WHAT FIRST COMES TO MINDé é .WITH BASIC STATISTICAL TERMS

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Introduction

Over time we develop habits of thought and expectation and configure incoming information to conform to this frame of reference. Frames are organizing principles that are socially shared and persistent over time, that work symbolically to meaningfully structure the social world (Reese et al., 2001). Therefore, frames of reference are big ideas ï shared and durable cultural models ï that we use to make sense of our world. These simplifying concepts are triggered by such available, familiar and highly charged vehicles as symbols, pictures, metaphors and messengers and ones evoked, provide the reasoning necessary to process information and to solve problems. Priming, as well as Zallerôs (1992) related RAS model, tell us that respondents answer survey questions on the basis of what first comes to mind, in other words what is most accessible or available in memory

In this paper we empirically develop a conceptual framework to analyze the array of different notions that primary school teachers develop and use to understand statistical terms and illustrate how these notions interact and inform their views and attitudes towards statistical investigation process.

As educators, we need to identify these frames of reference and asses and interpret what is immediately accessible in memory, in order to plan better courses and to point out in specific preconceptions or incorrect (fault) frames or to enforce proper default frames.

Additionally, these frames allow us to better understand statistical thinking and reasoning of the teachers (or any other professional category) and apply the necessary interventions.

Methodology

At the beginning of a course in Statistics, during a professional development program of in-service primary school teachers, we decided to explore the ideas and notions that those teachers had regarding some basic concepts and terms that are usually met in statistical investigation process (Friel & Joyner, 1997) which was at the very center of the course. We aimed to find out the association of ideas they have and the connections they do whenever they have to think about general terms, such as Statistics and Probabilities but also with specific concepts or procedures.

We chose to use a questionnaire rather an interview mainly because of time economy. The questionnaire comprised of two parts. The first part contained demographic information (sex, age, years of service, attainment of statistics course) while in the second part teachers were asked to write down briefly what first comes to their minds when they hear or meet some specific terms. The nine terms were either single words or phrases: Statistics, Probabilities, Average, Population, Sample, Data, Collecting data, Displaying data and Analyzing data.

We adopted a qualitative approach as we aimed to gain in-depth understanding of representations of statistical terms rather than testing a hypothesis, or producing generic results

Sample

The sample consisted of 102 in-service primary school teachers in the urban and suburban area of Thessaloniki, Greece. Almost half of them were males (54%) and the other half females (46%). A 20% of the teachers were 25 to 34 years old, a 65% 35 to 44 and 15% over 45 years old. Accordingly, 20% of the sample has been in service for 1 to 9 years, 60% for 10 to 19 and 18% for 20 to 29 years. Finally, half of the teachers mentioned that they have taken a course of any kind in Statistics mainly during their basic studies (in university). The task was completed without any problems.

Results

The findings are presented in the same order as the items on the questionnaire. The first term was the word **Statistics**. As we can see in Table 1, one out of four teachers associated Statistics with ñ*Science of collecting and analyzing data*ò even though some of them (seven) referred to a *method* and not a *science*. Twenty responded either *gallop* and *elections* or *athletics* and *television*. Those who responded gallop and elections mentioned private companies or persons that make research in political agenda (keep in mind that our research took place some time after general elections in Greece in October 2009, and almost all media presented numerous relevant gallops and researches). It suggests that, when planning a course, instances or facts from everyday life should be taken in mind. A same number of teachers (fourteen), associated statistics with *percentages*, *numbers* and *measures* and with distinct *steps of statistical inquiry* (e.g. mainly analyzing data, or collecting data, or interpreting results). To *Mathematics*, or *branch of Mathematics* referred twelve teachers, while eight of them connected Statistics to *research*. Finally, seven teachers mentioned *concepts*, mainly mean and two of them associated statistics with *pseudoscience*!

Table 1: ***ñ****When you hear the word* ***Statistics,*** *what first comes to mind?****ò***

Representations	N[1]
Science of collecting and analyzing data	25
Gallop, elections, athletics, TV	20
Percentages, numbers, measures	14
Fragmentary views-distinct steps of statistical inquiry	14
Mathematics ï branch of mathematics	12
Research	8
Concepts (i.e. mean)	7
Pseudoscience	2

The second term was the word **Probabilities**. In Table 2 we can see that almost one out of two teachers associated Probabilities with *chance*, *gambling* (tzoker, lotto) and *accidents*. Fourteen teachers referred either to *probabilities laws* or to *probability theory* and other thirteen mention only one word, *possible*. As with the word Statistics, twelve teachers associated Probabilities with *percentages*, while seven and six of them referred to *predicting random facts* and *trying to predict* respectively. Finally, two teachers mention *irrelevant* phrases.

Table 2: ***ñ****When you hear the word* ***Probabilities,*** *what first comes to mind?****ò***

Representations	N
Chance, gambling (tzoker-lotto) accidents	48
Probabilities laws ï probability theory	14
Possible	13
Percentages	12
Predicting random facts	7
Trying to predict	6
Irrelevant	2

The third term was the word **Average**. In Greek, the term average concludes the word ñmesosò as does the term **mean**. As a result, most of the teachers associated the term with the *mean*, while twenty one and five of them associated the term with *median* and *mode* respectively. Noticeably, the responds were one word only. Fourteen teachers associated, correctly, the word average with *typical or representative value*, while four used the general term of *statistics* and three the *results*.

Table 3: ***ñ****When you hear the word* ***Average,*** *what first comes to mind?****ò***

Representations	N
Mean	55
Median	21
Typical value ï representative value	14
Mode	5
Statistics	4
Results	3

[1] The sample consisted of 102 teachers so the number of actual responders could be taken as percent

The word **Population** was associated with *sum* or *whole* by the majority of the responders (58), while twenty of them referred to a *number of persons* or *things*. Eleven of them associated population with *sample* and *research* (seven and four respectively). Surprisingly, thirteen teachers associated population with *habitants and countries* (the geographical meaning of the term), even though previews terms should have introduced them in statistical terminology.

Table 4: ***ñ****When you hear the word* ***Population,*** *what first comes to mind?****ò***

Representations	N
Sum, whole	58
Number of persons, things	20
Habitants - countries	13
Sample	7
Research	4

The word **Sample** had the higher number of respondents to the same answer, *part of population* (70), while twelve of them used the word *representative* and ten the word *random* in their responses. Eight and three teachers respectively associated sample with *elections* or *gallop* and *choice*. An impressive number of teachers (twenty one) associated sample with something completely out of context (e.g. commercial product sample, random number of a category, test group, demonstration).

Table 5: ***ñ****When you hear the word* ***Sample,*** *what first comes to mind?****ò***

Representations	N
Part of a population	70
Elections - gallop	8
Choice	3
Irrelevant	21

With the term **Data** more than half of the sample referred to *pieces of information* or *elements*, while thirteen mention *information*. Eight teachers associated data with *personal computers* and *values*, seven with *results*, while four mentioned the *analysis of data* and nine gave again an *irrelevant* answer (e.g. things that are given in order to solve something, university research, the existing, the beginning of an exercise).

Table 6: ***ñ****When you hear the word* ***Data,*** *what first comes to mind?****ò***

Representations	N
Pieces of information, elements	53
Information	13
Personal computer	8
Values	8
Results	7
Analyzing data	4
Irrelevant	9

Collecting data was associated with *gathering pieces of information* by over the half of the respondents. Thirty teachers referred to some *measurement tools*, most of them to

questionnaire combined with *interview, observation* or *census*. Again, ten teachers associated collecting data with *gallop* and *elections,* while seven of them referred to *research*.

Table 7: ***ñ****When you hear the term* ***Collecting data,*** *what first comes to mind?****ò***

Representations	N
Gathering pieces of information	55
Measurement tools (questionnaire, interview, observation, census)	30
Gallop - elections	10
Research	7

Most of the teachers (forty seven) associated **Displaying data** with *graphical representation,* while twenty two used the actual word *graph* and fourteen the *bar graph-pie* combination. Also, fourteen teachers used *different words* of the term displaying. Only five teachers associated displaying data with *table*!

Table 8: ***ñ****When you hear the term* ***Displaying data,*** *what first comes to mind?****ò***

Representations	N
Graphical representation	47
Graph	22
Bar graph - pie	14
Different words	14
Table	5

One out of two teachers associated **Analyzing data** with *editing pieces of information* and twenty two used the exact phrase *calculating statistical measures*. Twenty teachers referred again to *elections, results* or *outcomes,* eight associated with *software* that perform statistical analysis (SPSS and Excel) or *computers* and two used the terms *qualitative* and *quantitative analysis.*

Table 9: ***ñ****When you hear the term* ***Analyzing data,*** *what first comes to mind?****ò***

Representations	N
Editing pieces of information	50
Calculating statistical measures	22
Elections, results, outcomes	20
SPSS, excel, pc	8
Qualitative ï quantitative analysis	2

Discussion

People are using availability when they make a judgment on the basis of what first comes to mind (Pritchard, 2001). As we can see in the findings, in most terms the available representations are relative or close to the ñproperò meaning. The terms Statistics, Probabilities, Data and Average have the most representations. According to Hastie (1986), because frames of reference are so individual in nature, they are often not the same for all people. If different people have different frames of reference for a given word or phrase, they will likely assign different meanings to that word or phrase. We saw that happened partly in the two first general terms (statistics and probabilities) and with the term data. Nevertheless,

even though many representations can be found in the answers, there is a relative consensus to some of them, which let us to believe that we can use these findings accordingly.

Furthermore, Foddy (1993) identifies the lack of clear empirical referents as leading to variance in meaning, which is often a problem with abstract terms. He also asserts that respondents seek contextual clues in order to assign meaning to questions. The media often provide key contextual clues through the effect of priming. Many dominant (or default) frames also seem to come (or influenced) from advertising, political rhetoric, public discourse, tradition and ñcommon knowledgeò. This is supported by our empirical findings since most of the terms were associated with gallops, elections, news and media by many of the teachers.

Most of the findings were the occasion for numerous discussions, controversies and interventions during our course. Statistics is a science or a method? Is it Mathematics or different subject? Gallops are made properly? Data are information? Average is the mean? This simple research gave us the food to feed the whole course and most importantly kept teacherôs interest high throughout the seminar.

On the other hand, there is a very limited bibliography regarding aspects of that kind of research (what first comes to mind) and more work is needed in that area.

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ABSTRACT

This paper focuses on what primary school teachers first think when they hear basic statistical terms (usually met in statistical investigation process) such as *Statistics*, *Probabilities*, *Sample*, *Data*, *Collecting data*, *Analyzing data*, *Plotting data* and *Average*, trying to comprehend the existing or dominant frames of reference. A sample of 102 in-service teachers responded to a written questionnaire where they were asked to mention what first comes to their minds when they meet or hear these terms. Analysis of the answers revealed quite interesting frames that include basic misconceptions, fragmentary views and also proper dominant references.