Game Theory Choice on Salient Phoneme-Realisation (SPR): Strategies on Variance in Speech Production and Perception

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The sound of salience comes in two forms (Rácz, 2013) [1]: salience of phonemes with lexical references and/or social indices. Though the notions of salience in phonemic alterations remains undefined, the appearance and perception of salience within speech is obvious when it appears in systematically occurring alternating speech patterns; which are perceived as "robust", dominant phonemes within phonological structures. In order to develop a deeper understanding of salience, this paper examines Game Theory choice of phonological variation in English specifically the plosive phonemes, the consequences for the perception of speech, and the distinction between cognitive and sociolinguistic salience.

The selection process on Salient Phoneme-Realisation (SPR) by a population of the speech community is especially in line with the static characterisation of Evolutionarily Stable Strategies (ESS) by John Maynard Smith (1982) [2]. A language speaker's choice on SPR is analogous to an evolutionary trajectory towards increased adaptation to the environment of a target sound within the language community, in which interactions between language interlocutors can be considered strategic games. In Game Theory, players have something to win or to lose in the interaction with other participants and the payoff for each player depends upon their strategic choice against said players. Maynard Smith [2] investigated various species and saw that participants within a population adopted strategies even if their genes were no to the benefit of future generations causing alterations or mutations that led to differences. The innate strategic aims of the participants according to Maynard Smith meant the populations evolved an evolutionarily stable strategy (ESS), the behaviour of individual participants would lead to certain dominant genetic traits in later generations throughout the population. Thus, individual interlocutors within a speech community inadvertently establish their SPR strategies upon the speech community altering the choice of salient sounds available to the speech community.

A language player's choice on Salient Phoneme-Realisation (SPR) from their own phonemic inventory in the ESS setting, the operationalisation mechanism of salience, can provide the player with two major sets of adaptation strategies in speech production: *Imitation* or *Mutation*. And here were eluted to measure the utility matrix of the speaker's strategy between imitation and mutation for SPR regarding its stability (cognitive salience) and dynamics (sociolinguistic salience) by focusing on /p/, /t/, /k/. If the speaker's strategic choice for robust phonemic realisations of the plosives in a game-like condition is evolutionarily stable, the strategies can be regarded as something intrinsically congenial with (linguistic) gene configurations [3].

In other words, continuous repetition and the payoffs of each game under the interlocutors' strategic interactions are accumulated as *fitness*, i.e. evolutionarily stable reproduction of SPR. If a certain strategy for *salient variants* of linguistic variance yields on average a payoff that is higher than the population average, its reproduction rate will be higher than the average and its proportion within the total population increases, while strategies resulted in *non-salient variants* with a less-than-average expected payoff decreases in frequency (Jäger, 2004) [3]. For example, the utterance of voiceless stop /p/ word-initially in English, if produced as aspirated [p^h], it is a salient variant; while the production of it as tensed fortis [p'] is a *non-salient variant*, i.e. evolutionarily unstable.

The game-theoretic analysis on Salient Phoneme-Realisation (SPR) under the framework of Evolutionarily Stable Strategies (ESS) requires five basic elements: players, rules of the game, information, strategies, and payoffs. This investigation examined a speaker's choice of phonological variation, i.e. the consequences for the perception of speech, and the distinction between cognitive and sociolinguistic salience. In line with the static characterisation of ESS, to

pinpoint the speaker's strategies between imitation and mutation for SPR in the production of English readings by Native speakers (NS, *n=16*) and late bilingual Korean learners (KL, *n=14*) [5], the plosives /p/, /t, /k/ were tested within the exemplar utility matrix for SPR. Strategically, the production of a voiceless stop /p/ word-initially, for instance, the interlocutors from the two populations (player 1: NS and player 2: KL) are expected to choose among the three options of sound variants; aspirated as in [pʰ], unaspirated/lenis [p], or fortis [p']. The concept of SPR, i.e. congenial to ESS, is strongly related to the rationalistic approaches of a Cognitive Salience Stability (CSS) and a Socio-linguistic Salience Dynamics (SSD). The CSS generates a Nash Equilibrium (NE) of a target phoneme, e.g. /p/ word-initially in English, if it is a best response to itself, resulting in [pʰ]; while the SSD entails a Strict Nash Equilibrium (SNE) of a target phoneme if it is the unique best response to itself, resulting in [p].

The outcome of the two players' choice on the same strategy can be generalised as an evolutionarily stable strategy since all individuals within a population adopt a strategy, e.g. imitation, will never leave this choice unless mutations occur. A set of *imitation* strategies (e.g., ±aspiration, ±neutralisation, ±voicing to the plosives as per their syllabic positional condition in English) are evolutionarily stable if they are resistant against small amounts of non-imitation mutant variant, e.g. fortis [p] in the syllabic onset position. The strategy of imitation sets are minimal evolutionarily stable sets, i.e. have not evolutionary stable proper sets [3, 4]. Therefore, it is predictable that each population of the speech community will approach a minimal evolutionarily stable set if the level of mutation variance is sufficiently small as the production of the target sound utterances by all the players converges to a CSS. However, the existence of Nash equilibrium SSD, the unique best response of [p] within both NS and KL players, illustrates the possibility of a social index that leads the operationalisation mechanism of salience variance.

In conclusion, the SPR Utility Matrix for the plosives realisations by Native English speakers and bilingual Korean-English speakers of the target phonemes revealed that speakers make lexical and social choices based on their phonemic inventories, i.e. the consequences for the perception of speech sounds results from both cognitive and sociolinguistic salience.

References

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