Cyberbullying and Executive Functions in children and adolescents: a systematic review

Ciberacoso y Funciones Ejecutivas en niños y adolescentes: una revisión sistemática

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Abstract

Cyberbullying, defined as bullying behavior through technologies, has become one of the most frequent psychosocial problems during childhood and adolescence. Brain mechanisms involved in the emergence of aggressive behaviors demonstrate the existence of a relationship between bullying and Executive Functioning. The aim of this research was to conduct a systematic review of published studies relating cyberbullying and Executive Functioning (EF)

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in children and adolescents. A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) review guide. The search for information was carried out in the Web of Science (WOS), Scopus, and Psycinfo databases. The selection of papers consisted of 32 articles that complied with the inclusion criteria. The studies analyzed indicate that there is a moderate relationship between a specific EF profile and being involved in a cyberbullying situation. The results reveal that a lower capacity for inhibition, self-control and problem solving may lead minors to participate as cybervictims, cyberaggressors or cyberaggressors-victimized. The findings are discussed considering the importance of executive functioning in the prevention and intervention of cyberbullying.

Key words: cyberbullying, Executive Functioning, systematic review, childhood, adolescence

Resumen

El ciberacoso, entendido como conducta de acoso a través de las tecnologías, se ha convertido en uno de los problemas psicosociales más frecuentes durante la infancia y la adolescencia. Los mecanismos cerebrales implicados en la aparición de conductas agresivas demuestran la existencia de una relación entre el acoso y el Funcionamiento Ejecutivo. El objetivo de esta investigación fue realizar una revisión sistemática de los estudios publicados que relacionan el ciberacoso y las Funciones Ejecutivas (FE) en niños y adolescentes. Se realizó una revisión sistemática siguiendo la guía de revisión Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). La búsqueda de información se efectuó en la base de datos de Web of Science (WOS), Scopus, y Psycinfo. La selección de trabajos se compuso de 32 artículos que cumplieron los criterios de inclusión. Los estudios analizados indican que existe una moderada relación entre un perfil específico de FE y el encontrarse involucrado en una situación de ciberacoso. Los resultados revelan que una menor capacidad de inhibición, autocontrol y resolución de problemas puede llevar a los menores a participar como cibervíctimas, ciberagresores o ciberagresores-victimizados. Los hallazgos se discuten considerando la importancia del funcionamiento ejecutivo en la prevención e intervención del ciberacoso.

Palabras clave: ciberacoso, Funciones Ejecutivas, revisión sistemática, infancia, adolescencia

Introduction

The massive use of Information and Communication Technologies (ICT) has led to an increase in risks related to cybersecurity, including the case of cyberbullying (Olweus and Limber, 2018). Cyberbullying consists of an aggressive, intentional, repetitive and constant act in time, carried out by an individual or group of individuals, through electronic means of communication, against a victim who cannot easily defend him/herself.

Cyberbullying has emerged as one of the most frequent psychosocial problems in the child and adolescent population, usually exceeding 20% of incidence and reaching prevalences of up to 72% (Escortell, Delgado, & Martínez-Monteagudo, 2020). These percentages usually present substantial variability among studies (Chun et al., 2020; Lozano-Blasco, Cortes-Pascual, & Latorre-Martínez, 2020), mainly due to the measures of analysis used and the inclusion criteria considered, such as the frequency or intensity of aggressive behaviors. The main roles involved in the phenomenon of electronic harassment are (1) the victim, who suffers the harassment; (2) the aggressor, the one who carries out the hostile action; and (3) the aggressor-victimized, who performs both roles simultaneously (Escortell et al., 2020).

Given the fact that cyberbullying is a recent phenomenon, its investigation has increased in recent years, including review studies (Camerini, et al., 2020; Chun et al., 2020; Kwan, et al., 2020). Camerini et al. (2020). These authors reported that cyberbullying is related to stress, anxiety, depression, hostility, loneliness, social problems, low self-esteem, substance use, life dissatisfaction, and suicidal ideation; and it was also associated with Attention Deficit Hyperactivity Disorder (ADHD). Chun et al. (2020) highlighted that cyberbullying was an exponentially growing phenomenon. They also indicated that its measurement presented inconsistencies, as many of their investigations employed ad hoc tests or generated their own questionnaire through different sources. Kwan et al. (2020), for their part, discovered that many of the longitudinal studies evaluated traditional bullying and internalizing problems as risk factors, but there was little evidence on the causal relationship with problematic Internet use, and other environmental factors such as relationships with parents and peers. All of them underlined that there were still gaps to be filled in this field of research.

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Executive functioning and cyberbullying

Executive Functions (EF) are a set of cognitive processes that comprise a multimodal system related to the ability to self-regulate and goal-directed behavior, which allows us to regulate our thinking and behavior (Miyake and Friedman, 2012).

Concerning the assessment of EF, psychometric tests that individually evaluate its basic components and neuropsychological batteries that evaluate all the processes involved are available. However, the only drawback of the neuropsychological batteries is that they are rather extensive to be implemented (Navarro-Soria et al., 2019). Furthermore, there are observational scales that allow measuring EF through the perception of specific symptoms. The last ones appear to be the most appropriate option regarding the balance between implementation time and wealth of outcomes.

A number of different components of EF are identified, collected in the scientific literature (Aran Filippetti & Lopez, 2013; Davidson, Amso, Anderson, & Diamond, 2006) frequently associated with aggressive and prosocial behavior: inhibition (the ability to ignore impulses or irrelevant information both internal and external when performing a task); self-control (inhibition behaviors, impulsivity and the need for short-term reinforcement); problem solving (organization of thoughts and planning of actions for the achievement of the goals set); time management (the ability to estimate the course of time, planning of activities and completion of behaviors in the expected period); and motivation/ activation (concentration maintained over time while working).

EFs are responsible for regulating behavior, managing emotions and controlling aggressiveness; therefore, they have an essential role in the prevention of bullying. Considering this relationship, the research of Rivera (2018) and Linero-Racines (2019), who found that the role of victim or aggressor is related to a deficit in Executive Functioning, draw special attention. Rivera (2018) assessed 76 students, of whom 26 were bystanders, 24 aggressors, and 26 victims. They were administered a battery of tests, including the Adolescent Peer Aggression Scale, the Zoo Map, the Hanoi Towers, and the Stroop Test, finding that victims had more planning difficulties, and aggressors had less capacity for behavioral inhibition and more frequency of risky impulsive decisions. In contrast, bystanders had greater regulation and planning, well-

controlled interference, and poorer decision making. Linero-Racines (2019) examined 101 adolescents in a bullying situation. She studied the relationship of EFs, behavioral maladjustment, and family functioning with social cognition. She used a neuropsychological assessment protocol to assess EFs and social cognition items, the Multimodal Behavioral Scale to evaluate clinical and adaptive indicators, and the School Coexistence Questionnaire. She reported moderate statistically significant correlations between EFs, such as processing speed, inhibitory control and working memory, and bullying.

These studies show the relationship among EF and traditional bullying behaviors, but do not explore online bullying, cyberbullying. Hence, the main objective of the present study focuses on developing a systematic review examining published studies that analyze the relationship between Executive Functioning and cyberbullying behaviors (victimization, aggression, and aggression-victimization) in children and adolescents. The specific objectives of the study aimed to further analyze inhibition, self-control, problem solving, time management, and motivation/activation of child victims, aggressors, and aggressor-victimized in cyberbullying situations. According to the scarce previous findings, it is expected that children and adolescents in a cyberbullying situation present a less adjusted Executive Functioning profile.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) review guide was followed for the systematic review. The search for information was conducted by two authors. The inclusion criteria for the articles were:

- Be peer-reviewed scientific articles.
- To be published until 2020.
- Be indexed in the Web of Science (WOS), Scopus, or Psycinfo database.
- Be written in Spanish or English.
- Having accessible full text.
- To have a sample of children and adolescents between 6 and 18 years of age.

All papers without scientific character, written in other languages, without accessible full text, with adult participants or not directly related to the subject of this research were excluded.

After deciding on the appropriate descriptors for the search of articles through the Medical Subject Headings (MeSH), we proceeded to perform a first exploration, with the main objective of finding studies that broadly related cyberbullying and EF (title, abstract, keywords and full text). The search equation was as follows: "cyberbullying" or "online bullying" or "virtual bullying" or "cyber victimization" and "executive function". However, no results were obtained.

Therefore, a second search was carried out based on the main components of EFs and their relationship with cyberbullying. The search equation was composed of " cyberbullying" or "online bullying" or "virtual bullying" or "cyber victimization" in the first part, and "inhibition", "self-control", "problem solving", "time management" and "motivation/ activation" in the second part, respectively.

Results

Selection of studies and data extraction

The search for information identified 229 articles. After reviewing the different studies, 10 duplicate articles were eliminated, 187 because they did not meet the inclusion criteria (Figure I). The final selection was composed of a total of 32 articles.

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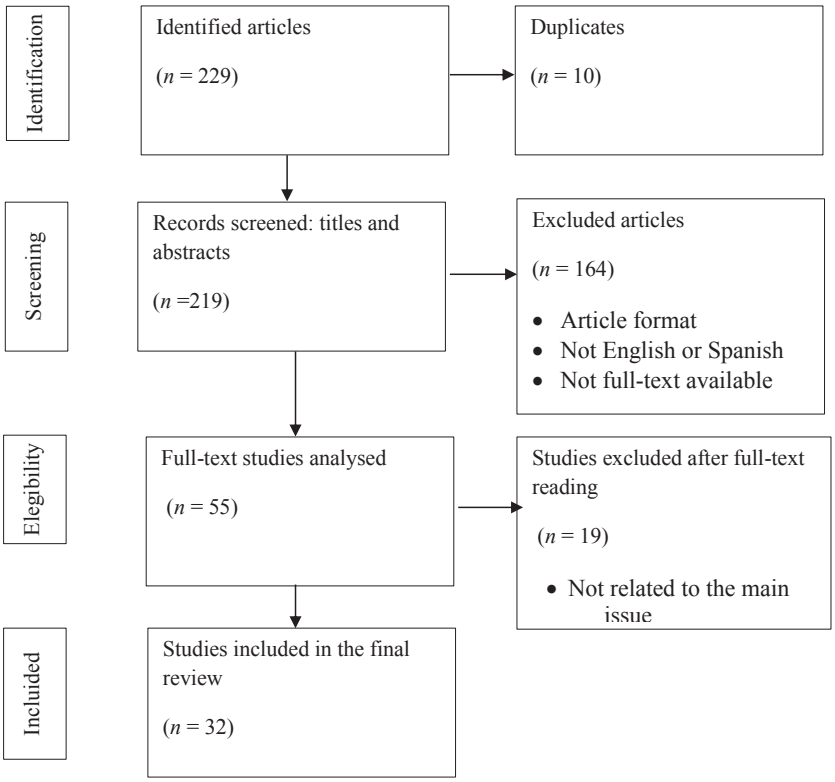
FIGURE I. Flow diagram of study selection process.



A qualitative analysis of the technical aspects of the research, such as the origin, date of publication or sample size of the research, as well as the results extracted in relation to cyberbullying and SF, are presented below.

Qualitative analysis

With respect to the country of origin of the research, there was a predominance of papers published in the United States (n=7) and Korea (n=5), followed by the United Kingdom (n=4), Italy, Spain, Germany,

Portugal (n=3) and Turkey (n=2). However, the least represented countries are Brazil, Belgium, Ireland, the Netherlands, Romania, Poland, China, Canada and New Zealand (n=1). Thus, the highest concentration of publications on the subject is in Europe (55%), followed by North America (23%) and Asia (16%). In Africa and Oceania, only one published study per continent was found (6%).

As for the sample, 34% of the papers evaluated children, 40% adolescents, and 26% combined children and adolescents. The predominance of one type of sample over another may be due to a higher prevalence of those involved in cyberbullying situations identified in that age range. Regarding the year of publication, an increasing trend is observed from 2015 to 2019, followed by a gradual decline thereafter. The decrease in research on cyberbullying and EF corresponds to the pandemic by COVID-19.

Regarding the instruments used in the studies analyzed, there are some tests that directly measure cyberbullying, such as Cyberbullying Questionnaire (CBQ), Cyber Victimization and Bullying Scale (CVBS), Bullying and Cyberbullying Behaviors Questionnaire (QCBC), Revised Cyberbullying Inventory (RCBI), and Online Hate Involvement Scale. Nevertheless, most studies utilize self-developed questionnaires or questionnaires created through other sources (Li et al., 2016; You & Lim, 2016; Wachs et al., 2019; Wachs & Wright, 2019).

As for measures used to assess the components of EFs, there are tests that evaluate impulsivity, Barrat Impulsiveness Scale (BIS-11); inhibition, Behavioral Inhibition and Behavioral Activation (BIS/BAS); self-control, Low Sel-Control Scale (LSC) or Brief Self-Control Scale (BSCS); problem solving, Problem Solving Inventory (PSI); aggression, Buss-Perry Aggression Questionnaire (BPAQ) or violence, Maudsley Violence Questionnaire. Overall, the high variability between the assessment measures is the result of the lack of agreement on the definition of the phenomenon of EF and cyberbullying.

Relationship between cyberbullying and Executive functions

Due to the lack of papers assessing Executive Functioning as a global construct in relation to cyberbullying, the results analyzed separately, taking into account both the main components of EFs and the different roles of cyberbullying, are presented below (Table 1).

Inhibition

Online disinhibition is the strongest predictor of cyberbullying perpetration (Lee, 2017). Other authors appear to agree with this fact. Thus, Wachs and Wright (2019) add that this online toxic disinhibition and sex have a moderating effect between online hate victimization and the externally held interpretation of that behavior. Especially males are more prone to commit online hate when they experience victimization. Wachs et al. (2019) also report that increased cyberbullying perpetration and online toxic disinhibition are positively linked to perpetration of hate manifested through networks. Harriman et al. (2020) found that online disinhibition is also affected by exposure to hateful messages in the online space and time spent on the internet, academic performance, communication with a stranger on social networks.

Problem solving

Ten studies analyze the relationship between problem solving and cyberbullying and assess the effectiveness of prevention programs. They use different techniques, one of the most used is the Quality Circle (QC; Hamilton et al., 2020; Paul, 2012; Paul et al. 2010) which consists of meeting in small groups to improve problem-solving skills. Another frequently utilized is the practice of coping strategies (Armstrong et al., 2019; Buils et al., 2020; Jose and Vierling, 2018; Bradbury, 2018). Those with the best results are problem solving, seeking social support, and self-control. Besides, many of the programs include the component of social skills work as a bullying prevention measure (Ferreira, et al., 2019; Palladino et al., 2012; Vives-Cases et al., 2019). The common point in all of them is that they share in considering the benefits that the development of problem-solving skills brings on the prevention and/or intervention in cyberbullying.

Self-control

All studies suggest that the capacity for self-control leads to a decrease in the risk of cyberbullying in minors. Thus, Camacho et al. (2021) point out that there is an effect of self-control on anger rumination, which is associated with cybervictimization and cyberaggression. On the same line, Kyobe et al. (2018) actually find that lack of self-control is the strongest predictor of cyberbullying via smartphones.

Indeed, self-control has also been shown to be an effective and preventive coping strategy for cyberbullying (Adorjan and Ricciardelli, 2019; Louise et al., 2018), as well as for the development of positive

social skills (Coelho and Marchante, 2018; Li et al., 2016). These studies have also consistently reported that other factors closely linked to self-control are aggressiveness, disinhibition, and impulsivity (Peker, 2017; You and Lim, 2016).

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Studies have highlighted that the problem of self-control EF deficits not only impacts aggressors, but it has also been found that more impulsive adolescents are less likely to help the cybervictim among observers of cyberbullying (Erreygers et al, 2016).

TABLE 1. Cyberbullying and components of EFs.

Authors	Components of EF	Sample	Objective(s)	Instruments	Results
Paul et al. (2010)	Problem solving	N = 32 11-14 years old United Kingdom (UK)	(1) To analyze how Quality Circle (QC) participants created a small anti-bullying working group, and (2) to observe whether they were able to engage in a problem-solving exercise over a period of time with the guidance of a facilitator.	– QC	QC is useful in the prevention of cyberbullying.

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Palladino et al. (2012)	Problem solving	N = 375 14-18 years old Italy	To describe and evaluate a peer-led anti-bullying and cyberbullying model.	– Bullying and victimization scales (Menesini, Calussi, & Nocentini, 2012). – Cyberbullying Scale (Menesini, Nocentini, & Calussi, 2011). – Coping Strategies Indicator (Amirkhan, 1990)	Increasing adaptive coping strategies, such as problem solving, and a significant decrease in maladaptive coping strategies, are measures to prevent cyberbullying.
Paul et al. (2012)	Problem solving	N = 30 11-14 year old UK	To further explore the use of QCs as an effective means of collecting information on bullying and cyberbullying.	– QC	QC is useful in the prevention of cyberbullying.
Vazsonyi et al. (2012)	Self-control	N = 25,142 9-16 years old 25 European countries	To test the importance of low self-control in the perpetration and victimization of cyberbullying.	– Adolescent Family Process (AFP) – Low Self-Control (LSC) – Bully/Victim Questionnaire (Olweus)	Negative indirect effects of low self-control on cyberbullying perpetration and victimization.
Rivituso (2014)	Self-control	N = 4 16-19 years old United States of America (USA)	To explore the lived experiences and psychological impact of cyberbullying victimization.	– Semi-structured interview	1) self-control in response to lack of control over cyberbullying instances; 2) distrust of technology and distrust of people; 3) the value of friends in college and its impact on the victim's self-esteem; 4) repeated instances leading to feelings of vulnerability and fear; 5) feelings of stress, depression, and shame; 6) frustration leading to self-blame.
Bayraktar et al. (2015)	Self-control	N = 2,092 12-18 years old Czech Republic	To discriminate between groups of cyberbullying participants (cyberbullies, cybervictims and cybervictim-victims) at the individual and relational level by controlling for age and gender.	– Buss–Perry Aggression Questionnaire scale (BPAQ; Buss & Perry, 1992) – Self-Esteem Scale (Rosenberg, 1965) – Parental Attachment Subscale of Parental and Peer Attachment Scale (Armsden & Greenberg, 1987) – Ad hoc	Stalkers and cyberbullying victims are similar to each other in terms of low self-control, offline aggressiveness, and gender, and have higher scores on measures of low self-esteem and offline aggressiveness.

Erreygers et al. (2016)	Self-control	N = 2,309 9-17 years old Belgium	To examine the relationship between impulsivity and helping behavior in cyberbullying bystanders.	– Barrat Impulsiveness Scale (BIS-11; Stanford et al., 2009) – Mpathic Responsiveness Scale (Olweus & Endresen, 2001) – Ad hoc	The most impulsive adolescents are less likely to help the cybervictim.
Li et al. (2016)	Self-control	N = 518 11-18 years old USA	To utilize the theories of low self-control and social learning in an attempt to further comprehend why adolescents engage in cyberbullying.	– Ad hoc	Components of social learning theory mediate the effect of low self-control.
You and Lim (2016)	Self-control	N = 3,449 11-14 years old South Korea	To analyze the effects of individual and psychological factors on the perpetration of cyberbullying.	– Ad hoc	Longer Internet use, a greater number of previous bullying experiences and victims, a higher level of aggression and lack of self-control are associated with greater perpetration of cyberbullying.
Lee (2016)	Inhibition	N = 321 M = 21.52 years old USA	To examine patterns of cyberbullying and victimization.	– Cyberbullying Questionnaire (CBQ; Calvete et al., 2010) – Buss–Perry Aggression Questionnaire scale (BPAQ; Buss y Perry, 1992)	Online disinhibition is the strongest predictor of cyberbullying perpetration.
Peker (2017)	Self-control	N = 353 14-18 years old Turkey	To explore the predictive effect of self-control on cybervictimization.	– Brief Self-Control Scale (BSCS; Nebıoglu, Konuk, – Akbaba y Eroglu, 2012). – Cyber Victimization and Bullying Scale (CVBS; Cetın, Yaman y Peker, 2011)	Negative relationship between impulsivity and self-discipline (self-control subscales) and cybervictimization.
Vazsonyi et al. (2017)	Self-control	N = 546 14- 18 years old Turkey	To assess the relationship between maternal and paternal parenting, self-control and bullying/cyberbullying.	– Health Behaviour in School-aged Children Survey – Ad hoc	Parental peer approval predicts bullying both directly and indirectly through low self-control. Low self-control predicts both bullying and cyberbullying behaviors.

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Bradbury (2018)	Problem solving	N = 329 11-14 years old USA	(1) To identify the most common coping strategies of adolescents; and (2) to determine from whom young people learn coping strategies for cybervictimization	– Internet Experiences Questionnaire (Raskauskas & Stoltz, 2007) – Experiences with Cyber-victimization Measure – Self-report Coping Measure for youth	Problem solving and seeking social support are most frequently used as coping strategies.
Coelho and Marchante (2018)	Self-control	N = 455 11-15 years old Portugal	To explore how social and emotional competencies develop as a function of engagement in cyberbullying.	– Social and Emotional Competencies Evaluation Questionnaire (QACSE; Coelho et al. 2015; Coelho & Sousa 2016) – Self-Description Questionnaire-II (Marsh et al., 1983) – Bullying and Ciberacoso – Behaviors Questionnaire (QCBC; Coelho et al., 2016)	Participation in cyberbullying (any role) is associated with negative self-control and social awareness trajectories. Victims and bully-victims show a more pronounced decline in self-esteem and relationship skills.
Jose and Vierling (2018)	Problem solving	N = 2,179 10-15 years old New Zeland	To determine whether the ability of cybervictimization to predict sleep adequacy would be mediated by adaptive coping (problem solving) as well as maladaptive coping (rumination).	– Ad hoc	Cybervictimization predicts lower levels of sleep one year after rumination. Problem solving mediates the temporal relationship of cybervictimization with sleep adequacy.
Kyobe et al. (2018)	Self-control	N = 3,500 14-18 years old South Africa	To explore mobile bullying among rural high school students, the factors influencing it, the applicability of the above theories, and legal and policy implications.	– Ad hoc	Mobile harassers are heavy users of chat rooms, Facebook and Twitter. Bullying by teasing increased up to age 14, declined at age 15 but increased again from age 16 to 18. Stalkers are mainly from unstable residential areas and lack of self-control is most predictive of mobile bullying..

Louise et al. (2018)	Self-control	N = 273 13-18 years old Brazil	To examine the prevalence of cyberbullying and its relationship with coping strategies.	– Revised Cyberbullying Inventory (RCBI; (Topcu & Erdur-Baker, 2010) – Inventario de Estrategias de Afrontamiento de Folkman y Lazarus (Savóia, Santana & Mejias, 1996)	A prevalence of 58%. The most commonly used coping strategies: self-control, social support and escape-flight (victims) and confrontation (victims and perpetrators).
Armstrong et al. (2019)	Problem solving	N = 321 11-15 years old USA	To compare the use and efficacy of coping strategies in face-to-face and cyber victimization contexts.	– Self-Report Coping Scale for Youth (Causey & Dubow, 1992) – Stress Questionnaire (RSQ; Connor-Smith et al., 2000)	Problem solving is associated with cyber-victimization coping efficacy.
Adorjan and Ricciardelli (2019)	Self-control	N = 115 13-19 years old Canada	To analyze the efficacy of cybersecurity programs in schools.	– Grupo focal	Students acquire a sense of caution and self-control.
Cho and Galehan (2019)	Self-control	N = 2,351 14-19 years old South Korea	To examine the influence of prior criminal behavior on future criminal behavior.	– Ad hoc	The relationship between low self-control and cyberbullying is partially mediated by cyber lifestyles. Prior perpetration of cyberbullying influences subsequent perpetration of cyberbullying.
Ferreira et al. (2019)	Problem solving	N = 676 10-18 years old Portugal	To analyze the relationship between the phases of the bystander intervention model and the mediating role of adolescents' self-efficacy beliefs.	– Ad hoc	Cyberbullying presents a direct and indirect effect on aggressive behavior, and an indirect effect on reporting and problem-solving behavior.

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Vives-Cases et al. (2019)	Problem solving	N = 270 13-17 years old Spain, Italy, Russia, Romania, Poland, Portugal	To evaluate the prevention of intimate partner violence (DV) through the promotion of protective factors: communication skills, empathy and problem-solving skills.	– Student Social Support Scale-Assesses (Nolten, 1995) – Questionnaire for Evaluating School Social Climate (Trianes, Blanca, De la Morena, Infante & Raya. 2006) – Maudsley Violence Questionnaire (Walker & Bowes, 2013) – Ambivalent Sexism Inventory (Glick & Fiske, 1996)	The program is effective
Wachs et al. (2019)	Inhibition	N = 1,480 12-17 years old Germany	To test the relationship between cyberbullying and cyberhate and whether this relationship is moderated by online toxic disinhibition.	– Ad hoc	Increased cyberbullying perpetration and online toxic disinhibition are positively related to cyberhate perpetration.
Wachs & Wright (2019)	Inhibition	N = 1,480 12-17 years old Germany	To explore the relationship between victimization and online hate perpetration and the possible moderating effects of online toxic disinhibition on this relationship.	– Ad hoc	Online toxic disinhibition and sex, as moderating effects, affect the relationship between online victimization and online hate perpetration.
Builes et al. (2020)	Problem solving	N = 159 8-12 years old Spain	To evaluate the effect of a cyberbullying prevention program.	– Emotional Education Questionnaire (EEQ; Álvarez, 2011) – Cyberbehavior Quality Assessment Scale(Ortega, Del Rey & Sánchez, 2012)	Significant differences are obtained in the following dimensions: emotional self-awareness, problem solving, responsible use, digital mentoring, and family supervision. The program is effective.
Cho and Rustu (2020)	Self-control	N = 2,351 14-19 years old South Korea	To integrate theories of self-control and opportunity approach to cyberbullying	– Ad hoc	Less self-control and less parental supervision, as well as engaging in more online activities make it more likely to be a cyberbully.

Hamilton et al. (2020)	Problem solving	N = 2,658 14-16 years old Ireland, England, Germany, Italy, The Netherlands	To address cyberbullying in an innovative way through a co-participatory and Quality Circle approach.	– Ad hoc	QC is useful in the prevention of cyberbullying.
Harriman et al. (2020)	Inhibition	N = 320 14-19 years old USA	To explore predictors of exposure to hateful material in the online space, including demographic characteristics (age, gender, and race), academic performance, online behaviors, online disinhibition, risk perception, and parental monitoring of online activities.	– Hawdon's Online Hate Involvement Scale	Positive association between exposure to hateful messages in the online space and time spent online, academic performance, communication with a stranger in social networks, and benign online disinhibition.
Wood and Graham (2020)	Self-control	N = 9,122 14-17 years old USA	To explore the links between cyberbullying victimization and an of health risk behaviors associated with juvenile delinquency (cigarette smoking, marijuana use, alcohol use, and sexual frequency).	– Ad hoc	Cyberbullying victimization increases the likelihood that a student will be classified in the "at-risk" group. This effect holds when controlling for physical bullying, a measure of self-control, and demographic variables.
Camacho et al. (2021)	Self-control	N = 3,017 11-16 years old Spain	To investigate the associations between cybervictimization, anger rumination, and cyberbullying.	– European Cyberbullying Intervention Project Questionnaire (Del Rey et al., 2015) – Anger Rumination Scale (Sukhodolsky et al., 2001)	Cybervictimization predicts anger rumination and cyberaggression. Anger rumination is associated with a subsequent increase in cybervictimization and cyberaggression. Cybervictimization mediates the association between anger rumination and cyberaggression. Intervention programs should focus on enhancing self-control.
Cho and Glassner (2021)	Self-control	N = 2,351 14-19 years old South Korea	To examine whether there are unique growing paths for cyberbullying perpetration when low self-control and opportunity factors are considered.	– Ad hoc	Low self-control is positively associated with early onset/decline in cyberbullying.

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Wang and Ngai (2021)	Self-control	N = 1,103 12-18 years old China	To develop an integrated framework for investigating the effects of power imbalance, the online disinhibition effect, internal states, and parental mediation on cyberbullying.	– Physical Self-perception Profile Scale (Lindwall et al., 2011) – Advanced Knowledge of the Internet Scale (Vandebosch & Van Cleemput, 2009) – Self-perceived Social Status Scale (Lee et al., 2018) – Toxic Online Disinhibition Scale (Udris, 2014). – Cyberbullying Perpetration Scale (Wong & McBride, 2018) – Self-Control Scale (Wong et al., 2018)	Social status among peers correlates directly with cyberbullying, and through low self-control to predict cyberbullying. Online disinhibition effect does not directly correlate with cyberbullying, but through moral disengagement and low self-control to predict cyberbullying. Physical power does not directly correlate with cyberbullying. Parental mediation moderates the effects of online disinhibition on cyberbullying and had no buffering effects when examining the relationships between physical power, social status, technology use, and cyberbullying.

Source: self elaboration.

Other research studies also indicate the relevance of complementary variables that affect the relationship between EFs and cyberbullying. Song and Lee (2020) highlight that the morality of youngsters plays an important role, whereas Cho and Rutsu (2020), Vazsonyi et al. (2017) and Wang and Ngai (2021) point out that parental control inversely affects bullying through the Internet. Likewise, Wood and Graham (2020) confirm the role of substance use and how being a victim of cyberbullying can become a risk factor for being a cyberbully. This is consistent with Cho and Galeman (2019) who find that lifestyle acts as a significant mediator between self-control and cyberbullying.

Discussion and conclusions

The main objective of this study was to conduct a systematic review to explore the relationship between EFs and cyberbullying in its different

roles (victims, aggressors and aggressors-victimized). The first aspect to highlight is the existence of a lack of review studies on the executive profile in children and adolescents who have been involved in online bullying situations. Hence, the search was adjusted to consider the relationship of cyberbullying together with the different components of EFs (problem solving, inhibition and self-control). A total of 32 published papers were obtained. Given this fact, it is important to highlight the novelty and relevance of this work since its findings allow us to explore a part of cyberbullying that has not been analyzed and that could be of special relevance for prevention and intervention.

From the studies analyzed we can observe that the highest percentage of publications are found in the United States and South Korea. This may be due to the fact that these are two of the countries with the largest population and scientific production in this area of knowledge. We can also observe that Europe is the continent with the highest number of publications. Regarding the year of publication, we observe an increasing trend from 2015 to 2019 with a slight decrease in 2020. This last fact may be due to the confinement situation derived from the COVID-19 pandemic. Due to the closure of both schools and research centers, studies in this field have been decreased, showing a lack of information in this regard. The sample range is fairly balanced among the different age groups, which reveals that this is not a phenomenon that is confined to a single range but is constant throughout childhood and adolescence.

EFs are the result of complex psychological processes which, together with the problematic phenomenon of cyberbullying, makes it especially important to analyze studies that cover different dimensions and variables, giving it greater richness. In light of the results found on the relationship with the different components of EF, it is highlighted that children with executive profile impairments such as lack of impulse control, lack of problem-solving skills, lack of inhibition capacity, etc., have a direct and positive relationship with being involved in a situation of cyberbullying in any of the different roles.

Inhibition allows a person to avoid irrelevant stimulation from both external and internal sources when carrying out an activity (Miyake & Friedman, 2012). This EF is closely linked to impulse control and, therefore, to self-control. This is probably why we would expect aggressors to show a greater deficiency in this aspect and find it difficult to inhibit/control certain behaviors that do not fit in with the social context in which they

find themselves, such as insults, threats or, given that this is an online modality, sending images or inappropriate content. The area of the brain responsible for this task is the prefrontal cortex, which allows or disallows the performance of behaviors that arise in response to deciding how to deal with a given situation, also considering environmental circumstances (Gutiérrez & Solís, 2011). These brain areas are among the last to complete their development, not reaching maturity until 21-23 years of age. If we look at this fact, we can understand why it is the youngest groups that are considered the most impulsive. This explains the fact of the high incidence of cyberbullying during adolescence (Blakemore & Robbins, 2012). From the aggressor's point of view, it is common to find an absence of filter in their self-control. Moreover, this is reinforced by the anonymity provided by the Internet, since online disinhibition is one of the strongest predictors of cyberbullying (Wachs and Wright, 2019). Concerning the victim, the way of dealing with cyberaggressions varies depending on the degree of development of their CPF, with adults being more likely to ignore the messages and provocations, but not the younger population, who end up falling into the cycle of aggression-victimization.

The concept of problem solving is linked to the procedure that makes it possible to solve (or even prevent) an undesirable situation. It begins with the identification of the problem in question. Once identified, it is necessary to establish a plan to develop the action that leads to the resolution. Depending on the context, problem solving may involve following certain steps, sometimes already learned, or it may depend on a single action or a sudden decision. In the case of cyberbullying, both can occur. In either case, the person needs to make decisions. Decision-making can be understood in different ways, as it can refer both to the decision alternatives and to the speed or quality of these decisions among the different actors in the context of bullying. Thus, the impulsivity derived from the absence of inhibition or self-control of the aggressors, leads them to make riskier decisions that cause them to be involved in this type of situations.

We have seen the different risk factors related to cyberbullying so far. But studies also showed that there are individual, social and family factors that act as protectors and decrease the likelihood of children and adolescents being immersed in cyberbullying. Among the personal factors we find good coping strategies (Bradbury, 2012; Louise at al., 2018; Palladino, 2012), high self-esteem (Bayraktar et al., 2015), ability

to empathize (Erreygers et al., 2016) and adequate socioemotional competence (Builes et al., 2020; Coelho and Marchante, 2018), and having a good family environment and support (Bayraktar et al., 2015; Vazsonyi et al., 2012, Vives-Cases et al. 2019).

This study is not without limitations. First, variability in the conceptualization and measurement of both EF and cyberbullying was observed, which makes it difficult to generalize the results and compare results from different studies. In addition, some components that make up EF (e.g., attention, working memory, processing speed) should be included but, due to the length of the study, have been discarded. Likewise, most of the studies are cross-sectional, which makes it impossible to examine the causality of the findings. Also, although there were two investigators in the selection of studies to eliminate possible duplicates, the Kappa Index was not calculated. Furthermore, it should also be mentioned that cultural bias was not taken into account, despite being a factor that may be influencing the activation of EFs and cyberbullying. Morality varies in different cultures and, as a result, cyberbullying behaviors may modify the interpretation of the results. For all these reasons, this study can be considered an initial exploratory review regarding the relationship between executive functions and cyberbullying that should be further systematized in future studies.

Notwithstanding these limitations, this study is a pioneer in the field and is particularly relevant because it covers the need for a review that brings together the different components of EF and cyberbullying. Additionally, these data may be of special relevance for the different agents who intervene with children and adolescents. Teachers, psychologists, educational psychologists, guidance counselors and all specialized personnel involved in this type of conflict can work from their different disciplines to fill these gaps in students who have been immersed in this type of situation. It can also be very useful in terms of prevention, since a program that includes the development of self-control, problem solving and inhibition can have positive effects in reducing cyberbullying in childhood and adolescence. Developing these prevention actions, especially in Primary Education schools, could help to reduce the high prevalence rates that are being observed, providing students with tools to avoid being involved in cyberbullying situations (Rivera et al., 2018).

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