The Michela stenotype system as a support to disabled people (a pre-experimental study)

(slide 1 cover)

Disability can always lead to isolation. It can also cause cultural and social deprivations due to the lack of appropriate cultural stimuli or, sometimes, the impossibility of carrying out certain communicative activities, such as writing, speaking or reading. It is a real form of discrimination that has begun to receive its protection in the various State legislations only at the end of past century. **(slide 2)**. The first forms of protection in this area were introduced in the 1990's in the United States with the American with disabilities act, the first legislation that protected the disabled from all forms of discrimination, followed by other Anglo-Saxon countries of the Common law system, including Australia, New Zealand, and the United Kingdom.

Subsequently, the United Nations also conformed **(slide 3)** with the "Convention on the Rights of Persons with Disabilities" in 2006. The latter then becomes a concrete tool for inciting all State legislators to combat discrimination and the violation of human rights in this field. Regarding the aspect of knocking down communicative and cultural barriers, following new legislation in this area, a number of services have been introduced in various countries to follow television and web broadcasts. Such services include support measures for Sign Language and Braille, as well as subsidies and tax incentives for the purchase of communication support tools. Concerning Italy, we recall **(slide 4)** the law no. 126 approved in 2007 entitled "Establishment of the National Braille Day" and Senate Act no. 302, which is still under discussion, entitled "Recognition of the Italian Sign language". Moreover the European Union has recently started consultations for an European Accessibility Act (EAA) aimed at improving the functioning of internal markets for accessible products and services **(slide 5)**.

Stenotype has always played a role in the repression of cultural barriers. How the late lamented prof. Gianpaolo Trivulzio recalled in his powerful monograph

"Stenotipia" **(slide 6)**: "Since the beginning of the stenotypic conception (...) inventors have thought that the stenotypic machine could facilitate communication with the blind (...) And, conversely, the blind could use the machine to resume speeches, possibly leaving the next transcript to other colleagues".

It must be enhanced that the application of stenography as an aid to disabled people may have been traced back to the Michela keyboard **(slide 7)** to the years following 1862**,** when the machine was first designed, even before its debut in the field of the parlamentarian reporting. Successively, **(slide 8)** the first American stenographic keyboard, invented by Miles Bartholomew in 1879, had also been revisited in 1888 to accomodate the blind. Prof. Trivulzio, in fact, claims, in the aforementioned volume, that the diffusion of stenographic machines accessible to blind people dates back to the early 1900s. The (**slide 9)** most widespread method was to use Braille keyboards with stenographic abbreviation and acronyms. Following the keyboard's success and growing diffusion, several people were trained in the use of ordinary stenographic keyboards (Stenotype, Grand Jean and Palantype) and **(slide 10)** in the 1950's a stenografic contest was organized in France to which blind people could partecipate. Nowadays **(slide 11)** we still have examples of this application: like the interesting report on "The profession of parliamentary reporter for disabled persons" by Jenny Laval and Gert Sandig during the 2011 IPRS meeting, Miriam Martin Garcia, who won two Intersteno junior world titles) and the program for the blind with the Yawey keyboard.

Recently, **(slide 12)** the subtitling services based on steno-keyboards have also been found to be popular in the field of higher education. (As we know Velotype is having an important experience in this field).

MICHELA AS A COMMUNICATION DEVICE FOR DISABLED PEOPLE (slide 13)

The idea of this study was born from the observation of the important connection between the stenographic world and the reality of individuals with disabilities, in order to highlight some specific uses of the Michela keyboard which had already been foreseen by its inventor and to evaluate it further in light of the possibilities offered by new technologies. Our focus was therefore on assessing the potential of this keyboard as a input/communication system for disabled people.

It should first be noted that Michela is well suited for this use, considering that, being a musical keyboard, it is much more ergonomic than the common QWERTY keyboard, due to the width and shape of the keys. It can also be easily used by disabled people, as demonstrated by several experiences in music therapy **(slide 14)**. It should also be emphasized that, according to the specific layout **(slide 15)** of the Michela system, each finger can operate no more than two contiguous keys and this greatly facilitates blind writing as finger movements are minimized.

As known, the Michela system (conceived in 1862) belongs to the category of phonetic keyboards **(slide 16)** (similar to the US Stenotype, Grand Jean, and Palantype keyboards) and it is perhaps the excelling phonetic system. It originates from the meticulous studies of Antonio Michela, who devoted his life to the search of a universal alphabet based on the representation of sounds **(slide 17)**. Unlike other keyboards, the Michela is characterized by a distinct "phonographic" and "universal" orientation. It is instantly recognizable by its layout, characterized by the representation of syllables and phonemes rather than words and by the presence of various **(slide 18)** (palatal (y), velar (w, ng) and interdental (th) sounds, plus some umlauts(Ü), diphthongs (oi), semivowels (oui) and silent vowel (mute e)) sounds that are not present in the Italian language but are typical of other idioms. The system **(slide 19)** is capable of representing a set of 37 phonemes (26 consonant sounds and 11 vocal sounds) in the four different positions in which they can be found **(slide 20)** within a syllable: onset (which, as is well known, can be formed from one or two consonant sounds), nuclues and coda. Some key combinations **(slide 21)** can take on different values to better adapt to the phonetic characteristics of other languages, as already stated by the inventor in his 1882 manual. The Michela set of phonemes corresponds, to a large extent, **(slide 22)** to all the sounds in the so-called IPA broad (or simplified) transcription and allows to adequately represent most of the sounds of a large part of common languages.

(slide 23) VOCAL COMMUNICATION DEVICE FOR MUTE PEOPLE OR PEOPLE WITH VOICE DISORDERS

One of the primary aims of this study was to allow vocalization of the phonemes produced by the Michela keyboard to test its use as a communication device for mute people. For this purpose, it was considered appropriate to use the Total Eclipse software, as a study tool, considering its great versatility, although the same results can be achieved with other software. To make the computer vocalize phonemes produced with the steno keyboard, it would have been possible to send the output of the phonetic decritter to a text to speech software. However it was decided to use single wav files for each phoneme, in order to allow for a vocalization of the phonemes syncronized with typing. This method may simplify the comprehension of the phonemes for the disabled. It may also allow the continuation of experiments in the field of speech therapy for Dyslexia **(slide 24)**, theme addressed at the 2010 FIDAPA Association conference "Michela Project - language and learning issues". A set of 1,600 entries **(slide 25)** to the most common syllabic sounds in the Italian language, was therefore created to which the respective phonemes sounds were associated in the form of wav files. Besides being able to reproduce phoneme sounds, the system could also display the phonemic structure using the International phonetic alphabet (IPA) symbols. This is a a brief demo of the vocal dictionary for Italian language **(it could seem that the reporter is writing a standard speech but actually in this case the process is reversed: it is the pc that vocalizes what the reporter is writing) (video 26)**.

If we dispose of an adequate number of wav files, it would be possible, using this system, to reproduce the sound of all 81,796 phonemic structures present in Michela keyboard and successively create a universal communication system for individuals with language handicaps (or for dyslexia therapy). This video shows the vocalization of simple sentences in different languages. **(Video 27)**. As you may know, the prevalent problem is speed, because the built in wav player of Eclipse seems to fail in keeping up with the actual translation. (so at the moment it’s not yet possible to write at steno speed without loosing the phonemes vocalization). To avoid this problem, it would be necessary to increase the wav file playing speed (without changing the pitch) as the writing speed increases. Lastly, because the Michela keyboard uses the MIDI protocol for music, which, as known, is capable of recording the force with which the keys are pressed, it would be reasonable to use this function to alter the voice pitch in relation to the pressure exerted on the keys.

(slide 28) WRITING DEVICE FOR BLIND OR VISUALLY IMPAIRED PEOPLE

The second phase of this study analized one of the first applications that was made for the Michela stenotype system in 1800, which was thoroughly described **(slide 29)** by the inventor in his first patent. The first Michela keyboards did not produce inked note pads, as the stenographic marks where imprinted, and were, therefore, similar to Braille characters **(slide 30)** (a system conceived in 1829 and already quite widespread in those years). These signs were known for their high legibility, as Antonio Michela had thought of a simplified system based on only six simple characters; comparable to the system designed by Louis Braille. The system’s first results with blind people were very promising, however, following the introduction of the first keyboard models capable of producing printed characters, which had been enthusiastically debuted in the most prestigious Assemblies **(slide 31)** of the time, the system then met an immediate success in the field of debate reporting (where it is still utilized to this day).

As a first step, **(slide 32)** the Michela keyboard has been equipped with braille symbols on each of the keys in order to facilitate the identification of the respective phonemes. A stenographic printed note pad using braille characters has also been made **(slide 33)** to promote the understanding of the visually impaired to syllable writing. As stated, the original system used punches; where the syllables where written as point sequences, from the left to the right. It was therefore decided to replicate the original steno notes in dry writing, replacing the Michela symbols with Braille symbols in order to make the interpretation of the phonemes easier for blind people today.

The results of this experiment underwent various protection associations **(slide 34)** for the visually impaired during a meeting organized by the Italian Senate, held on last February 21st on the occasion of the 16th National Braille Day. Reading tests **(Slide 35)** were carried out by numerous people affected by various forms of visual impairment. From these tests, no particular difficulties manifested themselves in interpreting the Braille signs written syllabically.

The second phase of this experiment involved the ability to produce word sequences rather than syllables in order to allow the system to be used by the blind or visually impaired people for faster text input (in ordinary characters or Braille) in a variety of writing and messaging applications.

For this pupose a specific orthographic theory has been developed. This theory has been chosen over the standard phonetic theory **(slide 36)** because it is easier to learn, allows for total control over spelling, can work even without a dictionary or an abbreviation system, can be developed with a simple and economical decryption software and, although not as fast as a phonetic system, permits far superior speed compared to a standard QWERTY keyboard.

In addition, the creation of an orthographic theory for Italian **(slide 37)** is quite simple due to the fact that this idiom is a allegedly considered a transparent language (along with Spanish, German, Finnish, Hungarian and Serbian-Croatian) and hence, unlike opaque languages (like English, French, etc.) every sound present in words finds its graphic expression. Therefore, each grapheme corresponds to a specific phoneme.

With this ortographic system, **(slide 38)** any operator can, after a training period of about twenty to thirty hours, be able to write any word. After an adequate training, an average operator can reach a standard speed of about 300 syllables per minute. For more experienced operators it has also been developed an abbreviation system for recurring prefixes, articulated prepositions, suffixes and consonant vowel groups present at the beginning or at the end of italian words. This could further increase the writing speed over 300 syllables per minute. As evident, these are more than adequate speeds for text input or verbal communication systems.

Experimental dictionaries for orthographic writing in other languages have also been developed, along with the use of Braille fonts **(slide 39)**.

Connecting the system to a display and a loudspeaker further allows writing in a sillabic mode thanks to the following implementations in the Michela, such as orthographic theory, phonemic vocalization, and Braille character representation) **(video 40).**

EMULATION OF A BRAILLE-PERKINS WRITER (slide 41)

Among the many questions arisen during the Braille meeting in the Senate, several have emphasized the possibility of using the Michela keyboard as a Braille terminal, and not just as an ordinary writing terminal. In fact, it has been noted that, both in Italy and abroad, Braille is spreading, as are people using Braille-Perkins keyboard to input text. Unlike ordinary keyboards **(slide 42)**, Braille keyboards do not have a key for each character, but consist mainly in six writing keys, corresponding to the six points of the Braille matrix, plus a space key, a backspace and return keys. To obtain a character, the person needs to simultaneously press every key that matches the dots needed to form that character. It was further considered, as a result of the aforementioned interest and the questions received on this topic, to develop a specific writing mode that would allow the emulation of a Braille keyboard in the Michela. Moreover, the use of musical keyboards for Braille systems was not an innovative idea since **(slide 43)** even one of the earliest Braille keyboards on the market, the Hall-Braille of 1892, used small piano keys, The development of such layout was thus inspired by the latter.

Two possible ways to emulate a Braille keyboard where developed.

The first system **(slide 44)** imitated the classic Perkins-Braille keyboard layout. In this case, the 6 internal black keys on the Michela keyboard corresponded to Braille matrix marks «3», «2», «1», «4», «5», «6», along with the two additional internal white keys, used as a space bar. The external black keys were instead used to indicate the return and delete keys.

The second system **(slide 45)** is aimed at increasing typing speed in Braille, mimicking the presence of two braille-type keyboards, one on both sides of the Michela keyboard. In this case, all six white keys of each keyboard are used to follow the six keys of each braille keyboard. The "space" will be obtained by pressing any of the black keys simultaneously with any combination of other keys. As you may have guessed, this "Stenobraille" method, may allow for the typing of two Braille characters at a time, but also for the use of the left keyboard to indicate the graphic attribute of the next character (uppercase, number, Greek alphabet, mathematical expression, etc.), according to the typical rules of the Braille system, with notable advantages in terms of speed over the conventional Braille keyboard.

FURTHER DEVELOPMENTS (slide 46)

Early results from this study highlight the Michela keyboard's potential as a major vehicle for the accessible communication systems. This is partly due to the limited number of keys provided by the system (it being the stenographic keyboard with the smallest number of keys in the world today) and its ergonomic features (music keyboard). This latter aspect **(slide 47)** also facilitates the creation of a Michela keyboard from simple and inexpensive MIDI keyboards by simply removing excess keys. For example, here **(slide 48)** you can observe an experimental studio on a split keyboard that, in addition to enhancing the portability of the system, allows for a larger space between hands (to place a screen or text). An additional study was also conducted for further simplification with the creation of a single-handed keyboard for a variety of uses. Tipically, single-handed alphanumeric keyboards **(slide 49)** consist of fewer keys to operate with one hand (for example, Frogpad, Maltron and Twiddler keyboards). Although such devices are defined "chorded keyboards", they remain alphanumeric keyboards, since each key, or any combination thereof, always corresponds to an only character and missing letters are matched with key combinations. Inspired by the split-keyboard, a 10-key device was created **(Slide 50)** (corresponding to the left-hand keyboard of the Michela) in order to create the first steno-single-handed keyboard. With this device, it is possible to represent groups of characters or simple syllables, and not just single characters. This device has been nicknamed "the Syllabox" for its features.

The use of solely **one of the two Michela keyboards** made it necessary to make minor changes to the layout **(Slide 51)**, such as placing the vowel bank in the place of the subsequent sound bank. Therefore, the keyboard consists of a primary bank representing consonantal sounds and a secondary bank representing vowel sounds. At each stroke it is thus possible to write a single consonant, a single vowel or a consonant-vowel group (CV). According to scientific publications **(slide 52)** from the Department of Language Sciences of Ca' Foscari University of Venice: "The simplest and most common syllable in human language is the one with the CV structure (vocal plus consonant), that is:

- the most frequent (about 60% of the syllables in Italian have this structure);
- the syllable that children understand first "pa.pà" "ta.to" "be.ne"
- the last one that the aphasics lose;
- the only structure present in every language worldwide".

Therefore a keyboard with CV layout is probably the most suitable for simplified writing.

Similarly to the previous examples, an orthographic theory has been developed also on the latter keyboard to represent, in addition to CV groups, also some recurring CC (consonant-consonant) groups and some recurring diphthongs in one stroke. It is also possible to indicate capital letters, digits, and blank spaces (without additional strokes). Moreover some shortcuts are provided to write the few monosyllabic words that end by consonant (eg: «il», «un», per», «con», «ad», «in», etc.).

The operator will therefore be able to write single letters, CV syllables (consonant-vocal), some recurrent CCV or CCV+dypthongs syllables. The remaining syllables with VC (vocal-consonant), or other kinds of CCV groups will be written using two or three strokes, making sure to always write the CV groups in a single stroke. For instance, all the Italian words with only CV groups **(Slide 54)** (eg «bene», «valore», «salutare», «comunicami») can be written with one hand, using this device, in less than half of the strokes required when using an ordinary QWERTY keyboard with two hands. Other more complicated words require some additional strokes, but, as you can see, the number of strokes is always much lower than that of a standard QWERTY keyboard**.** Here we can see a little demo **(video 55).**

Given its small size **(slide 56)**, the Syllabox keyboard could be used in endless ways, including: one hand text input; wereable vocalization device for disabled people; text input for systems having limited space available; command system for virtual reality (286 single-stroke commands available).

Now you'll have a brief demonstration of Syllabox as a wereable device (**Video 57)**.

(Slide 58) Dear friends, thank you for your kind attention and for your patience. We hope we have not bored you too much with this presentation. We will be available for any questions.