

On the Origin and Causes of Sound Change: A Review of Related Literature

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Abstract

There is no dispute over the fact that languages change and vary continually. All the inquiries in all languages have proven this statement to the extent that some linguists consider a change and a variation in languages as a rule. Knowingly, change and variation occurs at almost all core linguistic levels: phonetics, phonology, morphology, syntax, and semantics, etc. The most extensively investigated topic in studies of language variation and change, in particular, and in linguistic in general, is sound change (henceforth SC). SC is seen as a developmental process pertinent to both phonetics and phonology. However, differences in views have been witnessed on naming what has been traditionally called SC(e.g., the alternation theory; Baudouin: 1910 in Stankiewicz 1972),all the different points of view have the same sense of meaning. Yet what causes sounds to change, and from which origin they are drawn are the most tantalizing questions. The point worthy discussion in this paper is the different arguments and perspectives raised about the causes and origin of SC. Linguists who concerned themselves with the study of language variation and change have accounted for two major assumptions that have impacts on how sounds change namely: social and linguistic factors. This review excludes the first assumption and details the linguistic theories relative to the causes and origin of SC linguistically. There are three perspectives on the origin of sound change: articulatory, perceptual, and a combination of articulatory and perceptual theories, while two prominent controversies on the causes of SC have been identified as teleological vs. non-teleological causes of SC.

Keywords: Sound change; Articulatory theories; Perceptual theories; Teleology.

1. Introduction

All languages change continually and vary in many ways; changes occur at almost all levels of linguistics. There is a semantic, syntactic, phonological, lexical, phonetic, morphological change, etc. As far as we know, historical linguists concern themselves with the study of how languages change over time. This is achieved through two approaches; the first is the synchronic approach (e.g.,

the focus is exclusively on a language at one point in time), and the second is diachronic approach (the focus is on the language at different stages to compare or contrast one language with itself or with another throughout these various stages). Traditionally, the phonetic and phonological developments in a language go under the roof of the SC, which is one of the most controversial questions in the study of language variation and change. SC is one of the most commonly studied forms of language change in historical linguistics. There is no dispute over the fact that sounds change, but there are different views and accounts on how SC originates, and what causes a sound to change.

Starting from Pāṇini's work on Sanskrit Grammar in the 4th century BC in ancient India until this moment, works on SC have been progressing. But it prospers in the 20th century in the work of a group of linguists who are known as the Neogrammarians, a self-defined group of young scholars working in Leipzig in the 1870s. The Neogrammarians are usually thought of to have made a great contribution to the nature of SC for their *regularity hypothesis*; according to which, SCs *work mechanically and regularly without any exceptions*, and for the inclusion of analogy and dialect borrowing as causal factors that cause a change that did not follow regularity hypothesis.

Commonly, the Neogrammarians (e.g., Paul, 1880; Sievers, 1901) describe SC as an exceptionless, gradual, imperceptible while they are underway. They also hold that changes that are ungrounded in the articulatory processes have different natures. However, the importance of regular correspondence had already been recognized in the *Britannica* of the mid eighteenth century, in Turgot's article 'Etymologie' in Diderot's *Encyclopédie* (as cited in Lass 2015: 53). In consistence with the regularity hypothesis, Bloomfield (1933) held that the majority of SC was phonetically gradual, imperceptible while under way, and regular. The Neogrammarians' view of the occurrence of SC has been criticized in two ways, however. The first is that it has been branded a mere terminological stipulation without empirical consequences, and the second is that it has been considered false on the empirical ground (Bloomfield 1933:364; Kiparsky 2003:313).

These unbroken research traditions do not only document the nature of sound change, but also address a great number of questions in the 19th century. Such questions are: why does SC occur? What is its purpose? And what are the origins of SCs? In an attempt to answer these questions, linguists have exerted every possible effort to have a full view of the subject and approached it in various ways. For instance, while some linguists approach the study of language variation and change from a linguistic aspect (internal factors), many others (e.g., Labov, 1963, 1972) have depended on the social aspects of language (external factors). This review addresses the linguistic factors.

2. Articulatory & Perceptual Theories

2.1 Overview

Linguists who concern themselves in the study of SC are of different views on how sound changes. First, some linguists hold that we can grasp language change better if we take the phonetic

and psychological aspect of language into consideration (e.g., de Brosses 1765; von Raumer 1863; Key 1985; Osthoff and Brugmann 1878). Some others show that integrating phonetic studies with historical phonology helps us to understand factors that give rise to SC (e.g., Ohala 1993 & 1989; Foulkes 1997; Belvins 2004). To set examples about these different views, Osthoff and Brugmann's view of the origin of most SCs is mechanical (articulatory) and that their residual type is psychological (e.g., metathesis and dissimilation). On the other hand, Paul (1880, 1920) holds that the origin of most SCs is articulatory reduction and that their residual type is speech errors (e.g., metathesis: non-local assimilation and dissimilation).

2.2 Articulatory Theories

Articulatory-based theories (e.g., Sievers 1967; Baudouin de Courtenay 1910 as cited in Stankiewicz 1972; Grammont 1933; and Lindblom 1986, 1990) discussed below are of the view that SCs are teleological. The teleological approach is the most controversial question in the study of SC, just as the SC itself is to language variation and change. The concept of 'teleology' dates back to the nineteenth century. It means 'ease of articulation', or 'the economy of effort'. The general ideas behind it is that a speaker optimizes some aspects of communication to decrease the energy expended in speaking, to make his/her speech more distinctive in order to make it more intelligible, to simplify his/her speech grammar, to make his/her speech easier to pronounce, and/or easier for the listener to hear. The teleological approach's proponents hold that SCs that make things easier to say and hear should be favored. Articulatory perspectives account for how a speaker can be a source of SC. They claim that the SC occurs due to variation in coarticulation and through its synchronic and contextual phonetic variation it becomes diachronic.

Sievers (1967) stated that SC is based on an inadequate reproduction of traditional pronunciation and that the origin of the newly formed pronunciation is either an individual or a group of individuals. He held that the individual innovations spread throughout a large part of the community or even through its entirety by the means of imitation. According to Sievers, the innovation begins either within one and the same generation of speakers or in the process of passing speech from one generation to another. Even though the author admits that SC may proceed in a teleological manner, he criticized the generality of the 'ease of articulation' principle. He states that and here I am quoting, 'we can admit that many phenomena in the development of languages may be brought under this heading (to reduce the effort in articulation), the generality with which the statement is produced is false' (Sievers 1967: 265). In support of this statement, the author has demonstrated that some sound changes, fortitions, oppose the 'ease of articulation principle' because they create a sound that is more difficult to utter. For instance, the aspiration or affrication of stops requires greater airflow than lack of aspiration or frication. The 'ease of articulation principle' does not always stand true in accounting for SC. In Yemeni Arabic, for instance, the voiced velar stop /g/ changed into Voiced postalveolar affricate /dʒ/. He also notes that 'differences in the difficulty of producing speech sounds are extremely minute, and that actual difficulties concerning imitation generally exist only about unfamiliar sounds'. When the articulators get used to some sounds in course of acquisition or training, sounds involved will be easier; while those which the speaker did not get used to will be unfamiliar. Finally, Sievers stated that "sound law should merely indicate that

'if a shift in the manner of articulation has occurred, the new manner of articulation must be applied without exception in all instances which are subject to the same conditions; it is not meant to imply that under certain given conditions a certain result must necessarily follow everywhere (ibid).

Like Sievers, Baudouin (1910, as cited in Stankiewicz, 1972) sheds light on the teleological nature of SCin terms of a phonetic form and more abstract psychological form. But he emphasizes the importance of the social aspect of language. He argues that 'since language exists only in human society, the social aspect must always be considered in addition to the psychological aspect' (Baudouin 1897 [1972: 213]). In his statement of Linguistic Principles, Baudouin stated that:

The cause, the impulse for all linguistic change, is a tendency toward convenience, toward a minimum of effort in three areas of linguistic activity: in pronunciation (phonation), in hearing and perception (audition), and in linguistic thought (cerebration). (Ibid).

In his widely recognized work presenting what is known as an attempt at a Theory of Phonetic Alternation, Baudouin (1897 [1972:]), he has established the terms: '*alternants* and *alternation*' in lieu of phonetic and phonemic change. *Alternants* refers to phonetically different phonemes, which are part of etymologically related morphemes and which occupy the same position in the same phonetic structure of the morphemes, and their relationship to each other as the *alternation*. Similarly, he referred to the phonetic difference between related morphemes as *phonetic alternation*, while those alternating phonemes or *phonetic alternants* are sounds or phonemes which, though pronounced differently, can be traced to common historical, i.e., originating from the same phoneme (Baudouin 1897 [1972: 154]. For him, 'there is nothing of the types of 'transitions' such as *k* into *cz* or *ɛ* into *ə* and that there are neither *phonetic changes* nor *phonetic laws* and there can never be such'. He proclaimed that:

'...what links the separate speech acts- be that sounds, phonetic words or utterances (that are heard and perceived by the ear) are representations or images in the memory, which during the utterance itself serves as a stimulus to asset the speech organs into appropriate motion'. (Baudouin 1897 [1972: 158])

The author has accounted for the 'alternants and alternations' based on the psychological aspects of sounds (the representations) and the physiological aspects conditioning these *alternant* and *alternations* in a number of processes that take place during the production of human speech sounds. He stated that the production of speech sounds allows for two possibilities: the physiological conditions determining the activity of the speech organs may allow the full realization of the processed intended by the brain center or they may inhibit them. In the first case, the phonetic intention coincides with its realization; while the second case produces a discrepancy. In the latter, whether the phonetic habits or the universal phonetic, determining the production of speech sequences, compels us to modify the pronunciation of the intended sequences. Therefore, the discrepancy between phonetic intention and its realization is solved by substituting the impossible

intended activity by a possible one. The substitution is of two types the first is when one phoneme is replaced by another closest to it phonetically, and this takes place when the intention, which is found on related words, cannot be realized; and the second is an imitation of foreign sound in the speech of others, which we intend to reproduce. Phonetic change or ‘transition’ in all these cases results from the discrepancy between the intention and its realization. Therefore, the substitution of an intended pronunciation by possible one constitutes the only type of phonetic change or “transformation” that may occur in the synchronic state of a given language. What is ordinarily called phonetic change or transformation of one sound into another is, from the objective point of view, *coexistence* or *alternation*. Such *coexistence* or *alternation* is neither a phonetic change in the present nor succession in historical sequences. ‘However, its cause is still considered something of a puzzle’, Baudouin added. For him, phonetic change as ordinarily understood is a fiction, a delusion. Baudouin has concluded that there can be only:

- A. Substitution of intended activities by possible ones ‘stemming from’ the lack of coincidence or discrepancy between the phonetic realizations and intention.
- B. Synchronic phonetic differences, i.e., alternations of the historical origin of morphemes and their components, the phonemes (Baudouin 1897 [1972:160]).

On the original causes of every alternation, Baudouin sums up: ‘If the history of a given language is viewed as something continuous and uninterrupted, the cause or stimulus of a given alternation is a purely phonetic or anthropo-phonetic one. But in the case of mixed languages, the primary stimulus of an alternation is probably always an anthropo-phonetic in nature, but it may have its roots in(1) the native language, as is most frequently the case, or (2) the foreign language from which a given speech community has borrowed the entire alternations or one of its elements. The original cause of alteration may still be active in the present, synchronic state of the language or may have been active in the past’. Alternations are ascribed to three classes according to their causes: communal life, the physical and psychological make-up of the members of the speech community (Baudouin 1897 [1972:161]). Classification of alternations according to the possibility of determining their anthropo-phonetic causes operating in the synchronic state of a language are shown in table No. (1). Cause type No. six: class 1 & 2 are further explained in the paragraph immediately following the table 1 below.

No	Cause type	Class 1	Class 2
1	Anthropo-phonetic	Neo-phonetic alternations (Divergents): Their relationship: Divergence	Paleophonetic alternations (Non-divergent): Their relationship: Non divergence
2	Psychological	Psycho-phonetic alternants OrCorrelatives	Non-psychophonic alternants OrNon-

			correlatives
3	Traditional, and more generally social	All alternations are a result of: repetition and imitation (including transmission from one generation to another)	Independently of repetition and imitation
4	Internal (auto-glottic) or external	Uninterrupted historical evolution of a given language	Borrowed from other closely related languages
5	Difference between individual and social	Divergences and correlations are due to individual or collective-individual	Traditional Paleophonetics alternations are due exclusively to social.
6	Simplicity and complexity of their cause	All alternations have either one or two causes	The causality of certain alternation is either simple or complex

Table 1. Classification of alternations according to their causes (Baudouin 1897 [1972:161-64]).

On class 1: One cause is involved in *divergences* which are not supported by tradition, and *traditional alternations*, which are neither divergence nor correlations. Two causes may be involved in (1)*divergences* which depend not only on anthropo-phonic but also on linguistic intercourse (2)*traditional alternations* which are at the same time correlations or psychophonetic alternations. The causality of certain alternation is either simple or complex. One cause accounts for pure divergences, or purely *neophonetic alternations*, which are not affected by *traditions* and *linguistic intercourse* in general, and purely *traditional alternations*. Two causes account for *correlations*, which depend, on the one hand, on tradition, and on the other hand, on the individually formed psychophonetic relationships.

Moreover, the author has listed some other significant factors of change. For example, he emphasizes the importance of errors in hearing (*lapsus auris*), when one word is mistaken for another as a factor of change at any given moment of linguistic intercourse in any time in history of language as a social phenomenon. Among such errors are those mistakes or inaccuracies of comprehension that take place when speakers of one language face new and incomprehensible articulatory and auditory elements of another language. The inaccuracies of comprehension and incomprehensible articulation have been further explained by Ohala (1981).

In response to the principle ‘economy of effort’ and the failure it has shown in accounting for some SCs, the *need for clarity* construct was developed. The idea behind *the need for clarity* is that speakers hyper-articulate to make their speech clearer to listeners. This notion opposes the economy of effort principle. In 1933, Grammont (as cited in Belvins, 2004) makes a detailed distinction between these two opposing forces. Although he delimits SC to the imperfect process of child

language acquisition, he made a balance between ‘the least effort law’ and the ‘need for clarity’ in his explanation of most phonetically motivated sound changes. Thomas (2011: 274) has mentioned that the *maximal dispersion* is a recent offshoot of the need for clarity construct. This principle depicts contrastive sounds like the same poles of two magnets, which rebels against each other; contrastive sounds tend to be as far apart as possible in perceptual space. The maximal dispersion principle does not always stand true in accounting for all types of SC. This statement can be further illustrated by looking at some cases of a merger in which two contrastive sounds get merged. This means that SCs do not necessarily rebel against each other, but rather they embrace each other. To make the point clear, a pharyngealized voiced alveolar plosive /dˤ/ in Arabic merge with the voiced emphatic dental-fricative /ðˤ/ in most Arabic speaking world in general and in almost all Yemeni Arabic.

Lindblom’s (1989, 1990) ‘hyper’-and ‘hypo’ articulation (henceforth H&H) modern theory is consistent with Grammont’s position. But before reviewing this theory, it is very significant if we go through Lindblom’s (1983) work titled ‘Economy of Speech Gesture’. In this work, the author has explained that an analysis of the phonetic facts on vowel reduction and coarticulation is possible and can be made insightfully if a criterion of motor “economy” is introduced. On the other hand, he has demonstrated that phonological regularities interact with concurrent perceptual demands on the speech code and serve the purpose of *minimizing* the expenditure of physiological energy.

Lindblom’s H&H theory is developed to account for intra-speaker variation and from evidence showing two biological processes: *plasticity* and *economy*. These characteristics of speech motor control shape speaking and listening. Plasticity is evident when listener-oriented control is called for. Economy is a manifest in reductions and other talker-oriented simplifications (Lindblom 1989: 162). These two processes interact on a short-term basis to generate signals that may be rich or poor in explicit physical information (*ibid*). Additionally, they waver between hypo-speech (less clearly & system-oriented), when it does not impede communication, and hyper-speech (more clearly & output-oriented) when it is needed. Uttering unfamiliar words and speaking to somebody hard of hearing are some of the situations that call for hyper-speech. High speech rate and segmental deletion are features of hypo-speech ‘hypo-articulation’, or non-citation speech, where reduction is the result of a trade-off between production ease for the speaker and perception ease for the listener.

Lindblom (1990a) H&H theory distributes factors that influence the intra-speaker phonetic variation between the production constraints (physiological and cognitive) and perception constraints (social and communicative). According to this theory, speakers tune their performance according to communicative and situational needs, balancing between the demands of limiting articulatory effort against those of ensuring intelligibility for listeners. In simplification, when out-put constraints dominate, hypo-forms are expected, but when system constraints dominate, hypo-speech is observed (Lindblom 1990: 418). In the sense of the biologist’s term speech behavior is an adaptive process. The author has provided evidence in favor of language structure evolving as an adaptation to the constraints of the on-line processes of speaker-listener interaction. However, H&H proposed theory

conforms to accounts of speech production that views it as “the continual tug of war” between demands on the output and system constraints, Lindblom (1998: 245).

Some of the variations in speech signal can be traced to the speech production. They are included within the physical constraints attributed to the vocal tract like anatomical, elasto-inertial, neuro-muscular, aerodynamic, and acoustic (Ohala, 1989). The speech signal will vary if the effects of physical constraints vary. Some well-known aerodynamic constraints are those on voicing. The principle effects in this regard are that the longer the stop closure, or the further back the oral closure is, the more likely devoicing of the stops becomes. The constraints on voicing have shaped SC in many languages: if languages have no voicing distinction in obstruents, the series they do have is invariably voiceless. Second, if the language uses voicing contrast in stops but has gaps at certain places of articulations, these gaps are invariably in the back place of articulation. Long stop closures have a tendency to devoice especially to back articulated stops.

Another example of aerodynamic constraints consists in: (1)the shape of the channel through which airflows and(2) the volume velocity. The velocity increases as it is forced through a channel with a smaller diameter. This is the basis for a more fricated release of the stop, especially apical stops before high vowels and glides vis-a-vis the release before low vowels. Ohala claims that the devoicing of the stops and the frication of stop releases can happen inadvertently or unintentionally. *Elasto-inertial Constraints*: the amplitude of jaw opening decreases when the frequency of the gestures increases. If the rate of the speaking is increased, as it is during an unstressed syllable or a gesture has a target quite opposite from those of segments before and after it, articulatory positions may not be achieved as well as when more time is devoted to the gesture. This is a well-known principle of undershooting (Lindblom 1963). Ohala holds that this principle accounts for the frequently observed change of stops to fricatives in intervocalic position. Westbury (1986) stated that ‘voiceless stops are generally longer than voiced stops’. Ohala attributed this statement to the aerodynamic constraints: voiced stops are kept short to avoid the constraint, which imperils voicing. ‘It is the short time devoted to the gesture which leads to undershoot’.

Another example of elastic constraints is the perturbation of pitch after voiced and voiceless obstruents, specifically, the higher F_0 found after voiceless segments as opposed to voiced. One of the hypotheses is that the distinction between voiced and voiceless segments is due to some laryngeal tissues. The idea is that laryngeal tissues are tensed differentially in a way that affects F_0 (Hombert, Ohala, and Ewan 1979; Ohala 1978). Some of such features of pronunciation are exerted uncontrollably upon the speech signal produced by the speaker due to speech production anatomy and neuro-anatomy, but the speaker does not purposefully make them. Thus, the speech that emerges from the vocal tract is a product of physical constraints. Precisely speaking, Ohala has claimed that SC is drawn from the pool of synchronic, inadvertent variation in pronunciation. Yet much of his work emphasizes the role a listener plays in shaping sound change.

2.3 Perceptual Theories

Unlike articulatory theories, in which SC was seen as goal-oriented, perceptual theories (e.g., Ohala, 1971, 1974, 1975, 1981, 1983, 1989, 1990, 1993, 1999; Belvins, 2004; Lehmann 1992; Lass, 1980, 1997), view SC as non-optimizing; it is neither teleological nor purpose-driven. The speaker does not intend intentionally or consciously to change sounds. It is rather uncontrolled due to physical, physiological and neurological factors. Perceptual theories hold that a listener is a source of sound change. In these theories, the primary focus is on the acoustic auditory signal in speech perception. Both Ohala and Belvins argue that SC can arise in the misperception of acoustically similar sounds. The mapping between vocal tract shape and the output sound is many-to-one mapping, i.e. the same or similar sound may result from two or more different vocal tract configuration (Sweet 1874; Ohala 1981).

According to Ohala, when a listener fails to resolve the ambiguity in the speech signal, he hits upon articulation different from that used by the speaker. For example, the English word 'with' [wiθ] is realized as [wif] dialectally (Sweet, 1874 as cited in Ohala 1981:182; Passy, 1890). Sweet and Passy recognize that there is a relationship between vocal tract shape and sounds, which makes a speech signal inherently ambiguous with respect to how it was articulated. If the listener fails to decode the speech signal in the same way the speaker produces it or fails to filter out the inherent distortion, then SC takes place. Furthermore, the listener can be a source of change when he confuses similar sounds, from which he hits upon one meant not by the speaker.

In 1963, Lindblom has stated that there is measurably indefinite phonetic variability in speech signal of a word; some of which are only accepted in course of communication. According to Ohala, this variability makes speech signal noisy for the listener since s/he has to make an exact identification of the words in the speech signal. When he turns out to use the acoustic/auditory information one received from the other speaker, s/he can make the same pronunciation. Some features of pronunciation are exerted uncontrollably upon the speech signal produced by the speaker due to speech production anatomy and neuro-anatomy. Therefore, when the listener tries to repeat what he has heard, he must discover what phonetic events in the acoustic signal he should actively control and which one, he would let happen due to the mechanical properties of the vocal tract. More than this, the listener may be unfamiliar or lacking experience of the distortion that may accompany the speech signal in production. For instance, an American English speaker may not know about the tense voice quality that accompanies the production of Arabic [ʃ] (Ohala 1981:181). Consequently, the listener may not be able to copy the same phonetic feature of the signal produced.

Another example of the listener as a source of SC consists in a failure to apply reconstructive rules to detect the environment that causes the distortion. Ohala (1981: 183) has given this scenario as a clarification of the point mentioned: the speaker intends to produce /ut/, but /ut/ is distorted as [y(t)], heard as [y], interpreted as /y/ by the listener; and when the listener turns to speak it, s/he produces [y]. The speaker intends to say /ut/, which may become distorted, that the vowel is more like [y]. The [t] may be weakly articulated or unreleased or simply become masked by ambient noise, such that the signal is perceived by the listener as [y]. When this listener turns to speak it, he will minimally coarticulate it as [y]. In such a scenario, SC would occur. The listener makes correction

drawn upon his knowledge of how speech sounds interact. Because the correction he makes is not required and it results in a distortion of the speech signal, a change in sound occurs. This is what Ohala called *hyper-correction*, which is defined as applying reconstructive rules when not needed (cf. Ohala 1981: 187).

In 1989, Ohala argued that SCs are drawn from the pool of synchronic variation. He has incorporated synchronic variation, which he refers to as ‘pre-conditioned sound variation’ as a means to explain diachronic changes. He limits himself to the attested SCs in a similar form in diverse languages, which helps to guarantee that they owe something for universal and timeless physical or physiological factors. The duplication of the SC in the laboratory was to test the similarity of speech sounds. According to him, sounds that look similar in the spectrogram will be similar to the ear. In other words, those sounds which show similarity in their spectrographic representations will be perceptually similar. ‘Hidden variation’ was also employed to refer to those aspects of variations exhibited but which both the speakers and the listeners do not recognize as variations (Ohala 1989:175). These hidden variations can create ambiguity and lead to a listener’s miscomprehension norm. Hence, a miscomprehended pronunciation is a changed pronunciation, i.e., SC. When there is no error correction of this miscomprehended sounds or the correction is not perfected, the signal is changed between the source and the target.

Ohala demonstrates that a listener plays an important role in SC. First, the listener recognizes and factors out the speech signal’s inherent phonetic variability that would have led to SC. Second, the listener unknowingly participates in SC by faithfully copying the inherent phonetic variation. Third, in some cases, the listener triggers SC by misapplying the reconstructive rules that serve to correct phonetic variability. Ohala has excluded language- and culture-specific factors like spelling pronunciation, paradigm regularization, and fashion (social factors). He limited his study to the preconditions of SC and not their actual trigger or the subsequent spread through the lexicon, dialect community or one speech style to another. The focus was therefore on the type of SCs that have been attested independently in the same form in many unrelated languages to render what may be referred to as ‘universal factors’.

How variation in speech production can lead to sound change: hypo-correction (Ohala, 1993: 246)? According to Ohala, if the listener fails to correct the perturbations in the speech signal, then they will be taken at the face value and will form part of his conception of its pronunciation. Via such hypo-correction, the phonetic perturbations become part of the pronunciation norm. This is what is presumably referred to as phonologization.

Why would a listener fail to correct a perturbed speech signal ‘hypo-correction’? (Ibid)? The answer to this question is provided by Ohala as this: first, the listener may not have the experience to enable him to do such correction. Second, a listener fails to perceive the conditioned environment.

2.4 A Combination of Articulatory and Perceptual Theories

Like Ohala (1989 &1993), Belvins (2004) incorporated synchronic variation as a means to explain the diachronic change. Belvins proposed diachronic explanations for synchronic sound patterns which are both formal and non-teleological. On the other hand, Belvins looked at the language as transmitted from one individual to another and from generation to generation. During this transmission, Belvins holds that SC originates. She proclaims that language differs from living organisms in their fairly imprecise method of transmission.

In order for a signal to be transmitted, there must be two subjects: a producer (the speaker) and a receiver (the listener). The former provides input and the latter attempts to internalize his/her grammar to understand speech. Belvins associates the error committed by the speaker with the general typology of phonetically conditioned sound changes, utilizing three different natural phonetic sources of sound change. She refers to them as: (1) CHANGE, (2) CHANGE, and (3) CHOICE. One factor is the probability of an acoustic signal being misheard by the listener/learner in the course of language acquisition (Belvins, 2004: 32). If SC has a perceptual similarity as its primary basis, then it is a type of source 1. For instance, if a signal *A* can be misheard/learned by listener/learner as *B*, then a change of *A* to *B* is phonetically motivated. (1) CHANGE: The phonetic signal is misheard by the listener due to perceptual similarities of the actual utterance with the perceived utterance. Example:

Speaker: says [anpa]

Listener: hears [ampa].

This type of change has been referred to be Ohala in the previously mentioned works. The main idea behind this type of change in Belvin's work is that a listener mishears the signal due to perceptual similarity. In 'CHANGE' type two: the signal is produced and perceived accurately but because the signal is intrinsically phonologically ambiguous, the listener associates a phonological form with the utterance different from that internalized in the speaker's grammar. Example:

Speaker says: [ʔa?] for /a?

Listener hears: [ʔa?] and assumes /ʔa/ (Belvins, 2004: 32).

Finally, if a sound change has phonetic variation as its primary basis, it is classified as an instance of CHOICE (Belvins, 2004:33). If a single phonological form has multiple phonetic signals which represent variants and is perceived accurately but associates with a phonological form with the set of variants which differs from the phonological form in the speaker's grammar, then it is a type of CHOICE (*ibid*).

3. Conclusion

The articulatory theories hold that a speaker is the source of SC, and views SC as teleological. A speaker can be seen as a source of SC due to physical, physiological and neurological factors. On the contrary, perceptual theories assume that the listener is the source of SC. Perceptual theories view SC as non-teleological. According to perceptual theorists, SC is not purpose-oriented;

for neither the speaker nor the listener intends to change a sound. In her account on the origin and causes of SC, Belvins (2004) demonstrated that both a speaker and a listener are the sources of SC. As such, SC was seen as both teleological and non-teleological.

To sum it up, Ohala (1981, 1989, 1993) and Belvins (2004) have elegantly shown that a listener can be a source of variation due to: (1) Confusion of similar sounds: the principle idea behind this is that a listener confuses between sounds produced because some sounds are perceptually similar. Therefore, a listener may perceive a sound produced by a speaker differently. For example, the English word "through" [θ.u], may be heard as [f.u] (Sweet, 1888, 1874:15-16); (2) Hypo-correction: This takes place when a listener fails to implement corrective rules. (Ohala 1989: 188); and (3) Hyper-correction: The implementation of rules when they are not required is called 'hyper-correction'. SC occurs when a listener, at some point in time, takes the output of the rule as a pronunciation norm.

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