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LINCE PLUS: Research Software for Behavior Video Analysis

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Abstract

For many years the free LINCE software has been used by many researchers needing a tool to tag behaviors using video recordings, coding behaviors and data register. However, as a research group we envisage new challenges with regards to technology novelties, designing a new tool for the future that can be used in any type of device and closely working on line. LINCE PLUS is a free systematic observational research software that will enable including new trends such as artificial intelligence, web management, collaborative work as well as complex statistical packages, such as integrating the same R language compiler inside the application. It's time for LINCE PLUS.

Keywords: computerized observation, observable behaviors, multifunctional software, statistics, open source, R language

Background

LINCE platform (Gabin et al., 2012) has been successfully used in many investigations (i.e, Castañer et al., 2016; Lapresa et al., 2017; Lozano & Camerino, 2012; Tarragó et al., 2016) with big support from the community (Hernández-Mendo et al., 2014). "It is easy to use and integrates a wide range of necessary functions: coding, recording, data quality calculation and information analysis in specific formats, thereby enabling it to be directly exported to several applications." (Gabin et al., 2012, p. 4692). Considering that nowadays technology evolves continuously, the platform focuses on the possibility of being used in any operating system or platform, including tablets or smartphones. At a general level, the evolution of the LINCE software towards the new application must be able to analyze the data in a systematic way and, if possible, following the mandatory phases that are recommended for observation (Anguera et al., 2018; Portell et al., 2015). This starts with generating specific observational tools, coding, collecting observed data as well as enabling their analysis and easing their interpretation.

Features and aim of LINCE PLUS

Taking into account all the necessary aspects on portability and more practical software, we were forced to find which tools could simplify the most complex tasks about the observation process such as analysis and interpretation. Thus, the new application reuses part of the old version and delegates complexity on other tools in the market that were a standard as well as reliable.

A factor of great complexity is portability to any device, since many of them did not allow complex calculations and, on the other hand, each one needs a specific implementation of the application, creating Android and iOS apps or Mac Os and Windows installers. The only language that allows maximum portability and faster execution speed continues to be Java, but it can complicate portability in certain types of portable devices. However, there is a universal language to each application throughout the Internet: Html. Migrating all the code to a web behavior would encompass many additional problems at both statistical and video levels, but, nevertheless, it would facilitate the communication task between different devices. LINCE PLUS includes the simultaneity and synchronization of several videos at the same time. Web behavior enables several observers to simultaneously connect and perform independent analyses while working collaboratively. As LINCE PLUS also includes R language, in the future, we will be able to merge it with artificial intelligence.

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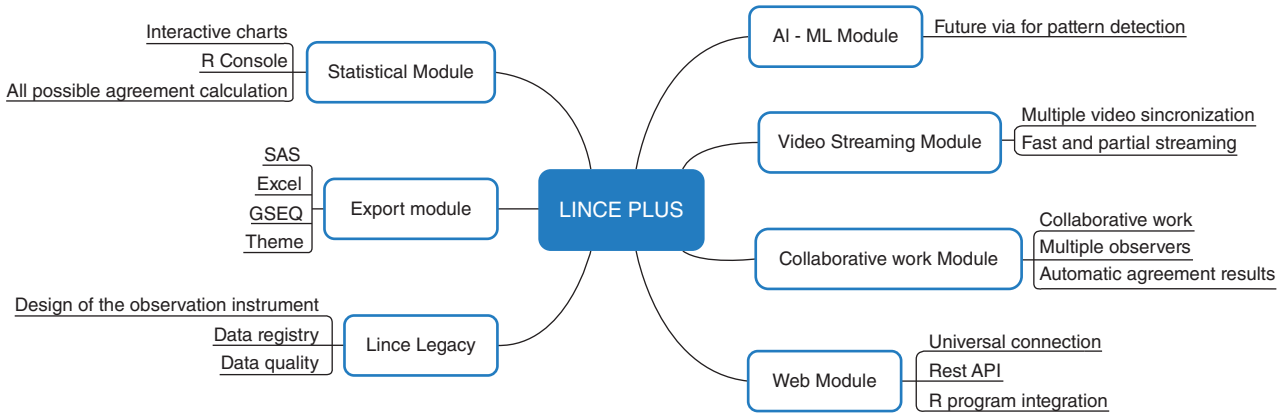

Figure 1. LINCE PLUS internal organization.

Functions of the application

As it can be seen in Figure 1, the software is divided into modules or layers that enable component independency and interoperability, allowing the execution of visualization tasks and information record in a collaborative way. Statistical calculations can be performed by an engine based in Java and R thanks to the adaptations of the open source code Renjin engine (Muhleisen et al., 2018) and the great help of the DKPro library for calculating the agreement index among different observers (Meyer et al., 2014). All this libraries and concepts are packaged together in an open source application hosted on Github that allows performing all the stages we describe.

Data observation and register

The observation of several videos at the same time, the visualization in different devices and even by simultaneous observers offer a new working ambience.

Figure 2 shows several videos synchronized in time and the detail that each one has its own reproduction

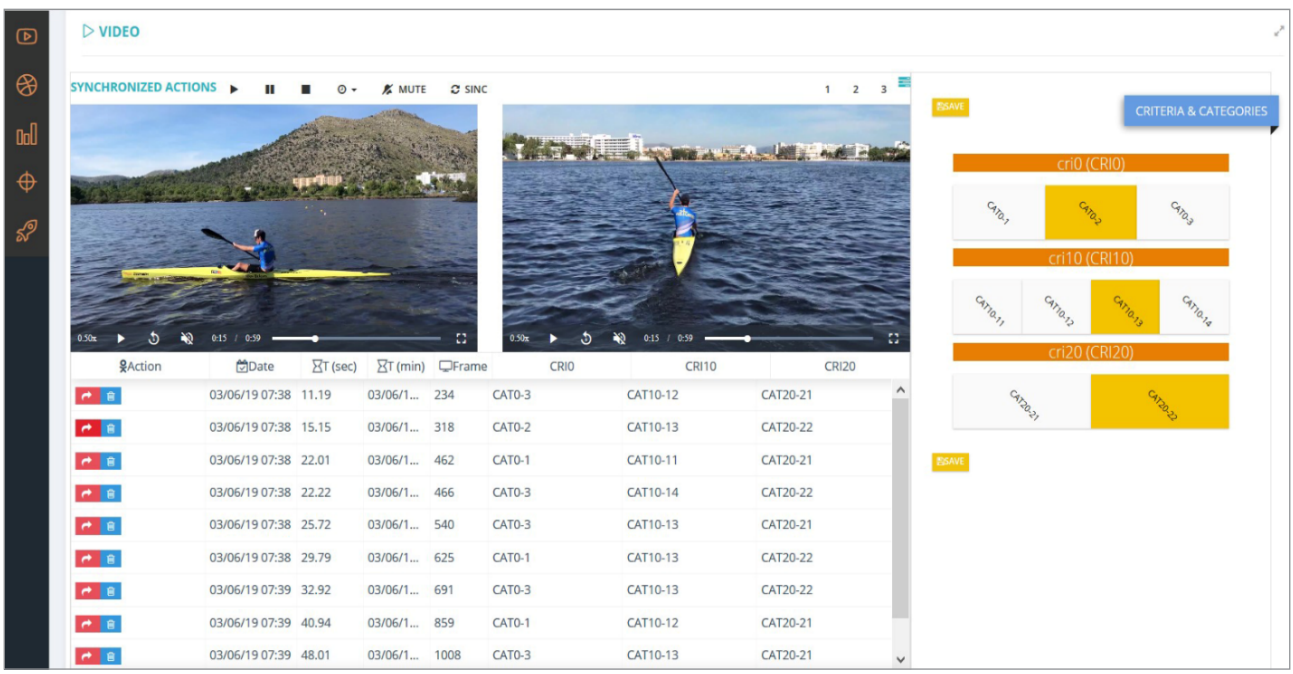

Figure 2. Multiple video synchronization feature, register and tagging.

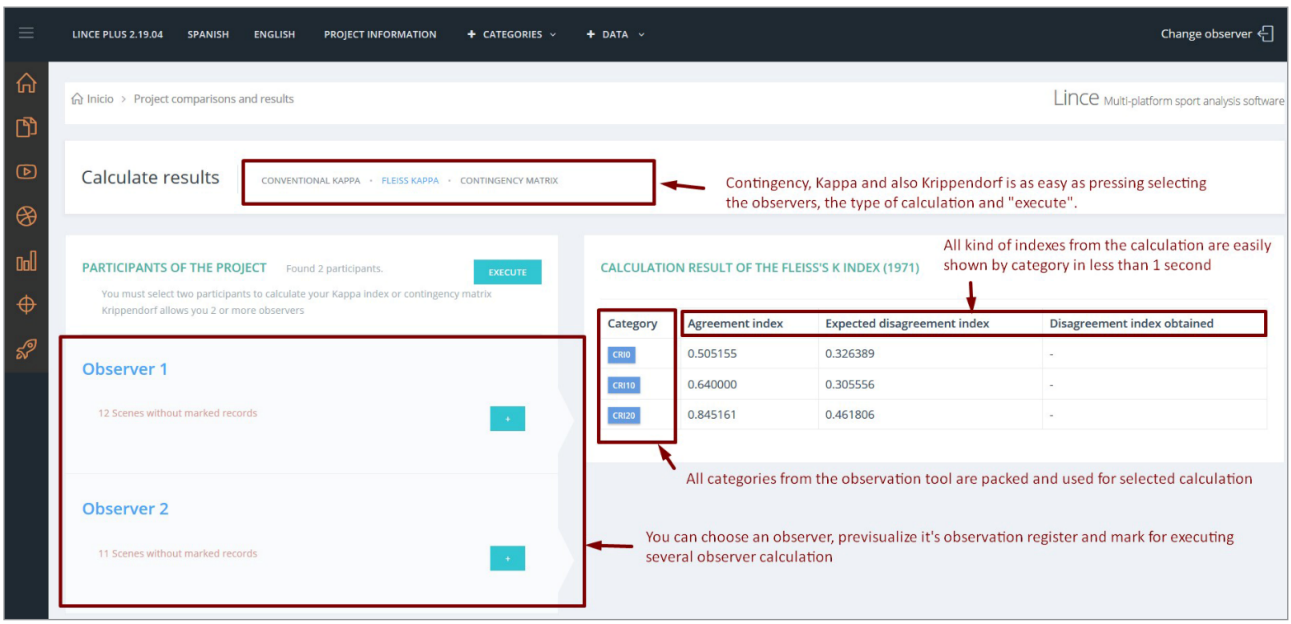

Figure 3. Example of Fleiss Kappa index. All calculations are made easy with just a few clicks.

player allowing them to act independently. On the upper section there is a playback bar that allows us to synchronize and manage all the videos synchronously with the possibility of changing the playback speed.

The behavior tagging design tool has been inspired by the previous LINCE version, therefore, the users that have used LINCE before can easily use this version. For example, the observation record of the behaviors observed is almost identical to LINCE's structure.

Data Quality

LINCE PLUS allows an integrative analysis of the data observed and its intra and interobservers data quality, enabling integrating external applications.

Figure 3 shows an analysis phase for multiple observers. Each observer has conducted a study on the videos using the same observation instrument, but they have observed different situations. In a very intuitive way, researchers can analyze if the observation is congruent and adequate based on the defined observation instrument.

This new characteristic allows us to calculate for any category of our observation instrument its Kappa or Krippendorf index, obtaining the agreement or disagreement index among several observers. In addition, we can quickly obtain the contingency table, and all using contrasted statistical analysis (Meyer et al., 2014).

Results

The results are displayed visually (Figure 4), incorporating an engine for the appropriate graphs, generating contingency tables for several observers or enabling the user to calculate them later using statistical software.

Considering the emergence of the R language created by Ihaka (Ihaka & Gentleman, 1996) and its wide use in research for data analysis algorithms in many scientific fields (Morandat et al., 2012), LINCE PLUS has a component to launch R code through the web interface. Although it has the limitation of not being able to launch the powerful charts of R Studio, researchers code their code easily and see the result in the output component in text mode. Researchers can access the observation register and the instrument without having to use external software and all guaranteeing the privacy of the study.

If more complexity is needed, with R Studio researchers can also directly connect with the current research thanks to the REST API that LINCE PLUS includes, and the guide that is provided to the user. Thus, any methodology or level of extensibility can be

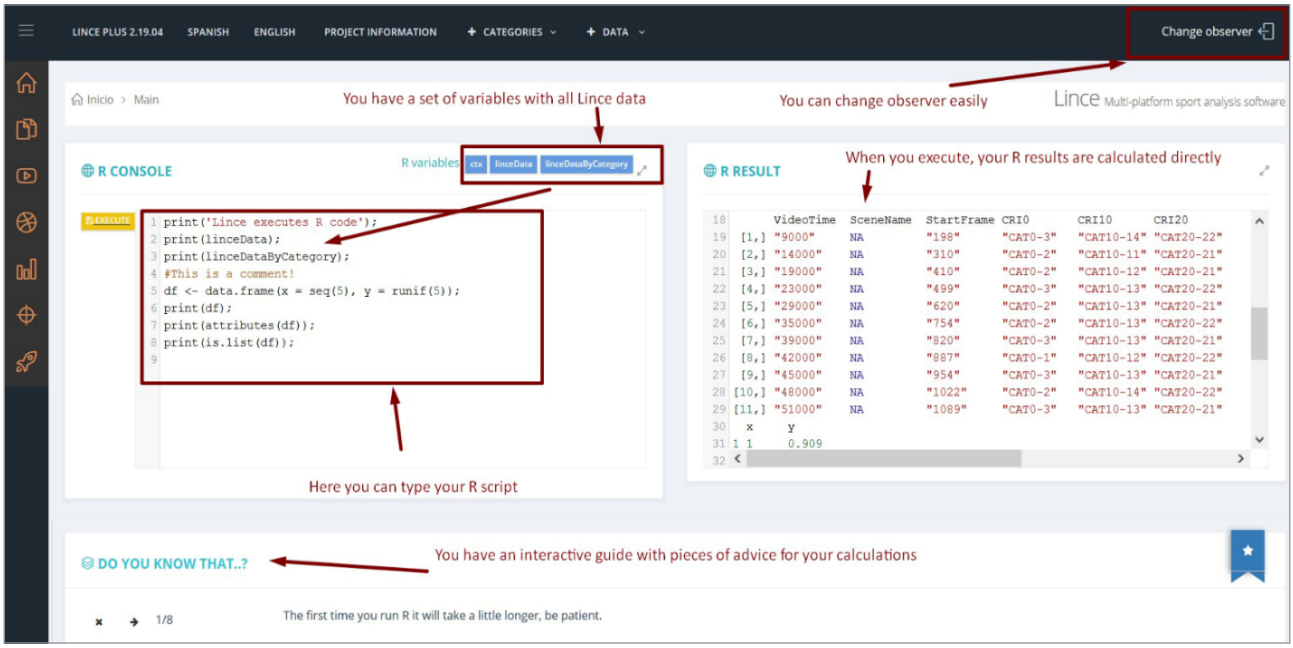

Figure 4. R Console. A script example with any code to achieve results without external programs.

achieved and, even more, all in real time while the study is still being carried out. Therefore, there is no need to import and export files between different programs.

Conclusions

The new LINCE PLUS version evolved from the well-known program LINCE and allows researchers to have an integrative tool, which is characterized by sharing video visualization and analysis with collaborative use and enables calculating any behaviour analysis in an easy and versatile free software platform. It offers multifunctional possibilities to systematic observational research, which always requires a long time by an observer, to be time shared and be carried out simultaneously. In sum, LINCE PLUS is a versatile software that contributes to optimize coding, recording, and calculate in specific formats as the research community needs. We are convinced that in the future LINCE PLUS will be able to incorporate artificial intelligence skills. LINCE PLUS, as an open source code platform built for the scientific community, can be downloaded from https://observesport.github.io/lince-plus/

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