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# The impact of registers of semiotic representation on problem solving for students entering tertiary education in France: case of the mean

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## Context

In this poster, we focus on the concept of the mean, studied in grades 7 to 10 in French classrooms. In the 1990s, several researchers studied the concept of the mean (notably Pollatsek et al., 1981; Batanero et al., 1994; Gattuso, 1999). Based on these foundational studies, several researchers explored the statistical knowledge of students at different levels. They widened the scope to study, among other things, the notions of variation and distribution (see for example Garfield & BenZvi, 2005). These studies have shown that, beyond the computational process, the meaning of the mean remains poorly understood by students. We wonder if such conclusions are still relevant in the French context today.

## Theoretical framework and research question

We only have access to mathematical objects through their semiotic representations. Duval (2017) defines a register of semiotic representation as a system of signs allowing three cognitive activities: formation, processing and conversion. The coordination of several registers of semiotic representation is necessary for a good conceptualisation of a mathematical object. In statistics, several registers of semiotic representations exist: the register of natural language, the register of diagrams (bar charts, etc.), the register of histograms, the register of frequency tables, the register of cross-tabulations, the algebraic register (formula), the numerical register... Moreover, institutional expectations for the flexible use of different registers are increasing in tertiary education (Gueudet & Thomas, 2020). Hence, we believe that this approach in terms of registers of semiotic representation would be appropriate to the study of statistical knowledge of students entering tertiary education.

Our research questions at this stage are the following: what do non-specialist students know about the concept of the mean as they enter tertiary education? What influence do registers of semiotic representation have on their knowledge?

## Method and data

To address our research questions, we designed and administered an online questionnaire (14 items) about descriptive statistics concepts studied in secondary education. Six items tackle the concept of

the mean. In this poster, we focus on 4 items centred on the same type of task, comparing the mean of two statistical distributions.

In these items, the registers of representation in which the distributions are given are diverse. In the first item, the two distributions list few ordered values, while in the second only one is represented explicitly in the form of an unordered list of values. In the other two items, the distributions are given in the form of a bar graph. In all four items, the mean of the two distributions is being compared (in the natural language register).

We administered the questionnaire in Fall 2022 to non-specialist entering students before their first statistics course. We obtained 382 complete responses from students who had completed their secondary education in France and were starting their tertiary education in one of the following fields: biology, psychology, economics and social sciences, or management.

### **Analysis of results**

In the poster, we will present the a priori analysis of the four items described above and the student answers to these items. The obtained results show a very limited understanding of the concept of mean, like in the 1990s. However, the analysis of the student answers highlights the impact of the initial register of representation considered on the students' success in similar tasks.

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