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Εκπαίδευση, Δια Βίου Μάθηση, Έρευνα και Τεχνολογική Ανάπτυξη, Καινοτομία και Οικονομία

Τόμ. 3 (2024)

Πρακτικά του 3ου Διεθνούς Επιστημονικού Συνεδρίου "Ελλάδα – Ευρώπη 2030: Εκπαίδευση, Έρευνα, Καινοτομία, Νέες Τεχνολογίες, Θεσμοί και Βιώσιμη Ανάπτυξη"

Behavioral Economics: A systematic literature review of the heuristics of representativeness, availability and anchoring in primary and secondary school students

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Περίληψη

Σκοπός της παρούσας συστηματικής βιβλιογραφικής επισκόπησης ήταν να εξετάσει εμπειρικές έρευνες που έχουν μελετήσει τις ευρετικές της αντιπροσωπευτικότητας, της διαθεσιμότητας και της αγκίστρωσης σε μαθητές/τριες πρωτοβάθμιας και δευτεροβάθμιας εκπαίδευσης. Η αρχική αναζήτηση απέδωσε 7.969 αποτελέσματα, από τα οποία εννέα άρθρα επιλέχθηκαν και συμπεριλήφθηκαν στην τελική ανάλυση. Κύρια ευρήματα ήταν ότι όλες οι έρευνες επέδειξαν ευρήματα εμφάνισης της ευρετικής της αντιπροσωπευτικότητας και της διαθεσιμότητας σε μαθητές πρωτοβάθμιας και δευτεροβάθμιας εκπαίδευσης, δε βρέθηκε όμως έρευνα για την ευρετική της αγκίστρωσης. Τα ευρήματα της επισκόπησης μπορεί να φανούν χρήσιμα σε εκπαιδευτικούς και σε ερευνητές των οικονομικών της συμπεριφοράς στην εκπαίδευση.

Λέξεις-κλειδιά: ευρετικές, αντιπροσωπευτικότητα, διαθεσιμότητα, αγκίστρωση, εκπαίδευση

1. Introduction

Behavioral economics combines economics with psychology (Camerer et al., 2004), in order to understand human behavior, challenging the classical economic theory's assumption of complete rationality. Herbert Simon (1955), who was awarded the Nobel Prize in Economics in 1978, introduced the term of “bounded rationality”. According to the Theory of Bounded Rationality, people are faced with constraints and limitations during the making-decision process (limited information, limited cognitive abilities, time pressure), which lead them to make decisions with limited and not complete rationality. Therefore, people do not maximize their utility, but make the best possible decisions with the data they have in each situation (Altman, 2012; Arnott et al., 2019; Schwartz, 2002).

Modern behavioral economics were based on the work of Amos Tversky and Daniel Kahneman (Arnott et al., 2019), who was awarded the Nobel Prize in Economics in 2002. Through a series of experiments, they showed that basic principles of Expected Utility Theory were violated and they argued that it was not an adequate model for describing human behavior (Tversky & Kahneman, 1973; Tversky & Kahneman, 1974).

In attempting to explain human behavior, behavioral economics rely on heuristics, a concept derived from cognitive psychology. Heuristics are defined as the strategies that one follows when called upon to make a decision or solve a problem (Goldstein et al., 2002). They are cognitive shortcuts that allow people to make a decision faster and under conditions of uncertainty or incomplete information, often because they do not process all available information (Todd, 2001). Heuristics represent a process of replacing a difficult question with an easier one (Kahneman, 2003). The use of

heuristics could lead to serious and systematic errors and cognitive biases, i.e. deviations from classical rational patterns (Todd, 2001; Tversky & Kahneman, 1974).

Simon was the first to propose the use of heuristics (Furnham et al., 2011), such as satisficing and means-ends analysis (Simon, 1990). Tversky and Kahneman (1973; 1974) studied representativeness, availability, and adjustment and anchoring, which lead to biases such as: (1) insensitivity to sample size, when people estimate that a parameter representing the population is more likely to occur, without taking into account sample size, (2) illusory correlation, when two events occur together, people tend to overestimate the frequency of their joint occurrence, and (3) biases in the evaluation of conjunctive and disjunctive events, when people tend to overestimate the probability of related events occurring together and underestimate the probability of occurrence of independent events. Other biases that have been researched are (1) the sunk-cost fallacy, when people persist in harmful choices simply because they have tried too hard or invested time or money, (Arkes et al., 1985; Thaler, 1980), (2) confirmation bias, when people select available information to match their original beliefs, (Nickerson, 1998; Wason, 1960) and (3) the endowment effect, when people tend to value something they already possess more than they would if it did not belong to them (Kahneman et al., 1991; Kahneman, 2012; Thaler, 1980).

According to Bilek et al. (2018), representativeness, availability and anchoring, the heuristics first studied by Kahneman and Tversky, play a prominent role among the various heuristics and biases. The influence they exert on people in the decision making process has been researched in various areas, such as finance (da Silva Rosa et al., 2007; Della Vigna, 2009), medicine (McDermott, 2008; Richie et al., 2018; Whelehan et al., 2020), geology (Wilson et al., 2019), and law (Kunst et al., 2021; Teichman et al., 2021).

One area of research, which by its very nature is a social process (Leaver, 2016), is education. It is not a process of storytelling, but an active and constructive process (Dewey, 1958). The most serious approaches to the educational process, from the Enlightenment to the present day, recognize the need for a holistic approach to it, taking into account the social environment and recognizing that it can perform a range of functions, from the reproduction of the status quo to emancipation.

When it comes to behavioral economics and education, it's an area of research that hasn't received much attention (Lavecchia et al., 2014). According to Leaver (2016), "the behavioral economics of education matter because over the past 30 years education policy based on rational choice theory has not produced the expected economic results, yielding, at best, only marginal overall benefits." The education sector is characterized as complex for many reasons: (a) many stakeholders are involved, such as students, teachers, parents and the institutional framework, (b) educational choices are not frequent and usually not repeated (Leaver, 2016), (c) educational choices are investments with uncertain outcomes (Checchi et al., 2004), (d) future earnings, which are underpinned by upfront educational choices and investments (DiMatteo, 2016), are uncertain (Fossen et al., 2017) and cannot be predicted (Tabetando, 2017) and (e) incomplete information about future labor market conditions (Tabetando, 2017). For example, technology is a factor that affects the labor market and its influence cannot be accurately predicted (Belzil et al., 2007).

Behavioral concepts that have been researched in the field of education are presented in Table 1.

Table 1: Behavioral concepts researched in education

Behavioral concepts	Research
Risk aversion	Belzilet al., 2007
Human capital of parents, i.e. parental human capital	Belzil et al., 2007; Brown et al., 2012; Checchi et al., 2014; Tabetando, 2018; Wolfel et al., 2012
Parental risk aversion	Belzil et al., 2007; Brown et al., 2012; Checchi et al., 2014; Tabetando, 2018; Wolfel et al., 2012
Preference heterogeneity	Belzilet al., 2007
Reference points in the form of ambitions and targets	Heath et al., 1999; Page et al., 2007
Framing	Bereby-Mayer et al., 2002; Page et al., 2007
Extrinsic and intrinsic motivation	Angrist et al., 2006; Angrist et al., 2009; Behrman et al., 2005; Bettinger, 2012; Fryer, 2011; Levitt et al., 2012; Leuven et al., 2010; Rodriguez-Planas, 2014
Self-confidence	Filippin et al., 2012; Wang et al., 2003
Self-control	Ariely et al., 2002; Bettinger et al., 2007; Bisin et al., 2014; Castillo et al., 2011; Duckworth et al., 2006; Golsteyn et al., 2014; Mischel et al., 1972; Sutter et al., 2013; Wong, 2008
Nudges to pupils, students, parents and teachers for behavior change	Castilla, 2014; DiMatteo, 2016

The influence of many concepts of behavioral economics can be examined in students and teachers in order to explain their educational choices. Such concepts can be the paradox of choice, prospect theory, confirmation bias, over optimism and herd behavior. For the purpose of this research, representativeness, availability and anchoring were selected, the three heuristics studied by Tversky and Kahneman (1974) and a literature review was conducted on primary and secondary school students.

Based on the above, the following research questions were identified:

(1) Which of the three aforementioned heuristics have been investigated in the field of education?

(2) At what educational level and at what ages have they been researched?

(3) What was the field of research or topic they focused on?

(4) What was the methodological design of the surveys?

(5) What have been the results of research on the use and influence of heuristic methods?

The structure of the article is as follows. The following section gives the definitions of the heuristics used in the survey. Previous literature reviews with other behavioral heuristics and bias investigated in education are presented below. Next, the methodology of this systematic literature review is presented, followed by the section with its results. The next section presents the conclusions, followed by the limitations of the research, as well as suggestions for future research.

2. Definitions of heuristics

The following definitions of heuristics are taken from the research of Tversky and Kahneman (1974).

Representativeness: According to this, people estimate the probability of an eventuality occurring not on the basis of statistics, but according to how well the possibility is represented at the time or resembles a stereotype (Tversky et al., 1974). Tversky and Kahneman (1974) give the example of Steve, who is an introvert and gentle man, who loves order and pays attention to details. According to the research of representativeness and stereotypes related to professions, the most popular answer for Steve's profession is that he is a librarian, not a farmer, a salesman or a pilot.

Availability: This heuristic occurs when people assess contingencies as more likely or more frequent because they are based on personal experiences or recent memory, rather than correct statistics. This means that when an event is more easily remembered, it is considered more likely to occur, as opposed to an event that is more difficult to recall and considered more unlikely to occur. For example, people assess the likelihood of a heart attack based on incidents from their familiar environment (Tversky et al., 1974).

Adjustment and anchoring: People make estimates and perceive the probability or frequency of an eventuality incorrectly because they start from an arbitrary baseline value, a reference point. This point acts as an anchor for people’s decisions, who will have to judge how far away they will be from this point (Tversky et al., 1974). For example, when asked how much you have to pay to buy a house, you will be affected by the price asked. The value of the house will appear higher if the initial sale price is high, compared to a lower initial price (Kahneman, 2012).

3. Previous literature research with a behavioral or educational approach

The literature research of Castro Sotos et al. (2007) focuses on statistics. They present 14 empirical studies from 1990 to 2006 conducted on students of various specializations. They conclude that although students have the ability to perform calculations with statistical data, they are subject to serious misunderstandings when interpreting the results. They also present an overview of these misconceptions, such as the law of small numbers and sample variability, different distributions, the central limit theorem and others.

Lavecchia, Liu and Oreopoulos (2014) focus on interventions designed to overcome behavioral barriers and modify student behavior. More specifically , they categorize behavioral barriers into four a: a) some students focus more on the present bias, b)

some rely more on daily routine (inertia),c)Some place more emphasis on negative identities and d) too many choices are more likely to lead to mistakes than paradox of choice. For each obstacle they present relevant surveys, conducted on pupils, students and parents from 1982 to 2014.For the first obstacle, 28 empirical studies on schoolchildren and students are presented. Using primarily monetary benefits, they were intended to offset direct costs with direct benefits. For the second obstacle, they present 18 studies in pupils and college students and eight in parents, which aimed to reduce their inactivity and change their daily routine regarding their educational choices. Some of the interventions used were informative emails, personal assistance in completing university admission applications, informative videos and brochures and guidance. They also present nine studies on pupils and students, which include interventions such as compulsory attendance at classes and compulsory assignments, thus strengthening the structure of these programmes and changing the routine of pupils and students exploiting external factors. For the third obstacle, they present 13 surveys of students that aimed to reinforce positive role models. The interventions used were educational play, writing a letter to an imaginary student and a course on intelligence and how it develops with effort. For the fourth obstacle, the researchers present a study conducted on parents of students that showed that simplifying information can lead to better academic outcomes. Their conclusion is that interventions shaped by behavioral theory are likely to be efficient and easily implementable, while providing significant results.

In his literature review, Leaver (2016) addressed three key behavioral concepts: (a) self-control, (b) self-efficacy, and (c) identity. On self-control, i.e. a child's ability to delay rewards, she studied 12 empirical studies conducted between 1972 and 2015 on schoolchildren. He found that self-control can predict with strong credibility future academic success. Oneself-efficacy, she studied nine studies conducted from 1968 to 2015 on schoolchildren and students that exploit variables such as anchoring, the Pygmalion effect, and the use of internal and external motivation. These studies show that the more a person believes in their abilities (self-efficacy), the more they will strive for the end result. For the identity of the individual, which is linked to his social interactions, he studied 13 studies from 1978 to 2014, which examine different identities, e.g. women, African-Americans and students from low economic backgrounds. These studies show that identities influence educational choices and academic outcomes.

4. Method

This research is a systematic literature review. A systematic literature review is defined as "a verifiable, scientific and transparent process aimed at minimizing bias by applying a testable sequence of decisions and conclusions" (Tranfield et al., 2003). According to Tranfield et al. (2003), the data provided by the systematic review are considered to be of high quality. Regarding the social sciences, which are characterized by low consensus on their basic research questions due to their different methodological approaches, its implementation is not considered easy (Bryman, 2012). However, it was considered appropriate in the present context, as the basic stages of the method were followed, such as defining the purpose and scope of the research, searching for relevant research, evaluating them, analyzing and synthesizing their findings (Bryman, 2012).

This systematic literature review was conducted electronically through a search on international scientific bases from 23 to 30 December 2021. The databases were Scopus, Emerald, ERIC, Science Direct, JSTOR, Springer Link and Sage Journals and the keywords used were: 'heuristics education', 'representativeness heuristic', 'availability heuristic' and 'anchoring heuristic'. The review was based on the PRISMA method (see Moher, Liberati, Tetzlaff, Altman & The PRISMA Group, 2009). The criteria for selecting the articles were as follows: (a) the surveys should provide empirical data from primary or secondary school students, (b) they should have research data on at least one of the three heuristics and (c) they should be written in English. The search resulted in 7.969 articles. After the initial audit, 7,888 articles were excluded because they did not refer to education or were not written in English. Following a thorough check, a further 72 were excluded because they were not relevant to the purpose of this review. A total of nine articles met the criteria and were used by this research (see Figure 1).These articles were analyzed in terms of:(a) the heuristics they investigated, (b) the level of education and the ages of the students, (c) the topic in which the research was conducted, (d) the methodology followed and (e) their results in terms of appearance and n influence of heuristics.

5. Findings

Table 2 presents the findings of the nine selected surveys on the use of the heuristics of representativeness, availability and anchorage in primary and secondary school students. An analysis of the findings follows regarding the research questions: (a) the heuristics used, (b) the levels of education and ages of the students, (c) the individual topics, (d) the methodological design of the research and (e) their results on the use and influence of heuristics.

5.1 Heuristics

Regarding the heuristics examined, the systematic literature review showed that representativeness was most frequently investigated with seven studies (Afantiti-Lamprianou et al., 2003; Bernard et al., 2016; Davidson, 1995; Gualtieri et al., 2018; Jacobs et al., 1991; Ridgway et al., 2010; Watson et al., 2013). Availability was investigated by two studies (Geurten et al., 2015; Rubel, 2007). No research was found examining the heuristics of anchoring in primary or secondary school students, only in university students (Fast, 1997; Gelman et al., 2000) or High School Teachers and Teachers (Parmigiani, 2012).

5.2 Level of education and ages

As far as school level is concerned, the distinction is based on the Greek data of primary (Kindergarten, Primary) and secondary (Gymnasium, Lyceum) education. (The corresponding ages are: Kindergarten: 3-6 years old, Elementary: 6-12 years old, Gymnasium: 12-15 years old, Lyceum: 15-18 years old). In primary education, six studies were found. At the kindergarten level, i.e. in children from 3 to 5 years old, two studies have been conducted (Gualtieri et al., 2018; Bernard et al., 201 6). Two more studies sampled elementary school students ages 6 to 12 (Davidson, 1995; Ridgway et al., 2010), while research by Geurten et al., 2015 combined kindergarten and primary school students.

Also, a survey sampled primary school students (grades A, C, F) and university students (Jacobs et al., 1991). Only secondary school students were surveyed. This is the research of Afantiti-Lamprianou et al. (2003), which sampled high school students aged 12 to 15. In addition, two studies combined primary and secondary education, elementary, middle and high school, (Rubel, 2007; Watson et al, 2013), while research by Watson et al. (2013) added student teachers to its sample.

Therefore, a sample of primary school students had eight surveys and a sample of secondary school students had three surveys.

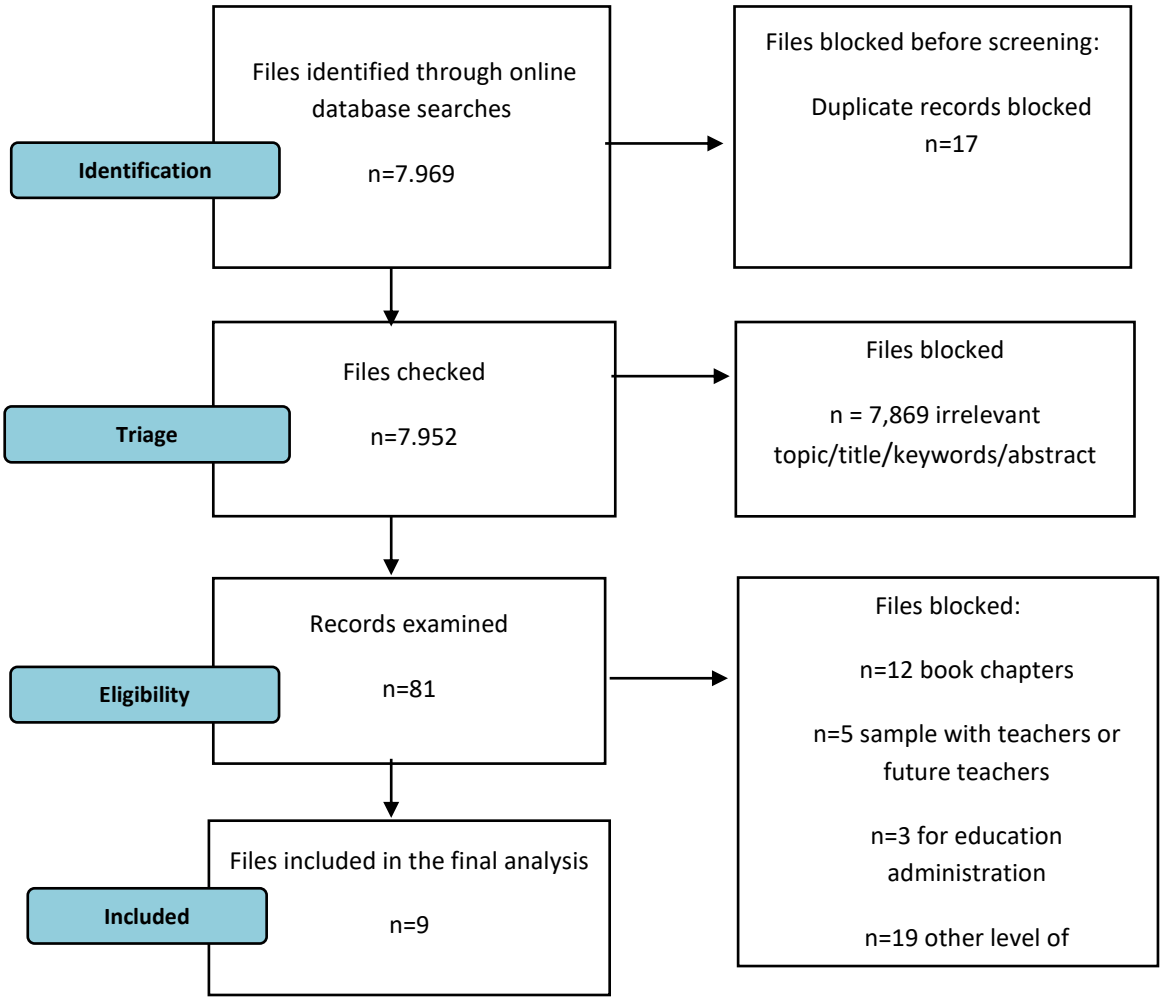

Figure 1PRISMA flowchart followed (Moher et al., 2009)

5.3 Thematic

The common denominator of all research is to investigate the way children/students think, how they make decisions and whether they are influenced by heuristics and prejudices. However, the individual themes of the research vary.

In the preschool age of kindergarten, the research of Bernard et al. (2016) investigated the wishful thinking of children aged 3, 4 and 5, i.e. whether their desires

affect their perception of reality. Gualtieri et al. (2018) examined whether representativeness heuristics can lead children aged 3 to 6 years to biased judgments.

Table 2: Surveys selected in the literature review

Writers	Purpose	Heuristic	Level of education	Thematic	Methodology			Results
					Type of survey	Specimen	Tool	
Afantiti-Lampriano u et al. (2008)	The development of an evaluation tool for diagnosing inappropriate use of representativenes s heuristics in the probability curriculum.	Representativeness	Secondary-Gymnasium	Mathematics	Quantitative-Qualitative	N=116	Questionnaire-Interview	Boys' thinking was more influenced than girls' in terms of representativeness heuristics. There were no statistically significant differences in age.
Bernard et al. (2016)	Proof of the presence of wishful thinking, when desires influence beliefs, in young children.	Representativeness	Primary-Kindergarten	Wishful thinking	Quantitative	N=77	Experiment	A group of 5-year-olds, with explicit representation of the result, used the heuristic of representativeness to guide their answers. In children 3 & 4 years old, wishful thinking prevailed.

Table 3: **(continued) Surveys selected in the literature review**

Davidson D. (1995)	Further evaluation of the use of the heuristic of representativeness by children.	Representativeness	Primary-Primary	Stereotypes	Quantitative-Qualitative	N=60	Interview	Students of the second, fourth and sixth grades showed the use of the heuristic of representativeness. Pupils in older grades (IV, VI) used more heuristics in terms of stereotypes.
Geurten et al. (2015)	To examine whether young children are affected by subjective experience related to the ease or difficulty of remembering events.	Availability	Primary-Kindergarten-Primary School	Recall from memory	Quantitative	N=71	Experiment	In some cases, young children may base decisions from memory on subjective ease of recall rather than objective number of items.

Table 4: **(continued) Surveys selected in the literature review**

Gualtieri et al (2018)	The study of the development of the heuristic of representativeness in young children.	Representativeness	Primary-Kindergarten	Stereotypes	Quantitative	N=96 (1st experiment) &N=192 (2nd experiment)	Experiment	The stereotype bias (eur. representativeness) is reinforced between 4-6 years of age, as children gain experience in drawing social conclusions based on characteristic information.
Jacobs et al. (1991)	The study of the heuristics of representativeness in social and objective decision-making.	Representativeness	Primary-Primary (& University)	Stereotypes	Quantitative-Qualitative	N=66 (A' class), N=86 (C' class), N=82 (F' class) &N=95 students	Interview	The use of representativeness heuristics in the social sphere develops at an early age and does not change significantly over the years.

Table 5: **(continued) Surveys selected in the literature review**

Ridgway et al. (2010)	The understanding of patterns, sequences and independence by primary school children.	Representativeness	Primary-Primary	Mathematics	Quantitative-Qualitative	98	Experiment	The number of students who are able to think in mathematics in a non-deterministic way increases with age. In multi-throw experiments, students made a mistake, failing to invoke the concept of independence.
Rubel L. H. (2007)	The study of probabilistic reasoning of middle and high school students.	Availability	Primary Primary Secondary-Gymnasium-Lyceum	Mathematics	Quantitative-Qualitative	N=173 (questionnaire) & 33 interviews	Questionnaire-Interview	About half of the students answered according to the availability heuristic, but of those, less than half justified their answer according to the availability heuristic.

Table 6: **(continued) Surveys selected in the literature review**

Watson et al. (2013)	The matching of students' statistical understanding and teachers' knowledge in relation to sample size and probabilities.	Representativeness	Primary Primary Secondary-Gymnasium-Lyceum (& teachers)	Mathematics	Quantitative	N=247 students &N=16 teachers	Questionnaire	The responses of the majority of students were influenced by the heuristics of representativeness

Davidson (1995) evaluated the use of its heuristic representativeness by children aged 7 to 12 years (to be more precise from 7.3 to 12.4) using stereotypes for older people. Geurten et al. (2015) examined whether 4-, 6- and 8-year-old students when making decisions from memory are affected by ease or difficulty recalling events (availability heuristic). The Jacobs et al. (1991) examined whether primary school students (grades A, C and F) make decisions based on objective or social characteristics or stereotypes (heuristics of representativeness).

Mathematics and more specifically probability is the main topic for the remaining four surveys. In particular, Ridgway et al. (2010), noting that the concept of independence is not given sufficient attention by mathematics curricula, although it plays a key role in understanding probability, investigated whether the heuristics of representativeness influence younger and older students' decisions about a series of random events, such as coin toss.

The Watson et al. (2013) selected the probability of occurrence of events in relation to sample size. For a fuller understanding of the heuristic of representativeness, which creates difficulties for students, they examine students' understanding of statistical concepts in combination with the help they receive from their teachers, which has to do with their statistical knowledge, their pedagogical background and knowledge of how students learn.

Afantiti-Lamprianou et al. (2003) developed an assessment tool that can help teachers diagnose inappropriate use of the heuristic of representativeness in answers given by high school students (12-15 years) to questions related to the probability curriculum. Finally, Rubel (2007) examined the probabilistic reasoning of middle and high school students, giving them to answer questions about probability and justify their answers, thus studying availability heuristics.

5.4 Methodology of surveys

For the methods followed by the nine surveys selected, the type of survey, the data collection tool and the sample number used were examined.

Five of the nine studies used a combination of quantitative and qualitative analysis (Afantiti-Lamprianou et al., 2003; Jacobs et al., 1991;Davidson, 1995; Ridgway et al., 2010; Rubel,2007),while the remaining four had only quantitative data (Gualtieri et al., 2018; Bernard et al., 2016; Geurten et al., 2015; Watson et al., 2013).

Regarding the data collection tool, a questionnaire used a survey (Watson et al., 2013), three surveys interviewed (Jacobs et al., 1991; Davidson, 1995; Geurten et al., 2015) and experimental approach followed by three other studies (Gualtieri et al., 2018; Bernard et al., 2016; Ridgway et al., 2010). Through a combination of questionnaire and interview, the remaining two studies (Afantiti-Lamprianou et al., 2003; Rubel, 2007).

6. Results

This sub-section presents the results of the studies under study regarding the appearance and effect of the heuristics they used.

The heuristic of representativeness was found in all seven who examined it. More specifically, Bernard et al. (2016) showed that a group of 5-year-olds, having an

explicit representation of the result, used the heuristic to answer the research questions. Gualtieri et al. (2018) showed that stereotype bias is reinforced between the ages of 4 to 6 years, as children begin to gain experience in drawing social conclusions based on characteristic information. Also in the social field and in terms of stereotypes, Jacobs et al. (1991) showed that the use of heuristics develops at an early age and increases in the elementary school years. In fact, students of older classes of Demotic (D' & F') use it more (Davidson, 1995).In the field of Mathematics, Ridgway et al.(2010) consider that it declines with age in cases of continuous tosses of a coin, but appears in the seventh series of tosses. Watson et al. They exploited Kahneman and Tversky's (1972) "hospital problem" and a coin toss variation of it and found that the responses of the majority of students were influenced by the heuristics of representativeness. Finally, the research of Afantiti-Lamprianou et al.(2003) in high school students showed that the predictors for the heuristic of representativeness are gender and ability. In terms of gender, boys' thinking was more influenced than girls' thinking, while ability was defined as students' performance on the test they underwent rather than general mathematical ability.

The availability heuristic also appeared in both studies that examined it. In particular, it occurred in young children, according to Geurten et al. (2015), which showed that 4-year-olds rely on subjective experience of ease in the decision-making process from memory. In Rubel's (2007) study of mathematics, about half of the students answered according to the availability heuristic, but less than half of them justified their answers according to the logic of heuristics. Rubel (2007) therefore challenges the dominance of this heuristic as the dominant strategy. As mentioned in the Heuristics section, no studies have been found that have studied the heuristics of shackling.

7. Discussion

The purpose of this systematic literature review was to examine empirical research that has studied the heuristics of representativeness, availability and anchorage in primary and secondary school students. Research from 1991 to 2018 was studied. The criteria selected yielded nine surveys, the results of which were presented in terms of the heuristics studied, the level of education and age of the sampled pupils, the topic chosen by the researchers, their methodological approach and their main findings on the occurrence of these heuristics.

The first research question aimed to examine which of the three heuristics (representativeness, availability and anchorage) have been investigated in primary and secondary school students. The review showed that representativeness was the heuristic most researched of the others. For the anchorage heuristic, no research has been found to have been conducted at these levels of education. Future research could study its effect on students and teachers. For example, to investigate whether pupils' grades or perception of their abilities act as anchors and influence their choices when filling in the computerised form for admission to higher education. Regarding teachers, it can be investigated whether students' grades from previous school years or whether students' social characteristics act as "anchors" and influence their judgment.

With regard to the second research question, the educational level at which the surveys have been carried out and the ages of the pupils , the review showed that most surveys have been carried out on primary school pupils and therefore on 3 to 12 year olds. Future research could focus on older ages of students, secondary

education and especially high school level, as data on these ages are very limited. Also, surveys with a combination of students and their teachers, such as the research of Watson et al. (2013), or pupils and their parents could provide safer conclusions about the school environment and about pupils' educational choices, such as their choice to study in higher education.

The third research question was intended to investigate the individual thematic areas or disciplines within which the research was conducted. The majority of research has focused on the subject of mathematics. There are many more subjects that could be set as a framework for conducting research, in order to explore the way decisions are made and the heuristics that are used or not by students. Students are also asked to make educational decisions characterized by uncertainty, such as the choice to study or not, the choice of type of school, the choice of orientation group, the choice to study in specific schools and departments, etc. Further research could highlight how students choose about the above, whether their judgment is affected by heuristics and biases, and identify factors that enhance the predictive character of heuristics.

The methodological approach of the surveys was the fourth research question. The majority of the studies combined quantitative and qualitative research and data collection methods in order to enhance the credibility of their findings. The methodological tools used by the surveys were questionnaires, interviews and experiments. The methodological approach could be strengthened by more longitudinal research combining quantitative and qualitative data.

The fifth research question aimed to identify the main results of research on the occurrence of heuristics and their influence. Although the surveys studied the heuristics of representativeness in the light of different themes and ages of students, the review showed that their thinking and decision-making was influenced by heuristics. The limited research on availability heuristics and the fact that they differ in topic, age of students and their results, do not allow safe conclusions to be drawn. More research on availability and anchorage heuristics, for which no research data have been found, will contribute to further understanding the effect of heuristics on primary and secondary school students.

8. Conclusions

This systematic literature review presents nine studies on the study of the heuristics of representativeness, availability and anchorage in primary and secondary school pupils.

The first conclusion is that the research carried out in this area is limited. The majority of the surveys concerned primary school pupils and focused mainly on mathematics. Secondary education and other subjects or educational choices in general have not yet been the focus of researchers.

There view also showed that the majority of the studies concerned the study of the heuristics of representativeness and less concerned with that of availability. No studies were found that have studied the heuristics of anchoring in students primary and secondary education, nor research combining all three heuristics. Also, all surveys show findings of representativeness, even from an early age, as is the case in adults, according to the research of Kahneman and Tversky (1972, 1973). One study even identified gender and ability as predictors, but not age. For availability, one of the

surveys challenged its dominance, unlike the research of Kahneman and Tversky (1972, 1973).

A systematic literature review has shown that there is room for further research on the use of behavioral economics in education. Future research could focus on the following areas: students' age, the individual topics chosen by the researchers, methodology, but also other heuristics and biases.

This review is one of the first to study the heuristics of representativeness, availability and anchorage focused on primary and secondary school pupils. The findings contribute to students' understanding of how they are used and therefore contribute to students' understanding of decision-making. Finally, they provide suggestions for future research in the field of behavioral economics of education.

All of the above could be used by teachers to know better how their students think and to be able to help them more effectively. They could also be used by researchers of behavioral economics of education to highlight students' decision-making patterns and identify factors that enhance the predictive nature of heuristics.

9. Restrictions- Future research

The present research is limited by the fact that the review was based on open access databases or databases accessible to the author's university.

A future systematic literature review of the heuristics of representativeness, availability and anchorage to higher education students could lead to a fuller understanding of the architecture of educational choices and the emergence of new research gaps.

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