Published by :

NURIA VITA-BARRULL (https://orcid.org/0000-0001-8245-111X)
Nuria Vita holds a PhD in Psychology from the University of Lleida. She is a member of the NeuroPGA (Neuropsicología, Genes y Ambiente [Neuropsychology, Genes and Environment research group]). She has specialized in the application of modern board games as a tool for cognitive and educational stimulation in the childhood stage. She is also an associate professor at the University of Lleida.

VERONICA ESTRADA-PLANA (https://orcid.org/0000-0002-7431-4964)
She is a general health psychologist and Ph.D. by the University of Lleida. Her dissertation was about the use of board games as a cognitive training tool in children and older people. Currently, she is working as a psychologist in a neuropsychological and pedagogical center. She also teaches cognitive psychology at the university. Her research is focused on the use of board games in the fields of education, neuropsychology and rehabilitation.

JAUME MARCH-LLANES (https://orcid.org/0000-0002-5977-8744)
Jaume March Llanes, who possesses a Ph.D. in Psychology and two master's degrees in Statistics, serves as a professor specializing in the methodology of behavioral sciences at the University of Lleida. He is an integral member of the research group Neuropsychology, Methodology, Individual Differences, and Cognitive Processes at the University of Lleida, which has been officially recognized by the Government of Catalonia as an emerging group under the designation 2021SGR1432. Additionally, he is the lead investigator, together with Jorge Moya Higueras, for the Neuropsychology, Genes, and Environment research group. Since 2014, this research group has been actively engaged in studying the psychological, emotional, behavioral, and educational advantages offered by modern board games.

NURIA GUZMAN (N/A)
Núria Guzmán Sanjaume has a degree in psychology, with a Master's Degree in Educational Neuropsychology, a Master's Degree in Violence Prevention and Intervention, a Master's Degree in Legal Psychology, Specialist in harassment, coexistence and emotional education. She is an expert in the use of playful methodologies and board games for psychological and educational intervention, especially for intervention in educational needs (high abilities, ADHD, dyslexia, Asperger's and autism). In 2014 she founded the association Afim21 dedicated to intervention with family, children and the elderly through play. In its trajectory Afim21 has received recognition from Fapace and Codapa as well as Innovation awards granted by La Caixa Foundation and EDP Foundation.

MARIA MAYORAL (https://orcid.org/0000-0001-9272-5065)
Maria Mayoral is a Clinical Psychologist form the Instituto de Investigación Sanitaria Gregorio Marañón IISGM. She has published some studies about Clinical, Cognitive and Developmental Psychology. She is associate professor at the Universidad Complutense de Madrid. She leads the ATraPA (Acciones para el Tratamiento de la Personalidad en Adolescentes [Actions for Treating the Personality in Adolescents]) research team and the PIENSA (Programa de Intervencción en Psicosis Adolescente [Intervention Programme in Adolescent Psychosis]).

JORGE MOYA HIGUERAS (https://orcid.org/0000-0001-7017-3087)
Jorge Moya Higueras holds a PhD in psychology. He is a professor of cognitive psychology at the University of Lleida. He is the coordinator of the research group Neuropsychology, Methodology, Individual Differences and Cognitive Processes of the University of Lleida, recognized by the Government of Catalonia as an emerging group (2021SGR1432). He is also the principal investigator, together with Jaume March Llanes, of the Neuropsychology, Genes and Environment research group. Since 2014 they have been conducting research on the psychological, emotional, behavioral and educational benefits of modern board games.

INTERNATIONAL JOURNAL OF GAMES AND SOCIAL IMPACT, Vol. 1 Issue no. 2
pp. 8-37
DOI: 10.24140/ijgsi.v1.n2.01
ijgsi.ulusofona.pt

COGNITIVE TELEINTERVENTION WITH BOARD GAMES DURING THE PANDEMIC LOCKDOWN IN SCHOOL-AGE CHILDREN:
A PILOT RANDOMIZED CONTROLLED TRIAL

NURIA VITA-BARRULL
Department of Psychology, University of Lleida, Lleida (Spain)

VERÓNICA ESTRADA-PLANA
Department of Psychology, University of Lleida, Lleida (Spain)

JAUME MARCH-LLANES
Department of Psychology, University of Lleida, Lleida (Spain)

NÚRIA GUZMÁN
Afim21, Almería (Spain)

MARIA MAYORAL
Instituto de Investigación Sanitaria Gregorio Marañón (IiSGM), Madrid (Spain)
Center for Biomedical Research Network on Mental Health (CIBERSAM), Instituto de Salud Carlos III, Madrid (Spain)

JORGE MOYA-HIGUERAS
Department of Psychology, University of Lleida, Lleida (Spain)
Center for Biomedical Research Network on Mental Health (CIBERSAM), Instituto de Salud Carlos III, Madrid, Spain

Corresponding author
Jorge Moya-Higueras, Department of Psychology, University of Lleida, Estudi General Avenue, 4, 25001, Lleida, Spain. Email: jorge.moya@udl.cat

Conflict of interest/Financing:
This research is a part of an Industrial Doctorate with Mercurio Distribuciones supported by the Plan of Industrial Doctorates of the Secretariat of Universities and Research of the Department of Business and Knowledge of the Generalitat de Catalunya, the Comissionat per a Universitats i Recerca del DIUE. The first author was the person who carried out the industrial doctoral project hired by the board game publisher Mercurio. This research was supported by CIBER -Consorcio Centro de Investigación Biomédica en Red (CB/07/09/0037), Instituto de Salud Carlos III, and by the Agència de Gestió d'Ajuts Universitaris i de Recerca de la Generalitat de Catalunya (2021SGR1432), and the Spanish Ministry of Science, Innovation and Universities (MICIU/ FEDER; project RTI2018-099800-B-I00). The funding sources were not involved in the design, data collection, analysis, interpretation, or writing of this work, nor in the decision to publish this article.

Acknowledgments

We thank the participating families for their collaboration and trust in the project. Also, to the children who played with us for their generosity and effort in the remote play sessions. As for the colleagues who have collaborated in the implementation of the sessions (Núria Terés and Asmae Nanoukh) and the assessments (Andrea Batlle), we would like to thank them for their engagement and professionalism in the development of this research.

Author Contributions:
Conceptualization, Vita-Barrull, Nuria; Estrada-Plana, Verónica and Moya-Higueras, Jorge.; Methodology, March-Llanes, Jaume; Investigation, Vita-Barrull, Nuria; Estrada-Plana, Verónica; Moya-Higueras, Jorge; Data curation, Vita-Barrull, Nuria, March-Llanes, Jaume and Moya-Higueras, Jorge; Writing—original draft preparation, Vita-Barrull, Nuria; Writing—review and editing, Vita-Barrull, Nuria, Estrada-Plana, Verónica; March-Llanes, Jaume; Guzman, Nuria, Mayoral, Maria and Moya-Higueras, Jorge; Supervision, Moya-Higueras, Jorge; Project administration, Vita-Barrull, Nuria and Moya-Higueras, Jorge; Funding, Moya-Higueras, Jorge. All authors have read and agreed to the published version of the manuscript.

Abstract

Background. Playing modern board games has been linked to cognitive enhancement in children when playing face-to-face. However, because of the SARS-CoV-2, playing in an analog way was difficult. *Objective.* To test the efficacy of a cognitive intervention program with board games in school-age children (25 Spaniards; 5-12 years) delivered remotely through web conferencing. *Methods.* We performed a randomized controlled trial with a wait-list control group (n=10) and pre-post testing (updating, inhibition, flexibility, and verbal fluency). The study was preregistered on clinicaltrials.gov (NCT04823338). The experimental group (n=15) played commercialized board games adapted to an online format during 12 sessions. *Results and Conclusions*. We found higher flexibility and verbal fluency improvements in the experimental than in the control group. We also saw improvements in visuospatial updating solely in the passive control group. Board games played remotely could entail some cognitive benefits, though we found paradigmatic results too. Board games may benefit the most when played face to face.

Keywords: board games; cognitive teleintervention; school-age children; executive functions; randomized controlled trial.

1. Introduction

In March 2020, the streets were empty with the declaration of a state of alarm in Spain due to the covid-19 pandemic. After four months of lockdown, new normality arrived in which sanitary and hygiene measures and how to relate to other people were intensified. Some consequences on the well-being and cognitive and emotional level were also detected in boys and girls who lived through this experience of lockdown and health restrictions (Chambonnière et al., 2021; Di Giorgio, Di Riso, Mioni, & Cellini, 2021; Erades & Morales, 2020; Hendry et al., 2022; Lavigne-Cerván et al., 2021; Navarro-Soria et al., 2021).

Lockdowns and infections increased mental health issues in children (Lavigne-Cervan et al., 2021; Samji et al., 2022), decreased cognitive functions (Chambonnière et al., 2021; Lavigne-Cervan et al., 2021) and limited the chance of playing in shared spaces. According to the reports of Spanish children during the first weeks of lockdown, it is precisely this need for interaction with peers for socialization one of the most affected factors (Idoiaga Mondragon, Berasategi Sancho, Dosil Santamaria, & Eiguren Munitis, 2020). The new normality maintained restrictions that impacted opportunities for social interaction with peers and play.

Play does not represent something trivial in childhood. As Fadhli et al. (2020) pointed out, playing and learning go hand in hand in children's lives. Playing is a right recognized in the Convention on the Rights of the Child, although it is one of the most ignored (Payà & Bantulà, 2021). Given the limited access to specific play spaces and decreased social interactions with peers due to prevention, a lot of leisure time (and playtime) was shared with the family during the pandemic. Stucke, Stoet, & Doebel (2022) analyzed the type of activities performed by young children during the COVID-19 pandemic. They found that cognitive functioning was better in children who spent more time in less structured activities (such as playing with puzzles and with legos) than children who spent lower time in these activities. The authors found no association between highly structured activities (mainly guided school lessons and activities on computers and tablets) or time used in passive activities (such as playing video games). Also, the results of the study by Manzano-León et al. (2022) after implementing a family leisure program during confinement in Spanish families suggest that leisure activities and games could have reduced the psychosocial impact of covid-19 preventive measures.

In this line, one of the leisure options that skyrocketed during the pandemic was playing board games. Interestingly, even though toy sales declined during the pandemic, the market for board games in Spain has increased (NPD Group, 2021). The board games that sold the most were family games (Guinot Cuesta & Moreno Garrido, 2021), which allowed families to spend their leisure time with an activity they could carry out at home. These games are mostly fillers. In analog games, fillers are defined as those that expert players use to fill in the time between two "hard" games (Bartolucci, Mattioli, & Batini, 2019). The main characteristics of these games are that they are fast games, lasting between 15 and 20 minutes, with simple rules, and use a limited set of game mechanisms. That is why they are also known as light games.

However, the fact that light games are not so hard does not make them less demanding. Given their significant similarity to neuropsychological tests, fillers have been gaining ground as a source of entertainment and a possible tool to stimulate specific cognitive processes. Several recent investigations found a substantial improvement in memory and executive functions of different groups (school-age children, clinical population, and older adults with mild cognitive impairment) after cognitive interventions with board games (Benzing et al., 2018; Estrada-Plana, Esquerda, Mangues, March-Llanes, & Moya-Higueras, 2019; Estrada-Plana et al., 2021; Iizuka, Suzuki, Ogawa, Kobayashi-cuya, & Kobayashi, 2018; Kuo, Huang, & Yeh, 2018; Vita-Barrull, Guzmán, et al., 2022). The processes intended to be trained in these investigations, basic executive functions, were mainly working memory, inhibition, and cognitive flexibility. Basic executive functions are known as that set of differentiated but related mental processes that allow us to manipulate and update information for a short period, stop automatic behaviors when necessary, and alternate between different tasks or elements (Miyake et al., 2000). Working memory allows us to store and manipulate information temporarily, which is essential in cognitive tasks such as learning, language, or reasoning (Baddeley, 1992). Within the theoretical working memory model, the updating process is considered a basic executive function (Miyake et al., 2000). Working memory updating is the process by which we monitor the information we receive and, depending on its relevance to the task we are carrying out, remove what we no longer need from our temporary storage and update the important information (Miyake et al., 2000). On the other hand, inhibitory control refers to the ability to inhibit inappropriate responses and cognitive flexibility to the ability to adapt to changing situations in the environment by flexible alternation of actions or tasks (Cristofori, Cohen-Zimerman, & Grafman, 2019; Diamond, 2013). Other authors consider verbal fluency a basic executive function related to the language domain (Aita et al., 2019). Verbal fluency is considered to be the capacity for fluent speech and is usually distinguished into two types: phonemic (if access to the lexicon starts from a sound) or semantic (if a category guides it) (Aita et al., 2019).

Though more research is needed, some studies have shown how playing impacts the brain. First, the dopaminergic system is widely active when playing (Bateman & Nacke, 2010; Palaus, Marron, Viejo-sobera, & Redolar-ripoll, 2017), explaining why players invest so much time and effort in this activity. In addition, cognitive games activate the prefrontal cortex (Bateman & Nacke, 2010; Palaus et al., 2017), the main area of executive functions. Some studies have focused on board games specifically. For example, Atherton, Zhuang, Bart, Hu, & He (2003) found bilateral activations in the frontal, parietal, and occipital lobes while analyzing pawns' positions when playing chess. Similar activations were found when playing Go (Chen et al., 2003). Mastering board games seem to significantly affect the connectivity between brain networks (Duan et al., 2012, 2014). In addition, recent studies show that using board games as cognitive interventions changes brain structures (i.e., middle temporal gyrus) linked to the improvements when playing (Iizuka et al., 2020). So, playing games, specifically board games, seems to develop brain changes that could explain the cognitive benefits commonly found (Benzing et al., 2018; Estrada-Plana et al., 2019; Estrada-Plana et al., 2021; Iizuka et al., 2018; Kuo et al., 2018; Vita-Barrull, Guzmán, et al., 2022).

Executive functions develop across childhood (Fiske & Holmboe, 2019; Huizinga, Dolan, & Molen, 2006). Understandably, interventions have primarily focused on the school stage. In addition, it is essential to consider the role of playing at this stage in child development (Metaferia, Futo, Drew, & Takacs, 2020). More specifically, leisure time, playing, and board games could predict the development of these cognitive processes (Barker et al., 2014; Gashaj, Dapp, Trninic, & Roebers, 2021).

Considering this possible adverse effect of the pandemic on the cognitive health of school-age children and the potential that games could have in specific processes, the possibility of designing an intervention with board games adapted to the sanitary restrictions was raised. This research aimed to study whether a game program made up of different commercialized family filler games could improve the executive functions of school-age children.

The games were adapted to deliver the program via videoconference because we needed to respect the restrictions on mobility, interpersonal distancing, and social gatherings with people outside the family nucleus. The program was applied to an experimental group (playgroup) and compared with a passive control group based on the following hypothesis: the playgroup will present statistically greater increases in the performance tests of executive functions than the passive control group. We also wanted to control the effects of playing satisfaction, as past studies found that how children play and interpret playing could be important factors that may impact cognitive interventions (Vita-Barrull, Guzmán, et al., 2022).

2. Materials and Methods

We conducted a randomized controlled trial (random allocation by a masked researcher using Excel's randomization formula) approved by the ethics committee of the Arnau de Vilanova University Hospital in Lleida (CEIC-2371). The work described followed The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The study was preregistered on clinicaltrials.gov with the identifier NCT04823338. We followed the CONSORT-SPI 18 guidelines (Grant et al., 2018).

We posted an advertisement on the research team's social networks. Thirty-seven participants were interested in the study, but only 25 finally participated, as seen in the flowchart (See Figure 1). Inclusion criteria to participate in the study were: a) being 5-12 years of age; b) being enrolled in an educational center, whether public, private, or subsidized; c) providing informed consent from both parents and the participant's agreement to participate. Exclusion criteria were: a) comprehension difficulties due to language reasons (according to the opinion of the evaluator); b) sensory difficulties that make it impossible to carry out the program activities (according to the opinion of the evaluator); c) not having the necessary equipment to monitor the sessions online. As no children met any exclusion criteria, the sample was formed by 25 Spanish schooled children between 5 and 12 years old (mean=8, SD=1.94, % female = 52). However, we applied another exclusion criterion for the analyses because of outliers.

2.1. Outcome measures

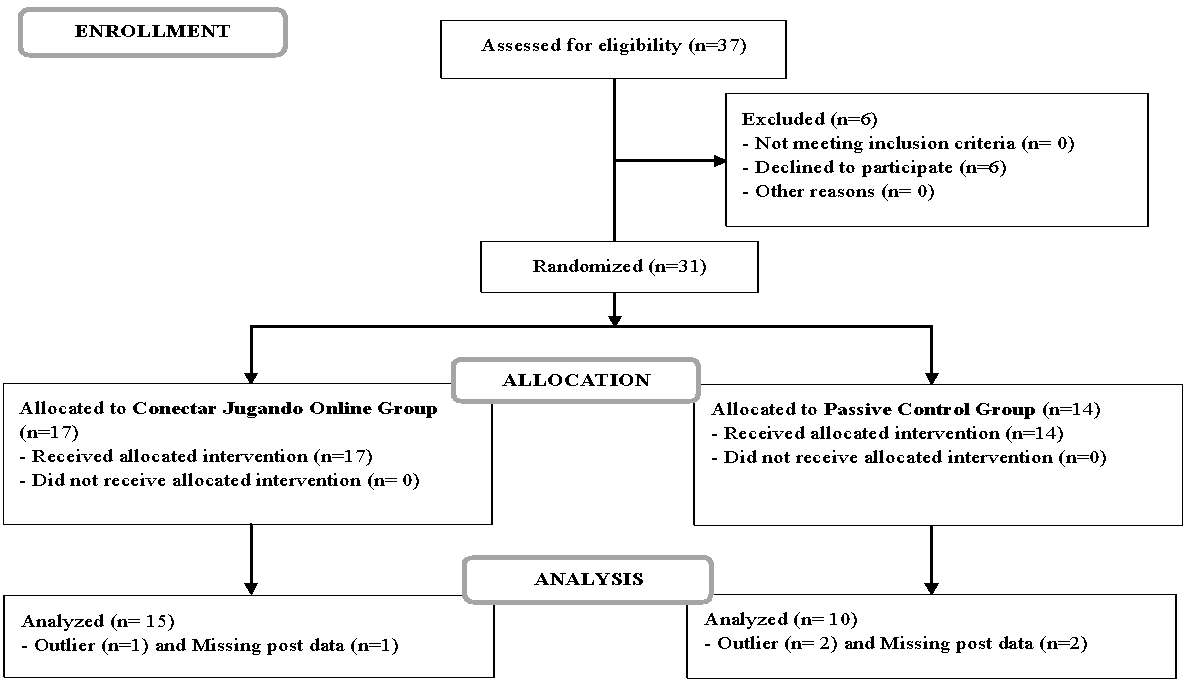

Figure 1.
Participant Flow Diagram.

We assessed the socioeconomic level, the leisure time, and the parents' beliefs towards the game through a computerized survey that we mailed to the participating families. Psychologists and researchers were adequately trained for the assessment and administered the tests via videoconference (Ahmed, Skibbe, McRoy, & Tatar, 2022). The evaluators were blinded to the experimental condition of the participants to avoid possible bias in the evaluations.

Sociodemographic data

The Hollingshead Index (Hollingshead, 1975) was used to collect data on the socioeconomic status of the participants' families. Other essential data, such as age, sex, and school year of the participating children, were also recorded.

2.1.1. Main outcomes

Working memory (updating). We used two versions of the Keep Track Task adapted from Tamnes et al. (2010).

Verbal Keep Track Task

For the evaluation of verbal updating, an adaptation of the Keep Track Task by Tamnes et al. (2010) described in Estrada-Plana et al. (2019) was used in two versions, Catalan and Spanish, according to the participant's native language. The task used six categories of words (animals, clothes, countries, colors, fruits, and relatives) and three possible words per category (for example, in the category "relatives" could appear as "father," "mother," or "brother"). The task had 11 trials, two training trials (with 2 and 3 categories), and 9 test trials: 4 trials of 3 categories, four trials of 4 categories, and a final trial of 5. In each trial, there are categories under which different words belonging to those categories appear. The goal is to remember the last word presented in each of the trial categories. The verbal updating measure is obtained from correctly remembered words (maximum 33).

Visuospatial Keep Track Task

The Visuospatial Keep Track Task has been an adaptation described by Estrada-Plana et al. (2019) based on the Tamnes et al. (2010) task. In this version, the linguistic stimuli were converted into visual stimuli: 6 colored faces (black, blue, green, red, white, and yellow). These colored faces move quickly through the different spaces on the screen. In the same way as in the verbal task, in this keep track task, the last stimulation presented must also be remembered, precisely the last position of each of the colored faces presented. It consists of 11 trials, two training, and nine tests, increasing difficulty (from 2 to 5 faces to remember). The visuospatial updating measure is obtained from correctly remembered words (maximum 33).

Inhibition and cognitive flexibility

Five digits test (Sedó, 2004)

Inhibition and cognitive flexibility were assessed using the 5-digit test, which consists of 4 tasks with differentiated conditions and similar stimuli. The first task of the test consisted of cells presented in rows within which numbers were 1 to 5 in different amounts. The objective of this first part is to read in rows the number given in each cell as quickly as possible until reaching the last cell. In the second task, the same cells are presented again, but there are no numbers but asterisks. Counting the number of asterisks given within each cell as quickly as possible is necessary. The next task consists again in counting the number of elements within the cell, but the asterisks are replaced by numbers from 1 to 5. Therefore, the automatic behavior of "reading" the presented number must be inhibited to count how many times appear that number in the cell and give an answer of quantity. The last task includes a new instruction. When the cells are highlighted in black, we should read the presented number. But when the cell is not highlighted, we follow the instruction from the previous task and count items inside the cell. In this way, you must flexibly alternate how to process the information and issue a response depending on the condition. Then, the measurement

of inhibition (time in the third task minus time in the first task) and flexibility (time in the third task minus time in the first task) were calculated.

Verbal fluency

Phonological and semantic fluency (letter M and animals, EN-FEN, Portellano & Martínez-Arias, R. Zumárraga, 2009)

To evaluate phonological verbal fluency, the children were given a letter (M), from which they had to look for words that began with the same letter. To do this, they had 1 minute. The total of correct answers was the direct score of phonological fluency. A category (animals) was said to evaluate semantic verbal fluency, and the children had to think of words that belonged to that category. In this second task, they also had 1 minute. The total of correct answers was the direct semantic fluency score.

2.1.2. Confounding outcomes

Reasoning

We assessed reasoning using the TONI-4 test (Ruíz-Fernández, 2019). This instrument has two forms: form A and form B. Both have 60 items in which incomplete series or matrices are presented and different options to complete them. The objective of the task is to identify the general rule of the item to select the option that allows it to achieve it, which makes sense. Form A was used for the baseline evaluation, and Form B for the assessment after the intervention. The test stops when the child fails three of the last five items presented. The total of correct answers was used as a reasoning measure.

Less-structured activities time

We used the "Parent Survey of Typical Child Time Spent in Less-structured Activities" (Barker et al., 2014) to measure this variable.

This survey asked parents about their children's unstructured leisure time. They should indicate how much time their children spend in unstructured and recreational activities on a 7-point scale based on frequency (from least to most). In this way, high scores on an item indicate a greater frequency of said activity. The measure in this variable is obtained from the sum of all the scores of each item (1 = "Never" and 7 = "Daily").

This scale has an item that asks about the time spent playing board games. This item was considered to know the previous experience with this type of game in the participating sample. We focused on this variable in an exploratory way.

Parent Play Beliefs

"The Parent Play Beliefs Scale (PPBS)" (Metaferia et al., 2020)

The questionnaire consists of 30 Likert-type response items with five options ranging from 1 (Disagree) to 5 (Strongly agree). Items are grouped into the Play Support scale and the Academic Focus scale. The Play Support scale assesses parents' beliefs about the benefits of games on their children's development and their involvement in children's play. High

scores on this scale indicate that parents enjoy the game and see it as a priority and a way of learning. The Academic Focus scale assesses parents' beliefs about the influence that playing might have on their children's academic development. High scores on Academic Focus would suggest that parents see the game as an essential tool academically.

Player satisfaction

In each game session, the participating children reported their level of satisfaction (from 1 to 5, being one a low score and five a high score) with the games used and the intervention session using a visual analog scale created ad hoc.

2.2. Treatment

The [project] Online program consisted of 12 one-hour intervention sessions (see Suppl Material). The sessions were biweekly, with a total duration of 6 weeks. The board games used in the program were Bee Alert (Knizia, 2012), Monster Match (Gruhl & Weir, 2018), Sherlock Express (Kermarrec, 2019), Streams (Itsubaki, 2011), and Blurble (Bernard, 2013) (see Suppl Material). All the games were used in their Spanish version. The games were selected according to their cognitive profile obtained from the assessment of 14 experts in psychology, education, and research in neuropsychology with experience in the professional use of board games (Vita-Barrull, March-Llanes, et al., 2022). The play sessions were conducted in groups of 2 to 4 children of similar ages (same school stage), according to the participants' availability. Two psychologists and a senior psychology student guided the play sessions. All of them were researchers in the research group that coordinated the study and did not participate in the assessments. In the sessions, the researcher projected the board and card games on the videoconference tool, and the participating children carried out their actions using their voices and the platform tools. The program was gamified through a narrative about a space trip to different planets to discover new games and get other mission badges, and super team badges in their logbook. In this way, it was intended to give continuity to the sessions and a group feeling since the super team badges were obtained when all the group members attended two consecutive missions. The researchers in charge of the gaming sessions recorded any technical incidents that might occur during the program.

2.3. Procedure

The study was conducted in two waves to obtain a larger sample volume. Both waves were made up of the following phases: a) recruitment of participants through social networks; b) delivery of the informed consent of the legal guardians (both parents); c) initial evaluation of participating children and completion of questionnaires by legal guardians; d) random assignment to playgroup and passive control group (wait-list); e) implementation of the intervention in the playgroup (See Supplementary Materials for a profound explanation of each game and the adaptation performed for the present research); f) post evaluation and re-completion of questionnaires; g) compensation of the passive control group.

Participants and their pre-intervention assessments in the first wave were recruited between mid-December 2020 and

the beginning of February 2021. Recruitment and preliminary evaluations took place in the second wave until mid-March 2021. The play sessions with the playgroup of the first wave started in mid-February until the end of March 2021. In the second wave, the play sessions of the playgroup began at the beginning of April and continued until mid-May. Post-intervention evaluations were performed on all participants two weeks after completing the cognitive training program in both waves. Researchers from the research group that did not intervene made pre- and post-assessments. A researcher external to the evaluation and intervention randomly assigned the participants to each experimental condition. The compensations of the passive control groups were carried out at the end of the post-intervention assessment, from mid-April to the end of May 2021 (first wave) and from the end of May to the end of June 2021 (second wave). This way, all the participating children could carry out the sessions during the school year.

2.4. Statistical Analysis

The normality of the variables was checked using the Kolmogorov-Smirnov statistic. We did not meet normality criteria in the variables analyzed, so non-parametric measures were used. The chi-square statistic was used for categorical variables, and U Mann-Whitney tests for continuous variables to test for significant differences between the groups at the baseline. For pre-post comparisons, the Wilcoxon signed-rank test was used for the entire sample (time) and by groups (playgroup and passive control group). In turn, the effect sizes were determined in all the analyses performed, following Cohen's rules (Cohen, 1988).

3. Results

3.1. Baseline

At baseline, no significant differences were found between both groups in sociodemographic variables such as age, sex, or socioeconomic level of the participating children. Only baseline differences were found in semantic verbal fluency (see Table 1) regarding the cognitive outcomes. Finally, no significant differences were identified in the time spent in unstructured leisure and recreational activities before the start of the study. In both groups, we found a high frequency of playing board games (almost daily) before the intervention. So, all the sample was used to play board and card games.

3.2. Pre-post comparisons

As can be seen in Table 2, when we analyzed the entire sample, pre-post comparisons showed significant changes over time in flexibility (Z=-3.58, p=.00, d=2.05), phonological verbal fluency (Z=-3.33, p=.00, d =1.78) and semantic verbal fluency (Z=-2.52, p=.01, d=1.17). No significant time effects were found in the rest of the cognitive variables in the total sample.

When we split the sample according to the experimental group, we found greater decreases in the time to respond to the flexibility task in the playgroup (Z=-2.93, p=.00, d=2.31) than in the passive control group (Z=-2.09, p =.04, d=1.76). We also found a greater increase in correct answers on phonological verbal fluency in the playgroup (Z=-2.62, p=.01, d=1.83) than in the passive control group (Z=-2.08, p=.04, d=1.75).

Table 1.
Baseline in sociodemographic variables, previous board game and leisure experience, executive functions of the experimental play group and the passive control group (wait-list)

Demographic characteristics	**Play (n=15)**	**Control (n=10)**	***U / x²***	***p***	***d / V***
Age, M (SD)	7.87 (2.10)	8.20 (1.75)	63.50	.52	.26
Gender, n (% girls)	53,3%	50%	.03	.87	.03
Socioeconomic Status, M (SD)	41.40 (7.75)	40.50 (9.76)	74.50	.98	.01
Less-structured time, M (SD)	75.33 (6.84)	77.50 (7.99)	59.50	.39	.35
Board game frequency, median (IR)	6 (1)	5 (1)	63.50	.49	.26
Verbal Working Memory, M (SD)	21.67 (5.63) n=12	24.75 (2.82) n=8	29.00	.14	**1.19**
Visuospatial Working Memory, M (SD)	21.53 (5.46)	22.40 (4.48)	66.50	.64	.19
Inhibition (time), M (SD)	23.67 (10.68)	32.00 (34.46)	74.50	.98	.01
Inhibition (errors), M (SD)	1.93 (2.02)	1.40 (1.35)	66.00	.61	.20
Flexibility (time), M (SD)	45.47 (18.08)	54.60 (59.78)	69.50	.76	.12
Flexibility (errors), M (SD)	2.93 (3.45)	3.50 (1.96)	58.00	.34	.38
Reasoning, M (SD)	26.80 (6.11)	28.10 (5.45)	67.50	.68	.17
Phonological verbal fluency, M (SD)	6.47 (2.90)	6.80 (3.05)	72.00	.87	.07
Semantic verbal fluency, M (SD)	12.80 (4.33)	16.20 (3.01)	**36.50***	**.03**	**.95**

Surprisingly, we only found significant increases in visuospatial working memory (Z=-2.15, p=.03, d=1.85) and semantic verbal fluency (Z=-2.03, p=.04, d=1.67) in the passive control group, but not in the playgroup.

3.3. Effects of playing satisfaction

On average, we can consider that the degree of satisfaction was high in the game sessions (Mean=4.77 SD=.37) and the board and card games used (Mean=4.55 SD=.78).

The sample of the playgroup was divided according to their degree of satisfaction with the game sessions and the games used into two groups, those who reported a degree of satisfaction below the mean and above the mean. In this way, it was possible to compare the potential changes in executive functions according to the satisfaction reported by the participants.

Significant improvements were found in two variables (flexibility and phonological verbal fluency) in those participants who showed higher satisfaction levels in the sessions and towards the games used (above the average). These pre-post effects were not significant in participants with a lower level of satisfaction (below the mean) towards the sessions (Flexibility: Z=-1.07, p=.29, d=1.57; Phonological verbal fluency: Z=-.45, p=.66, d=.54) and towards the games (Flexibility: Z=-1.47, p=.14, d=1.75; Phonological verbal fluency: Z=-1.29,

Table 2.
Pre-post comparisons in executive functions.

	Play Pre (n=15) Median (IR)	Play Post Median (IR)	Play (Z)	Play (p)	Control Pre (n=10) Median (IR)	Control Post Median (IR)	Control (Z)	Control (p)
Verbal WM	22.00 (8.50) (n=12)	23.00 (7.75)	-.67	.50	24.50 (5.25) (n=8)	22.00 (7.00)	-1.21	.23
Visuospatial WM	24.00 (10.00)	21.00 (9.00)	-.25	.80	22.50 (9.50)	26.00 (6.50)	-2.15	.03
Inhibition	28.00 (17.00)	26.00 (21.00)	-.69	.49	24.50 (32.25)	21.00 (10.50)	-.97	.33
Flexibility	38.00 (30.00)	37.00 (25.00)	-2.93	.00	38.50 (32.00)	34.00 (23.75)	-2.09	.04
Reasoning	27.00 (9.00)	28.00 (7.00)	-.43	.67	27.00 (7.25)	29.50 (8.50)	-.10	.92
Phonological verbal fluency	6.00 (3.00)	9.00 (8.00)	-2.62	.01	6.00 (4.75)	10.00 (4.00)	-2.08	.04
Semantic verbal fluency	13.00 (4.00)	13.00 (5.00)	-1.64	.10	16 (5.25)	18.50 (3.25)	-2.03	.04

Note. WM=Working Memory, IR=Interquartile Range. The reduction in the number of participants in the verbal keep track task is explained by the elimination of this test in the protocol for those participants who had not acquired the ability to read. Bold numbers are significant results.

p=.20, *d*=1.41). In the group that had high satisfaction with the sessions, a significant reduction was found in the execution time of the flexibility task after the intervention (*Z*=-2,68, *p*=.007, *d*=2.43). A significant increase was also obtained in the number of correct answers in the phonological fluency task (*Z*=-2.52, *p*=.01, *d*=2.12). In the group with high satisfaction towards the games, the same significant improvements in flexibility (*Z*=-2.32, *p*=.02, *d*=2.43) and phonological verbal fluency (*Z*=-2.03, *p*=.04, *d*=1.83) were found.

4. Discussion

The research objective was to study whether executive functions could be trained through a program with board games via videoconference. As hypothesized, board games could have certain cognitive benefits, even when adapted for remote application. The research results indicate that board games in this format could favor cognitive flexibility and phonological fluency abilities.

The results found in the present study are consistent with what was found in previous studies with board games as cognitive training. For example, in a recent study in which they intervened with commercialized board games in older people's homes and day centers for older people, they found improvements in inhibition and phonological fluency after the intervention (Estrada-Plana et al., 2021). This significant change in phonemic fluency is similar to what was obtained in the present study. In line with these results, the improvement in cognitive flexibility also agrees with a study carried out with a school population in which they intervened in the classroom with cognitive games created ad hoc (Benzing et al., 2018).

A possible explanation for these results may be that the changes in games within the sessions and between sessions, and therefore, changes in the game mechanics, may have favored the development of the ability to alternate between different conditions and tasks of children who participated in the game program. In addition, three of the five commercialized board games used in the [project] Online program have mechanics that boost the player to alternate their focus of attention between different elements and actions to perform. For example, in the Monster Match game (Gruhl & Weir, 2018), you must catch a monster that meets the condition or the "Poff" token if neither meets the requirement. Therefore, the behavior to be carried out changes depending on the game's conditions at each moment. On the other hand, if we analyze the game Sherlock Express (Kermarrec, 2019), we see a similar mechanic besides making deductions (reasoning). When there is only one possible culprit among the suspects, we must catch him. But when every suspect in sight has an alibi, we must catch Moriarty, who is in the deck located in the middle. So, we have different actions to alternate depending on the game conditions here. And finally, we see that in the Streams game (Itsubaki, 2011), we are free to place random numbers in a series, trying to get them placed in ascending order. But the fact that the numbers are random means that we sometimes have to change our idea of where to put them to suit changing game conditions. For example, if you have not left a gap between a 15 and a 17, a 16 appears, and you have to start a new ascending series.

Regarding the result in verbal fluency, all the instructions from the guide and the players were oral. This fact could explain the improvement in the ability to access the lexicon of the game group. Despite the gain at the phonological level, the results in verbal fluency should be interpreted cautiously, considering the limitation of baseline differences in semantic verbal fluency that could make it difficult to generalize the results.

However, an unexpected result was obtained. In the present study, a significant improvement in visuospatial working memory was found in the passive control group that was not observed in the playgroup. In addition, we did not find any change in verbal working memory. Past interventions with board games in the general and clinical school population (ADHD) showed significant improvements in working memory and short-term memory in the group that played board games, but no significant result was found in the passive control group (Benzing et al., 2018; Estrada-Plana et al., 2019). A possible limitation in the study that could also partly explain the unexpected results obtained is that the recruitment of the participants was done through the social networks of the research group. Considering that the followers on social networks are mainly families and teachers with an intrinsic interest in board games, the children who participated were probably from families in which board games were already well established in family leisure. Hence, it could be possible that the participants assigned to the passive control group also played board games in their free time despite not being through the structured sessions we carried out with the playgroup. In the survey before the intervention, we saw that both the play and passive control groups had a high frequency in the time they spent playing board games (from 2-3 times a month to 2-3 times a week, even daily). Future studies could include a record or survey to determine the time spent playing board games by the passive control group during the

intervention due to its possible influence on the results. However, we cannot discard that playing board games in a digital format could imply side effects. Past research showed that playing board games in an analog form has more benefits for children than playing them in a digital format (von Steinkeller & Grosse, 2022).

Regarding reasoning, no significant differences were found after the intervention. Previous studies found a relationship between fluid intelligence/reasoning and board games. Specifically, Bartolucci et al. (2019) found that expert adults in board games scored higher reasoning performance test scores. They also compared the possible effects on fluid intelligence of intervention with board games and intervention with educational activities with children, finding better fluid intelligence scores in the game group after the intervention. Perhaps the differences in the application of the Bartolucci et al. (2019) intervention and the present study could explain the differences in the results. Their intervention was more intensive because they played for three hours daily from Monday to Friday for two weeks in the morning. In contrast, the online intervention carried out in this research lasted six weeks with two sessions of 1 hour per week. In addition, the sessions were held in the afternoon, at the end of the school day. Future research could explore whether the cognitive benefits obtained from the intervention may be greater depending on the intensity and frequency of the sessions. The time of day in which the cognitive intervention is carried out could also be relevant in case there are fluctuations in children's cognitive performance throughout the day, as suggested by some previous research (Van Der Heijden, De Sonneville, & Althaus, 2010).

Another limitation of the present study is that we adapted the games using webcams and other resources. However, in future studies, remote intervention with board games could be considered through platforms specifically designed for this use (such as Tabletopia© or Board Game Arena©) and perhaps more faithfully maintain the dynamics of the original games. It might be interesting to carry out a study with three experimental groups to answer these questions. One group playing board games remotely, a second group playing board games in person, and a passive control group not playing to any game. In this way, we could compare if the same benefits are obtained by playing the same game remotely and face-to-face or if there is one modality that may be more convenient depending on the cognitive process you want to train. For example, in an intervention study with the game of Go, greater cognitive benefits were obtained when playing physically (Iizuka et al., 2019). Perhaps the manipulation of the physical components of the games and the greater face-to-face social interaction with other people that analogical games allow (von Steinkeller & Grosse, 2022) could be aspects to consider when designing playful interventions with cognitive purposes.

Considering the importance that interest in the tasks can have in obtaining cognitive benefits from this type of training (Jaeggi, Buschkuehl, Jonides, & Shah, 2011), satisfaction was one of the aspects considered in this study. The improvements in flexibility and phonological verbal fluency that are only obtained in those with high satisfaction suggest that the motivation for the training can be critical in getting benefits. For this reason, future research should include measures of interest and task difficulty to determine these variables' effect on the

efficacy of cognitive training programs. Perhaps it would be interesting to design future research on what the participants enjoy from the intervention (their level of experience or performance in the game, its theme, and the dynamics generated between the players).

Finally, two more limitations need to be explained. First, the sample size was small. We cannot generalize the present results because of lacking statistical power. Second, a follow-up after finishing the board game cognitive intervention is usually recommended(Grant et al., 2018). It was challenging to do so in the present study because of the COVID situation.

The present study has several clinical implications. First, board games seem to be usefully delivered online for cognitive intervention. However, these games must be played face-by-face to harness their full potential. Second, enjoyment while playing is a core experience. Children who enjoyed a lot when playing benefited from the cognitive intervention, while children who not enjoyed it so much did not improve in executive functions.

In summary, we found that applying modern board games as cognitive teleintervention could improve cognitive flexibility and verbal fluency. However, we also saw greater improvements in working memory tasks in the passive control group. We need more studies to determine if confounding factors (i.e., the time spent playing board games during the study) affected the present results or if applying modern board games as cognitive teleintervention has side effects. Finally, it seems that the participants who benefited from the intervention liked the games and the playing sessions. Future research could measure the maintenance of the effects in the medium-long term and their possible transfer to other capacities of daily life.

References

Data available on request from the authors

Ahmed, S. F., Skibbe, L. E., McRoy, K., & Tatar, B. H. (2022). Strategies, recommendations, and validation of remote executive function tasks for use with young children. *Early Childhood Research Quarterly*, *60*, 336–347. https://doi.org/10.1016/j.ecresq.2022.03.002

Aita, S. L., Beach, J. D., Taylor, S. E., Borgogna, N. C., Harrell, M. N., & Hill, B. D. (2019). Executive, language, or both? An examination of the construct validity of verbal fluency measures. *Applied Neuropsychology:Adult*, *26*(5), 441–451. https://doi.org/10.1080/23279095.2018.1439830

Atherton, M., Zhuang, J., Bart, W. M., Hu, X., & He, S. (2003). A functional MRI study of high-level cognition. I. The game of chess. *Cognitive Brain Research*, *16*(1), 26–31. https://doi.org/10.1016/S0926-6410(02)00207-0

Baddeley, A. (1992). Working Memory Components of Working Memory The Slave Systems of Working Memory Individual Differences in Working Memory. *Science*, *255*(ii).

Barker, J. E., Semenov, A. D., Michaelson, L., Provan, L. S., Snyder, H. R., & Munakata, Y. (2014). Less-structured time in children's daily lives predicts self-directed executive functioning.

Frontiers in Psychology, *5*(JUN). https://doi.org/10.3389/fpsyg.2014.00593

Bartolucci, M., Mattioli, F., & Batini, F. (2019). Do board games make people smarter? Two initial exploratory studies. *International Journal of Game-Based Learning*, *9*(4), 1–14. https://doi.org/10.4018/IJGBL.2019100101

Bateman, C., & Nacke, L. E. (2010). The neurobiology of play. In *Future Play 2010: Research, Play, Share–International Academic Conference on the Future of Game Design and Technology* (pp. 1–8). New York, New York, USA: ACM Press. https://doi.org/10.1145/1920778.1920780

Benzing, V., Schmidt, M., Jäger, K., Egger, F., Conzelmann, A., & Roebers, C. M. (2018). A classroom intervention to improve executive functions in late primary school children: Too 'old' for improvements? *British Journal of Educational Psychology*, 1–14. https://doi.org/10.1111/bjep.12232

Bernard, G. (2013). *Blurble*. Mercurio Distribuciones. Retrieved from https://boardgamegeek.com/boardgame/121995/blurble

Chambonnière, C., Fearnbach, N., Pelissier, L., Genin, P., Fillon, A., Boscaro, A., … Duclos, M. (2021). Adverse collateral effects of COVID-19 public health restrictions on physical fitness and cognitive performance in primary school children. *International Journal of Environmental Research and Public Health*, *18*(21). https://doi.org/10.3390/ijerph182111099

Chen, X., Zhang, D., Zhang, X., Li, Z., Meng, X., He, S., & Hu, X. (2003). A functional MRI study of high-level cognition: II. The game of GO. *Cognitive Brain Research*, *16*(1), 32–37. https://doi.org/10.1016/S0926-6410(02)00206-9

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. *International Biometric Society*, *26*(3).

Cristofori, I., Cohen-Zimerman, S., & Grafman, J. (2019). Executive functions. In M. D'Esposito & J. H. Grafman (Eds.), *Handbook of Clinical Neurology, The Frontal Lobes* (3rd series, Vol. 163, pp. 197–219). Chicago, IL, United States: Elsevier B.V. https://doi.org/10.1016/B978-0-12-804281-6.00011-2

Di Giorgio, E., Di Riso, D., Mioni, G., & Cellini, N. (2021). The interplay between mothers' and children behavioral and psychological factors during COVID-19: an Italian study. *European Child and Adolescent Psychiatry*, *30*(9), 1401–1412. https://doi.org/10.1007/s00787-020-01631-3

Diamond, A. (2013). Executive functions. *Cognitive Training: An Overview of Features and Applications*, *64*, 135–168. https://doi.org/10.1007/978-3-319-42662-4_9

Duan, X., Liao, W., Liang, D., Qiu, L., Gao, Q., Liu, C., … Chen, H. (2012). Large-scale brain networks in board game experts: Insights from a domain-related task and task-free resting state. *PLoS ONE*, *7*(3), 1–11. https://doi.org/10.1371/journal.pone.0032532

Duan, X., Long, Z., Chen, H., Liang, D., Qiu, L., Huang, X., … Gong, Q. (2014). Functional organization of intrinsic connectivity networks in Chinese-chess experts. *Brain Research*, *1558*, 33–43. https://doi.org/10.1016/j.brainres.2014.02.033

Erades, N., & Morales, A. (2020). Confinement by COVID-19 and associated stress can affect children's wellbeing. *Revista de Psicologia Clinica Con Ninos y Adolescentes*, *7*(3), 27–34. https://doi.org/10.21134/rpcna.2020.mon.2041

Estrada-Plana, V., Esquerda, M., Mangues, R., March-Llanes, J., & Moya-Higueras, J. (2019). A Pilot Study of the Efficacy of a Cognitive Training Based on Board Games in Children with Attention-Deficit/Hyperactivity Disorder: A Randomized Controlled Trial. *Games for Health Journal*, *8*(3). https://doi.org/10.1089/g4h.2018.0051

Estrada-Plana, V., Montanera, R., Ibarz-Estruga, A., March-Llanes, J., Vita-Barrull, N., Guzmán, N., … Moya-Higueras, J. (2021). Cognitive training with modern board and card games in healthy older adults: two randomized controlled trials. *International Journal of Geriatric Psychiatry*, *36*(6), 839–850. https://doi.org/10.1002/gps.5484

Fadhli, M., Brick, B., Setyosari, P., Ulfa, S., & Kuswandi, D. (2020). A meta-analysis of selected studies on the effectiveness of gamification method for children. *International Journal of Instruction*, *13*(1), 845–854. https://doi.org/10.29333/iji.2020.13154a

Fiske, A., & Holmboe, K. (2019). Neural substrates of early executive function development. *Developmental Review*, *52*(December 2018), 42–62. https://doi.org/10.1016/j.dr.2019.100866

Gashaj, V., Dapp, L. C., Trninic, D., & Roebers, C. M. (2021). The effect of video games, exergames and board games on executive functions in kindergarten and 2nd grade: An explorative longitudinal study. *Trends in Neuroscience and Education*, *25*(September), 100162. https://doi.org/10.1016/j.tine.2021.100162

Grant, S., Mayo-Wilson, E., Montgomery, P., Macdonald, G., Michie, S., Hopewell, S., … Yaffe, J. (2018). CONSORT-SPI 2018 Explanation and Elaboration: Guidance for reporting social and psychological intervention trials. *Trials*, *19*(1), 1–18. https://doi.org/10.1186/s13063-018-2735-z

Gruhl, K., & Weir, Q. (2018). *Monster Match*. Mercurio Distribuciones. Retrieved from https://boardgamegeek.com/boardgame/246696/monster-match

Guinot Cuesta, J., & Moreno Garrido, B. (2021). El Estado del Mercado de Juegos de Mesa en España 2020, (February).

Hendry, A., Gibson, S. P., Davies, C., Gliga, T., McGillion, M., & Gonzalez-Gomez, N. (2022). Not all babies are in the same boat: Exploring the effects of socioeconomic status, parental attitudes, and activities during the 2020 COVID-19 pandemic on early Executive Functions. *Infancy*, (June 2021), 1–27. https://doi.org/10.1111/infa.12460

Hollingshead, A. (1975). *Four Factor Index of Social Status*. New Heaven, Connecticut: Yale University.

Huizinga, M., Dolan, C., & Molen, M. W. Van Der. (2006). Age-related change in executive function: Developmental trends and a latent variable analysis. *Neuropsychologia*, *44*(2006), 2017–2036. https://doi.org/10.1016/j.neuropsychologia.2006.01.010

Idoiaga Mondragon, N., Berasategi Sancho, N., Dosil Santamaria, M., & Eiguren Munitis, A. (2020). Struggling to breathe: a qualitative study of children's wellbeing during lockdown in Spain. *Psychology and Health*. https://doi.org/10.1080/08870446.2020.1804570

Iizuka, A., Ishii, K., Wagatsuma, K., Ishibashi, K., Onishi, A., Tanaka, M., … Fujiwara, Y. (2020). Neural substrate of a cognitive intervention program using Go game: a positron emission tomography study. *Aging Clinical and Experimental Research*, (0123456789). https://doi.org/10.1007/s40520-019-01462-6

Iizuka, A., Suzuki, H., Ogawa, S., Kobayashi-cuya, K. E., & Kobayashi, M. (2018). Pilot Randomized Controlled Trial of the GO Game Intervention on Cognitive Function, *33*(3), 192–198. https://doi.org/10.1177/1533317517753362

Iizuka, A., Suzuki, H., Ogawa, S., Kobayashi-cuya, K. E., Kobayashi, M., Inagaki, H., … Fujiwara, Y. (2019). Does social interaction influence the effect of cognitive intervention program ? A randomized controlled trial using Go Game. *International Journal of Geriatric Psychiatry*, *34*(2), 324–332. https://doi.org/10.1002/gps.5024

Itsubaki, Y. (2011). *Streams [Numerama]*. Mercurio Distribuciones. Retrieved from https://boardgamegeek.com/boardgame/103814/streams

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Shah, P. (2011). Short- and long-term benefits of cognitive training. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(25), 10081–10086. https://doi.org/10.1073/pnas.1103228108

Kermarrec, H. (2019). *Sherlock Express*. Mercurio Distribuciones. Retrieved from https://boardgamegeek.com/boardgame/271774/sherlock-express

Knizia, R. (2012). *Bee Alert [Abejitas zum zum]*. Mercurio Distribuciones. Retrieved from https://boardgamegeek.com/boardgame/129492/bee-alert

Kuo, C. Y., Huang, Y. M., & Yeh, Y. Y. (2018). Let's play cards: Multi-component cognitive training with social engagement enhances executive control in older adults. *Frontiers in Psychology*, *9*(DEC), 1–13. https://doi.org/10.3389/fpsyg.2018.02482

Lavigne-Cerván, R., Costa-López, B., Juárez-Ruiz de Mier, R., Real-Fernández, M., Sánchez-Muñoz de León, M., & Navarro-Soria, I. (2021). Consequences of COVID-19 Confinement on Anxiety, Sleep and Executive Functions of Children and Adolescents in Spain. *Frontiers in Psychology*, *12*(February), 1–11. https://doi.org/10.3389/fpsyg.2021.565516

Lavigne-Cervan, R., Costa-López, B., Juárez-Ruiz de Mier, R., Sánchez-Muñoz de León, M., Real-Fernández, M., & Navarro-Soria, I. (2021). Implications of the online teaching model derived from the covid-19 lockdown situation for anxiety and executive functioning in spanish children and adolescents. *International Journal of Environmental Research and Public Health*, *18*(19). https://doi.org/10.3390/ijerph181910456

Manzano-León, A., Rodríguez-Ferrer, J. M., Aguilar-Parra, J. M., & Herranz-Hernández, R. (2022). Gamification and family leisure to alleviate the psychological impact of confinement due to COVID-19. *Children and Society*, *36*(4), 433–449. https://doi.org/10.1111/chso.12495

Metaferia, B. K., Futo, J., Drew, R., & Takacs, Z. K. (2020). Parents' Beliefs About Play and the Purpose of Preschool Education , Preschoolers' Home Activity and Executive Functions, *11*(May). https://doi.org/10.3389/fpsyg.2020.01104

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The Unity and Diversity of Executive Functions and Their Contributions to Complex "Frontal Lobe" Tasks: A Latent Variable Analysis. *Cognitive Psychology*, *41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Navarro-Soria, I., Real-Fernández, M., de Mier, R. J. R., Costa-López, B., Sánchez, M., & Lavigne, R. (2021). Consequences of confinement due to covid-19 in spain on anxiety, sleep and executive functioning of children and adolescents with adhd. *Sustainability (Switzerland)*, *13*(5), 1–17. https://doi.org/10.3390/su13052487

NPD Group. (2021). El sector del juguete cierra 2020 con unas ventas de 929 millones de euros en España, un 7% menos. Retrieved from https://www.npd.com/news/press-releases/2021/el-sector-del-juguete-cierra-2020-con-unas-ventas-de-929-millones-de-euros-en-espana-un-7-menos/

Palaus, M., Marron, E. M., Viejo-sobera, R., & Redolar-ripoll, D. (2017). Neural Basis of Video Gaming : A Systematic Review, *11*(May). https://doi.org/10.3389/fnhum.2017.00248

Payà, A., & Bantulà, J. (2021). Children's Right to Play and Its Implementation: A Comparative, International Perspective. *Journal of New Approaches in Educational Research*, *10*(2), 279–294. https://doi.org/10.7821/naer.2021.7.665

Portellano, J. A., & Martínez-Arias, R. Zumárraga, L. (2009). *ENFEN. Evaluación neuropsicológica de las funciones ejecutivas en niños.* Madrid, España: TEA Ediciones.

Ruíz-Fernández, B. (2019). *TONI-4. Test of Non-verbal intelligence*. Madrid: TEA Ediciones.

Samji, H., Wu, J., Ladak, A., Vossen, C., Stewart, E., Dove, N., … Snell, G. (2022). Review: Mental health impacts of the COVID-19 pandemic on children and youth – a systematic review. *Child and Adolescent Mental Health*, *27*(2), 173–189. https://doi.org/10.1111/camh.12501

Sedó, M. A. (2004). Test de las cinco cifras: Una alternativa multilingüe y no lectora al test de Stroop. *Revista de Neurologia*, *38*(9), 824–828.

Stucke, N. J., Stoet, G., & Doebel, S. (2022). What are the kids doing? Exploring young children's activities at home and relations with externally cued executive function and child temperament. *Developmental Science*, (May), 1–14. https://doi.org/10.1111/desc.13226

Tamnes, C. K., Østby, Y., Walhovd, K. B., Westlye, L. T., Due-Tønnessen, P., & Fjell, A. M. (2010). Neuroanatomical correlates of executive functions in children and adolescents: A magnetic resonance imaging (MRI) study of cortical thickness. *Neuropsychologia*, *48*(9), 2496–2508. https://doi.org/10.1016/j.neuropsychologia.2010.04.024

Van Der Heijden, K. B., De Sonneville, L. M. J., & Althaus, M. (2010). Time-of-day effects on cognition in preadolescents: A trails study. *Chronobiology International*, *27*(9–10), 1870–1894. https://doi.org/10.3109/07420528.2010.516047

Vita-Barrull, N., Guzmán, N., Estrada-Plana, V., March-Llanes, J., Mayoral, M., & Moya-Higueras, J. (2022). Impact on Executive Dysfunctions of Gamification and Nongamification in Playing Board Games in Children at Risk of Social Exclusion. *Games for Health Journal*, *11*(1), 46–57. https://doi.org/10.1089/g4h.2021.0034

Vita-Barrull, N., March-Llanes, J., Guzmán, N., Estrada-Plana, V., Mayoral, M., Moya-Higueras, J., & Committee, C. J. (2022). The Cognitive Processes Behind Commercialized Board Games for Intervening in Mental Health and Education : *Games for Health Journal*, *11*(6). https://doi.org/10.1089/g4h.2022.0109

von Steinkeller, A., & Grosse, G. (2022). Children are more social when playing analog games together than digital games. *Computers in Human Behavior Reports*, *6*(April), 100195. https://doi.org/10.1016/j.chbr.2022.100195

SUPPLEMENTARY MATERIAL

Table S1.
Play sessions planning

Play sessions	Modern board and card games	Cognitive domains
Session 1	Welcome session to the program, presentation of group members, training on the functions of the videoconference tool and presentation of the gamified narrative.	
Session 2: Mission 1 (First planet)	Bee Alert Monster Match	Visuospatial Working Memory Inhibition and cognitive flexibility
Session 3: Mission 2 (First planet)	Sherlock Express Blurble	Reasoning Verbal fluency
Session 4: Mission 3 (Second planet)	Bee Alert Streams	Visuospatial Working Memory Planning
Session 5: Mission 4 (Second planet)	Monster Match Sherlock Express	Inhibition and cognitive flexibility Reasoning
Session 6: Mission 5 (Third planet)	Streams Blurble	Planning Verbal fluency
Session 7: Mission 6 (Third planet)	Bee Alert Monster Match	Visuospatial Working Memory Inhibition and cognitive flexibility
Session 8: Mission 7 (Fourth planet)	Sherlock Express Streams	Reasoning Planning
Session 9: Mission 8 (Fourth planet)	Bee Alert Blurble	Visuospatial Working Memory Verbal fluency
Session 10: Mission 9 (Fifth planet)	Monster Match Sherlock Express	Inhibition and cognitive flexibility Reasoning
Session 11: Mission 10 (Fifth planet)	Streams Blurble	Planning Verbal fluency
Session 12: Final Battle	Program closure: Final battle! We play the games we like the most to say goodbye to this fight against the evil Captain Divoc who won't let us play together. We ended up looking at our logbook (planet and super crew badges) and said goodbye to our colleagues.	Games of their choice

Table S2.
Modern board and card games selection

Games (Author, date)	Description	Recommended age	Approximate duration

Bee Alert (Knizia, 2012)	A series of colored bees are hidden under their hives. Players must memorize their starting position. According to the card obtained in each turn, players will have to: a) bee card, find the hive in which the bee is the color of the card; b) hive card, take any hive from the center of the table or the space of another player; c) bear card, return a hive to the center of the table. The player who gathers four hives wins the game.	+4	15 min
Blurble (Bernard, 2013)	Verbal fluency game in which the active player ("Blurble") challenges each of the players to vocabulary duels. A card is presented in which a picture appears, for example a "farmer", and both players must say as quickly as possible another word that begins with the same letter as the element presented on the card, for example "forest" (both they start with the letter F). The player with the most cards at the end of the last round is the winner.	+8	15 min
Monster Match (Gruhl & Weir, 2018)	Monsters have taken all our donuts and our mission is to get them back. To do this, we place 10 monster cards on the table, which can have 1, 2 or 3 donuts, and we roll two dice: one for parts of the body and the other with numbers from 0 to 5. At that moment, all the players to at the same time, they must identify a monster that meets the condition of the dice, for example, look for a monster with 3 legs. When they find it, they place their finger on the card and, if it's correct, they keep it. If the dice show a condition that none of the monsters in sight meet, players must place their finger on the central POFF tile. The fastest to do so takes a card from the deck and 10 more monster cards are added to the center of the table. When the cards in the deck are used up, the player with the most donuts will win.	+6	10 min
Sherlock Express (Kermarrec, 2019)	Deduction game in which the players will be Sherlock's assistants in his investigations. The game features suspect cards and alibi cards. If you place the deck of suspect cards in the center and 6 cards are turned around. On the other hand, all the alibi cards are shuffled and dealt equally among the players. Alibi cards can contain settings (park, room, library), accessories (monocle, hat, mustache), or character type (koala, tiger, panda). One by one the players will turn over alibi cards, which will indicate which suspects are innocent. For example, if an alibi letter that features a mustache is flipped over, we will rule out all suspects with a mustache as guilty. Alibi letters will be flipped until a single culprit is identified among the suspects on view. The same process is repeated in each round, until one of the players manages to identify 5 suspects and the game ends.	+7	10 min
Streams (Itsubaki, 2011)	This is a game in which the objective will be to achieve ascending series of numbers as long as possible. Tiles with numbers from 1 to 30 and a wild tile are placed in a bag. Inside the bag we will have 1 tile for each number from 1 to 10 and from 20 to 30 and two tiles for each number from 11 to 19. Without looking, we will remove a tile from the bag and place it in a grid with 20 spaces. At that time, all players must place the number indicated on the tile in one of the 20 free spaces of their player template. The templates have a sequence of 20 spaces that will be filled throughout the game with each tile that is taken out of the bag. Once the number is written in one of the spaces, it cannot be deleted or changed. So players should think carefully about where to place each number presented on the tiles to try to get ascending sequences of numbers in their template. Long sequences give more points at the end of the game. When the twentieth tile has been shown, it is placed in the last free space, the ascending sequences achieved are identified and the points obtained with each of them are added. The player with the most points will be the winner.	+7	10 min

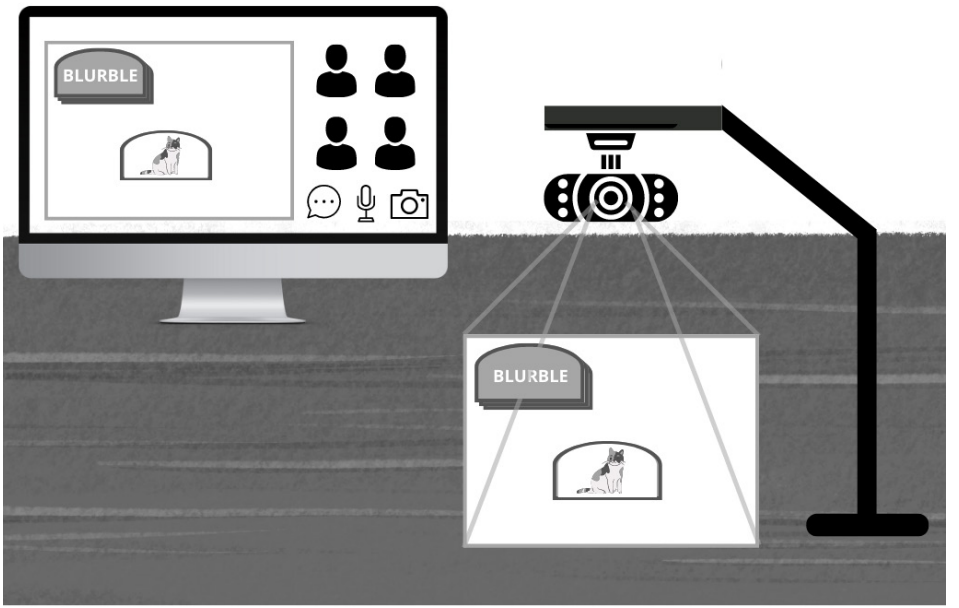

Figure S1.
Explanation of how we presented the games in a digital format. The physical games were projected in the videoconference tool through a webcam placed in a zenithal plane. In this way, players could see the components of the game even without being in the same physical space and play in real time giving instructions to the guide of the session through voice and chat tools.

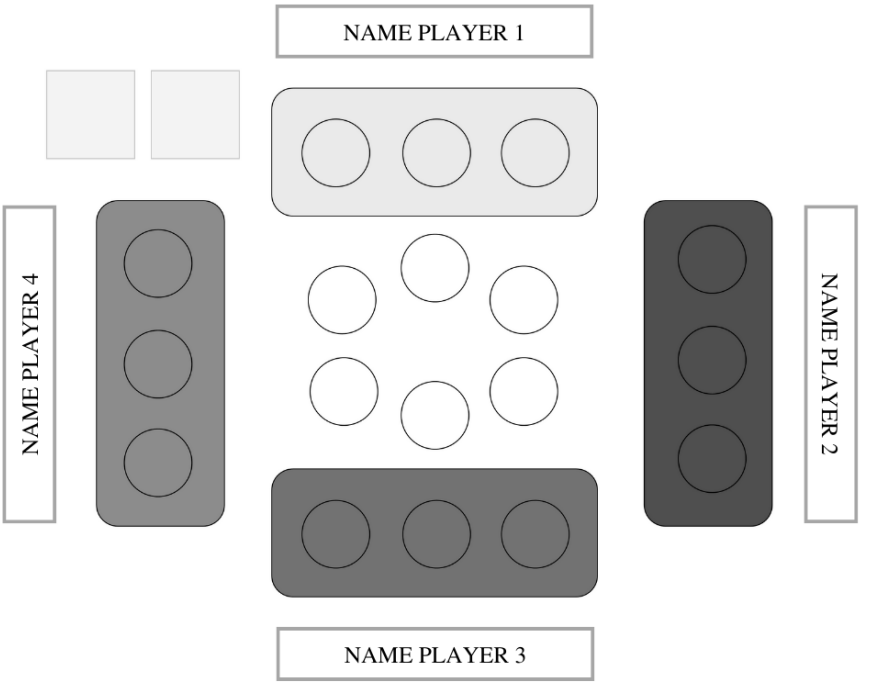

Figure S2.
Adaptation of the game Bee Alert. This template was used to facilitate the placement of the hives and the cards within the zenithal plane projected in the videoconference. Each player had a separate space with three circles in which he would place his collected hives. On each turn, the session guide flipped a card from the deck and the active player indicated via voice or chat which hive they wanted to discover or move.

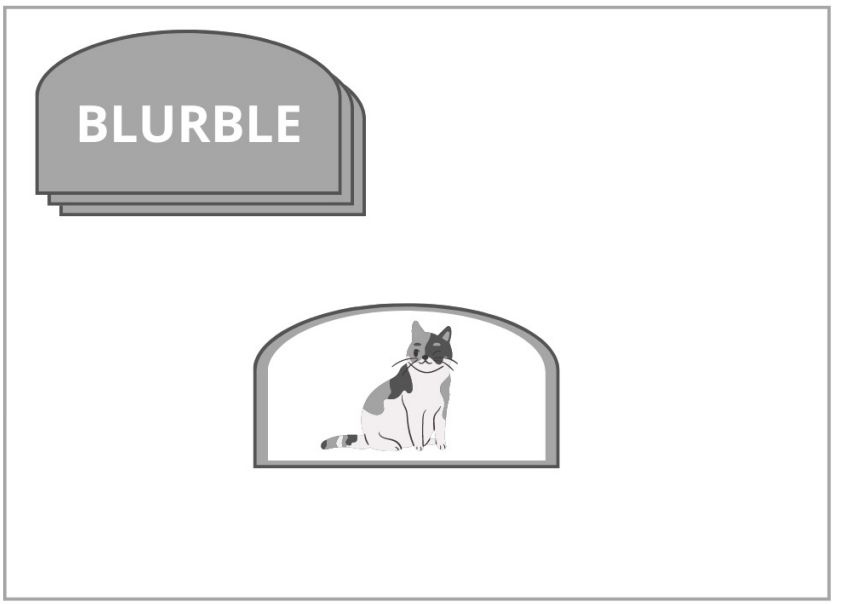

Figure S3.
Adaptation of the game Blurble. The deck of cards was projected and the top of the deck was turned over. At that time, all the participants had to write on a piece of paper all those words that came to mind that began with the same letter as the object in the image. In this example, they should write all those words that begin with the letter C of CAT (car, cactus, camel,...). The player with the most written words got a point in that round. When the time dedicated to this game ended (20-25 minutes), the player with the most points won the game.

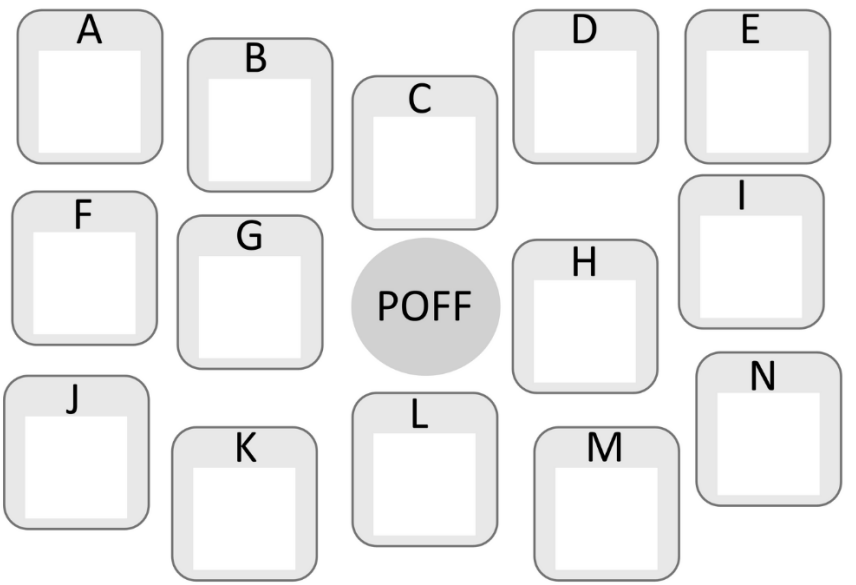

Figure S4.
Adaptation of the game Monster Match. To facilitate the selection of the monster that each child wanted to catch, the monster cards were placed inside spaces identified by letters. When a player discovered a monster that met the characteristics of the dice, he had to indicate the corresponding letter by chat or voice. If more than one player chose the same letter, the fastest one took it.

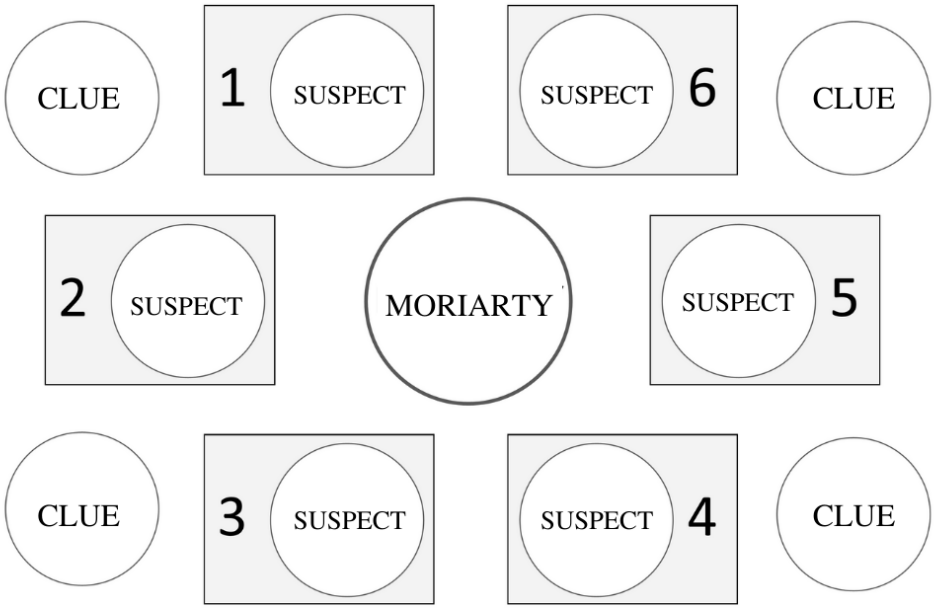

Figure S5.
Adaptation of the game Sherlcok Express. The suspect cards were placed in the rectangular spaces identified by numbers from 1 to 6. The clue cards were placed in the corners of the zenithal plane. In this way, players could indicate which suspect was the culprit by voice or chat by specifying the corresponding number.

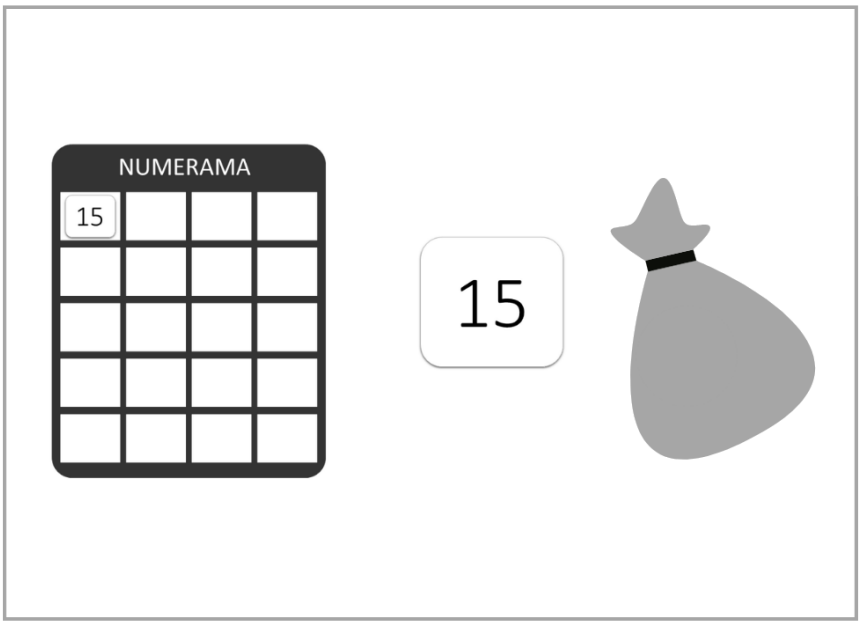

Figure S6.
Adaptation of the game Streams. The bag from which the tokens were taken and placed on the grid with the 20 spaces was projected on the zenith plane. In this way, the players always had in view the chips that had already been drawn.