The Matter of the Root
Visualizing co-occurrence relationships of verbal root consonants in Maltese

The morphology of a large number of verbs in Maltese is based on roots consisting of three and, less frequently, of four consonants. There is, however, a discrepancy, in Maltese as in other Semitic languages, between the number of verbal roots that are theoretically possible and their actual numbers as attested in the lexicon. The question arises naturally whether the unattested forms are mere accidental gaps or whether there are systematic constraints for the proper shape of a root. We seek to answer this question by investigating the phonological structure of an exhaustive list of around 1,800 verb-creating roots in Maltese which we compiled using Serracino-Inglott (1975-1989) and Aquilina's (1987-1990) dictionaries as well as Mifsud's (1995: 272-295) corpus of loan verbs which are fully assimilated into the root-and-pattern system. In order to detect patterns and regularities in the data, we make use of some of the methodology developed in the field of visual analytics. Statistical values reflecting the various interrelations are mapped to pre-attentive variables, making an at-a-glance evaluation possible.

The investigation consists of two main parts. In the first part, the emphasis is on the co-occurrence restrictions which hold for the consonants in the verbal roots of Maltese, which, to the best of our knowledge, has not yet been studied systematically. It has been known for quite some time that in Semitic the co-occurrence of certain consonant pairs in roots is restricted. Studies on the verbal lexicon of Arabic and Hebrew (cf. Greenberg 1950; Bachra 2001; inter alia) report that for triconsonantal roots there are strong combinatory restrictions on pairs of consonants that belong to the same consonant group. Our visualizations in Figure 1 show that these restrictions in terms of place and manner of articulation can be confirmed for Maltese.

Figure 1: The matrices show whether a certain succession within root consonants is more (+, blue) or less (-, red) frequent than expected. The color saturation reflects the degree of association strength ɸ. The left matrix shows that similar places of articulation (l: labial, c: coronal, d: dorsal) are avoided (as can be seen in the red main diagonal). Likewise, successions of consonants with similar manners of articulation (o: obstruents, s: sonorants; right matrix) are statistically underrepresented.
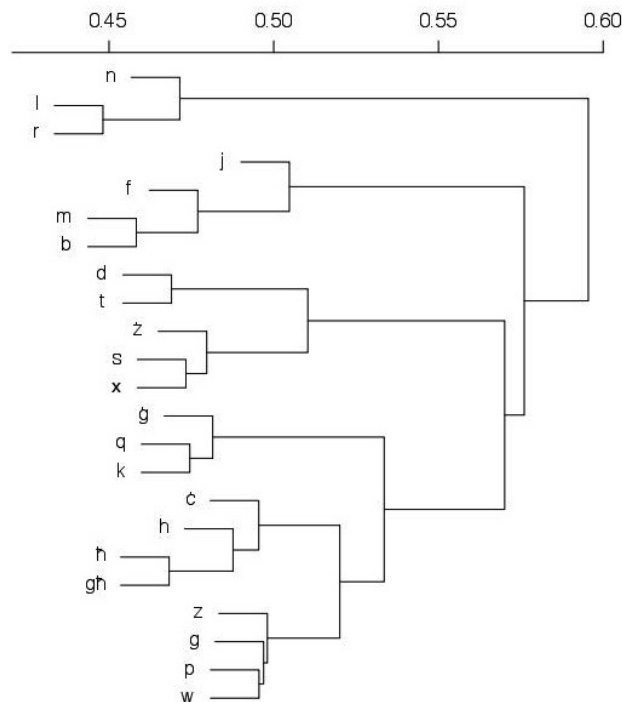
Figure 2: The dendrogram shows the similarity of consonants in Maltese based on their distribution in roots. The less frequently consonants occur in adjacent positions in roots the more similar they are.

The second part deals with correlations between the phonological structure of the verbal roots and the patterns or *binyanim* they are mapped into. Since roots are discontinuous bound morphemes which do not exist independently of their patterns, the question is whether the phonological shape of the root determines to a certain extent the patterns in which it may be realized. For instance, binyan 8 involves an infixed /t/ immediately after the first consonant which is reflected in the fact that roots with /t/ in initial (C1) and second (C2) position are not realized in this pattern due to phonotactic reasons (See Figure 3).

	1	2	3	5	6	7	8	9	10	
t (C1)	23	33	2	21	6	17	0	2	0	104
t (C2)	35	53	3	43	8	18	0	3	0	163
t (C3)	28	46	2	41	5	16	10	1	0	149

Figure 3: Number of cases where the consonant /t/ is realized in the different binyanim for each position in the triconsonantal root.

References:
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