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Executive functions: updating, set-shifting, and inhibition in non-Mapuche urban children, Mapuche urban children, and rural Mapuche children in La Araucanía, Chile

Habilidades ejecutivas: actualización, cambio entre conjuntos mentales e inhibición en niños no mapuche urbanos, mapuche urbanos y mapuche rurales de La Araucanía, Chile

Habilidades executivas: atualização, mudanças entre conjuntos mentais e inibição em crianças não mapuches urbanas, mapuches urbanas e mapuches rurais de La Araucanía, Chile

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The data set supporting the results of this study is not available.

Abstract: Children's cognitive abilities differ according to the cultural development settings in which they are raised. Assuming cultural variability, this study compared the executive functions in 110 children, aged 9 to 11 years, belonging to three groups: urban non-Mapuche, urban Mapuche, and rural Mapuche, from communes in the Araucanía region, Chile. A descriptive and correlational design was used to contrast children's performance on the variables of interest. The battery of instruments comprised three tests that assessed updating, set-shifting, and inhibition, respectively. The results indicate no statistically significant differences in updating and set-shifting, but there was a statistical significance for differences in inhibition, with non-Mapuche children having greater inhibition than the other two groups. The findings are discussed according to the hypothesis that skill development is related to the daily practices, demands, and sociodemographic characteristics of the settings in which children are raised.

Keywords: cultural contexts; cultural differences; executive functions; Mapuche children; culture; Chile

Resumen: Las habilidades cognitivas de los niños varían conforme a los contextos de desarrollo cultural en los que se desenvuelven. Asumiendo la variabilidad cultural, este estudio tuvo por objetivo comparar las habilidades ejecutivas en 110 niños, entre 9 y 11 años, pertenecientes a tres grupos: no mapuche urbanos, mapuche urbanos y mapuche rurales, de comunas de la región de La Araucanía, Chile. Se usó un diseño descriptivo y correlacional para contrastar el desempeño de los niños en las variables de interés. La batería de instrumentos estuvo formada por tres pruebas que evaluaron: actualización, cambio entre conjuntos mentales e inhibición, respectivamente. Los resultados indican que no hubo diferencias estadísticamente significativas en actualización y cambio entre conjuntos mentales, pero sí hubo significancia estadística para las diferencias en inhibición; siendo los niños no mapuche quienes tuvieron mayor inhibición respecto de los otros dos grupos. Se discuten los hallazgos según la hipótesis de que el desarrollo de habilidades se relaciona con las prácticas cotidianas, demandas y características sociodemográficas de los contextos en los que los niños se desarrollan.

Palabras clave: contextos culturales; diferencias culturales; habilidades ejecutivas; niños mapuche; cultura; Chile

Resumo: As habilidades cognitivas das crianças variam conforme os contextos de desenvolvimento cultural em que elas se desenvolvem. Partindo do pressuposto da variabilidade cultural, este estudo teve como objetivo comparar as habilidades executivas de 110 crianças, com idades entre 9 e 11 anos, pertencentes a três grupos: não mapuche urbanas, mapuche urbanas e mapuche rurais, de municípios da região de La Araucanía, Chile. Foi utilizado um desenho descritivo e correlacional para comparar o desempenho das crianças nas variáveis de interesse. A bateria de instrumentos foi composta por três testes que avaliaram: atualização, mudança entre conjuntos mentais e inibição, respectivamente. Os resultados indicam que não houve diferença estatisticamente significativa em atualização e mudança entre conjuntos mentais, mas houve significância estatística para as diferenças em inibição, com as crianças não mapuches apresentando maior inibição do que os outros dois grupos. Os resultados são discutidos de acordo com a hipótese de que o desenvolvimento de habilidades está relacionado às práticas cotidianas, demandas e características sociodemográficas dos contextos em que as crianças se desenvolvem.
Palavras-chave: contextos culturais; diferenças culturais; habilidades executivas; crianças mapuches; cultura; Chile

Executive functioning is a multidimensional construct encompassing a series of higher-order cognitive processes necessary to perform goal-directed tasks (Diamond, 2013; Lehto et al., 2003). For Lezak (1982), attributed with coining the term executive function (EF), executive functioning includes high-level cognitive abilities to formulate goals, plan how to achieve them, and execute them effectively, which affects behavior and social skills. Executive functions depend on the dorsolateral prefrontal cortex and develop from six months of age through adulthood (Diamond, 2002). During childhood, executive function increases as the brain matures, regulating thought, actions, and emotions. However, due to incomplete maturation of the frontal lobes, these are limited at this stage (Anderson et al., 2001). In childhood, executive functions transition from easy to complex to progressively reach greater flexibility and adaptation to unexpected events and overcome actions on "autopilot" (Diamond, 2013). In adolescence, an executive function similar to that observed in adulthood is reached (García-Molina et al., 2009).

Numerous studies have discovered that age, as a measure of maturity, is an explanatory factor for executive function: the older the person, the higher the scores in executive functions (Ardila et al., 2005; Bausela, 2014), although the increase in scores may depend on the type of measure used. For example, Anderson et al. (2001), in a study of 138 children aged 11 to 17 years, found that the developmental trajectory for executive functioning remained largely stable during late childhood and early adolescence. This study shows the need to assess the progression of executive functions at different ages through a broad battery of tasks with a latent variable approach rather than a single test that does not accurately demonstrate a complex cognitive processing level with more marked shifts in performance over the years (Anderson et al., 2001; Lehto et al., 2003; Obradovic & Willoughby, 2019).

The skill set that constitutes executive functioning varies among different authors, but there is consensus that there are three fundamental components: updating and overseeing representations of the working memory (hereafter updating), shifting between mental sets or tasks, and inhibition of dominant responses (inhibitory control including self-monitoring and interference control) (Lehto et al., 2003; Miyake et al., 2000). The operational definition of these executive functions is more accurate than others, and all three are likely involved in the performance of more complex conventional executive functions (Diamond, 2013; Miyake et al., 2000). For example, the Five-Digit Test is proposed as a test that measures set-shifting to switch between classification principles as well as inhibition to suppress inappropriate responses (Sedó, 2007).

Updating is the ability to retain information to fulfill a task and is a critical skill for reasoning (Lehto et al., 2003). It allows reordering and working with data mentally to update them while performing tasks related to those data (Carpendale & Lewis, 2006; Diamond, 2013). Set-shifting is the ability to change one way of solving a problem to another to respond appropriately to a situation (Lewis & Carpendale, 2009). It requires shifting the attentional focus from one class of stimuli to a different one and switching between two cognitive sets (van der Linden et al., 2000). This ability makes it possible to generate different ideas, consider alternative behaviors, and respond to new situations; therefore, it is relevant for regulating behavior, and if reduced, it can produce rigid and inflexible behavior (Diamond, 2002). Finally, inhibition is "ability to deliberately inhibit dominant, automatic, or prepotent responses when necessary" (Miyake et al., 2000, p. 57). It is constituted by inhibitory control and self-control:

inhibitory control makes it possible to suppress salient reactions (Lewis & Carpendale, 2009), and self-control allows one to master one's own performance to make sure that the goal has been appropriately achieved (Lehto et al., 2003). In summary, inhibition facilitates effective self-regulation, motivation to execute behaviors, and the acquisition of emotional control (García-Molina et al., 2009).

Most research identifying disparities in children's executive functions has been conducted with middle-class Western populations and has employed tasks incorporating various lower-order skills (e.g., reading proficiency, expressive and receptive language, among others), such that a lack of experience in these skills may lead to low overall scores on executive functioning assessments, despite the absence of cognitive deficits (Anderson et al., 2001). This way of assessing skills neglects the importance of sociocultural factors that support divergent development of executive functioning (Gaskins & Alcalá, 2023). By not assessing all components of the executive domain, the instruments may lack ecological validity in culturally diverse groups (Gioia et al., 2000; Miller-Cotto et al., 2022).

In this light, it is imperative to know the characteristics of the child's developmental context to assess executive functions since cultural practices and socio-familial demands condition the development of cognitive skills (Carpendale & Lewis, 2006), and, in turn, enhance certain executive functions over others (Gaskins & Alcalá, 2023; Georgas et al., 2003). Psychological processes arise from engagement in culturally and historically mediated actions (Rogoff et al., 2018).

This cultural perspective makes it possible to overcome the normative and standard view of children's abilities (Hein et al., 2015; Rogoff & Mejía-Arauz, 2022). Differences in skills do not occur because of a lack of universal traits, but rather because of the adaptation of executive developmental predispositions to the specific practices of varying cultural contexts (Keller & Kärtner, 2013; Stucke et al., 2022). Therefore, it is incongruous to presume that children living in highly diverse cultural settings will exhibit identical developmental patterns (Worthman, 2010).

According to socioecological development models, the family environment and the characteristics of the home setting are ecologies that directly or indirectly impact children's learning, which favors the development of particular cognitive skills (Bronfenbrenner, 1986; Worthman, 2010). In line with these ideas, Keller (2015) proposed the model of ecocultural development - originally formalized by Whiting (1994) - which posits that skills develop according to eco-social conditions, cultural models, and socialization strategies (Keller & Kärtner, 2013).

Eco-social contexts refer to specific groups of families and communities distinguished according to their level of formal schooling, place of residence, type of family economy, and whether they are communities of post-industrial societies (Keller, 2015). The interrelation of these variables influences the implementation of learning practices and the cultivation of specific skills.

The education level of the children's caregivers produces differences among eco-social contexts. The abstract knowledge acquired at school could determine the parents' occupations and, thus, the family's socioeconomic level, which affects children's daily practices (Greenfield, 1996). In this sense, the socioeconomic characteristics of eco-social contexts promote specific practices that enable the emergence of cognitive processes that, in turn, are modulated by the demands of the same settings (Lewis & Carpendale, 2009; Rogoff et al., 2018).

Keller (2015) proposed three eco-social development contexts that in this study are assumed as the basis for distinguishing three different groups of children: urban non-Mapuche, urban Mapuche, and rural Mapuche.

The first context comprises Western middle-class, non-indigenous, urban families from post-industrialized countries whose caregivers have a high education level (12 or more years). They often have skilled labor occupations in a free market economy. These are nuclear families with few children whose interactions are based primarily on school issues (Keller, 2019; Morelli et al., 2003). These families assume that better school performance in childhood facilitates better jobs in adult life (Sternberg et al., 2001). As a result, children often occupy their time in “childhood-like” activities, engaging in institutionalized practices that promote the development of abstract skills, individual exploration, expressive communication, and reflective self-awareness (Keller & Kärtner, 2013). For these families, the ultimate goal of child development is equivalent to scholastic achievement (Rogoff et al., 2003).

Families in this eco-social context value their children's school dynamics, which could greatly affect the executive performance of these children (Baker et al., 2012). Training these children in school routines could notably influence high scores on executive functioning tests, especially in visual memory (Ardila et al., 2005; Spiegel et al., 2021); thus, familiarity with school activities would facilitate greater executive performance (Blair & Razza, 2007; Carpendale & Lewis, 2006; Jacob & Parkinson, 2015).

In Chile, the results of the Survey of Activities of Children and Adolescents (EANNA) show that this eco-social context is formed by urban non-Mapuche families (Ministerio de Desarrollo Social, 2012). It tends to be a nuclear family, and parenting is carried out by a narrow network of people, which could restrict children's possibilities to participate in collaborative activities with others, according to the Third Longitudinal Survey of Early Childhood (ELPI) (Ministerio de Desarrollo Social, 2017). As a result of a change in parental beliefs that value early education and the achievement of secondary school certification, Chilean children have stopped helping with household chores (Ghiardo Soto & Dávila León, 2016). Family interactions revolve around school performance, which implies that they invest a lot of time in academic activities and practices conducive to independence and autonomy (Urzúa et al., 2009) while they spend little time (one hour per week) participating in the household (sweeping, cleaning, etc.) (Ministerio de Desarrollo Social, 2012).

A second eco-social development context comprises middle-class, non-Western urban families of indigenous heritage. This heritage is perceived as a patrimony of values, beliefs, and practices associated with the indigenous identity of origin, shared among individuals of multiple generations (Rogoff et al., 2003). In these families, parents possess advanced education and reside in urban areas due to migration from rural regions, driven by their need for employment opportunities and access to formal education (Cárcamo et al., 2015). The family bond persists while concurrently fostering a feeling of individual identity (Keller, 2019), attributable to schooling, the decline of an agricultural economy, and employment outside the house (Greenfield, 2009).

In Chile, urban Mapuche families share the characteristics of this second context. They have migrated from rural areas due to land usurpation by the State and private individuals. Obtaining specialized jobs and access to schools have been other causes of migration (Imilan & Álvarez, 2017). Some of these families stay in contact with their communities of origin in a relationship of socio-spiritual dependence between the country and the city (Imilan & Álvarez, 2017). They have some command of the Mapuche language and maintain their cultural identity, participating in practices that bring the extended family together (Becerra et al., 2018). However, their daily routine has adapted to the Chilean education system, which imposes a monocultural model of school knowledge acquisition (Quilaqueo et al., 2022). Children must fulfill school obligations, and since adult jobs are not performed at home, they have fewer opportunities to collaborate in the family. Children's daily activities are carried out according to the direction of parents who encourage speed and efficiency in their actions (Murray et al., 2015). By not having frequent contact with nature, children learn in simulated contexts, making it difficult to explore and manipulate elements in the natural environment (Egert & Godoy, 2008).

The last eco-social context is represented by extended families with indigenous heritage residing in rural areas, whose parents have a low education level (eight years or fewer) (Keller & Kärtner, 2013). This aligns with minimal interaction with urban centers and the preservation of traditional customs (Rogoff et al., 2018). The jobs performed by these families do not require academic training, as they are trades learned from generation to generation that include agricultural, livestock, and domestic activities. In this context, children interact with people of different ages and progressively cooperate in tasks such as planting and harvesting, caring for animals, making textiles to sell, and others (Morelli et al., 2003).

Children's collaboration is aligned with family interests and practices, with group achievement predominating over personal achievement (Alcalá et al., 2021). In this setting, children develop self-regulation, problem-solving, organization, and goal execution, all skills characteristic of executive functioning (Gaskins & Paradise, 2010). However, standardized measurements report that children from indigenous communities obtain low scores when remembering lists of objects (Gauvain & Pérez, 2015). This may occur because the items on the tasks are not specific to their developmental contexts, and these instruments likely present measurement biases by not considering the contextual perspective (LeCuyer & Zhang, 2015).

Rural Mapuche families correspond to this eco-social context, as they maintain ancestral practices, an agricultural-livestock economic system, and low levels of formal education, the average being 8.2 years in La Araucanía (Instituto Nacional de Estadísticas [INE], 2019). Therefore, it can be assumed that Mapuche cultural practices are not so permeated by academic knowledge. Parenting practices are shared in a system of multiparenting in the extended family, i.e., the child is in the care of various adults who respect their learning pace, avoiding constant supervision and direct verbal instruction in activities (Cárcamo et al., 2015). Rural Mapuche children can experiment and participate in household and community practices that foster learning, physical contact, and gross motor stimulation (Farkas et al., 2017). Given that adult work occurs in the home and the community assumes that experiences are important for all members, children help in activities according to the skills they acquire by participating in community activities (Alarcón et al., 2021). Interaction with adults is horizontal and collaborative, as children are considered legitimate participants (Alonqueo et al., 2022; Murray & Tizzoni, 2022; Szulc, 2021).

The practices described for each of the three groups - urban non-Mapuche, urban Mapuche, and rural Mapuche - enable the development of cognitive skills adapted to the needs of each environment (Lewis & Carpendale, 2009). As a cultural and psychological process, executive functions progress from the external and social to the individual and internal (Vygotsky, 1997). Thus, skills are acquired in cultural practices and refined in eco-social contexts (Leontiev, 1978).

No published studies assess executive functioning in the three groups of children described above. In general, the analysis of executive functioning in Chilean children focuses on differences by socioeconomic status and parents' education level (e.g., Rodríguez et al., 2019). The low scores of children with families with low education levels and low socioeconomic backgrounds are due to the measurement being based on school-enhanced skills (Blair & Razza, 2007; Georgas et al., 2003). For this reason, it is important to study executive functions considering the practices and contexts of eco-social development to understand children's abilities better (LeCuyer & Zhang, 2015). The differences among the three groups in executive functioning should not be understood as a “deficit” in which the more “disadvantaged” groups are identified in terms of lacking skills (Kärtner et al., 2008). Conversely, distinctions are acknowledged based on a theoretical framework that recognizes that cultural practices in each environment facilitate the diverse development of skills (Rogoff, 2014).

The research question guiding this study was: What are the differences in the executive functions of urban non- Mapuche, urban Mapuche, and rural Mapuche children aged 9 to 11 years? The study's general objective was to contrast the differences in executive functions between urban non-Mapuche, urban Mapuche, and rural Mapuche children aged 9 to 11 years.

Method

Design

We used a descriptive design and a correlational study to describe and contrast executive functions in three groups of children (Howitt & Cramer, 2011).

Participants

In Chile, the Mapuche people are the largest indigenous people, with a total population of over one million inhabitants (1,745,147) (INE, 2019), of which 471,742 are children and adolescents (Defensoría de la Niñez, 2021).

Convenience sampling was used to select 110 children between 9 and 11 years of age, belonging to three cultural groups: 39 urban non-Mapuche children, 31 urban Mapuche children, and 40 rural Mapuche children. In both the rural and urban groups, belonging to the Mapuche people was determined by self-ascription. Children who did not fulfill the criteria of belonging to the Mapuche people or having Chilean nationality, who were outside the age range of interest, or who had a developmental disorder, such as cognitive or motor disability, were excluded from the sample. The distribution of the groups according to age and sex is shown in Table 1.

Table 1
Distribution of participant groups according to age and sex

	Urban non-Mapuche (*n* = 39)			Urban Mapuche (*n* = 31)			Rural Mapuche (*n* = 40)		
	9 years	10 years	11 years	9 years	10 years	11 years	9 years	10 years	11 years
Boy	6	4	7	4	4	5	8	8	4
Girl	8	6	8	10	6	2	5	4	11
Total	14	10	15	14	10	7	13	12	15

Instruments

Sociodemographic questionnaire: Data such as date of birth, sex, cultural group, origin, and education level of mothers and fathers were recorded.

The instruments for assessing executive function (EF) were previously tested and selected because they have been used in studies with children and do not involve a strong relationship with lower-order skills, so they are more appropriate for assessing executive functioning in participants from non-Western, indigenous, and rural contexts (Rosselli & Ardila, 2003; Rossen et al., 2005).

"Perros"*:* This is a test of the Spanish Batería Psicopedagógica Evalúa-4 (García, 2016), validated in Chile. It assesses the ability to stay focused (analytical observation) and to update short-term information in recognition tasks (García et al., 2004). It consists of recognizing items identical to a model within three minutes*.* The test consisted of 36 items, each scored as 0 = incorrect (not identical to the model) or 1 = correct (identical to the model). The maximum score was 36 points.

Block Design: A subtest of the Weschler Intelligence Scale for Children (WISC-III), standardized in Chile by Rosas and Ramírez (2009). This test assesses the ability to analyze components, perceptual organization, and model reproduction*.* Therefore, it could be used to evaluate set-shifting. It consists of recreating red and white designs according to a pattern, using a specific number of blocks. There were 12 designs to be made, each with a pre-set time limit for scoring. The correction considered whether the items were an exact reproduction of the models, carried out within the allotted period (no bonus was given for speed of execution). 0 points were assigned to designs made outside the time limit, or that were incorrect, and 1 point to correct designs made within the time limit. The maximum total score was 12 points.

Five Digit Test (Sedó, 2007): This consists of presenting a sheet with 10 stimuli (numbers) and the respective subtest with 50 stimuli, distributed in 10 rows. Participants must read the digits and, in a second part, count the numbers, i.e., perform automatic numerical transcoding that involves mentioning the number of numerical stimuli inside the box, inhibiting their value (Sedó & DeCristoforo, 2001). The score obtained in inhibition corresponds to the subtraction of the execution times in choice minus the reading times (inhibition=choice-reading). Faster times indicated better performance on the test. Concerning the evidence of the validity of the instrument, a comparison with the Stroop Test revealed a correlation ranging from -.57 to -.74 ($p < .01$) (Sedó & DeCristoforo, 2001).

The instruments do not have a previously defined reliability in groups of rural Mapuche and urban Mapuche children; therefore, internal consistency analysis with Cronbach's Alpha was applied. McDonald's omega analysis was also used, as it measured reliability without depending on the number of items (Ventura-León & Caycho-Rodríguez, 2017). Despite the unacceptability of the reliability of all items, the internal consistency achieved can be deemed reliable, given the sample size and the nascent nature of the study within the national context (Table 2).

Table 2
Reliability statistics for internal consistency of the instruments used

Measures	Cronbach's alpha	McDonald's omega	Acceptable
Perros	.72	.82	Significance
Block Design	.66	.69	Low
Choice	.59	.61	Low

Procedure

Together with the teachers of the children participating in the study, the days and times for applying the instruments were set. Sociodemographic data were collected from the information sheets that the schools had on each student.

The battery of instruments was administered by two assistants who applied them individually to each of the children in a room in the school. Before applying the instruments, it was made clear that the evaluations were not graded. They were motivated to answer the measurements as quickly as possible.

In the *Perros* task, it was explained to the child that they should first look at the model and then mark all the drawings that were exactly the same as the model and that they could erase if they made a mistake. For Block Design, the assistant showed the child the blocks, placed the stimulus booklet on the right side of the table, and modeled the first design. It was mentioned that the work consisted of putting the blocks together to reproduce the models. For each child, the completion times for each of the 12 models were recorded with a stopwatch and it was recorded if there was a failure for not adjusting to the model or for exceeding the time limit. For the Five Digit Test, in the first part of the test (reading), the assistant showed the child a test, pointing out that they had to read the number that appeared in each box. Then, the test was applied, where the child had to read aloud the numbers in each box. In the second part (choice), the trial and test were applied, asking them to count how many numbers were in each box. In both parts, the assistant for each child counted errors and timed the total time, i.e., the time for the reading and choice tests.

Upon completion of the set of tasks, the children received a pencil and an eraser as a thank-you.

Ethical safeguards

The Science Ethics Committee of the Universidad de La Frontera approved this study. Ethics protocol involved obtaining informed consent from both school administrators and the parents of each family. Also, informed consent was obtained from the participating children, previously authorized by their guardians.

Data analysis

The items on the instruments presented low variance, so only those with correct and incorrect values between 20 % and 80 % were selected. Scores were created by calculating the average of the selected items. As the scores were prepared by selecting items with acceptable variance, the Perros score was called updating (17 items) and the Block Design score set-shifting (5 items).

The inhibition score of the Five Digit Test was calculated by subtracting the time in Choice minus the time in Reading. This implied that the higher the score, the lower the inhibition (Sedó, 2007). Reading did not have acceptable variance, and Choice was left with 16 items. A descriptive analysis was performed with the scores obtained.

As the variables could be interpreted jointly, a one-way between-subjects MANOVA (three cultural groups) was applied. The assumptions associated with the test were: Kolmogorov-Smirnov indicated that the measures did not have univariate normality, although this was not verified when observing the skewness and kurtosis indices, since in all scores (updating, set-shifting, and inhibition) these indicators were < 1.96; therefore, the normal distribution was fulfilled. With the results of Levene's test, independence of error variance was assumed for the three dependent variables, since they obtained a $p > .05$. Finally, the covariance matrices in the dependent variables were equal in all groups, Box's M test $F\ (12) = 7.48$, $p = .85$, with a p value > .05.

Subsequently, a one-way between-subjects ANOVA was used to examine the differences among the dependent variables. The a posteriori Games-Howell test, the most robust statistic, was used to analyze the differences among groups. In addition, a one-way between-subjects ANOVA was used to evaluate differences in the errors made by the three groups in inhibition.

Analyses of differences by sex were performed with the t-test for independent groups comparing updating, set-shifting, and inhibition by the fixed factor sex. A one-way between-subjects ANOVA analysis (age as a fixed factor) was performed to evaluate differences by age.

Results

First, a descriptive analysis of the dependent variables across the three groups of participants is provided, and then the results of the study objectives are presented. Table 3 presents the means, standard deviations, and confidence intervals of updating (*Perros*), set-shifting (Block Design), and inhibition (Choice - Five Digit Test) scores.

Table 3
Descriptive statistics of executive function measures

	Urban non-Mapuche			Urban Mapuche			Rural Mapuche		
Variables	*M (SD)*	95 % CI		*M (SD)*	95 % CI		*M (SD)*	95 % CI	
		LL	UL		LL	UL		LL	UL
Updating	0.69 (0.20)	0.63	0.76	0.72 (0.21)	0.64	0.80	0.67 (0.18)	0.61	0.72
Set-shifting	0.45 (0.26)	0.36	0.54	0.42 (0.29)	0.31	0.53	0.33 (0.27)	0.24	0.42
Inhibition	26.85 (13.46) [a]	22.48	31.21	35.94 (13.25) [a]	31.07	40.80	34.50 (10.99) [a]	30.98	38.02

Note. Letters in superscript indicate statistically significant differences between cells with the same letter.

In the updating variable, the urban Mapuche children had the highest mean, i.e., these children used updating more than the other two groups. Regarding set-shifting, the non-Mapuche children performed better than the urban Mapuche children and the rural Mapuche children. A similar situation occurred with inhibition: the non-Mapuche children had lower scores and thus greater inhibition since they took less time on the test.

First, the differences among the study variables were analyzed according to sex and age. No statistically significant differences were observed in any of the three cultural groups. Comparison between boys and girls in updating, set-shifting, and inhibition [$t(108) = 0.626$, $p = .53$; $t(108) = 0.608$, $p = .54$; $t(108) = -0.387$, $p = .69$, respectively] shows that performance according to sex is similar. There were also no statistically significant differences in terms of age in the three cultural groups in updating, set-shifting, and inhibition [$F(2, 107) = 0.318$, $p = .72$; $F(2, 107) = 1.712$, $p = .18$; $F(2, 107) = 0.64$, $p = .52$, respectively].

To answer the general study objective, revealing statistically significant differences across the three groups of children, as demonstrated by Wilks' lambda = 0.87 [$F(6, 210)$, $p = .028$ with η^2p .07]. Specifically, there was a significant main effect only in the inhibition variable [$F(2, 107) = 5.591$, $p = .005$, η^2p .09], whereas there were no statistically significant differences among groups for the variables of updating and set-shifting [$F(2, 107) = 0.669$, $p = .514$; and $F(2, 107) = 2.019$, $p = .138$, respectively].

The three groups' inhibition differences were obtained using the Games-Howell test. Urban non-Mapuche children were faster ($M = 58.21$ seconds, $SD = 8.22$ seconds) than rural Mapuche children ($M = 62.38$ seconds, $SD = 12.54$ seconds); consequently, they had a significantly higher inhibition score $p = .019$, 95% CI [-16.79, -1.39]. The comparison between the non-Mapuche children and the urban Mapuche children ($M = 66.61$ seconds, $SD = 15.90$ seconds) showed that the non-Mapuche had greater inhibition ($p = .017$, 95% CI [1.39, 16.79]). In the case of the urban Mapuche group and the rural Mapuche group, no statistically significant differences were observed ($p = .88$, 95% CI [-8.52, 5.65]).

The number of errors committed in inhibition was also analyzed (non-Mapuche $M = 2.97$, $SD = 2.94$; urban Mapuche $M = 4.10$, $SD = 4.49$; rural Mapuche $M = 4.68$, $SD = 4.64$). The differences among the three cultural groups were not statistically significant ($F(2, 107) = 1.764$, $p = .176$).

Discussion

This study examined differences between three cultural groups in updating, set-shifting, and inhibition. In inhibition, statistically significant differences were noted with an effect size close to large (Fritz et al., 2012). Despite the non-Mapuche children exhibiting the highest levels of inhibition, it is essential to contextualize this observation within the framework of the measurement, which, when administered individually, assessed execution speed by calculating the number of numerical stimuli in

the boxes rather than evaluating the numerical values themselves (Sedó, 2007). Additionally, it is important to note that the number of errors was similar in the three cultural groups, and there were no significant differences. In turn, the results showed that the differences among groups were not statistically significant in the updating and set-shifting variables.

Possibly, the rural Mapuche children took longer in the choice test (Five Digit Test) and, therefore, obtained lower scores in inhibition because they are not as accustomed to the format of evaluations that require timed and limited execution times. These children may experience time differently from the non-Mapuche group since they can explore and engage with their natural surroundings without adult intervention hastening their learning process (Becerra et al., 2018; Gaskins & Alcalá, 2023; Murray et al., 2015). Additionally, the parents' education level of both the urban and rural Mapuche is lower than the non-Mapuche, an issue that could encourage cultural practices unrelated to time-bound schoolwork (Sternberg et al., 2001).

Although they were instructed to complete the test as quickly as possible, the Mapuche children (rural and urban) worked more thoroughly. This way of approaching tasks has also been observed in children from other indigenous peoples, who take longer to execute actions and complete tests than children in the US (Alcalá et al., 2018; Mejía-Arauz et al., 2018). Performing activities without speeding up the execution of actions is likely a cultural way of learning and developing skills that rural Mapuche indigenous children may have (Murray & Tizzoni, 2022).

Mapuche children may present lower performance over time, depending on the specific skills the tests measure (Baker et al., 2012; Gioia et al., 2000). The disparities in executive function assessments stem from their developers, who are part of a cultural group with a high level of education and who design these measurements for such populations; consequently, children from academic backgrounds achieve higher scores (Ardila et al., 2005). Therefore, the scores of non-Mapuche children whose families have a high education level do not necessarily reveal that they have more skills than the other groups. Rather, it could demonstrate that the executive functions of the non-Mapuche group are reinforced by familiarity with school activities, which prioritize lower-order cognitive skills associated with academic knowledge (Urzúa et al., 2009).

It is important to note that research on the development of executive functions has predominantly relied on studies conducted with Euro-American children, the primary eco-social context, resulting in their performance level serving as the normative benchmark against which all children are assessed, irrespective of their cultural background (Morelli et al., 2003). This study is contrary to this idea since it understands that executive functions are diverse in child development due to the practices and demands of the sociocultural contexts in which children grow up (Gaskins & Alcalá, 2023).

However, gender was not a predictor of significant differences in updating, set-shifting, and inhibition, which is consistent with the findings of Villaseñor et al. (2009). On the other hand, no differences by age were observed, a result that differs from the idea that an increase in the development of executive functioning depends transcendentally on age (Ardila et al., 2005; Lehto et al., 2003). This may have occurred because the age range, not being wide, was perhaps not representative of a gradual developmental curve nor of accentuated changes in executive functioning (Bausela, 2014).

The results are regarded as a theoretical contribution to the development of updating, set-shifting, and inhibition skills in children from different environments, as they highlight the disparities among the three eco-social contexts based on their possible practices. Furthermore, conducting studies according to cross-cultural variability and according to a culturally sensitive assessment of executive functions is encouraged (Carpendale & Lewis, 2006; Rosselli & Ardila, 2003). This is because the measures are cultural devices that operate differently in each eco-social context; therefore, the differences in executive functions reported by these measures occur because of the particular cultural practices of the contexts, which affect how the children's skills develop (Cole & Packer, 2019). Consequently, that an instrument shows that one group scores better or worse is not evidence of a "lack of skills" but rather reveals cultural differences in executive skill development (Farkas et al., 2017; Gaskins & Alcalá, 2023; Rosselli & Ardila, 2003). No cultural group is disadvantaged; they develop their skills differently according to the opportunities and needs of their contexts (Kärtner et al., 2008; LeCuyer & Zhang, 2015).

Conclusions

This study obtains exploratory results and provides empirical evidence for understanding the executive functions of non-Mapuche, urban Mapuche, and rural Mapuche children. The findings reveal the importance of considering other ways children's abilities develop according to developmental contexts (Keller & Kärtner, 2013). The results demonstrate the need for available instruments that assess executive functioning according to cultural practices. Therefore, recognizing the cultural context in which the child learns is essential for an in-depth assessment of both executive and cultural dimensions (Gioia et al., 2000).

It is suggested that future research should conduct more studies that consider the cultural practices and executive functions of children in Chile to have a fuller understanding of the effect of these practices on the development of the skills of updating, set-shifting, and inhibition. Moreover, future studies must consider that performance times differ among children from culturally diverse backgrounds (Gaskins & Alcalá, 2023).

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