
15. Oblique: -sfx/ prp- + -sfx
16. Passive: prp- + -sfx/ prp- + prfx- + -sfx
17. Past continuous: prp- + prfx + -sfx
18. Past contiguous frequentative: prp- + prfx- + -sfx
19. Past iterative: -sfx
20. Past perfect: prp + -sfx
21. Past perfect frequentative: prp- + -sfx
22. Past simple: -sfx
23. Patient: -pp
24. Plural number: [prp-] + 3 -sfx
25. Present perfect: prp + -sfx
26. Reflexivity: prfx/-sfx
27. Singular number: [prp-] + 3 -sfx
28. Subject: [prp-] + 6 -sfx
29. Subjunctive: -sfx/ prp+ -sfx

4.2.2. English^Lithuanian

“^” is sign of VGCI operation.

1. Active voice: E: zero marker ~ Li: zero marker 1
2. Agent: E: prp-[prp-] + 6 -sfx ~ Li: [prp-] + 6 -sfx 0.75
3. Causative: E: prp- ≠ Li: -sfx 0
4. Deontic: E: prp-/prp-2/prp-3/prp-4 ~ Li: prp- 0.62
5. Desiderative: E: prp-/prp-2 ~ Li: prp- 0.75
6. Future continuous: E: prp + prp + -sfx ~ Li: prp + prfx- + -sfx 1
7. Future prefect: prp- + prp- + inner fusion/ prp- + prp+ -sfx ≠ Li: prp- + -sfx 0
8. Future simple: E: prp ≠ Li: -sfx 0
9. Hortative: E: prp- ≠ Li: inner fusion 0
10. Imperative: E: R ~ Li: R/ prfx- + -sfx 0.75
11. Indicative: E: zero marker ~ Li: zero marker 1
12. Negation: E: prp- ~ Li: prfx- 1
13. Passive: E: prp- + -sfx/prp- + inner fusion ~ Li: prp- + -sfx/ prp- + prfx- + -sfx 0.5
14. Past continuous: E: prp + -sfx ~ Li: prp- + prfx + -sfx 0
15. Past perfect: E: prp + -sfx / prp + inner fusion ~ Li: prp + -sfx 0.75
16. Past simple: E: inner fusion/suppletivism/-sfx ~ Li: -sfx 0.66
17. Patient: E: -pp ~ Li: -pp 1
18. Plural number: E: prp-[prp-] + 3 -sfx ~ Li: [prp-] + 3 -sfx 0.75
19. Present perfect: E: prp + sfx/ prp + inner fusion ~ Li: prp + -sfx 0.75
20. Present simple ~ General tense: E: R + -sfx ≠ Li -sfx 0
21. Singular number: E: prp-/ [prp-] + 3 -sfx ~ Li: [prp-] + 3 -sfx 0.75
22. Subject: E: prp-/ [prp-] + 6 -sfx ~ Li: [prp-] + 6 -sfx 0.75
23. Subjunctive mood: E: prp- ~ Li: -sfx/ prp- + -sfx 0

\[(23/29 + 23/33)/2*(5 + 8*0.75 + 0.66 + 0.62 + 0.5)/23 \approx 0.41\]

4.3. English and Latin

List of English forms can be seen in (4.1.1).

4.3.1. List of Latin forms

List of Latin forms has been compiled after (Bennet 1913).

1. Active voice: zero marker
2. Agent: [prp-] + 6 suffixes
3. Deontic modality: prp-
4. Desiderative: prp-
5. Future perfect: -sfx
6. Future simple: -sfx
7. Hortative: inner fusion
8. Imperative: -sfx
9. Indicative: zero marker
10. Negation: prp-
11. Passive: -sfx/ -sfx + -pp
12. Past simple: -sfx
13. Patient: prp/-pp
14. Pluperfect: -sfx
15. Plural number: [prp-] + 3 suffixies
16. Potential: prp-
17. Present indefinite: -sfx
18. Present perfect: -sfx
19. Prohibitive: prp-
20. Singular number: [prp-] + 3 -sfx
21. Subject: [prp-] + 6 -sfx
22. Subjunctive/Conditional: -sfx

4.3.2. English^Latin

1. Active voice: E: zero marker ~ L: zero marker 1
2. Agent: E prp- / [prp-] + 6 -sfx ~ L: [prp-] + 6 -sfx 0.75
3. Deontic: E: prp-1/prp-2/prp-3/prp-4 ~ L: prp- (1+1/4)/2 ≈ 0.62
4. Desiderative: E: prp1/prp2 ~ L: prp- 0.75
5. Future perfect: E: prp- + prp- + -sfx / prp- + prp- + inner fusion ≠ L: -sfx 0
6. Future simple: E: prp- ≠ L: -sfx 0
7. Hortative: E: prp- ≠ L: inner fusion 0
8. Imperative: E: R ≠ L:-sfx 0
9. Indicative: E: zero marker ~ L: zero marker 1
10. Negation: E: prp ~ L: prp- 1
12. Past perfect ~ Pluperfect: E: prp + -sfx / prp + inner fusion ≠ L: -sfx 0
13. Past simple: E: inner fusion/suppletivism/-sfx ~ -sfx 0.66
14. Patient: E: -pp ~ L: prp-/-pp 0.75
15. Plural number: E: prp-/ [prp-] + 3 -sfx ~ L: [prp-] + 3 -sfx 0.75
16. Possibility ~ Potential: E: prp ~ L: prp- 1
17. Present perfect: E: prp- + sfx/ prp + inner fusion ≠ L: -sfx 0
18. Present simple: E: R + -sfx ≠ L: -sfx 0
19. Prohibitive: E: prp-1/prp-2 ~ L: prp- 0.75
20. Singular number: E: prp-/[prp-] + 3 -sfx ~ L: [prp-] + 3 -sfx 0.75
21. Subject: E: prp- / [prp-] + -sfx ~ L: [prp-] + 6 -sfx 0.75
22. Subjunctive: E: prp- ≠ L: -sfx 0

(22/22 + 22/33)/2*(4 + 7*0.75 + 0.62 + 0.66)/21 ≈ 0.4

4.4. English and Persian

List of English forms can be seen in (4.1.1).

4.4.1. List of Persian forms

List of Persian forms has been compiled after (Rubinchik 2001).

1. Active voice: zero marker
2. Agent: [prp-] + 6 -sfx
3. Aorist: [prfx-] + inner fusion
4. Causative: -sfx + -pp
5. Deontic: prp-
6. Desiderative: prp-
7. Future perfect: prfx- + inner fusion
8. Imperative: [prfx-] + inner fusion+ -sfx
9. Indicative: zero marker
10. Negation: prfx-
11. Optative: prfx- /-sfx + -pp
12. Passive voice: -sfx + -pp
13. Past concretive: prp- + prfx-
14. Past continuous: prfx-
15. Past perfect: -sfx + -pp
16. Past simple: R-
17. Patient: -pp
18. Plural number: [prp-] + 3 -sfx
19. Possibility: prp-
20. Present concretive: prp- + prfx- + inner fusion
21. Present-future tense: prfx- + inner fusion
22. Present perfect: -sfx + -pp
23. Singular number: [prp-] + 3 -sfx
24. Subject: [prp-] + 6 -sfx
25. Subjunctive: prfx- /-sfx + -pp

4.4.2. English^Persian

1. Active voice: E: zero marker ~ P: zero marker 1
2. Agent: E: prp- /[prp-] + 6 -sfx ~ [prp-] + 6 -sfx 0.75
3. Causative: E: prp- ≠ P: -sfx + -pp 0
5. Desiderative: prp-1/prp-2 ~ P: prp- 0.75
6. Future perfect: prp- + prp- + inner fusion/ prp- + prp+ -sfx ~ P: prfx- + inner fusion 0
7. Imperative: E: R ≠ [prfx-] + inner fusion+ -sfx 0
8. Indicative: E: zero marker ~ P: zero marker 1
10. Optative: E: prp- ~ P: prfx- /-sfx + -pp 0.75
11. Past perfect: E: prp + -sfx / prp + inner fusion ≠ P: -sfx + -pp 0
12. Past simple: inner fusion/suppletivism/-sfx ≠ P: R- 0
13. Patient: E: -pp ~ P: -pp 1
14. Possibility: E: prp ~ P: prp 1
15. Plural number: E: prp- /[prp-] + 3 -sfx ~ P: [prp-] + 3 -sfx 0.75
16. Present continuous ~ Present concretive: E: prp + -sfx ≠ prp- + prfx- + inner fusion 0
17. Present perfect: E: prp- + prp + -sfx ≠ P: R+ -sfx + -pp 0
18. Present simple ~ Present-future: E: R -sfx ≠ prfx- + inner fusion 0
19. Singular number: E: prp- /[prp-] + 3 -sfx ~ P [prp-] + 3 -sfx 0.75
20. Subject: prp- /[prp-] + 6 -sfx ~ P: Subject: [prp-] + 6 -sfx 0.75
21. Subjunctive: E: prp- ~ P: prfx- /-sfx + -pp 0.75

\[(21/25 + 21/33)/2*(7*0.75 + 0.62 + 5)/21 \approx 0.38\]
4.5. Chinese and Tibetan

4.5.1. List of Chinese forms

List of Chinese forms has been compiled after (Ross, Sheng Ma 2006).

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Active voice: zero marker</td>
</tr>
<tr>
<td>2.</td>
<td>Agent prp-</td>
</tr>
<tr>
<td>3.</td>
<td>Attemptive aspect: -R- -infx- -R-</td>
</tr>
<tr>
<td>4.</td>
<td>Causative: prp1/-prp2/-prp3-</td>
</tr>
<tr>
<td>5.</td>
<td>Deliminative aspect: -RR-</td>
</tr>
<tr>
<td>6.</td>
<td>Deontic modality: prp1/prp2</td>
</tr>
<tr>
<td>7.</td>
<td>Desiderative: prp1/prp2-</td>
</tr>
<tr>
<td>8.</td>
<td>Diminutive: -RR-</td>
</tr>
<tr>
<td>9.</td>
<td>Durative aspect: prp- / -pp</td>
</tr>
<tr>
<td>10.</td>
<td>Experiential aspect ~ Past simple: -pp</td>
</tr>
<tr>
<td>11.</td>
<td>Horative: -pp</td>
</tr>
<tr>
<td>12.</td>
<td>Imperative: -pp</td>
</tr>
<tr>
<td>13.</td>
<td>Intensiveness: -RR-</td>
</tr>
<tr>
<td>14.</td>
<td>Indicative: zero marker</td>
</tr>
<tr>
<td>15.</td>
<td>Interrogative: -pp</td>
</tr>
<tr>
<td>16.</td>
<td>Negation: prp1/prp2-</td>
</tr>
<tr>
<td>17.</td>
<td>Optative: -pp</td>
</tr>
<tr>
<td>19.</td>
<td>Perfect aspect ~ Present perfect/Past simple: -pp</td>
</tr>
<tr>
<td>20.</td>
<td>Patient: -pp</td>
</tr>
<tr>
<td>21.</td>
<td>Possibility: prp1/prp2/-prp3/-prp4</td>
</tr>
<tr>
<td>22.</td>
<td>Present-future/gen. tense: zero marker</td>
</tr>
<tr>
<td>23.</td>
<td>Subject: prp-</td>
</tr>
</tbody>
</table>

4.5.2. List of Tibetan forms

List of Tibetan forms has been compiled after (Parfionovich 2007).

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agent: prp-</td>
</tr>
<tr>
<td>2.</td>
<td>Causative: -pp</td>
</tr>
<tr>
<td>3.</td>
<td>Deontic: -pp</td>
</tr>
<tr>
<td>4.</td>
<td>Desiderative: -pp</td>
</tr>
<tr>
<td>6.</td>
<td>Hortative: -pp</td>
</tr>
<tr>
<td>7.</td>
<td>Imperative: inner fusion + -pp</td>
</tr>
<tr>
<td>8.</td>
<td>Indicative: zero marker</td>
</tr>
<tr>
<td>9.</td>
<td>Interrogative: -pp</td>
</tr>
<tr>
<td>10.</td>
<td>Intesiveness: -RR-</td>
</tr>
<tr>
<td>11.</td>
<td>Negation: prp1/-pp</td>
</tr>
<tr>
<td>12.</td>
<td>Optative: -pp</td>
</tr>
<tr>
<td>14.</td>
<td>Patient prp-</td>
</tr>
<tr>
<td>15.</td>
<td>Potential: -pp</td>
</tr>
<tr>
<td>16.</td>
<td>Potential2: -pp1/-pp2</td>
</tr>
<tr>
<td>17.</td>
<td>Present continuous: -pp + -pp + -pp</td>
</tr>
<tr>
<td>18.</td>
<td>Present perfect: inner fusion + -pp + -pp</td>
</tr>
</tbody>
</table>
19. Present simple: zero marker
20. Prohibitive: prp+ inner fusion
21. Reliable modality: -pp
22. Subject: prp-
23. Unidentified agent: omission of agent

4.5.3. Chinese^Tibetan

1. Agent: Ch: prp~ T: prp- 1
2. Causative: Ch: prp1-/prp2-/prp3- ≠ T: -pp 0
3. Deontic modality: Ch: prp-~/prp-2 ≠ T: -pp 0
4. Desiderative: Ch: prp-~/prp-2 ≠ T: -pp 0
5. Durative aspect: Ch: prp-/pp ≠ T: -pp + -pp + -pp 0
6. Imperative: Ch: -pp ≠ T: inner fusion + -pp 0
7. Indicative: Ch: zero marker ~ T: zero marker 1
8. Intensiveness: Ch: -RR~ T: -RR-1
9. Interrogative: Ch: -pp ~ T: -pp 1
10. Horative: Ch: -pp ~ T: -pp 1
11. Negation: Ch: prp-~/prp-2 ~ T: prp-/pp 0.5
12. Optative: Ch: -pp ~ T: -pp 1
14. Patient: Ch: -pp ≠ T: prp- 0
15. Perfect aspect ~ present perfect: Ch: -pp ≠ T: inner fusion + -pp + -pp 0
16. Possibility: Ch: prp-1/prp2-/prp3- ≠ T: -pp1/-pp2/-pp3 0
17. Present simple: zero marker ~ T: zero marker 1
18. Subject: Ch: prp~ T: prp- 1

(18/23 + 18/23)/2*(8 + 0.66 + 0.5)/18 ≈ 0.39

4.6. Hawaiian and Lha’alua

Lha’alua is a Formosan language, one of Tsouic languages, Lha’alua also is known as Saaroa (pic 2; pic 3). Tsouic languages are thought to be the most distant languages to any other Austronesian and especially to Eastern Polynesian languages.

4.6.1. List of Hawaiian forms

List of Hawaiian forms compiled after (Krupa 1979).

1. Active voice: zero marker
2. Agent: -pp
3. Attemptive mood: prp-
4. Causative: prp-
5. Consequence: -pp
6. Continuous aspect: crp---crp1/ crp---crp2
7. Deontic modality: prp-
8. Desiderative mood: prp-
9. Frequency: -RR-
10. If mood: prp-
11. Imperative mood: prp-
12. Indicative mood: zero marker
13. Intensiveness: -RR-
14. Interrogative: -pp
15. Negation: prp-
16. Non-past tense ~ general tense: prp-
17. Passive voice: -pp
18. Past simple: prp-
19. Patient: -pp
20. Perfect aspect: prp-
22. Possibility: prp-
23. Prohibitive mood: prp-
24. Reason ~ in order to: prp-
25. Singular number: -pp
26. Subject: -pp

4.6.2. List of Lha’alua forms

List of Lha’alua forms compiled after (Pan 2012).

1. Actor voice: prfx-/ -infx- / zero marker + R
2. Agent prfx-/6 -sfx
3. Attenuative/diminutive aspect aspect: reduplication
4. Causative: prfx-
5. Change of state aspect: -sfx
6. Continuous aspect: triplcation/reduplication
7. Evidence (reported evidence): -sfx
8. Exclusive: -sfx
9. Existential negation: prp-
10. Experiential aspect: prfx-
11. Habitual aspect: -RR-
12. Hortative: -sfx
13. Imperative 1: polite request -sfx
14. Imperative 2: strong request: prp-/ -sfx
15. Imperfective aspect -sfx
16. Inchoative (beginning aspect): prfx-
17. Inclusive: -sfx
18. Indicative: zero marker
19. Interrogative: -sfx
20. Irrealis: prfx- / -infx- / -RR-
21. Iterative aspect: -RR-/triplication
22. Locative voice -sfX1 / -sfX2 / - sfX3
23. Negation: prp-
24. Patient voice: -sfx
25. Perfective aspect: prfx-
26. Plural number: prfx-/4 -sfx
27. Potential modality: -sfx
28. Prohibitive: prp-
29. Realis: zero marker
30. Singular number: prfx/-sfX1/-sfX2/sfx-3
31. Uncertain modality: -sfX1/-sfX2 / - sfX3
4.6.3. Hawaiian^Lha’alua

1. Active voice ~ Actor voice: H: zero marker ≠ Lh: prfx-/ -infx- / zero marker + R (1 + 1/3)/2 ≈ 0.66
2. Agent: H: -pp ~ Lh: prfx-/6 -sfx (1 + 1/7)/2 ≈ 0.57
4. Continuous aspect H: crp---crp1 / crp---crp2 ≠ Lh: -RR-/triplication 0
5. Frequency ~ Iterative: H: -RR- ~ Lh: reduplication/triplcation 0.75
6. Imperative: ~ Strong request: H: prp- ~ Lh: prp-/sfx 0.75
7. Indicative: H: zero marker ~ Lh: zero marker 1
8. Interrogative: H: -pp ~ Lh: -pp 1
12. Past simple ~ Realis ~ Past simple: H: prp- ~ Lh: zero marker 0
13. Plural number: H: -RR- + -pp/ prfx- + pp / -pp ~ Lh: prfx-/4 -sfx (1/3 + 1/5)/2 ≈ 0.26
14. Possibility: H: prp- ≠ Lh: -sfx 0
15. Perfect aspect: H: prp- ~ Lh: prfx- 1
17. Singular number: H -pp ~ Lh: prfx-/sfx1/-sfx2/sfx3 (1 + ¼)/2 ≈ 0.62

\[
\frac{17/26 + 17/31}{2} \times (7 + 2*0.66 + 2*0.75 + 0.62 + 0.57 + 0.26)/17 \approx 0.39
\]

Pic. 2 Map representing location of Taiwan in Eastern Asia


Austronesian languages are actually great material for proving that dichotomy of morphology and syntax is nothing but very naïve and perfunctory and very eurocentric point of view:
Austronesian languages can have morphology or can almost have no morphology like Hawaiian but positional distributions of grammatical meanings remains almost the same.

5. Measurement of error

In order to estimate measurement error I make comparison of Hawaiian and Lha’alua using another grammar of Hawaiian (Elbert, Pukui 2001).

5.1. New list of Hawaiian forms

1. Active voice: zero marker
2. Agent: -pp
3. Causative: prp-
4. Conditional: prp-
5. Continuous aspect: crp---crp1/crp---crp2/crp---crp3/crp---crp4
6. Desiderative: prp-
7. Frequency: -RR-
8. Imperative: prp-/prp-2/prp-3/prp-4
9. Indicative: zero marker
10. Intensiveness: -RR-
11. Negation: prp-
12. Passive voice: -pp
13. Patient: -pp
15. Plural number: prp- + pp/ -RR- + -pp /-pp
16. Potential: prp-
17. Present – future tense: crp---crp1/crp---crp2/crp---crp3
18. Prohibitive: prp-
19. Singular number: -pp
20. Subject: -pp

List of Lha’alua forms and their positional distributions can be seen in (4.6.2).

5.2. New VGCI of Hawaiian and Lha’alua

Each meaning of the intersection is followed by its positional correlation index

1. Active voice ~ Actor voice: H: zero marker ≠ Lh: pf- / -infx- / zero marker + R 0.66
2. Agent: H: -pp ~ Lh: prfx-/6 suffixes (1 + 1/7)/2 ≈ 0.57
5. Frequency ~ Iterative: H: -RR- ~ Lh: -RR-/triplication 0.75
6. Imperative: ~ Strong request: H: prp-1/prp-2/prp-3/prp-4 ~ Lh: prp-/sfx (¼ + ½)/2 ≈ 0.37
7. Indicative: H: zero marker ~ Lh: zero marker 1
10. Plural number: H: prp- + pp/ -RR- + -pp /-pp ~ Lh: prfx-/4 suffixes (1/3 + 1/5)/2 ≈ 0.26
11. Possibility: H: prp- ≠ Lh: -sfx 0
15. Singular number: H -pp ~ Lh: prfx/-sfx1/-sfx2/sfx-3 (1 + ¼)/2 ≈ 0.62

\[
(15/20 + 15/31)/2* (5 + 0.75 + 0.57 + 0.62 + 0.26 + 2* 0.66 + 0.37)/15 ≈ 0.37
\]

5.3. Measurement of error estimation

Thus we have got two values of VGCI of Hawaiian and Lha’alua: 0.39 (4.6.3) and 0.37.

In order to estimate measurement error we should calculate standard deviation of discrete random variable values, its formula is the following:\(^3\):

\[
\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \mu)^2}
\]

Where \(x_i\) is certain concrete value and \(\mu\) is arithmetical mean of all received values.

In our case \(\mu\) is the following: (0.39 + 0.37)/2 = 0.38

And then \(\sigma = \sqrt{(0.38 - 0.39)^2 + (0.38 - 0.37)^2}/2 = \sqrt{0.01^2} \approx 0.01\).

And finally in order to estimate degree of potential error we take \(\sigma/\mu\) ratio: 0.01/0.38 that is about 2%.

We should also keep in mind that value of error can be flexible and actually right now has been estimated a particular error for a very particular issue, but in other cases it can be different, however, ever a rough estimation is better than no estimation at all.

6. Whether is it possible for random languages to be coincidentally related?

6.1. Estimation of probability of coincidence

One can probably say that occasionally any tow randomly taken languages can seem to be relatives. Let’s think whether it is possible. Let’s estimate the probability of such event. We have seen that intersections of sets of meanings are shaped by 15 – 24 elements. Let’s suppose that each meaning is expressed by only one positional mean which can be the following:

1) prp-
2) prfx-
3) crp---crp
4) crfx---crfx
5) -infx-
6) –RR-
7) inner fusion
8) suppletivism

\(^3\) Mood, Graybill 1963
We can say that prp- and prfx- and so on are actually very close and can modify this list:

1) prp- ~ prfx-
2) crp-~crp ~ crfx---crfx
3) -infx-
4) -RR-
5) inner fusion
6) suppletivism
7) R
8) -sfx ~ -pp
9) tr-sf-x

We got 9 positions but actually it would be more convenient to deal with list of 10 positions so let’s round the value we got and let’s suppose there are 10 positions.

According to our above proposition we supposed that one meaning can be expressed only in one position. What is probability to choose coincidentally the same position as has been chosen by certain another language? Imagine that you toss up a decahedron. What is probability that once certain face will appear? The probability is one tenth and it is same for any other faces. But we should get about 19 average positions at the same time so we should multiply 0.1 by 0.1 seventeen times. The probability is $10^{-19}$. Actually real probability is much less than $10^{-19}$ since in current estimation has been counted only probability of positional correlation and has not been estimated and counted probability of chose of similar sets of grammatical meanings. Anyway this probability is very little, it is much less than, for instance, probability of meeting Earth with a truly dangerous asteroid that is about $2.5 \times 10^{-4}$ (the Earth exists about 4 milliard years and serious asteroids visit it about once per million year).

6.2. Test of VGCI of unrelated languages with close values of PAI

Prefixation Ability Index (PAI) is tool that allows us to see whether languages can potentially be genetically related: if PAI values differ less than fourfold there are no obstacles for further research (Akulov 2015a: 15), i.e.: for applying of VGCI method.

According to this methodological recommendation have been chosen unrelated languages which PAI don’t differ more than fourfold: Chinese, English. Latin and Tibetan.

6.2.1. Chinese^English

List of Chinese forms can be seen in (4.5.1); list of English forms can be seen in (4.1.1).

1. Active voice: Ch.: zero marker ~ E.: zero marker 1
2. Agent: Ch: prp- ~ E: prp-/ [prp-] + 6 -sfx 0.75
3. Causative: Ch.: prp-1/prp-2/prp-3 ~ E: prp- 0.66
4. Deontic: Ch: prp-1/prp-2 ~ E: prp-1/prp-2/prp-3/prp-4 0.75
5. Desiderative: Ch: prp-1/prp-2 ~ E: prp-1/prp-2 1
6. Durative aspect ~ Present continuous: Ch: prp/-pp ≠ E: prp + -sfx 0
7. Experiential aspect ~ Past simple: Ch: -pp ~ E: inner fusion/suppletivism/-sfx 0.66
8. Hortative: Ch: -pp ≠ E: prp- 0
9. Imperative: Ch: -pp \neq E: R 0
10. Indicative: Ch: zero marker \sim E: zero marker 1
11. Interrogative: Ch: -pp \neq E: prp- 0
12. Negation: Ch: prp_{1}/prp_{2} \sim E: prp- 0.75
13. Optative: Ch: -pp \neq E: prp- 0
14. Passive: Ch: prp- \neq E: prp- + -sfx/prp- + inner fusion 0
15. Past simple: Ch: -pp \sim E: inner fusion/-sfx/suppletivism/ 0.66
16. Patient: Ch: -pp \sim E: -pp 1
17. Possibility: Ch: prp_{1}/prp_{2}/prp_{3}/prp_{4} \sim E: prp- 0.62
18. Present-future tense \sim Present simple: Ch: zero marker \neq E: R + -sfx 0
19. Perfect \sim Present perfect: Ch: -pp \neq E: prp + sfx/ prp + inner fusion 0
20. Subject: Ch prp \sim E prp/- [prp-] + 6 -sfx 0.75

(20/23 + 20/33)* (4 + 2*0.66 + 4*0.75 + 0.62)/20 \approx 0.32

6.2.2. Chinese^Latin

List of Chinese can be seen in (4.5.1); list of Latin forms can be seen in (4.3.1).

1. Active voice: Ch: zero marker \sim L: zero marker 1
2. Agent: Ch: prp- \neq L: [prp-] + 6 -sfx 0
3. Deontic: Ch: prp_{1}/prp_{2} \sim L: prp- 0.75
4. Desiderative: Ch: prp_{1}/prp_{2} \sim L: prp- 0.75
5. Hortative: Ch: -pp \neq L: inner fusion 0
6. Imperative: Ch: -pp \sim L: -sfx 1
7. Indicative: Ch: zero marker \sim L: zero marker 1
8. Negation: Ch: prp_{1}/prp_{2} \sim L: prp- 0.75
9. Passive voice: Ch: prp_{1}/prp_{2}/prp_{3}/prp_{4} \neq L: -sfx/ -sfx + -pp 0
10. Patient: Ch: -pp \sim L: -pp 1
11. Perfect aspect \sim Present perfect: Ch: -pp \sim L: -sfx
12. Possibility: Ch: prp_{1}/prp_{2}/prp_{3}/prp_{4} \sim L: prp- 0.62
13. Present-future \sim Present simple: zero marker \neq L: -sfx 0
14. Subject: Ch: prp- \neq L: [prp-] + 6 suffixes 0

(14/22 + 14/23)/2*(4 + 0.62 + 3*0.75)/14 \approx 0.3

6.2.3. English^Tibetan

List of English forms can be seen in (4.1.1); list of Tibetan forms can be seen in (4.5.2)

1. Agent: E: prp-/[prp-] + 6 suffixes \sim T: prp- 0.75
2. Causative: E: prp- \neq T: -pp 0
3. Deontic: E: prp_{1}/prp_{2}/prp_{3}/prp_{4} \neq T: -pp 0
4. Desiderative: E: prp_{1}/prp_{2} \neq T: -pp 0
5. Future simple: E: prp- \neq T: inner fusion/ -pp + -pp / inner fusion + -pp + -pp 0
6. Hortative: E: prp- \neq T: -pp 0
7. Imperative: E: R \neq T: inner fusion + -pp 0
8. Indicative: E: zero marker \sim T: zero marker 1
9. Interrogative: E: prp- \neq T: -pp 0
10. Negation: E: prp- \sim T: prp/- -pp 0.75
11. Optative: E: prp- \neq T: -pp
12. Past simple: E: inner fusion/suppletivism/-sfx ~ T: inner fusion/ -pp + -pp/inner fusion + -pp + -pp (1/3 + 1/3)/2 0.33
13. Patient: E: -pp ≠ T: prp- 0
14. Potential: E: prp- ≠ T: -pp1/-pp2/-pp3 0
16. Present perfect: E: prp + sfx/ prp + inner fusion ≠ inner fusion + -pp + -pp 0
17. Present simple: E: R + -sfx ≠ T: zero marker 0
18. Prohibitive: E: prp-1/prp-2 ≠ T: prp- + inner fusion 0
19. Subject: E: prp-[prp-] + 6 suffixes ~ T: prp- 0.75

(19/23 + 19/33)/2*(1 + 3*0.75 + 0.33)/19 ≈ 0.13

7. Values of VGCI thresholds

Thus we can see that from one hand we have the following VGCI values:

VGCI (English and Russian) ≈ 0.53;
VGCI (Hawaiian and Lha’alua) ≈ 0.39;
VGCI (English and Lithuanian) ≈ 0.41;
VGCI (English and Latin) ≈ 0.4;
VGCI (English and Persian) ≈ 0.38;
VGCI (Chinese and Tibetan) ≈ 0.39.

Languages that are distant relatives demonstrate values of VGCI about 0.4 or higher.

From other hand we have such facts as:

VGCI (Chinese and English) ≈ 0.32;
VGCI (Chinese and Latin) ≈ 0.3;
VGCI (English and Tibetan) ≈ 0.13.

Unrelated languages demonstrate values of VGCI about 0.3 or less.

8. Conclusion

1) Idea of VGCI method is actually very simple: it is based on the fact that language is determined by set of grammar meanings and set of their positional distributions, and degree of correlation of both sets can be estimated and calculated.

2) If value of VGCI is about 0.4 or more than 0.4 then languages are related (i.e.: belong to the same stock), if value of VGCI is about 0.3 or less than 0.3 then languages are not related. Such values as 0.39 and 0.38 also are variants of 0.4; while 0.31 or 0.32 are variants of 0.3.

3) The more precise is notation the more precise will be conclusions. Current way of notation allows seeing whether languages are related but obviously it can become more precise. Good grammars and correct notation are matters of utmost importance in VGCI method. It’s better not to estimate VGCI at all rather than estimate it inaccurately. If someone receives, for instance,
VGCI value 0.35, it means that there are some serious mistakes in notation or that used grammar doesn’t describe considered language in a sufficient way. There can be no such values as 0.35, VGCI of any pair of languages normally should be is somewhere outside of the ‘corridor’ between 0.3 and 0.4. It is hardly possible to count more than 50 elements and obviously as well as less than 20 elements. If certain list of grammatical meanings consists of less than 20 elements then it should be considered as a very doubtful issue that can only leads to wrong conclusions about VGCI value.

4) Prefixation Ability Index (PAI) is A-bomb while VGCI is something alike H-bomb of comparative linguistics based on typology: PAI is helpful, but it just shows potentially perspective directions, while VGCI can give almost the same information about degree/index of prefixation and beside it can give complete imagination about structure of language and completely answers many other questions.

5) VGCI obviously can be extremely perspective in America, Papua-New-Guinea and Australia where many languages of uncertain genetic affiliation and unknown history.

6) Method represented in current paper actually isn’t new invention, but is just formalization of well forgotten methodological ideas of founding fathers of linguistics.

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