

# MLS PSYCHOLOGY RESEARCH

<https://www.mlsjournals.com/Psychology-Research-Journal>

ISSN: 2605-5295



## How to cite this article:

Cognitive style, information processing, memory and attention. Bibliometric review 2008-2018. *MLS Psychology Research* 2 (2), 23-40. doi: 10.33000/mlspr.v2i2.319

## COGNITIVE STYLE, INFORMATION PROCESSING, MEMORY AND ATTENTION. BIBLIOMETRIC REVIEW 2008-2018

**Marisol Niño Ramos**

Secretary Office of the Education District (Colombia)

[mninor@educacionbogota.edu.co](mailto:mninor@educacionbogota.edu.co)

**Cristian Fidel Rojas-Montero**

Multimedia Editorial San Pablo

[criso\\_78@gmail.com](mailto:criso_78@gmail.com)

**Abstract.** This article presents a bibliometric review of the studies published between 2008 and 2018, on the stylistic dimension of dependence and field independence (FDI) and its relation to the processing of information, memory and attention. In order to identify indicators of production and impact, and characterize the main findings of the studies found. 21 publications made between 2008 and 2018 were analyzed. Information was searched in the ScienceDirect, Proquest and Scopus databases. The results allow identifying and characterizing the number of annual publications, publications by country, magazine and in-text citations by article, type of study carried out, educational level of the participants in empirical studies, and representative findings of the relationship to the FDI cognitive style and information processing, memory, and / or attention. Most studies show that the stylistic dimension "field independence" has a positive correlation with more effective attention processes, working memory and information processing. More research is required on the characterization of cognitive processes associated with FDI, especially the stylistic polarity of field dependence. The study of FDI and cognitive processes is a line of action that contributes to improving teaching and learning processes in different educational environments.

**Keywords:** cognitive style, information processing, memory and attention.

## ESTILO COGNITIVO DEPENDENCIA E INDEPENDENCIA DE CAMPO, PROCESAMIENTO DE INFORMACIÓN, MEMORIA Y ATENCIÓN. UNA REVISIÓN BIBLIOMÉTRICA 2008 A 2018

**Resumen.** Este artículo presenta una revisión bibliométrica de los estudios publicados entre los años 2008 y 2018, sobre la dimensión estilística de dependencia e independencia de campo (DIC) y su relación con el procesamiento de información, memoria y atención. Con el fin de identificar indicadores de producción e impacto, y caracterizar los principales hallazgos de los estudios encontrados. Se analizaron 21 publicaciones realizadas entre los años 2008 y 2018. Se efectuó la búsqueda de información en las bases de datos ScienceDirect, Proquest y Scopus. Los resultados permiten identificar y caracterizar cantidad de publicaciones anuales, publicaciones por país, revista y citas por artículo, tipo de estudio realizado, nivel educativo de los participantes en estudios empíricos, y hallazgos representativos de la relación al estilo cognitivo DIC y el procesamiento de información, memoria, y/o atención. La mayoría de los estudios evidencian que la dimensión estilística “independencia de campo” tiene una correlación positiva con procesos atencionales, memoria de trabajo y procesamiento de información más efectivos. Se requiere mayor investigación sobre la caracterización de los procesos cognitivos asociados a la DIC en especial a la polaridad estilística de la dependencia de campo. El estudio de la DIC y los procesos cognitivos es una línea de acción que contribuye a mejorar los procesos de enseñanza y aprendizaje en diferentes entornos educativos.

**Palabras clave:** estilo cognitivo, procesamiento de información, memoria y atención.

### Introduction

Cognitive Style (CS) addresses the way information is perceived and processed. Considering various authors' point of view, Cognitive Style has been conceived as the “stable aptitudes, preferences or habitual strategies that determine the ways in which individuals perceive, remember, think and solve problems” (Messick, 1976, p.5); Similarly, Jonassen and Grabowski (1993) consider that CS deals with habitual forms or preferences for information processing. In relation to the concept of style, Hederich (2010) states that the style is characterized by being differential and relatively stable. Likewise, it integrates different personality domains and is value-neutral. In short, Cognitive Style deals with the categorization and grouping of individual characteristics, which allude to the habitual and spontaneous way of processing information, building upon perception, the focalization of attention and the use of memory. All this is observed in the different ways of solving problems and facing life by undertaking different types of tasks regardless of the content.

One of the most studied dimensions of Cognitive Style is the field dependence-independence dimension (FDI). Field-dependent subjects (FDs) are socially close and prefer teamwork and collaboration, their level of autonomy is low, meaning they are dependent on authority and their motivation towards learning is extrinsic. In contrast, field-independent subjects (FIs) are socially distant, prefer individual work, like to compete and gain individual recognition, have a high level of autonomy, are independent of authority, and are intrinsically motivated to learn. In the field of education and learning achievement, FI students have shown greater success than FD students (Hederich and Camargo, 2000b; Tinajero and Páramo, 1998; López, Hederich and Camargo, 2011, cited by Hernández, 2014, p.2). In this regard, questions have arisen about the neutral character of the FDI stylistic dimension, especially with highly FD students (Tinajero and Páramo, 1998). Additionally, the unipolar measurement character of the Embedded Figures Test (EFT) instrument is questioned, as it accounts for an individual's restructuring aptitude

levels, indicating high scores for FIs, while low scores are by default achieved by FDs. This suggests the need for an indicator that measures field dependence. In order to broaden the picture of stylistic differences between FI and FD, several studies have been conducted (Goodenough, 1976; Tinajero and Paramo, 1998; Hederich and Camargo, 2000a; Hederich, 2004) in relation to information processing, attention and memory.

The perspectives from which attention and memory are dealt with are briefly presented hereunder. In relation to attention, it is addressed from the approaches by Lupiáñez et al. (2016), who propose an integrating, attention model from cognitive neuroscience, which is based on the postulates by Posner and Corbetta. The model proposed by Posner defines three interrelated systems or networks. According to Lupiáñez et al., (2016) these networks are: (a) The *Posterior Attention Network*, “Its function is to select information at the perceptive level in the early stages of processing. The involved brain structures would be the parietal cortex and the union” (Lupiáñez et al., 2016, p.120). (b) The *Anterior Attention Network* deals with executive control, that is, the control of actions, in such a way that it adjusts to certain short-term objectives (Lupiáñez et al., 2016); Based on the neuronal circuit, it is situated in “the dopaminergic system, and brain structures such as the prefrontal cortex, the anterior cingulate cortex and the basal ganglia” (Lupiáñez et al., 2016, p.120). And (c) the *Vigilance Network* is in charge of generating and maintaining the alertness required to carry out a task; “The frontal and parietal cortex” are involved in this system (Lupiáñez et al., 2016). In addition, Lupiáñez et al. (2016) include two levels of control proposed by Corbetta. These controls consist in the fact that “attention can be directed from top to bottom by our goals, or from bottom to top by our own stimuli” (Lupiáñez et al., 2016, p.121). On the other hand, we assume memory from the working memory model proposed by Baddeley and Hitch (1974); It is a multicomponent system composed of a central executive system in charge of managing the working memory and coordinating two subsystems called the phonological loop and the visuospatial agenda. According to Baddeley (1998) and Baddeley, Eysenck and Anderson (2009), the articulatory or phonological loop is in charge of managing information based on language, while the visuospatial sketchpad performs an analogous function with visual and spatial information.

In the study “FDI and Information Processing: The Origin Of A Disadvantage,” Tinajero and Páramo (1998) analyze studies and reflections on the FDI dimension and information processing. Results of interest are highlighted hereunder: FI subjects present greater selective attention (Rozestraten, 1981). In order to understand the concepts, FDs tend to retain information, while FIs break down and analyze information (Nebelkopf and Dreyer, 1973). As the information retention capacity is the same in both polarities, the difference lies in the control processes used by FIs (Bennink and Spoelstra, 1979). Remembering elements from a given structure is the same for both styles, but when recalling material that lacks structure, FIs perform better since they organize the elements according to subjective parameters (Coward and Lange, 1979). FIs benefit more than FDs from generating more mental images during the information-storing process (Annis, 1979; Pierce, 1980). FIs resort to their own or external information scheme during information retrieval (Spiro and Tirre, 1980). In this review, the authors express that problem solving requires a restructuring aptitude; Therefore, FIs obtain more benefits. In situations where social keys are available, FDs are more willing than FIs to use them, emphasizing that “insofar as restructuring aptitude is required in such tasks, differences in performance will arise among subjects with different styles” (Tinajero and Paramo, 1998, p. 425).

Subsequently, the study developed by Guisande, Páramo and Tinajero (2007) on Attentional Functioning and FDI Cognitive Style found that FI children deliver better performance than FD children in tests measuring verbal working memory, the ability to direct and keep attention, and sustained attention. In the study by Tinajero, Páramo and Guisande (2007), it was proposed that research be needed on the cognitive processes underlying field dependence and independence CS, instead of addressing studies on new instruments to measure FDI.

In relation to the understanding of cognitive processes, and specifically in information processing, memory and attention, studies on FDI require further broadening the spectrum of characterization of both stylistic polarities (FD and FI) regarding deeper cognitive characteristics. This article aims to present the results of a bibliometric review which covers other studies that have addressed the stylistic dimension of FDI in relation to information processing, attention and memory.

### **Method**

The search for the research articles that constitute the sample to be analyzed was carried out in databases with high academic impact and a significant number of publications in indexed journals. These are: ScienceDirect, Proquest and Scopus. The search criteria used was: (“cognitive style”) AND (“field dependence” OR “field independence”) AND (“memory” OR “attention” OR “information processing”).

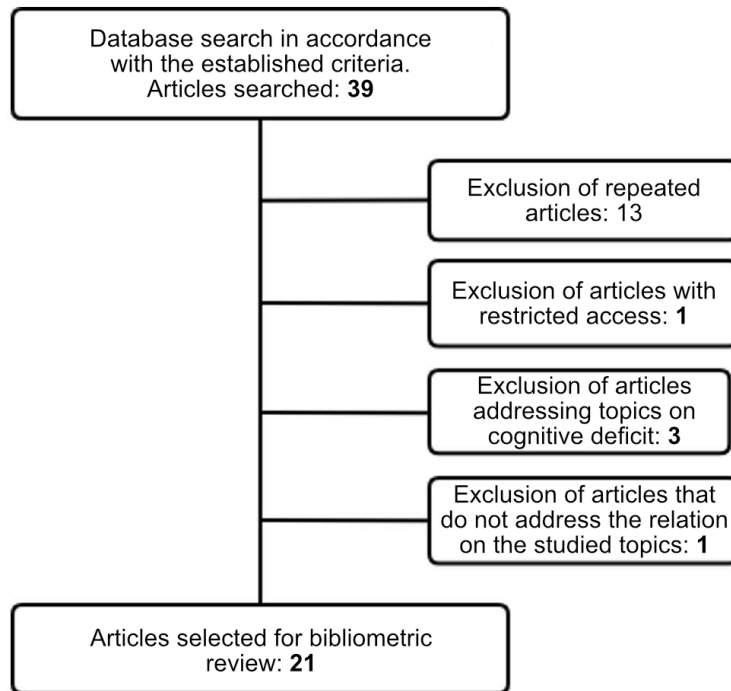
The search was performed in the fields: title, abstract and keywords. Two filters were applied: a) type of selected document: article, and b) years of publication: between 2008 and 2018. The exclusion criteria used were: a) repeated articles, b) articles dealing with cognitive deficits, c) articles whose content did not address the relationship between ICD and information processing, memory and/or attention, and d) articles to which the complete document was not accessible. This search was conducted between July and August 2018.

The systematization of the articles that passed the filters and met the inclusion criteria was carried out in the Microsoft Excel program. For this, a matrix was made with the following categories and fields: a) identification of the articles: database, title and abstract, b) production and impact indicators: author(s), year of publication, publications by country, journal and citations by article, and c) content analysis: type of study, educational level of the participants in empirical studies, and description of the most representative findings of the relation of the cognitive FDI style and the processing of information, memory, and/or attention of the studies analyzed. From these results a descriptive analysis based on frequencies, minimum and maximum, and content analysis is carried out.

### **Results**

39 articles were found, distributed in the databases as follows: a) ScienceDirect: 3 articles, b) Proquest: 12 articles, and c) Scopus: 24 articles. 13 repeated articles were discarded, three articles dealing with cognitive deficits, an article that did not deal with the relationship between ICD and information processing, memory and/or attention, and

an article to which the complete document was not accessible. Consequently, 21 articles remained for the bibliometric review. (See Figure 1).



*Figure 1.* Flowchart of the article selection process.

*Note:* Source: Prepared by the authors, (2018).

The following is an analysis of the 21 articles that met the inclusion criteria. The analysis is conducted according to the following criteria: a) number of articles published per year, b) number of publications per country, c) number of publications per journal, d) number of articles published per author, e) studies with the highest number of citations, f) type of study conducted and number of publications, g) educational level of participants in empirical studies, and h) main findings in FDI results, information processing, memory and/or attention.

### ***Number of articles published per year***

Figure 2 shows the number of articles published annually. The average number of annual publications during the decade 2008 to 2018 corresponds to two articles. In 2018, the greatest number of publications was made (three articles). In 2013 and 2016, the lowest number of publications was produced, corresponding to one per year. The low but permanent number of annual articles is in line with the fact that the FDI dimension is a psychological construct with a long trajectory that has already lived its research "moment of glory", but whose theoretical soundness keeps it in the focus of attention of some working groups.

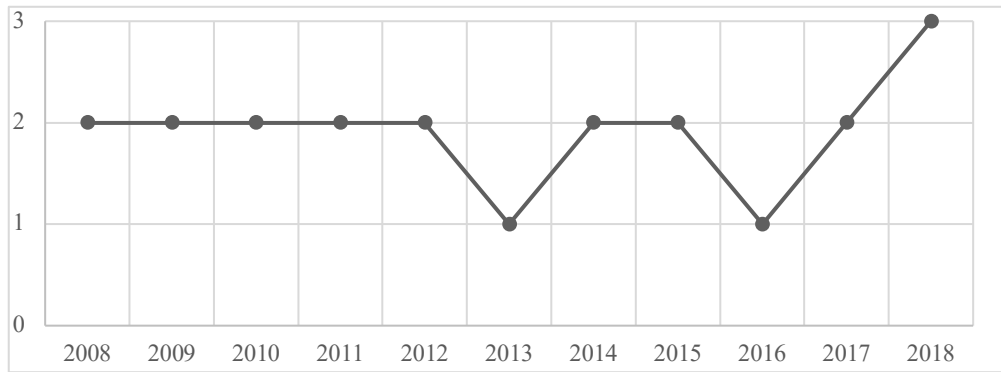


Figure 2. Number of articles published per year

Note: Source: Prepared by the authors, (2018).

### Number of publications by country

The systematized articles in this paper have been published by authors from 15 countries. Figure 3 shows the number of articles published by country. It is evident that the countries with the highest number of publications are Spain and the United Kingdom with four articles. In second place is China with three publications. And in third place the United States and Italy with two articles. The other countries have one publication each. In addition, there is teamwork among several countries in three publications, such as Spain and Italy, Spain and Portugal, and Belgium, the Netherlands and the United Kingdom. The list of publications includes a Latin American article (Uruguay).

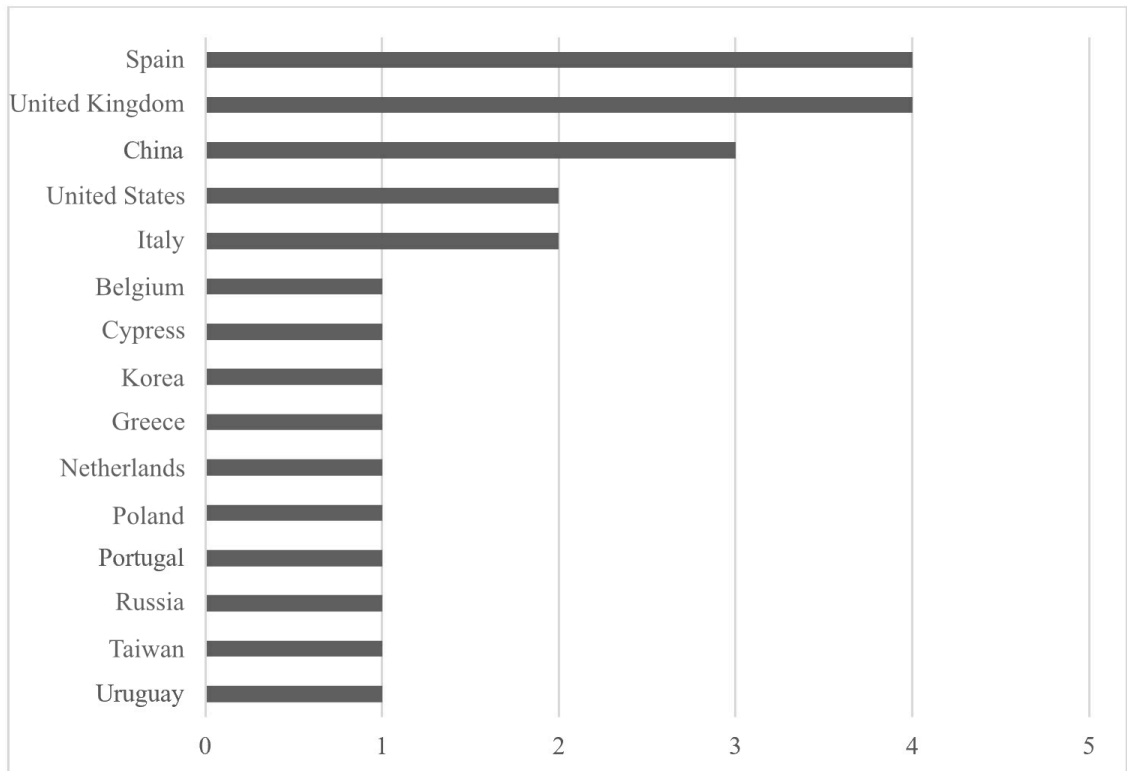


Figure 3. Number of publications by country.

Note: Source: Prepared by the authors, (2018).

### ***Number of publications per journal***

The analyzed studies in this search have been published in 19 scientific journals. Table 1 shows the journals in which the articles of this review have been published. The journals that have published more articles are *Psychological reports* with two publications and *Frontiers in pharmacology* with two publications. The remaining 17 journals have each published one article. Much dispersion is then observed in the research environments. As it can be deduced from the names of the serials, these environments range from medical-pharmacological research, through basic psychological studies, to fields of work in educational contexts.

Table 1

### ***Number of publications per journal***

<b>Journal:</b>	<b>Number of publications</b>
Psychological reports	2
Frontiers in pharmacology	2
The Social Sciences	1
Studia Psychologica	1
Psicologia: Teoria e Pesquisa	1
Polish Psychological Bulletin	1
Perceptual and motor skills	1
PeerJ	1
Neuroscience	1
Neuropsychologia,	1
Journal of Educational Computing Research	1
International Journal of Human-Computer Studies	1
Interacting with Computers	1
Food Research International	1
Experimental brain research	1
Educational Technology Research and Development	1
Chemistry Education Research and Practice	1
British Journal of Educational Psychology	1
Asia Pacific Education Review	1

*Note:* Source: Prepared by the authors, (2018).

### ***Number of articles published by author***

A total of 58 authors have participated in the publications reviewed in this study. Table 2 presents those authors who have published three and two articles. Guisande, Páramo and Tinajero stand out with three publications, followed by Boccia and Piccardi with two publications. In fact, Professors Guisande, Páramo and Tinajero, all three from the University of Santiago de Compostela, have been leading the research on the FDI dimension, which seems not only in their country, Spain, but also in the European context.

Table 2

*Number of articles published by author*

Author	Number of publications
Guisande	3
Páramo	3
Tinajero	3
Boccia	2
Piccardi	2

Note: Source: Prepared by the authors, (2018).

***Studies with the highest number of citations***

The analyzed research articles have a total of 287 citations. Table 3 presents 13 studies out of 21, which had the highest number of citations ( $\geq 10$ ) and/or the highest estimate of number of citations per year since publication. Each column presents the following information: In the first column is the reference of each article. The second column presents the number of citations for each study, using Google Scholar®. There are three articles with more than 30 citations each. The article with the highest number of citations is Rittschof, K. A. (2010).

Table 3

*Studies with highest number of citations*

Reference	Number of quotes
Rittschof, K. A. (2010).	56
Billington, J., Baron-Cohen, S., y Bor, D. (2008).	43
Evans, C., Richardson, J. T., y Waring, M. (2013).	32
Alamolhodaei, H. (2009).	26
Mawad, F., Trías, M., Giménez, A., Maiche, A., y Ares, G. (2015).	26
Overton, T. L., y Potter, N. M. (2011).	22
Jia, S., Zhang, Q., y Li, S. (2014).	15
Bednarek, H., y Orzechowski, J. (2008).	11
Guisande, M. A., Tinajero, C., Cadaveira, F., y Páramo, M. F. (2012).	10
Nisiforou, E., y Laghos, A. (2016).	8
Raptis, G. E., Fidas, C., y Avouris, N. (2018).	4
Boccia, M., Vecchione, F., Piccardi, L., y Guariglia, C. (2017).	3
Liu, H. C. (2018).	2

Note: Source: Author's creation (2018).

***Type of study and number of publications***

Figure 4 shows the number of publications according to the type of study carried out. Most of studies are empirical, equivalent to 90% of publications. And 10% of the research are theoretical studies. For instance, in one of the theoretical studies carried out by Evans, Richardson and Waring (2013), they made a documentary review about the evidence of polarity of field independence.



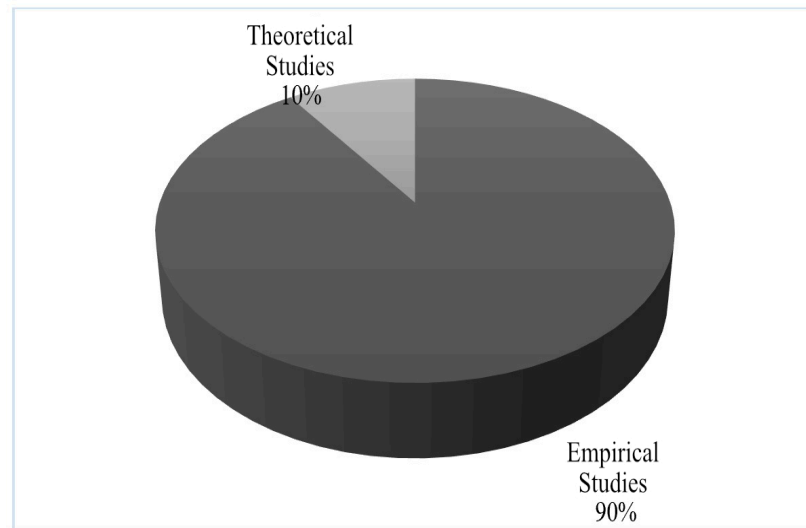


Figure 4. Type of study and number of publications.

Note: Source: Author's creation (2018).

#### ***Educational level of the participants of the empirical studies***

The educational level of the participants of the empirical studies is assessed. 15 out of 19 studies specify the participants' educational level. Figure number 5 shows the distribution of the educational level of the participants of 15 empirical studies that reported the educational level of the sample. 73% of the studies worked with college students equivalent to 11 investigations. 13% of the participants are high school students, equivalent to two studies. 7% are elementary school students, with one study. And 7% correspond to a study in which its participants are from both levels, (elementary and high school students).

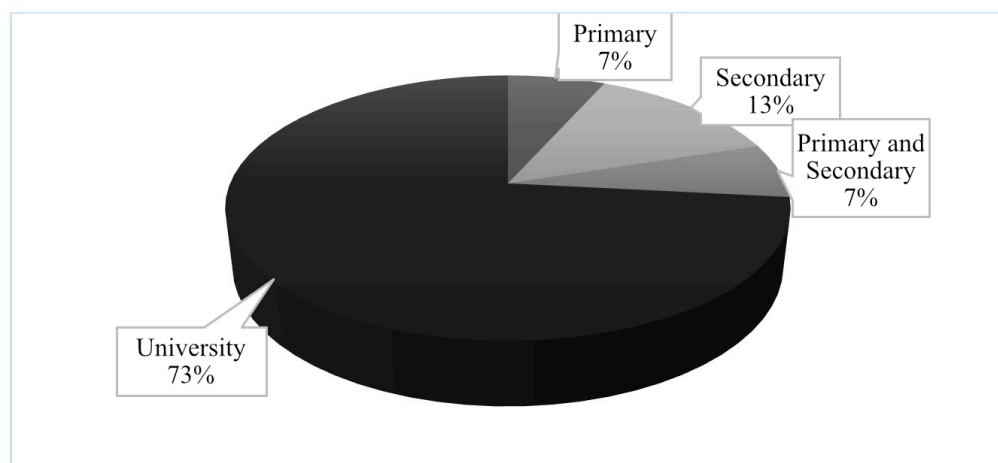


Figure 5. Educational level of the participants of the empirical studies.

Note: Source: Author's creation (2018).

### ***FDI results, processing of information, memory and attention***

As said before, cognitive style refer to the preferred way an individual acquires, comprehends, processes, and remembers information (Kozhevnikov, 2007 citado por Raptis, Fidas y Avouris, 2018). According to Curry's onion model<sup>1</sup> (1987), the cognitive styles present stability in time, since they address cognitive aspects of the individual. Therefore, cognitive style is one of the individuals distinguishing features in relation to the way they prefer to perceive and process the information. So that the studies analyzed in the last decade allow to extend the comprehension of the cognitive characteristics of FDI stylistic dimension regarding the processing of information, memory and attention. Also, lets us see recent work trends. Now, the most important findings are presented. They follow an evolutionary path from 2008 to 2018.

The study by Billington, Baron-Cohen and Bor (2008) addresses the relationship between systematization, understood as the ability to analyze rules underlying systems in order to predict, and FI as the ability to pay attention to local details without regard to cognitive distractors. The researchers used functional magnetic resonance imaging (fMRI). The study determined behavioral and neural evidence for the association of FI cognitive style with systematization. In addition, systematization was associated with increased activation in the brain regions (the prefrontal, parietal, and extra-striatal visual cortexes) with increased and maintained attention. Bednarek and Orzechowski (2008) investigated the possible connections between cognitive factors (attention and memory) and behavioral factors (structure of temperament traits) as predictors of FD and FI . They determine in their results that FI subjects have an adequate reaction in long-lasting activities, a high resistance to emotional stress, a high capacity to process external stimuli and an efficient selection mechanism. While FD individuals have low resistance to external distractors, low resistance to emotional stress and low capacity to process external stimuli.

In another context, Guisande et al. (2009) conducted a study on attentional processes and FDI. Results showed lower performance especially in a group of FD children in tasks involving sustained attention or ability to maintain attention on relevant stimuli. Regarding Alamolhodaei's work, H. (2009) one of the objectives was to explore the relationship between cognitive style (FDI), working memory and mathematical anxiety, and to examine their effects on students' mathematical problem solving. According to this study, FI cognitive style students tend to have a high working memory capacity compared to FD students. Furthermore, it suggests that teaching style and mathematical tasks are adapted to students' cognitive styles (FD/FI) and their working memory. In a similar paper, Rittschof (2010) describes that FDI is generally measured as visuospatial ability and executive functioning in working memory. He asserts the positive correlation between working memory and FI cognitive style polarity. This paper presents possible implications for the design and research of instruction systems based on FDI and its relationship with visuospatial and executive functioning in working memory.

On the other hand, Tinajero, Castelo, Guisande and Páramo et al. (2010) addressed the study of self-regulated learning in female students with different cognitive styles. Female FD students reported increased use of some learning strategies, specifically self-

---

<sup>1</sup> It is a style integrator model. In which the following information is explained "interactions between cognitive style, learning style and learning strategies. This model shows a progressive relationship from the most stable cognitive functions (center of the onion) to the less stable ones (outer layers) in the subjects. The center is made up of elements corresponding to personality traits (cognitive style). It is followed by a layer related to the subjects' preferred ways of receiving information in a learning environment (learning style) and, finally, the last layer is composed of the subjects' instructional preferences" (López et al., 2011).

instruction, counteracting distractions (avoiding context and personal distractions), self-questioning, self-monitoring, and self-assessment. These findings on metacognitive strategies are inconsistent with previous research. The results can be explained by the fact that FD individuals have greater confidence in external references and could be considered a bias towards "appropriate responses. Meanwhile, Overton and Potter (2011) consider that FI is crucial to success in solving open, context-rich problems. The context used requires extracting the relevant information from a problem that contains more "noise" than a more traditional algorithmic problem. On the other hand, the work developed by Xu, Si and Zhang (2011) investigated if distractors interfere with the numerical estimation in students with cognitive style FDI. Distractors are elements that require the individual to allocate more attention and generate an increase in the cognitive load. The results indicate that no significant differences were found between FI and FD subjects.

From a different approach, the study by Meng et al. (2012), argues that styles, essentially FDI, are studied with special emphasis on the psychological and educational fields and hardly from the neuroscience. This study proposed that the components of the ERP event related potential could help to explain how FD and FI subjects process information. For this purpose, the functional neuroanatomy of attention control is characterized, which is composed of a dissociable sub-process of conflict control and cognitive control, performed by the lateral frontal cortex and the dorsal anterior cingulate cortex. It was found in relation to information processing that FI subjects have a deeper analysis and FD subjects a more automated and superficial analysis. As far as the ability in the "cognitive control" the FI subjects have a better capacity to mobilize and/or to assign mental-attentional capacity. Regarding the study by Guisande, Tinajero, Cadaveira and Páramo et al. (2012) found that FI children scored higher than FD children on attention function tests. Regarding visuospatial tasks, FI children scored higher than FD children in the field and intermediate in the block design test. A relevant result of the present study is that FI children seem to be able to use their attention span more efficiently.

Additionally, Evans, Richardson, and Waring (2013) conducted a review of the research evidence on FI. The review highlights that there is a large number of research studies that identify a clear relationship between FI and working memory. Cognitive psychologists have suggested that measures of FI depend on a system of working memory (Bennink and Spoelstra, 1979, cited by Evans et al., 2013). FI is associated with improved working memory performance, especially on tests of spatial ability and tasks involving visuospatial memory. Independent field students can minimize their cognitive load and maximize the efficiency of working memory by placing more emphasis on selectively coding information so that they have less information to process in working memory and therefore demonstrate greater information processing ability (Kozhevnikov, 2007; Richardson and Turner, 2000; St. Clair-Thompson et al., 2010, cited by Evans et al., 2013). Finally, it proposes some topics for future work such as conducting more detailed studies of all FI measures in relation to the components of working memory and identifying the cognitive mechanisms involved.

In the work of Jia, Zhang and Li (2014) it is evident that cognitive style in the FDI dimension can modulate a person's efficiency in isolating and filtering irrelevant information from a visual working memory task. FI individuals have a superior ability to isolate and filter irrelevant items from tasks than do FDs. Consequently, FI individuals can selectively attend only to task-relevant information and prevent irrelevant information

from accessing working memory, while FD individuals cannot successfully filter out irrelevant information. On the other hand, Marquez and Ellwanger (2014) determine that the hypothesis where collectivism and individualism are associated with differences in more analytical (FI) or holistic (FD) cognitive processing needs further investigation. On the other hand, the work developed by Artischeva (2015) on the structure of psychic states among people with different style preferences during the processing of information, found that the structural organization of the image of the mental state of the FD subjects is the most holistic, integrated and highly organized than subjects with FI .

On the other hand, Mawad, Trías, Giménez, Maiche and Ares (2015) carried out a study that does not have full affinity to the educational or psychological field, but there is evidence of the characteristics of the subjects based on the FDI and their relationship with some elements of the information processing. In the nutritional research, it stands out that FD consumers tend to make less reflective information processing than FI consumers when making decisions, and FD consumers made less fixation on traditional nutritional information on yogurt labels. Additionally, Nisiforou and Laghos (2016) addressed individual eye tracking. They investigated the association between cognitive style and eye movement of adults as they interacted with a set of visual tasks. FD subjects have a more disoriented and unstructured eye activity, therefore, a greater number of fixations and saccadic movements are generated as opposed to neutral FI and FDI. On the other hand, Tascón, Boccia, Piccardi, and Cimadevilla (2017) in examining the EFT results in relation to a spatial memory recognition test that required memorizing a location of a green box in an image of a virtual room determines that FI participants were associated with improved spatial memory performance. FIs were more accurate than FDs when they had few reference points available in the environment and were faster than FDs when all reference points were available. The results suggest that cognitive style affects spatial memory performance and this phenomenon is modulated by the complexity of the environment.

For their part, Boccia, Vecchione, Piccardi and Guariglia (2017) addressed the study of the effect of FD on learning and retrieval of navigation environments. They found that the FI cognitive style is fundamental to restructure environmental information into a global and flexible representation of the environment in the long term in the modeling of the cognitive map, as well as to facilitate changes in perspective that allow individuals to reorient and recognize places from a different point of view from the familiar one. FI individuals performed better than FD in the mapping task and in the spatial orientation and perspective taking test. The results suggest that FD affects learning and recovery from the navigation environment. On the other hand, the research work of Huygelier, Van der Hallen, Wagemans, de-Wit and Chamberlain, (2018) studied the extent to which performance on a new Embedded Figure Test (L-EFT) correlated with measures of intelligence, executive functions and estimates of local/global perceptual styles. The results indicated that performance on L-EFT does not correlate strongly with estimates of local/global perceptual style, intelligence or executive functions.

On the other hand, Liu's study (2018) used eye-tracking technology to discover whether FD and FI students differed in terms of their visual search efficiency and their multimedia learning performance. FI students outperformed FD students. FI students were more capable of identifying visual signals and showed efficient visual search patterns by learning using different information formats. Finally, the study carried out by Raptis et al. (2018) determines that mixed reality<sup>2</sup> amplifies the effects of FDI differences

---

<sup>2</sup>It is the combination of virtual reality and augmented reality.

in the specific behavior of the game and the visual behavior of the user. The mixed reality context favors most FI users, as they adapted more easily to the visually enriched environment and were therefore more effective in the search for visual information. It is suggested to provide personalized mechanisms to the cognitive characteristics of users to support the efficiency of users in the processing of information and improve immersion in mixed reality applications.

In short, most analyzed studies provided empirical evidence for understanding the cognitive characteristics of each stylistic polarity in the FDI dimension. A high percentage of the analyzed research studies explored the FI and FD subjects' attention and memory. Broadly speaking, there is an advantage of FI subjects in contrast to FD subjects in relation of the processing of information.

### Discussion and conclusions

Some characteristics of the study can be highlighted when carrying out a bibliometric revision of the FDI stylistic dimension related to the processing of information, memory and attention of the articles published in the ScienceDirect, Proquest and Scopus databases during the 2008 to 2018 decade. Regarding the articles published per year, there is evidence of an annual average of two articles, which shows a continued interest in research in the matter. In addition, there has been an increase in the number of publications over the last analyzed years, which would suggest a recent interest in the topic. In terms of the number of publications per country, Europe leads the way, while in Latin America and the Caribbean less research is carried out.

Regarding the number of publications per journal, it is highlighted that the *Psychological reports* journal published two articles in 2011 and 2014, and the *Frontiers in pharmacology* journal published two in 2017. In terms of the number of articles published per author, Guisande, Páramo and Tinajero stand out as the ones who have published more articles, and it is noted that these publications were made by groups of four or five authors in 2009, 2010 and 2012. These publications are geographically located in Spain and Portugal, affiliated to the University of Santiago de Compostela (Spain), the University of Minho (Portugal) and the Catholic University of Portugal (Portugal). This allows to conclude that teamwork has an impact on the fact that research on this subject is published with a certain frequency, as well as on the consolidation of research work groups. Regarding the studies with a greater number of citations, studies from 2008, 2010 and 2013 stand out, with more than 130 citations. There are also recent articles (Nisiforou and Laghos, 2016, Boccia et al., 2017, Liu, 2018, Raptis et al., 2018). This allows to confirm that in the field of study there are relevant and high-credibility publications to support further research.

Regarding the kind of study carried out and the number of publications, it is shown that most studies, 90% of them, are empirical, while the rest, the remaining 10%, are theoretical. When finding a significant number of empirical studies, the importance of evidence in this kind of studies is highlighted, since it makes it possible to understand the cognitive processes in the population, which stylistically differ by field dependence and independence. In this sense, according to the studies reporting the participants' educational level, most of the studies were carried out with university students and a smaller percentage with primary and secondary school students. This may suggest that most researchers have greater access to carrying out research work with university

population. It also makes it possible to establish the need to work more frequently in other educational level such as the child and adolescent population of schools. There, results regarding FDI in relation to the processing of information, memory and attention, could shed light in the educational sphere, with evidence and suggestions of possibilities to address more effective educational processes in schools.

Regarding the main findings of the studies analyzed on FDI in relation to the processing of information, memory and attention, it is found that the FI subjects show a positive correlation with a high performance with working memory (Alamolhodaie, 2009, Rittschof, 2010, Evans et al., 2013). There is evidence of better performance of FI individuals in terms of spatial memory, especially in the recovery of environmental or simulated environments (Tascón et al., 2017, Boccia et al., 2017). Regarding the attention processes, the ability to maintain attention is higher in FI subjects than in FD subjects (Guisande et al., 2009, Guisande et al., 2012, and Jia et al., 2014). For their part, Billington et al. (2008) found a connection between systematization ability and the FI cognitive style. Meanwhile, Overton and Potter (2011) determined that field independence is a success factor in solving open problems in disciplinary chemistry. For their part, Meng et al. (2012) have found that FI subjects perform a more in-depth analysis and FD subjects perform a more automated and superficial analysis. Mawad et al. (2015) conclude, when it comes to making decisions, FD subjects tend to perform a less reflective processing of information than FI subjects. In relation to technological applications, mixed reality favor most of FI users, since they adapt to the environment more easily and their search for visual information is more effective.

On the other hand, Bednarek y Orzechowski (2008) find that FD individuals show low resistance to external distractors, low emotional resistance to stress and a low capacity to process external stimuli. Moreover, Tinajero et al. (2010) prove that FD subjects showed a greater use of some learning strategies, specifically self-instructions, distraction counteracting, self-questioning, self-monitoring and self-evaluation, in the reporting of self-report questionnaires. Artischeva (2015) discovered that the structural organization of the mental state image of FD subjects is the most holistic, integrated and highly organized, compared to FI subjects. For their part, Xu et al. (2011) did not find any significant differences in attention processes in the numerical estimation of FD and FI subjects. Meanwhile, Marquez and Ellwanger (2014) conclude that the hypothesis associating collectivism and individualism with differences in more analytical (FI) or holistic (FD) cognitive processing requires further research. Regarding the studies about visual activity and tracking, FD were found to have a more disoriented and unstructured visual activity as opposed to FI (Nisiforou y Laghos, 2016). Liu (2018) noted that FI students showed a greater ability to identify visual cues, as well as efficient visual search patterns when learning by using different visual cues.

In short, bibliometric review of the FDI stylistic dimension and its relation to the processing of information, attention and memory during the 2008 to 2018 decade shows that it is a field of ongoing research interest. It is interesting to observe how research on this subject is carried out in different fields of study. It is noted that most of the 21 studies have mainly contributed to the consolidation of empirical studies. Works by Billington et al. (2008) and Meng et al. (2012) used brain response techniques such as fMRI and ERP in order to consolidate evidence about information processing and the FDI stylistic dimension. In this regard, Goode, Goddard and Pascual-Leone (2002) find these techniques to be valuable for further exploration of the FDI psychological construct and the functional brain systems behind the cognitive style differences. In conclusion, it is necessary to increase the number of studies in the subject of analysis of this study in order

to contribute to a greater characterization of the cognitive processes related to FDI, especially to stylistic polarity of field dependency and in groups of primary and secondary school students.

### References

- Alamolhodaie, H. (2009). A working memory model applied to mathematical word problem solving. *Asia Pacific Education Review*, 10(2), 183-192.
- Annis, L. F. (1979). Effect of cognitive style and learning passage organization on study technique effectiveness. *Journal of Educational Psychology*, 71(5), 620-626. doi: [10.1037/0022-0663.71.5.620](https://doi.org/10.1037/0022-0663.71.5.620).
- Artischeva, L. V. (2015). Structure of psychic states among people with different style preferences during information processing. *The Social Sciences*, 10(5), 571-575.
- Baddeley, A. (1998). *Memoria humana: teoría y práctica*. En español. Editorial Mc Graw Hill.
- Baddeley, A., Eysenck, M y Anderson, M. (2009). *Memoria*. Madrid: Alianza.
- Bednarek, H., & Orzechowski, J. (2008). Cognitive and temperamental predictors of field dependence-independence. *Polish Psychological Bulletin*, 39(1), 54-65. doi: <https://www.degruyter.com/downloadpdf/j/ppb.2008.39.issue-1/v10059-008-0008-5/v10059-008-0008-5.pdf>.
- Bennink, C. D., & Spoelstra, T. (1979). Individual differences in field articulation as a factor in language comprehension. *Journal of Research in Personality*, 13(4), 480-489. doi: [10.1016/0092-6566\(79\)90010-2](https://doi.org/10.1016/0092-6566(79)90010-2).
- Billington, J., Baron-Cohen, S., & Bor, D. (2008). Systemizing influences attentional processes during the Navon task: An fMRI study. *Neuropsychologia*, 46(2), 511-520. doi: [10.1016/j.neuropsychologia.2007.09.003](https://doi.org/10.1016/j.neuropsychologia.2007.09.003).
- Boccia, M., Vecchione, F., Piccardi, L., & Guariglia, C. (2017). Effect of cognitive style on learning and retrieval of navigational environments. *Frontiers in pharmacology*, 8, 496. doi: [10.3389/fphar.2017.00496](https://doi.org/10.3389/fphar.2017.00496).
- Coward, R. T., & Lange, G. (1979). Recall and recall-organization behaviors of field-dependent and field-independent children. *Psychological Reports*, 44(1), 191-197. doi: [10.2466/pr0.1979.44.1.191](https://doi.org/10.2466/pr0.1979.44.1.191).
- Evans, C., Richardson, J. T., & Waring, M. (2013). Field independence: reviewing the evidence. *British Journal of Educational Psychology*, 83(2), 210-224.
- Goode, P. E., Goddard, P. H., & Pascual-Leone, J. (2002). Event-related potentials index cognitive style differences during a serial-order recall task. *International Journal of Psychophysiology*, 43(2), 123-140. doi: [10.1016/S0167-8760\(01\)00158-1](https://doi.org/10.1016/S0167-8760(01)00158-1).
- Goodenough, D. R. (1976). The role of individual differences in field dependence as a factor in learning and memory. *Psychological bulletin*, 83(4), 675.
- Guisande, M. A., Almeida, L. S., da Ponte, F. E., Tinajero, C., & Páramo, M. F. (2009). Processos atencionais e dependência-independência de campo: estudo com crianças e adolescentes portuguesas. *Psicologia: teoria e pesquisa*, 25(4), 561-567. Retrieved from <http://www.scielo.br/pdf/ptp/v25n4/a11v25n4>.

- Guisande, M. A., Páramo, M. F., Tinajero, C., & Almeida, L. S. (2007). Field dependence-independence (FDI) cognitive style: An analysis of attentional functioning. *Psicothema*, 19(4), 572-577.
- Guisande, M. A., Tinajero, C., Cadaveira, F., & Páramo, M. F. (2012). Attention and visuospatial abilities: a neuropsychological approach in field-dependent and field-independent schoolchildren. *Studia Psychologica*, 54(2), 83.
- Hederich, C. (Marzo de 2014). *Presentación magistral procesos cognitivos*. En el seminario de Cognición y Lengua escrita. Universidad Pedagógica Nacional. Bogotá, Colombia.
- Hederich, C. (2004). *Estilo Cognitivo en la dimensión de Independencia-Dependencia de Campo -Influencias culturales e implicaciones para la educación*. (Tesis doctoral). Universidad Autónoma de Barcelona, Barcelona, España.
- Hederich, C. y Camargo, A. (2000a). Estilo cognitivo y logro académico en la ciudad de Bogotá. *Revista Colombiana de Educación*, 40-41, 147-172.
- Hederich, C. y Camargo, A. (2000b). Estilo cognitivo en la educación. Itinerario Educativo. *Revista de las facultades de educación*, 36, 43-74.
- Hederich, C. (2010). Acerca de la noción general de estilo en la educación pertinencia, importancia y especificidad. *Actualidades Pedagógicas*, (55), 13-21.
- Hernández, A. (2014). La dimensión de independencia y dependencia de campo en educación: una revisión bibliométrica (2003-2013). *Revista Colombiana de Educación*, (66), 149-170. Retrieved from <https://www.redalyc.org/pdf/4136/413635257007.pdf>.
- Huygelier, H., Van der Hallen, R., Wagemans, J., de-Wit, L., & Chamberlain, R. (2018). The Leuven Embedded Figures Test (L-EFT): measuring perception, intelligence or executive function?. *PeerJ*, 6, e4524.
- Jia, S., Zhang, Q., & Li, S. (2014). Field dependence–independence modulates the efficiency of filtering out irrelevant information in a visual working memory task. *Neuroscience*, 278, 136-143. doi: [10.1016/j.neuroscience.2014.07.075](https://doi.org/10.1016/j.neuroscience.2014.07.075).
- Jonassen, D. H., y Grabowski, B. L. (1993). *Handbook of individual differences, learning, and instruction*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Liu, H. C. (2018). Investigating the Impact of Cognitive Style on Multimedia Learners' Understanding and Visual Search Patterns: An Eye-Tracking Approach. *Journal of Educational Computing Research*, 55(8), 1053-1068.
- Lupiáñez, J., Correa, Á., Chica, A., Vivas, A., Callejas, A., Sanabria, D. y Botella, J. (2016). Atención. In Bajo, T., Fuentes, L., Lupiáñez, J. y Rueda, C. (Ed.). *Libro Homenaje a Pio Tudela*, pp. 117-150. Editorial Alianza.
- López, O., Hederich, C. y Camargo, A. (2011). Estilo cognitivo y logro académico. *Educación y Educadores*, 14(1), 67-82. Retrieved from [http://disde.minedu.gob.pe/bitstream/handle/123456789/1261/2011\\_L%C3%B3pez\\_Estilo%20cognitivo%20y%20logro%20acad%C3%A9mico.pdf?sequence=1&isAllowed=y](http://disde.minedu.gob.pe/bitstream/handle/123456789/1261/2011_L%C3%B3pez_Estilo%20cognitivo%20y%20logro%20acad%C3%A9mico.pdf?sequence=1&isAllowed=y).
- Marquez, R. C., & Ellwanger, J. (2014). Independent and interdependent self-construals do not predict analytic or holistic reasoning. *Psychological reports*, 115(1), 326-338.



- Mawad, F., Trías, M., Giménez, A., Maiche, A., & Ares, G. (2015). Influence of cognitive style on information processing and selection of yogurt labels: Insights from an eye-tracking study. *Food Research International*, 74, 1-9.
- Meng, X., Mao, W., Sun, W., Zhang, X., Han, C., Lu, C., & Wang, Y. (2012). Event-related potentials in adolescents with different cognitive styles: field dependence and field independence. *Experimental brain research*, 216(2), 231-241.
- Messick, S. (1976). Personality consistencies in cognition and creativity. En S. Messick (Ed.), *Individuality in learning* (pp. 4–23). San Francisco: Jossey-Bass.
- Nebelkopf, E. B., & Dreyer, A. S. (1973). Continuous-discontinuous concept attainment as a function of individual differences in cognitive style. *Perceptual and Motor Skills*, 36(2), 655-662. doi: [10.2466/pms.1973.36.2.655](https://doi.org/10.2466/pms.1973.36.2.655).
- Nisiforou, E., & Laghos, A. (2016). Field Dependence–Independence and Eye Movement Patterns: Investigating Users’ Differences Through an Eye Tracking Study. *Interacting with Computers*, 28(4), 407-420.
- Ohlmann, T. (1982). Plasticité des activités classificatoires. *Bulletin de la Société Française pour l'Etude du Comportement Animal*, 2, 371-380.
- Overton, T. L., & Potter, N. M. (2011). Investigating students' success in solving and attitudes towards context-rich open-ended problems in chemistry. *Chemistry Education Research and Practice*, 12(3), 294-302.
- Pierce, J. W. (1980). Field independence and imagery-assisted prose recall of children. *Journal of Educational Psychology*, 72(2), 200. doi: [10.1037/0022-0663.72.2.200](https://doi.org/10.1037/0022-0663.72.2.200).
- Raptis, G. E., Fidas, C., & Avouris, N. (2018). Effects of mixed-reality on players’ behaviour and immersion in a cultural tourism game: A cognitive processing perspective. *International Journal of Human-Computer Studies*, 114, 69-79. doi: [10.1016/j.ijhcs.2018.02.003](https://doi.org/10.1016/j.ijhcs.2018.02.003).
- Rittschof, K. A. (2010). Field dependence–independence as visuospatial and executive functioning in working memory: implications for instructional systems design and research. *Educational Technology Research and Development*, 58(1), 99-114.
- Rozestraten, R. (1981). Les mouvements des yeux et les mesures de dépendance-indépendance du champ. *L'annee Psychologique*, 81(2), 511-533.
- Smith, E. E., & Kosslyn, S. M. (2008). *Procesos cognitivos: modelos y bases neurales*. Madrid: Pearson Educación.
- Spiro, R. J., & Tirre, W. C. (1980). Individual differences in schema utilization during discourse processing. *Journal of Educational Psychology*, 72(2), 204.
- Tascón, L., Boccia, M., Piccardi, L., & Cimadevilla, J. M. (2017). Differences in spatial memory recognition due to cognitive style. *Frontiers in pharmacology*, 8, 550.
- Tinajero, C., Castelo, A. M., Guisande, M. A., & Páramo, M. F. (2010). Self-regulated learning in female students with different cognitive styles: An exploratory study. *Perceptual and motor skills*, 111(1), 31-44. doi: [10.2466/04.11.22.28.PMS.111.4.31-44](https://doi.org/10.2466/04.11.22.28.PMS.111.4.31-44).
- Tinajero, C., & Páramo, F. (1998). Field dependence-independence in second-language acquisition: Some forgotten aspects. *The Spanish journal of psychology*, 1, 32-38. doi: [10.1017/S1138741600005382](https://doi.org/10.1017/S1138741600005382).

- Tinajero, C., Paramo, M. F., & Guisande, A. (2007). Futile debate on assessment of field dependence–independence. *Perceptual and motor skills*, 105(2), 654-656. doi: [10.2466%2Fpms.105.2.654-656](https://doi.org/10.2466%2Fpms.105.2.654-656).
- Xu, J., Si, J. W., & Zhang, W. (2011). Distractors interfere with numerical estimation in Chinese college students as a function of field-dependent or field-independent cognitive style. *Psychological reports*, 108(3), 825-842. Doi: [10.2466/04.22.PR0.108.3.825-842](https://doi.org/10.2466/04.22.PR0.108.3.825-842).

**Date received:** 07/09/2019  
**Date reviewed:** 18/11/2019  
**Date accepted:** 13/12/2019