Empirical investigation of fine consonant contrasts in different dialects of Arabic have included timing approaches to contrast the duration of the audio signal of a single consonant (singleton) with that of word-internal geminates in the same word context (Hassan, 2002; Ingleby & Boathman, 2002; Khattab, 2007). These studies have shown that the duration of geminates is about twice that of a singleton (Figure 1a, following page). Such studies are concerned with external articulatory contrasts, but in these experiments we investigate auditory and cognitive aspects of the contrasts, probing the mental models that mediate perception. Given incongruent stimuli, in which the audio and visual signals are in conflict, many observers report a perception that differs from the data in either channel. The phenomenon is known as McGurk fusion (McGurk & MacDonald, 1976). Typically audio ‘ba’ temporally aligned with visual ‘ga’ (lip movements) elicits the fusion percept ‘da’, or more symbolically

\[(1) \text{AUD}\left(bait \| \text{gate}\right)_{\text{VIS}} \rightarrow \left(date\right)_{\text{PER}}\]
\[(2) \text{AUD}\left(map \| \text{mack}\right)_{\text{VIS}} \rightarrow \left(mat\right)_{\text{PER}}\]
\[(3) \text{AUD}\left(baal \| \text{qaal}\right)_{\text{VIS}} \rightarrow \left(daal\right)_{\text{PER}}\]

and also (4) \(\text{AUD}\left(nahab \| \text{nahaq}\right)_{\text{VIS}} \rightarrow \left(nahad\right)_{\text{PER}}\)

For an incongruent phonetic segment, the fusion rate (proportion of participants reporting fusion depends on the segment’s syllabic context, and can serve as a probe of structure. When English syllable structure is probed in this way, the abiding pattern is that for fusion rates amongst Anglophones are significantly less for syllabic onsets than for codas (Ali & Ingleby, 2005). The onset/coda differences survive in branching constituents, polysyllabic words and words embedded in natural phrase contexts. The onset/coda differences were, however, not observed when Arabic stimuli were put to Arabophones - thus adding to growing evidence that Arabic may be a coda-less CV language at the level of the mechanisms mediating perception in Arabophones (Ali et al., 2005).

The experiments in this paper move further towards isolating differences in cognition of fine phonetic detail between Anglophones and Arabophones. We use Arabic stimuli with word-internal audiovisual incongruity at sites of singleton/geminate phonemic contrast, as exemplified by

\[(5) \text{AUD}\left(haabaa \| \text{haqaa}\right)_{\text{VIS}} \rightarrow \left(hadaa\right)_{\text{PER}} \quad \text{vs} \quad \text{AUD}\left(habb-a \| \text{haq-q-a}\right)_{\text{VIS}} \rightarrow \left(hadd-a\right)_{\text{PER}}\]

In the first experiment, we put the Arabic stimuli (incongruent stimuli randomized amongst distracting congruent stimuli) to Arabophones. In the second experiment we put the Arabic words to Anglophones. In both experiments participants were given open choice response forms; in Arabic script for Arabophones (e.g. بحبّ) and transcription form for Anglophones (e.g. ‘habba’). None of the participants had any linguistic knowledge and were allowed to replay the video clip at will before reporting a percept.

The results showed distribution of fusion rates is bimodal for Arabophones, with a lower-rate peak for geminate consonants and a higher peak for singletons. But, for Anglophones there was a unimodal distribution law that indicates a failure to perceive the singleton/geminate contrast. We impute this difference of perception between our two subgroups of participants to a difference of mental models, similar to the differences of model reflected in the failure of Arabophones to perceive onset/coda contrasts.

Such differences of mental model internalize obvious habituation patterns. Externally, singleton/geminate contrast is semantically important and very common in Arabic; but in English, though textual gemination is a common orthographic feature, truly phonemic gemination is rarer. When attested, it is a product of collisions – morphological (e.g. ‘unknown’ and ‘soulless’), or cross-word (e.g. ‘big game’ or ‘top post’) or across phrase boundaries (e.g. ‘Jack, cutting in, said…’ or (‘Pop, posing a question, stood…’). Durational studies (Benus, Smorodinsky & Gafos, 2004) show that these lead to corresponding
gradience in geminate binding: shortest duration, strongest binding for morphological collisions; longer
duration, weaker binding at word boundaries; weakest binding at phrase boundaries, where the geminate
integrity may even be compromised by a reduplicated burst. The collision phenomena of Arabic are made
more complex by case endings, glottal stops and normative elision processes in possessives, so for present
purposes we have investigated only word-internal cases. They are internalized differently by Arabophones
and Anglophones.

The differences of perceiving coda/onset fine contrasts may also be internalizations, but of the more
elusive notion of syllable. Arabophones are exposed to CV patterns through their orthography in which
words are built from consonants pointed with vowel diacritics, and through traditions of Qur’anic recitation.
This has been represented in a CV element phonology for Arabic recently (Ingleby & Baothman, 2002). The
use of codas (closed syllables) in the teaching of Arabic prosody is part of a Western classical tradition
borrowed from Latin and Greek verse and used in studies of prosody in Germanic and Romance languages.

Whatever habituation patterns are responsible for the observations, there is a need to probe further: larger
samples, corroborative priming experiments, the usual procedures of psycholinguistics. And in the longer
term, a comparative psycholinguistic study of collision phenomena and cross-boundary coarticulation will
be needed before internalization in the mentallexicon is fully understood.

Figure 1: Schematic distribution of (a) duration of singleton and geminate consonants (b) fusion rates for singleton
and geminate consonants.

References
Proceedings of XXVII Annual Conference of the Cognitive Science Society (pp.91-7). Stresa, Italy.
Benus, S., Smorodinsky, I., & Gafos, A. (2004). Gestural coordination and the distribution of English “geminates”. In
S. Arunachalam & T. Scheffler (Eds.), Proceedings of 27th Penn Linguistic Colloquium (pp.33-46). Penn
Linguistics Club.
An instrumental and comparative approach. TMH-QPSR Vol.44, Fonetik.
Ingleby, M., & Baothman, F (2002). Empty nuclei in Arabic speech patterns and the diacritic sukuun. In Sami Boudelaa
(Ed.) Perspectives on Arabic Linguistics XVI. (pp83-94). Amsterdam: John Benjamin.