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VOCALISM OF INDO-EUROPEAN ROOT IN THE MIRROR OF PROBABILITY THEORY

Probability theory is extrapolated to vocal changes in Indo-European root. The all-encompassing power of the phenomenon of normal distribution, which is the basic category of probability theory, is demonstrated. Probability theory coupled with motion theory make it possible to reveal the causes and patterns of vocal root alternations, as well as to better understand the nature of the sonant coefficient, postulated by F. Saussure. The article for the first time proposes a diagram of the normal distribution (Gaussian curve) in the pronunciation of Indo-European vowels localized in the phonetic field of the Hellwag triangle bounded by cardinal phonemes I – A – U. The diagram highlights the fields of high training (when acquired automatism) and low training (lack of automatism) when pronouncing vowels. Based on the diagram, the formula for the probability of vocal transitions is derived for the first time: P (A → E) > P (A → I), or P (A → O) > P (A → U), which is organically related to the formula first proposed by the author in 2001: t i → a = t i → e + t e → a, or t a → u = t o → a + t o → u. The truth of the diagram and formulas is confirmed by a large number of examples from Indo-European languages, as well as new experimental data on the articulatory-acoustic distance (ε) between the vowels of the Hellwag triangle. In addition to explaining the patterns of vocal changes, diagram and formulas can serve as a reliable key to the correct etymologization of some Indo-European lexemes. The application of the mathematical approach, as well as the theory of movements to speech phenomena are an original scientific and methodological paradigm, which is presented in the article.

Key words: *alternation of vowels, Hellwag triangle, probability theory, motion theory, normal distribution.*

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ВОКАЛІЗМ ІНДОЄВРОПЕЙСЬКОГО КОРЕНЯ У ДЗЕРКАЛІ ТЕОРІЇ ЙМОВІРНОСТЕЙ

Теорію ймовірностей екстрапольована вокалічні зміни в індоєвропейському корені. Продемонстровано всеохопну силу феномену нормального розподілу, який являє собою базову категорію теорії ймовірності. Нормальний розподіл, простираючись на усі природні явища, охоплює і мовну матерію, зокрема вокалічну мінливість індоєвропейського кореня, яка розглядається як множина фізіологічних (артикуляторних) рухів. Такий підхід дав можливість розкрити причини і закономірності вокалічних кореневих альтернацій, а також краще зрозуміти природу появи сонатного коефіцієнта, постульованого Ф. Соссюром. У статті вперше запропоновано діаграму нормального розподілу (крива Гауса) при артикуляції індоєвропейських голосних, що локалізуються у фонетичному полі трикутника Хеллвага, обмеженого кардинальними фонемами I – A – U. У діаграмі виділено поля високого тренінгу (коли набуто автоматизм) і низького тренінгу (відсутність автоматизму) при вимові голосних. На основі діаграми вперше виведено формулу ймовірності вокалічних переходів: P (A → E) > P (A → I), або P (A → O) > P (A → U), яка органічно пов'язана з формулою, вперше запропонованою автором іще у 2001 р.: t i → a = t i → e + t e → a, або t a → u = t o → a + t o → u. Істинність діаграми і формул підтверджено великою кількістю прикладів із індоєвропейських мов, а також новими експериментальними даними щодо артикуляторно-акустичної відстані (ε) між голосними трикутника Хеллвага. Окрім пояснення закономірностей вокалічних змін, діаграма і формули можуть слугувати надійним ключем для правильної етимологізації деяких індоєвропейських лексем.

Застосування математичного підходу, а також теорії рухів до мовних явищ являють собою оригінальну науково-методологічну парадигму, яка представлена у статті.

Ключові слова: *альтернація голосних, трикутник Хеллвага, теорія ймовірності, теорія рухів, нормальний розподіл.*

The task of science is to explain the nature of things, that is, to discover a new causal relationship between two or more phenomena in a certain area of reality.

The object of the proposed discourse is the word, which should be considered the central unit of language, and its subject – vocalic changes in the word, which, in fact, are the central crossroads in the study of the word.

Every component of a word – syllable, morpheme, phoneme, vocalism, consonantism, accentuation – the all paradigmatically and syntagmatically, must be studied in order to find strong causal relationships.

In the proposed article, we will limit ourselves to the study of vocal changes. It is known that the most significant contribution to the study of Indo-European vocalism was made by Ferdinand de Saussure in his *"Mémoire sur le système primitif des voyelles dans les langues indo-européennes"* (1879). In this work, the scientist put forward the theory of sonant coefficients, trying to find vocal analogies (parallels) in Sanskrit, Greek, Latin, Gothic and Aryan. The essence of the theory is that, according to Saussure, in the pre-Indo-European language there were indefinite vowels (i.e. sonant coefficients), which in different positions and in different Indo-European languages could pass whether into [A], or into [E], then into [O]. For example: I.E. ***a*** corresponds to Aryan ***a***, European ***e*** and ***a***, Gothic ***i*** and ***a***, Greek ***e***, ***a*** or ***o*** (Соссюр, 1977: 303, 310, 311). Saussure simply stated vocal alternations in Indo-European languages, without emphasizing the ontological reasons for their occurrence. The approach to I.E. vocalism in the aspect of probability theory can serve as a supplement to his theory of the sonant coefficients because it explains the nature of their emergence.

From the standpoint of W. Humboldt and A. Schleicher, language is a natural phenomenon that is similar to the human body, animals, plants, so language changes occur according to the same laws as changes in living organisms (Cited by Кондрашов, 1979: 63). Thus, in the study of linguistic phenomena it is possible and necessary to apply the same approaches as to other natural phenomena, including mathematical ones.

That is why as a heuristic start we offer two short excursions – one – in **the theory of motion**, the second – in **the theory of probability**. Both theories are a cornerstone in explaining the nature of things.

Regarding the theory of movements, we note that articulatory movements are regulated and controlled by the same motor center of the hemispheres of the human brain as other muscle movements. Subconsciously, this is recorded by our ancestors, even in the token itself, the Ukrainian word *мова (language)* derived from the I.-E. root *mov-* (as Polish. *mowa*, Latin *moveo*, *mōvī, mōtum*, here also English *move*, French *mouvoir*, German *movieren*, Spanish *mover*), where the central are the seme *to move*, *to set in motion*). This fact is a long-standing and true evidence that speech movements by their neurophysiologic nature are identical to other physical movements of man. As Ramanand Tivari noted, "words are the oldest witnesses of history. Cultural and historical facts are so firmly engraved in them that they cannot be refuted. Due to their divine (subtle) nature and connection with society, they act as bold and objective witnesses in the language court" (Cited by: Тищенко, 2006: 7). This is also consciously proved in the works of scientists, in particular, the founder of the theory of movements N.A.Bernstein. In his article *"Природа навыка и тренировки"* the author analyzes in detail "motor skills", as well as the phenomenon of automatism, and the very process of developing this autmatism, which he calls the process of automation of the motor act. (Бернштейн, 1979: 81 – 84). On the way to acquiring a person's automatic skill of accurate hitting, i.e. the main, normalized correct movement-state lies a number of unconscious, awkward and inaccurate movements, which N. Bernstein calls "background technical movements" (Ibid). For example, when playing darts, we make sure that under the same conditions, the probability of hitting by the second and third darts the same point where the first darts were hit is very small. Each subsequent dart often hits an adjacent point, even when they all hit a single digit field.

Pic. 1

Holes in the target show the scatter of inaccurate (background) hits when trying to strike at the top ten. Similarly, when articulating by adjusting the movements of the articulatory organs provides self-control of the subject in pronunciation, vocals, and provides reconciliation of their own phonation with orthoepic standards and standards of singing, as well as by adjusting the "posing" movements provides verification of body position with reference position. In all types of human movements it should be distinguished "series of technical background's movements" and the "main, correct automatic movement". Self-learning entity in the formation of pronunciation, vocal are

Pic. 2

***Note**: Interestingly, semantic corrections in this regard are correlated with sensory-motor, i.e. with acoustic-graphic corrections. They also are initially "clumsy", inaccurate, until they become automatic, but this is the subject of another study.*

provided by adjusting movements and verification (Шмидт, Визендангер, 1996: 88–128).

The speech movements are carried out according to the same biological, neurophysiologic laws as all other human movements. Unconscious speech error has the same neurophysiologic causes as the failure of the second and third darts to hit the target point, which we hit the first dart when playing darts, because at first, in the absence of automatism, every movement to the goal is awkward and is accompanied by a series of semantic and sensory corrections. Automatism occurs when the movement is performed, so to speak "without looking", and its implementation occurs beyond the threshold of consciousness (Бернштейн, 1979: 83).

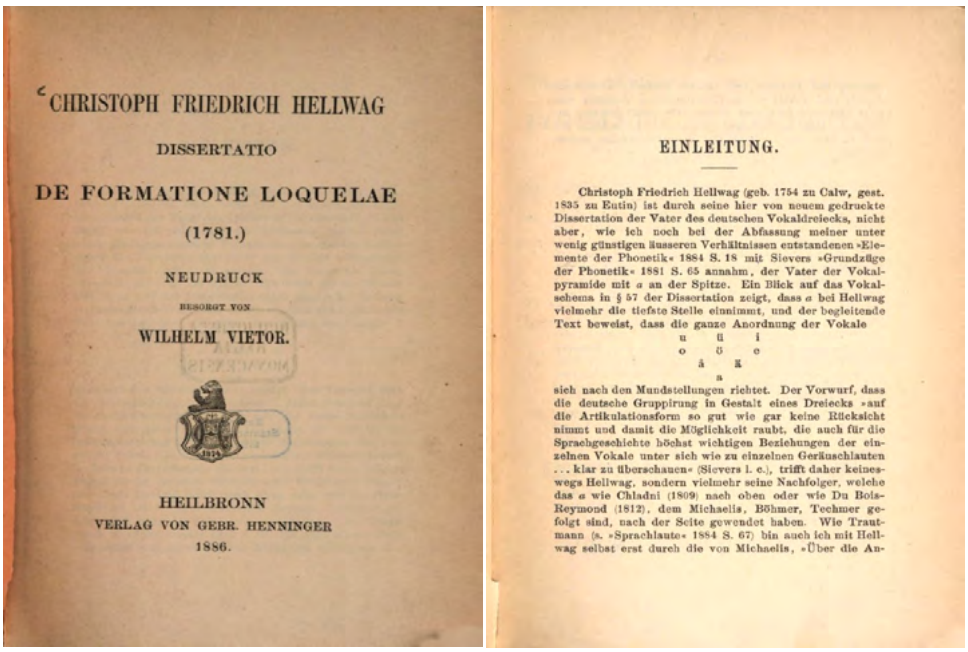
A wrong choice of the target is more probable, the smaller the difference (distance) between these targets: ***n*** substitutes ***b*** in ****norn***, ***t – r*** in ****rourist***, ***f – d*** in ****worf*** because the keys with these letters are adjacent figures in the visual gestalt of the keyboard so just as ***e*** substitutes ***i*** in the pronunciation of the word [***ekə'nɔmiks***] / [***i:kə'nɔmiks***] because these sounds are also adjacent, but in acoustic field. These facts demonstrate the phenomenon of **normal distribution** in probability theory. (Analysis of the mistakes shows that in the English language ***z*** is never substituted by ***l*** or ***x*** by ***p***, because the keys with these letters are not contiguous on the keyboard (Pic. 2)

Let us turn to the vowel triangle, first proposed by Christoph Friedrich Hellwag (1754–1835) in his study *"Dissertatio de formatione loquelae",* written in Latin in 1781. Here are the facsimile pages of his work (Pic. 3).

We can see that on the pages of Hellwag's work his triangle is depicted in a mirror image, which is unusual in comparison to its later images in phonetics textbooks:

u ü i
o ö e
å ä
a

In all variations of the image of the Hellwag triangle, which are found in other researchers, for example, A. Bell (1894), Л. Щерба (1937) (Зиндер, 1979: 198–200), and Daniel Jones (Jones, 1997: IV) the fixation of the cardinal, i.e. the most distant vowel phonemes in the triangle remains unchanged. These three phonemes form a field of phonetic events and between



CHRISTOPH FRIEDRICH HELLWAG

DISSERTATIO

DE FORMATIONE LOQUELAE

(1781.)

NEUDRUCK

BESORGT VON

WILHELM VIETOR.

HEILBRONN

VERLAG VON GEBR. HENNINGER

1886.

EINLEITUNG.

Christoph Friedrich Hellwag (geb. 1754 zu Calw, gest. 1835 zu Eutin) ist durch seine hier von neuem gedruckte Dissertation der Vater des deutschen Vokaldreiecks, nicht aber, wie ich noch bei der Abfassung meiner unter wenig günstigen äusseren Verhältnissen entstandenen »Elemente der Phonetik« 1884 S. 18 mit Sievers »Grundzüge der Phonetik« 1881 S. 65 annahm, der Vater der Vokalpyramide mit *a* an der Spitze. Ein Blick auf das Vokalschema in § 57 der Dissertation zeigt, dass *a* bei Hellwag vielmehr die tiefste Stelle einnimmt, und der begleitende Text beweist, dass die ganze Anordnung der Vokale

u ü i
o ö e
å ä
a

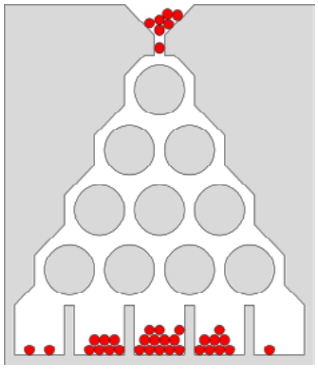
sich nach den Mundstellungen richtet. Der Vorwurf, dass die deutsche Gruppirung in Gestalt eines Dreiecks »auf die Artikulationsform so gut wie gar keine Rücksicht nimmt und damit die Möglichkeit raubt, die auch für die Sprachgeschichte höchst wichtigen Beziehungen der einzelnen Vokale unter sich wie zu einzelnen Geräuschlauten ... klar zu überschauen« (Sievers l. c.), trifft daher keineswegs Hellwag, sondern vielmehr seine Nachfolger, welche das *a* wie Chladni (1809) nach oben oder wie Du Bois-Reymond (1812), dem Michaelis, Böhmer, Techmer gefolgt sind, nach der Seite gewendet haben. Wie Trautmann (s. »Sprachlaute« 1884 S. 67) bin auch ich mit Hellwag selbst erst durch die von Michaelis, »Über die An-

Pic. 3. Hellwag

them in this field the all variety of vowels that occurring in different languages can be gradually placed.

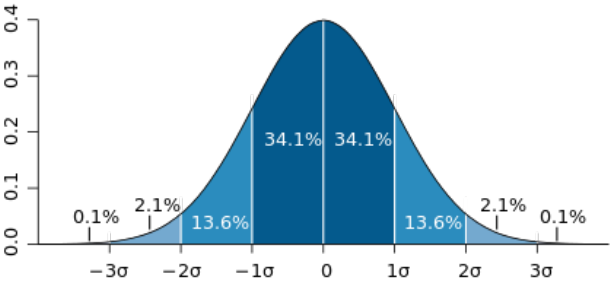
Regarding the excursus into **the probability theory**, we note that such a branch of mathematics has historically grown out of people's attempts to understand the laws of gambling, such as card games, roulette, dice, dominoes, darts, and others. People always wanted to break the jackpot and therefore tried to understand the regularity of the game and predict the game event. Ch. Huygens, B. Pascal, and P. Fermat are considered to be the pioneers of probability theory. But their approaches were mostly applied ones. The first theoretical substantiation of probability theory was made by J. Bernoulli. Finally, probability theory as a branch of mathematics was substantiated by A. Kholmogorov, who formulated a system of axioms of probability theory.

A significant contribution to probability theory was made by Charles Darwin's cousin, Francis Galton (1822–1911), who invented and constructed the so-called **Quincunx**, or **Bean machine**, which was later called the **Galton box**. Galton's invention is a successful visualization of what is called a normal distribution in probability theory (Pic. 4).



Pic. 4. Bean machine

The graph of the density of probabilities of a normal distribution is one of the most important functions of probability theory, which is traditionally represented by the Gaussian curve (Pic. 5).

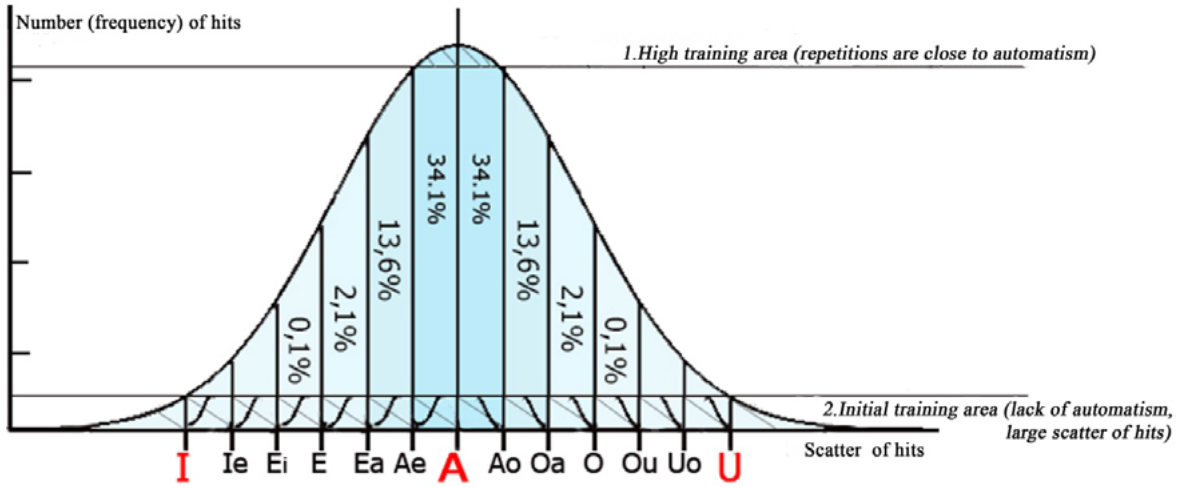


Pic. 5. Normal Distribution

The number or frequency of events is plotted on the ordinate axis, and the scatter of events in space is plotted on the abscissa axis. If we extrapolate the diagram to human motions, it turns out that the zero mark on the abscissa will mean an ideal motor hit, so to speak, an ideal intention to move, or a situation where the intention completely coincided with its actual execution. The marks to the right and left of zero will illustrate the scatter of real motor attempts that deviate from ideal intent. The Gaussian curve illustrates this relationship: the greater the number of movements or their frequency, that is the greater the training, the closer our movements are to their ideal performance, in other words, the more accurate the hit that occurs with automatic movement.

Extrapolating the curve of normal distribution on the pronunciation of cardinal vowels **I – A – U**, we obtain the following diagram (Pic. 6).

The ordinate axis shows the number (frequency) of events, in our case articulations; the abscissa axis shows the value of the normal distribution of



Pic. 6

Table 1

Speaker 1						Speaker 2					
A-I	**A-o**	**A-U**	**I-o**	**I- U**	**o-U**	**A-I**	**A-o**	**A-U**	**I-o**	**I-U**	**o-U**
1256	840	**1054**	991	**406**	940	**1328**	920	**1690**	1279	749	1200

(Дрюченко, 2014: 193)

these events (articulations) in space as a percentage. The farther from the central perpendicular, the more deviations in articulation. On the abscissa axis in the lower horizontal shaded area of the initial training in phylogeny (i.e. geo-historical, statistical sense) there is to be, so to speak, a normal distribution of the second order: on the left – the links A → Ae → Ea → E → Ei → Ie → I, and on the right – respectively the links from A to U. This statement seems relevant for ontogenesis, when the teacher by durable repetition achieves accurate student's pronunciation of a sound; this is shown in the upper shaded area.

The following formulas follow from the diagram: **P (A → E) > P (A → I)**, or **P (A → O) > P (A → U)**, which should be read as follows: the probability of transition of sound A to sound E is greater than that to sound I, and, accordingly, the probability of transition of sound A to sound O is greater than to sound U. Obviously, the probability of transition of vowels (or their substitutions) is greater, the shorter the location, and hence the acoustic distance between them in the phonetic field of the triangle. It is significant that our conclusions coincide with the experimental (acoustic) data, which are given in the work of O. Driuchenko *"Голосні звуки мови: Terra incognita"*, the table iom which we present here:

Minimum distances ***ε*** between elementary segments of different pairs of sounds in Russian (averaged values), where ***ε***, according to O. Driuchenko, is "an indicator of the plane of motion of vowel sound trajectories" (Дрюченко, 2014: 217), or in other words – a zone of probability of vowel substitution in the phonetic space of the Hellwag triangle (Table 1).

In bold in the table, we have highlighted the index of the greatest distance that takes place between the extreme (cardinal) Russian vowels of the Hellwag triangle. (The exception is the pointer o – **U**, speaker 2).

In other words, here we have experimental confirmation of our equation, described in 2001: **t *i* → *a* = t *i* → *e* + t *e* → *a***, or **t *a* → *u* = t *o* → *a* + t *o* → *u*,** where **t** is the time of formation of vowel substitution in the geo-historical aspect. (*Безпаленко, Беспаленко*, 2001: 107 – 111).

The equation should be read as follows: if in the synchrony of a certain Indo-European language there is a two-membered alternation of (cardinal) phonemes in a root, then there must be or previously existed outside the norm (in dialect), or in a related language also a variant of the root with a transitive phoneme.

Let's illustrate with examples (Pic. 7).

Observation of the alternation of the extreme (cardinal) vowels I – A – U in Germanic languages, especially in the system of German strong verbs also confirms the validity of proposed formula:

for *b**I**nden – b**A**nd – geb**U**nden (tie)* we find *Eng. b**E**nd – bond [bɔnd];*

for *f**I**nden – f**A**nd – gef**U**nden (find)* we find *Old Germ. f**E**ndeo – Lat. p**O**ntis (bridge), Gr. p**O**ntos (sea)* (Harper, 2000: F, 6) here also *Rus. ф**О**нд (fund);*

for *tr**I**nken – tr**A**nk – getr**U**nken (drink)* we find *Old Germ. dr**E**nken* (Harper, 2000: D, 19) – *Eng. draw [drɔ:];*

for *r**I**ngen – r**A**ng – ger**U**ngen (fight)* we find *Old Germ. kr**E**ngas, Old Fr. r**E**ng*

*– Dutch r**O**ng, Gr. kor**O**nos* (Harper, 2000: R);

for *s**I**ngen – s**A**ng – ges**U**ngen (sing)* we find *Old Germ. s**E**ngwanan* (Harper, 2000: S, 24), *Eng. sang [sæŋ] – Eng. song [sɔŋ];*

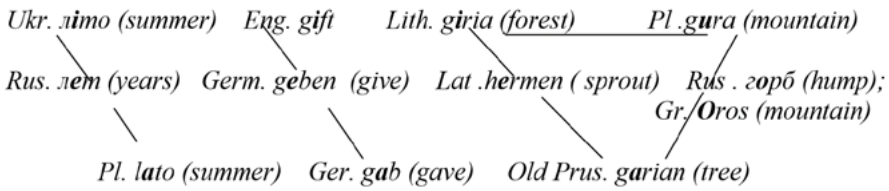
for *s**I**nken – s**A**nk – ges**U**nken (sink)* we find *Old Eng. s**E**nch – Old Nor. s**Ö**kkva* (Harper, 2000: S, p. 24);

for *w**I**nden – w**A**nd – gew**U**nden (enwind, plait)* we find *Old Ger. w**E**ntas,*

*Lat. v**E**ntus, Lith. v**E**tra – Eng. wander [wɔndə]* (Harper, 2000: W, 9);

for the strong German verb with the alternation **A – I – A**:

*f**A**ngen – f**I**ng – gef**A**ngen (catch),* where, it would seem, there could never be the forms with alternates *E* та *O*, consistently we find them in diachrony or



Pic. 7

in other languages: *Old Eng. f**E**ngtoð (catching) – Eng. f**O**n (Pre-Ind. fangen)* (Harper, 2000: F, 2).

The evidences from English language:

In the roots of English words, where the diphthong [ƏI] ***make*** [mƏIk], ***take*** [tƏIk] occurs, in etymological analysis we find the sound **A**, which is adjacent to the first vowel Ə and which not only closes all vowels on the left side of the triangle, but in the root ***tak**-e* even extends to the right its side, including vowels O and **U**:

***make** [m**ƏI**k] Old Eng. m**A**cian, Old Fris. m**A**kia (build), Dan. m**A**ken, Ger. m**A**chen (make)* (Abbyy Lingvo, 2011; Harper, 2000: M, 1);

take** [t**ƏI**k]* originates from *Old Eng. t**A**can*, which in turn comes from *Old Norv. t**A**ka,*** which related to *Goth. t**E**kan*, and connected with *Eng. t**OU**ch* with the variant ***O***, and also *t**o**ke [t**Oŏŏ**k],* that means *a puff with a cannabis cigarette*, and from the variant ***O*** the transition to the variant with adjacent ***U*** in the form of *took* (Abbyy Lingvo, 2011; Harper, 2000: T, 1);

In other English Irregular verbs we also find related sounds in etymological analysis.

For example, for ***ƏI – Oŏŏ*** (***break –*** broke, broken) we find related *Eng. brake* (Abbyy Lingvo, 2011), which, in turn, comes from the *Old Fr. br**A**c (handle, lever)*, containing adjacent ***A*** (Harper, 2000: B, 31);

for ***Æ – ŏŏ*** (***can*** *– could)* we find middle sound ***A*** in Old Fris. *k**A**nna (know, receive)* and *Goth. k**A**nnjan (the same)* (Harper, 2000: C, 5] which moves even on the right side of the triangle in *Germ. k**Ö**nnen* (can) with the variant ***O***; and for ***shall*** *– should* we find Old Eng. *sc**E**al, sce**O**ld, Ger. soll,* which are related to *Old Norv. sk**A**l, Old High Germ. sc**A**l* and *Dan. z**A**l* (Abbyy Lingvo, 2011), where, as we

see, all adjacent vowels of the triangle are involved, except the extreme ***I***;

for ***Æ – Ↄ:*** (***catch*** *– caught*) we find the neighboring ***A*** in *Old Fr. c**A**cchen, c**A**chier (pursue)*, *Lat. c**A**ptāre, c**A**pere (grasp)* (Abbyy Lingvo, 2011);

for ***U: – I –*** ʌ (***do – did – done*** – the verb, the forms of which includes the extreme vowels of the Helwag triangle, in the etymological analysis we find also all intermediate vowels: in *Old Eng. d**Ō**n, Old Fris. du**Ā**n , Old High Germ. t**U**on , Lat. abd**E**re (postpone, save), Gr. t**I**th**E**nai (place)* (Abbyy Lingvo, 2011; Harper, 2000: D);

for ***E – O (ɒ)*** (***get –*** *got*) we find the reflex with ***I*** in *Old Eng. g**I**etan*, wich is related to *Old Norv. geta (get, receive,)* (Abbyy Lingvo, 2011; Harper, 2000: G) and *Old Sw. g**I**ssa (consider*), and the reflex with the adjacent ***A*** in *Gr. kh**A**ndanein (hold, keep), Wel. g**A**nnu, Old Eng. *g**IE**tan* in the form of Past Tense *g**A**t* (Harper, 2000: G, 8);

for ***I: – Ↄ:*** (***see –*** *saw*) we find the reflexes with both adjacent vowels on the left side of Helwag`s triangle: with ***A*** in *Old Eng. s**A**gu* with the meaning of *saying,* from were *s**A**ga* comes*,* which related to the reflexes with ***E*** in *Germ. s**E**hen*, *Old Fris. s**E**d, Lat. s**Ē**dēs (seat, place)* and related to *Lat. s**E**dēre (sit)* (Abbyy Lingvo, 2011, Harper,etymological forms for *see, saw*).

Note: Here we have a sensational version; according to which in English verbs ***see***, ***sit*** and ***say*** were the common figures occurring in the combined semantic field. Indeed, in order ***to say,*** you had ***to sit*** opposite and ***see*** the eyes of an interlocutor. D. Harper even notes that English ***see*** originally meant only *"follow with the eyes",* that is, to follow the eyes of the interlocutor (Harper, 2000: S). Once again, we are convinced of the incredible structuring power of the phenomenon of normal distribution (here in relation to the semantics of a word) and the power of the principle of adjacency of the events on the abscissa axis. Once recorded by our ancestor, a word and its semes stated in it, necessarily explicitly or in disguise leave their mark (trace) in a language. All that remains to be done by an etymologist is to be able to "dig" this distributive adjacency with its semes out. But this is a topic for another article.

For ***E – O*** (***sell –*** *sold,* which is related to *Sp. s**O**ldar – s**UE**ldo (solder, weld, connect, bring together, make ends meet)* we find the reflexes with adjacent sound ***A*** in *Sp. s**A**ldar (make ends meet, sell cheap),* from were *Sp. s**A**ldo (balance)* comes;

for ***I –*** ʌ(Ä) (***win –*** *won*) we find *Proto-Ger. *wen-w**A**nan* and *Pre-I.E.***v**A**n* with the meaning *outdo, conquer* (Harper, 2000: S, 9), which includes ***A***;

for ***AI – Ↄ*** (***buy –*** *bought*)*,* which is related to *Old Eng.* and*. Middle Eng. budge (move, change)* and *budget* we find *Pre-I.E. *bh**E**lgh (stomach, abdomen, inflate),* from which, according to Harper, they originate and which includes the adjacent ***E*** (Harper, 2000: B, 37, 41], and which completely closes the left side of the triangle.

For ***I: – Əŏŏ*** (***speak –*** *spoke*) we find *Old Eng. sp**E**can*, which is related to *Old High Germ. sp**E**hhan, Middle High Germ. sp**E**chten (gossip), Middle Dan. sp**E**ken* and *Old Eng. sp**Ā**ca* (Abbyy Lingvo, 2011; Harper, 2000: S);

for ***steal –*** *stole* we find *Old Eng. st**E**lan,* which is related to *Old Fris.* and *Old Norv. st**E**la, Goth. st**I**lan, Germ. st**E**hlen, Old.Eng. st**O**le* from *Lat. st**O**la, Gr. st**O**lē (clothing)* (Abbyy Lingvo, 2011; Harper, 2000: S), where the all adjacent vowels are represented.

In addition, many English Irregular verbs have alternations of *vowel – vowel* or *vowel – diphthong,* which, as in a number of German strong verbs,

directly confirm the all-encompassing force of **normal distribution**, because either one vowel alternates with adjacent, or adjacent vowels are combined in diphthong, so to prove the strength of the principle of **normal distribution** in phonetics it does not require special etymological research: ***become*** – became (**∧ – *E***); ***come*** – came (**∧ – *EI***); ***feel*** – felt (***I: – E)***; ***give*** – gave ***(I – EI)***; ***keep*** – kept ***(I: – E)***; ***read*** – read ***(I: – E); swim*** – swam (***I – Æ)***; ***seat*** – sat ***(I –Æ); go*** – *gone* ***(ƏʊI – ŋ)***.

It is possible to conclude that **the vowels in the Indo-European roots play the role of fragile filler in the rigid frame of the consonants**. The consonants in the root play role of its identifying factor.

Thus, it is possible to see that the use of probability theory in combination with motion theory makes it possible, on the one hand, to reinterpret morphonologic changes in word, and thus, on the other hand, can serve as a supplement to Saussure's theory of the sonant coefficients because it explains the nature of their emergence. And finally it serves as a reliable key for adequate etymological analysis. And besides that it gives an opportunity to understand the process of the pronouncing mistakes occurring and thus to avoid them: to put a learner the correct pronunciation, you need to teach him or her precisely to select the only correct acoustically-motor goal among others in sensory-motor shade. It can be achieved by multiple repetitions and corrections.

In language there are strict causal relationships between phenomena that are similar to biological and physical relations in nature, therefore language is a natural phenomenon and linguistics is exclusively the natural science, like biology, physics and mathematics, and must be described using compact formulas.

In general, language teaching is nothing but training (*Fr. dressage*) of movements at different levels of consciousness. We (teachers) are actually coaches (*Fr. formateurs*), especially in the early stages of language learning.

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