A preliminary description and analysis of the phonology of Portuguese Sign Language for computational modeling purposes

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Since the 1960s, when Stokoe (1960) demonstrated that sign languages are linguistic systems with typical behavior of natural languages, sign languages began to be studied as complex structural linguistic systems, even if their visual modality differs from the auditive modality of spoken languages. After Stokoe (1960) proved that American Sign Language (ASL) has minimal sign pairs, research on sign language has shown that signs are composed of small meaningful units which, when combined in a certain way, create a lexicon. Several approaches have been proposed for the structure of signs: Supalla & Newport (1978) observed in ASL that there are pairs of verbs and nouns that can be distinguished by the movement associated with them. Lidell & Jonhson (1986, 1989) proposed the Move-Hold Model, which shows that the internal structure of signs is composed of movements and holds features based on a possible syllable structure of discrete sign languages. In recent years, developments in autosegmental theory led to research focusing on the simultaneous and sequential phonological elements of the internal structure of the sign. Following this approach, Sandler (1989) presented the Hand Tier Model, which proposes that handshape, location and movement are the three major categories taking part in sign languages, which can be combined in a sequential way in the sign structure. The Hand Tier Model is based on some of the categorizations of Stokoe (1960) and has introduced elements from the Move-Hold Model by Lidell & Jonhson (1986, 1989).

Despite the large number of studies of sign languages in the last 50 years, Portuguese Sign Language (Língua Gestual Portuguesa, LGP) only began to be scientifically studied since 1980, with a small systematic analysis of its phonological, morphological and syntactic aspects by Prata & Martins (1980). Since then, Amaral et al. (1994) have published research grounded in an exploratory approach to grammatical features of LGP. Although some important studies were carried out and a number of limited sign vocabularies have been created, so far LGP has not been studied in a systematic and consistent manner in the major areas of linguistics and was only officially recognized by at State level in 1997.

In this paper we present the first systematic study on the phonological structure of signs in LGP, based on the three sequentially combined major categories. The research involved a nearly exhaustive collection of possible segments, features, articulators and traces from the three major categories as well as a number of LGP lexical units, with their own hierarchical representations described and classified into binary traces based on the Hand Tier Model.
The collected data is now being compiled into a database, in which each segment, feature, trace, articulator and expression will be computationally modeled for a future interface with lexical resources for LGP, allowing for a sign synthesis system. The main goal is to create the largest lexical database of LGP, in which signs are computationally modeled and stored into a lexical database. The data in that database are then used by a number of tools to represent for future the modeled signs by a three-dimensional avatar. This resource will be linked to an existing online lexical resource of Portuguese (the Portal da Língua Portuguesa), allow for signers to search for a given sign both via its individual constituting segments and by each sign’s the orthographic equivalent in Portuguese. The administrative tools of this lexicographic and linguistic description system are user friendly, and the lexicographers in the team are sign language native speakers. This allows for easy updates and quick expansion of the lexical database, keeping the resource up-to-date and relevant. In order to generate new lexica, native signers are able to add new signs through the interface by combining different Major Category elements already existing in the database. This project is still a work in progress. The collection, description and preliminary analysis of the phonological elements and phenomena of LGP are the highlight of this first phase. Phonological knowledge regarding signs structure is crucial, not only to define the phonological structure of LGP but also to improve the performance of the whole system, including the lexical database.

Another benefit of having such a setup is that it allows for a detailed phonological study of LGP: the analysis of segments which distinguish minimal sign pairs; the definition of boundary constraints on the combination of segments; the identification of contrast parameters in handshapes and hierarchical representations; the establishment of place and setting in location; the description of general and internal movements; the characterization of possible lexical expressions, etc. The results of this analysis are the main focus of this paper. This database will allow us to investigate whether phonological universals of sign languages (Sandler, Lillo Martin 2006) apply to LGP, enabling us to discuss in more depth the hierarchical representations and internal classifications into binary traces based on the Hand Tier Model.

References