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ASTRONOMY AND DEAFNESS

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Abstract. Scientific and technical words in Astronomy are often absent in many sign languages. To alleviate this problem, we present the first on-line dictionary which includes a comparative list of signs which can be used especially in sign language for countries in which they have not been yet defined. After a brief summary of the history and evolution of the sign language in France, we show that many common signs can be adopted as universal, taking into account the individual heritage of each country

Keywords: Astronomy, Deafness, Communication

1 Introduction

I m not deaf, just a little hard of hearing ! This statement of Professor Tournesol's is current throughout Hergé's work and one can ask oneself how, in a scholastic and academic world in which there is little inclination to integrate the deaf community, Tournesol could have progressed to becoming a Professor of science. But leaving Tintin aside, a caring society has to make scientific culture available to all, including the deaf community. We shall see how, thanks to French Sign Language (LSF) as well as sign language from other countries, scientific communication in astronomy has become established in a remarkable way through knowledge of deaf culture and through sign language which has established complete communication between the deaf and the hearing.

2 A dialogue of the deaf

The French Sign Language, LSF is a complete language possessing its own vocabulary, grammar and declensions just like any other national language. However, whereas in many countries it is completely integrated into the culture, in France there is considerable intellectual catching-up to be done. The abbé de l'Epée (1712-1789) is credited with inventing a structured sign language. Since then, however LSF has known many changes of fortune over the course of the years and it was even forbidden by the Congress of Milan in 1880 thanks to religious and social prejudice (19th century society that had yet to overcome prejudices such as *don't point* or *masturbation will make you deaf*, which were the creations of August Tissot (1728-1797) a doctor from Lausanne). The isolation of the deaf community gave rise to a normal reaction in the face of oppression: a resistance movement. In particular, a desire to communicate between the young happens naturally by signing. Little by little, countries discovered with what success the deaf were integrated into the scientific mainstream in countries such as USA, Canada, Great Britain ans Sweden. Nowadays, sign language has finally obtained its status as a complete language in more and more countries. It continues to make itself steadily known in an attempt to regain its status as a language in its own right. In France, it wasn't until 1977 (!) that the Minister for Health lifted the ban and we then had to wait until 1991 for the Assemblée Nationale to allow children to be educated using sign language. An unmourned French Minister for Education wouldn't even allow in 1988 for it to be taught in its own right.

There are numerous examples of well-known figures in the arts and music who were deaf, among them Pierre de Ronsard (1524-1585), Francisco Goya (1746-1828) and Ludwig van Beethoven (1770-1827). Two other famous deaf people who won fame through their inventions were Alexander Graham Bell (1847-1922) and Thomas Edison (1847-1931). In astronomy, John Goodricke (1767-1786) who discovered the family of Cepheids was totally deaf as well as Henrietta Swan Leavitt (1868-1921) whose discovery of how to effectively measure vast astronomical distances led to a shift in the understanding of the scale and nature of the universe.

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3 A word to the wise

LSF is a complete language, totally structured in form and having its own vocabulary and grammar. It is expressed following precise rules which are associated with basic body gestures. It has its own natural evolution with a continuous definition of new signs e.g. for Internet, DVD or digital camera (by signing alternate 1-0-1-0 + camera). It can express every degree of abstraction and can also allow everyone to communicate and exchange all types of information. To achieve this, there have to be frequent changes of situation. For example, the past discovery of water on Mars by the probe *Mars-express* requires a description in double time: firstly, a rocket which went from Earth to Mars (where, when, how far, how long) and secondly, changing the subject to Mars itself where the probe carried out its tests and detected water (height of the probe above the ground, types of tests, etc). Using sign language therefore involves furnishing a number of background data which are more important than in spoken language and which thus give it its richness and precision. It is obviously impossible to reproduce word for word a scientific exchange between the deaf and the hearing; that's why we have limited ourselves to some examples drawn from mathematics, physics and astronomy.

In mathematics, numbers are linked up using a number of signs. 1789 is signed as 1 - thousand - 7 - hundred - 89 . Big numbers (millions, billions) have their own sign as well as operators. All quantities are signed as weight, surface, volume, distance; there is no difference between oral and signed expressions. Physics has a very explicit number of signs. Constants are signed using the same letters but it has to be stated precisely that, for example, c is the velocity of the light so we sign one time c = 300,000 km per second and afterwards we only only design it with c. Chemistry is indicated by the two fists with thumbs outstretched which give the impression of mixing the constituents of a chemical solution. The elements are signed either specifically or by their symbol.

Astronomy is one of those areas where translation into LSF is at once a rigorous as well as a poetic exercise. The description of the planets in the solar system is signed as a function of their own characteristics. For example, Mercury is hot, Venus surrounded by clouds, Mars red and Jupiter is signed by making a round sign with the fingers of one hand against the other hand held out flat the red spot. The sign for Saturn is the same as for a galaxy so it has to be preceded by the sign for planet. The naming of items in the sky is simplified because many of the constellations are associated with a classical sign such as the Great (or Little) Bear, Swan, Goat, Fish, Whale, etc. Mythological names such as Andromeda or Perseus are simply spelled out or associated with known shapes such as *W* for Cassiopeia. In scientific communication in LSF, the expression on one's face is all important in expressing, for example, a mathematical series that tends towards the infinite (getting very small) or that the star *Mintaka* (delta Orionis) has a surface temperature of 30,000 (getting very hot). In addition to the strict nature of a translated scientific discourse, the signer uses sensitive gestures as part of the talk. This interpreter-interpretation interaction can transform the barest subject-matter into something both understood and felt. Thus Sign Language makes complete communication possible from simple concepts to subtle nuances. Sometimes, a *recent* object is easy to sign such a black hole (simply sign black + hole).

This rapid overview can obviously only give a bare outline of scientific communication in sign language. Facial expression is of great importance whether its to express large or small quantities such as temperature, pressure etc. In addition to the precision of a scientific discourse, the signer accompanies his talk with gestures in which the series of signs depends on interpretation in the musical sense of the terms. This interpretership/interpretation duality turns a talk in the strict sense into a talk that is not only understood but felt as well. In this way, the association of bodily expression with academic tradition adds a touch of humanity and sharing in a somewhat rough world.

4 Hands on the stars

Since 25 years, the French deaf Community has access to astronomy at Paris Observatory through a specific teaching adapted from the LSF, including direct observations with the observatory telescopes. From this experience, an encyclopedic dictionary of astronomy: *The Hands in the stars* was published by Proust *et al.* (2009), containing approximately 300 astronomical signs describing several classical celestial bodies such as planets, asteroids, stars (dwarf, giant, binary, variable) galaxies (single, groups and clusters) etc. as well as technical terms such as telescope, spectrograph or photometry. Recently, in the context of the association *Les Amis de la Main à la Pâte* (French Académie des Sciences), a new book with the same title containing astronomical signs, has been published by Proust (2024) and edited by CNES and ESA.

Fig. 1. The sign *astronomy* in 22 different deaf language.

In 2016/2017, a large project led by the IAU Commission of Astronomy for Equity and Inclusion (IAU Division C, Commission C1 WG3) with funding from the IAU Office of Astronomy for Development (OAD) decided as a 1st Goal to translate the Encyclopedic Dictionary of French terms into English and Spanish (Ortiz Gil *et al.* 2017).The dictionary can be accessed from the website of the Commission through these links: French, English and Spanish (Ortiz-Gil et al. (2017). After this work, a second goal was to develop a comparative list os astronomical terms, as many technical words in astronomy are either absent in many sign languages, and/or represented by signs linked to the cultural tradition and evolution of each country. As an example, Fig.1 shows the sign ASTRONOMY in 22 different languages. To alleviate this problem, we developed a first comparative list comprising 52 astronomical terms in 31 languages: French - France, French - Canada, Spanish - Spain, Spanish - Argentina, Italian, Japanese, English-USA, English-UK, English - UK Scotland, English-India, Bulgarian, Croatian, Chinese, Czech, Estonian, Finnish, German-Austria, German-Germany, Greek, Icelandic, Latvian, Lithuanian, Polish, Portuguese-Portugal, Portuguese-Brazil, Russian-Russia, Russian-Belarus, Romanian, Swedish, Turkish and Ukrainian. The list is available at http:/bit.ly/2HHsXul. We are currently working on an expansion of this list to 100 terms with 50 collaborators from various countries.

The project arouse especially when we noticed the lack of resources in the field, assessed the interest on it after making some consultations ans established the need for resources in the subject that the deaf and hearing impaired teachers themselves recognized. In the scientific world in general, and astronomy in particular, Sign Language has been able to establish communication in a remarkable manner by its knowledge of deaf culture and suitable semiotics -the study of signs- which removes barriers and offer a dialogue between the deaf and hearing population (Garcia *et al.* 2015).

5 Conclusions

In each country the different terms arise and evolve as in any other living language. And precisely because this origin and evolution is rooted deeply in the community's particular culture, it is extremely difficult to reach a consensus among different communities/countries to establish a unique sign for a particular term. The list of astronomical terms proposed in this work aims to help in the cases in which a particular sign has not been yet developed (when this is the case the word is spelled in signs letter by letter which make the communication slow and cumbersome).

This proposal mainly aims to become a tool to teach astronomy to the deaf, but also seeks to detect those astronomical terms that have a sign in some countries but no counterparts in others. Although we think that our maximum objective of reaching a consensus in every language for the astronomical terms will not be attainable, we still aim to achieving a unique set of signs, for everyone, of astronomical terms in sign language. We know that it is a very complex task, because sign language is a cultural construction and as such it has particularities that cannot be the same for all the deaf in the world, but we are commited to at least indentifying points of contact between all Human beings who use this resource to communicate.

6 Contact

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