



# Improving children's self-regulation and executive functions: a pilot intervention with immigrant mothers

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## Abstract

Self-regulation—comprising behavioral and emotional regulation and cognitive processes (i.e., executive functions)—is pivotal for children's social development and achievement. Parents, especially mothers, can promote children's self-regulation, however, relevant parental interventions are scarce. Moreover, showing appropriate self-regulation strategies in different contexts can be challenging for collectivistic-oriented immigrant children living in individualistic-oriented countries. This study developed and investigated a pilot intervention for collectivistic-oriented immigrant mothers and their children, aged 5–11 years, living in Switzerland, aiming to improve the children's self-regulation and executive functions. Fifteen mothers (11 Turkish, 2 Albanian, 1 Spanish-Portuguese-German, and 1 Portuguese;  $M_{Age} = 36.92$ ,  $SD_{Age} = 3.10$ ) and 20 children ( $M_{Age} = 7.15$ ;  $SD_{Age} = 1.84$ ) participated in the pilot intervention. The intervention lasted 6 weeks and consisted of 3 training sessions for mothers and 3 self-learning phases with translated learning materials (videos and exercises) for mothers and their children. In a pre- and post-test, the mothers rated their children's executive functions and behavioral self-regulation. The mothers also rated their domain-specific self-efficacy in supporting children's self-regulation based on the intervention content. In addition, we assessed the acceptability of the pilot intervention based on interviews with 7 mothers. The participants strongly adhered to the intervention and reported an overall high level of acceptance. We found a significant increase in the mothers' domain-specific self-efficacy regarding self-regulation. Furthermore, we found positive and significant pre-post changes in most children's executive functions but not in behavioral self-regulation.

**Keywords** Self-regulation · Executive functions · Intervention · Mothers · Immigrant children · Culture

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## 1 Introduction

Self-regulation is pivotal for children's academic and social development (Blair & Raver, 2015; Eisenberg et al., 1997; Eisenberg & Spinrad, 2004; McClelland et al., 2007; Wilson et al., 2021). Broadly speaking, self-regulation is the capacity to manage one's own behavior and emotions to achieve desired goals (Carver & Scheier, 2012; McClelland et al., 2007; Trommsdorff, 2009). Self-regulation includes behavioral self-regulation (BSR), which involves skills such as inhibiting impulsive actions, supported by executive functions (EFs) as cognitive processes (McClelland et al., 2007). In addition, emotional self-regulation (ESR) refers to processes that initiate, inhibit, or modulate emotions with an outcome of social adaptation (Eisenberg & Spinrad, 2004). Parental involvement can enhance children's self-regulation, yet effective parental interventions remain rare, and most parental interventions show no effect (O'Reilly et al., 2025). Moreover, although cultural practices affect self-regulation, interventions are not designed for collectivistic-oriented immigrant families living in individualistic-oriented countries (Yanaoka et al., 2022).

Cultural orientation can be described as individualistic or collectivistic (Oyserman & Lee, 2008; Komisarof & Akaliyski, 2025); these orientations can also coexist (e.g., Kağitçibasi, 1996). Individualism, also known as independence, focuses on the autonomy, self-determination, and personal needs of an individual. Collectivism, also known as interdependence, focuses on the needs of a community or group; accordingly, therein, maintaining harmony and fulfilling social obligations are pivotal (Jaramillo et al., 2017; Markus & Kitayama, 1991; Oyserman & Lee, 2008). In earlier research, collectivism and individualism were often attributed to entire nations (Hofstede, 1980). Although there is substantial variation between nations and ethnic groups (Komisarof & Akaliyski, 2025). Research emphasizes that cultural value orientations should be understood as individual-level constructs (Kağitçibasi, 2007). These cultural orientations not only guide personal goals but shape which forms of self-regulation are considered appropriate (Jaramillo et al., 2017). For collectivistic-oriented immigrant families in individualistic-oriented contexts, cultural value gaps can affect children's self-regulation (Gys et al., 2024).

This study developed and investigated a pilot intervention for collectivistic-oriented immigrant mothers and children living in an individualistic-oriented country, with the aim to improve self-regulation in 5–11-year-olds as well as the mothers' self-efficacy in applying specific strategies that can lead to improved BSR and ESR in the children (e.g., Wittkowski et al., 2017).

### 1.1 BSR, EFs, and ESR as aspects of self-regulation

Among many definitions of self-regulation (Blair & Raver, 2012; Eisenberg et al., 2000; McClelland et al., 2007), behavior and emotions are both crucial aspects of self-regulation, as they support goal-directed action (Eisenberg et al., 2000; Hofmann et al., 2012). BSR refers to skills to regulate behavior, such as paying attention, following instructions, and inhibiting inappropriate actions (McClelland et al., 2007). BSR is organized by top-down components, which refer to EFs and are considered cognitive processes (Blair & Raver, 2012; McClelland et al., 2007). EFs can be dif-

ferentiated by three dimensions (Miyake et al., 2000): working memory, inhibition, and cognitive flexibility. Working memory refers to storing information temporarily and working with the information cognitively (Miyake et al., 2000). Inhibition includes self-control to achieve a goal, which involves resisting temptations and not acting impulsively (Diamond, 2013; Hofmann et al., 2012). Cognitive flexibility refers to the ability to change perspectives or solve a problem by flexibly adapting to new demands or rules (Miyake et al., 2000).

Self-regulation and EFs overlap conceptually (Dörrenbächer-Ulrich & Bregulla, 2024; Hofmann et al., 2012), for instance, when inhibition relates to self-regulating behavior and emotions (Carver & Scheier, 2012). ESR refers to processes that initiate, inhibit, avoid, maintain, or modulate emotions to achieve individual goals or social adaptation (Eisenberg & Spinrad, 2004). ESR, BSR, and EFs have been found to positively affect achievement (for meta-analyses, see Pandey et al., 2018; Spiegel et al., 2021) and social competencies (Blair et al., 2015; Eisenberg et al., 2000). Despite their positive impact and relations, BSR, EFs, and ESR are seldom promoted together.

## 1.2 Self-regulation challenges for collectivistic-oriented immigrant families living in individualistic-oriented contexts

As parenting mediates the influence of culture on children's development (Super & Harkness, 1997), self-regulation is likewise embedded in culturally shaped parenting practices (Jaramillo et al., 2017). Through daily interactions, parents transmit cultural values and goals to guide behavior, which children internalize (Jaramillo et al., 2017; Kim et al., 2023; LeCuyer & Zhang, 2015). These goals influence how children appraise experiences, decide on the timing of self-regulation strategies (Díaz & Eisenberg, 2015), and prioritize strategies when personal and relational goals conflict (Trommsdorff & Cole, 2011). For example, in terms of inhibition, and in line with culturally shaped parental practices, American children may wait longer before opening gifts, whereas Japanese children may wait longer before beginning a meal (Yanaoka et al., 2022). Parents with individualistic-oriented values focus on individual needs and independence (Trommsdorff, 2001). In contrast, parents with collectivistic-oriented values place importance on community needs and often prioritize collective (family) goals (Trommsdorff, 2001). Such collectivistic orientation is more common among people from Asia, Southern Europe, and the Balkan states, whereas individualistic orientation is more common in the United States and Central Europe (Green et al., 2005; Kağıtçıbaşı, 1996), although there is substantial variation among individuals within countries (Kağıtçıbaşı, 2007).

Given cultural orientations shape goals and behavior, the differing demands of collectivistic home practices and individualistic school settings can feel incongruent, leading to a cultural mismatch for collectivistic-oriented immigrant children (Gys et al., 2024). Cultural learning philosophies also reflect this mismatch: collectivistic-oriented settings often emphasize the product of learning (outcomes), whereas individualistic-oriented settings focus on activities within the learning process, such as active participation (Leung, 2001). In collectivistic-oriented contexts, nonacademic goals such as maintaining harmony, respecting authority, and fulfilling family obli-

gations (Jaramillo et al., 2017; Kim et al., 2023) also shape behavior in learning contexts (Mok et al., 2021), fostering hierarchical teacher-centered classroom interactions (Xudong & Li, 2020). In contrast, schools in individualistic-oriented contexts prioritize independence, self-expression, and assertiveness through student-centered learning (Faitar, 2006). These divergent goals can result in opposing demands for collectivistic-oriented students, leading to hesitation in academic help-seeking due to concerns of burdening others or the shame of appearing incompetent (Jeng, 2024). To succeed in individualistic-oriented classrooms, these students may benefit from support in adapting their goals and behaviors. One approach is to teach BSR strategies such as implementation intentions (“if-then” plans; Gollwitzer, 1999), which help students actively pursue individualistic-oriented goals in specific learning situations (e.g., expressing their own opinions in classroom discussions; Jeng, 2024; Yamamoto & Li, 2012).

ESR presents an additional challenge, as collectivistic-oriented families often expect children to suppress negative emotions to maintain harmony (Arens et al., 2012; Bariola et al., 2011; Voswinckel et al., 2019). In individualist contexts, such children may be less familiar with functional ESR strategies than their non-immigrant peers (Gust et al., 2014; Yang & Wang, 2016). As a result, they may lack a repertoire of context-specific ESR strategies such as recognizing and reflecting emotions in social situations or using relaxation techniques (Hillenbrand et al., 2018). Strengthening both ESR and BSR strategies, alongside cognitive processes such as EFs, can help children navigate the often conflicting demands of collectivistic-oriented family transmitted goals and individualistic societal expectations (Kim et al., 2023).

### 1.3 Parental interventions with immigrant children

Various school-based interventions have been developed to support children’s self-regulation (Diamond & Lee, 2011; Takacs & Kassai, 2019), but family-based interventions to improve children’s self-regulation remain rare or often have no effect (Bruder et al., 2004; O’Reilly et al., 2025). A meta-analysis by Pandey et al. (2018) identified only nine self-regulation interventions in which families were an important part. Approximately half of those interventions brought consistent changes in self-regulation measures and just two addressed immigrant or ethnically diverse families (Brody et al., 2005; Fosco et al., 2013). Immigrant parents, and especially mothers, often face barriers to participation in educational programs, such as language difficulties, inflexible work schedules, and perceived low parenting skills (Yamamoto & Holloway, 2010; Brown et al., 2020).

However, parents are key facilitators in the development of children’s self-regulation (Karreman et al., 2006). Effective parenting interventions often target both parental knowledge about self-regulation and behaviors to promote self-regulation (Morawska et al., 2019) in both children and parents (Sanders & Mazzucchelli, 2013). Surprisingly, little experimental research has examined the effects of parenting interventions on children’s self-regulation (Morawska et al., 2019). Moreover, there is growing evidence that parental self-efficacy plays a crucial role in the success of parenting interventions, particularly when an intervention is domain-specific (i.e., completing a specific task of the parenting role for a child) and aligned with

targeted parenting behaviors (Wittkowski et al., 2017). In the context of self-regulation, domain-specific parental self-efficacy refers to parents' beliefs in the ability to apply specific strategies that support their child's BSR and ESR (Wittkowski et al., 2017). Such domain-specific parental self-efficacy can lead to improvement in children's self-regulation (Wittkowski et al., 2017; Woolgar et al., 2025). This conceptualization is grounded in Bandura's (1997) notion of task-specific self-efficacy (Wittkowski et al., 2017).

Furthermore, no parental interventions targeting children's self-regulation have considered families' cultural orientation, despite theoretical and empirical evidence linking parenting values and practices to children's self-regulation (Jaramillo et al., 2017). To address conceptual gaps (Sanders & Mazzucchelli, 2013; Wittkowski et al., 2017) and important practical challenges (e.g., Yamamoto & Holloway, 2010), the present study developed a culturally sensitive intervention for collectivistic-oriented immigrant mothers and children. Our pilot intervention reduced access barriers by providing multilingual material and flexible blended-learning formats, while integrating theoretical input (e.g., on BSR, ESR, and EFs) with practical exercises to improve mothers' domain-specific self-efficacy regarding self-regulation (MSE-SR) and children's self-regulation.

## 1.4 The present study

The present study had three aims: first, to develop a pilot intervention tailored to collectivistic-oriented immigrant mothers and their children living in an individualistic country; second, to investigate feasibility via adherence to and acceptability of the pilot intervention; and third, to investigate the pre-post changes in MSE-SR, and in children's EFs and BSR. Accordingly, we addressed the following research questions (RQs):

**RQ1a:** How strongly do mothers adhere to the pilot intervention?

**RQ1b:** How do mothers rate the acceptability of the pilot intervention?

**RQ2:** To what extent do MSE-SR (RQ2a), children's EFs (RQ2b), and children's BSR (RQ2c) increase after the intervention?

For RQ1a and RQ1b, we hypothesized high levels of adherence and acceptance. For RQ2a–RQ2c, we hypothesized significant, positive pre-post changes.

## 2 Method

### 2.1 Participants

We recruited 16 Albanian, Portuguese, and Turkish immigrant mothers in the German-speaking part of Switzerland. These nationalities represent common immigrant groups in Switzerland and individuals could be reasonably assumed as more collec-

tivistic-oriented (Fibbi, 2014; Komisarof & Akaliyski, 2025; Mok et al., 2017). Consistent with our assumption, we found a high level of collectivistic value orientations for the participants ( $M=4.76$ ;  $SD=0.79$ ;  $range=3-6$ ). All participants were informed of the intervention's aim and that participation was voluntary. Mothers then provided informed consent after consulting their children.

Fifteen out of 16 mothers and 20 children participated in the pilot intervention. One mother left the intervention for personal reasons. The mothers were approximately 37 years old ( $M_{Age} = 36.92$ ,  $SD_{Age} = 3.10$ ; Albanian [ $n=2$ ], Portuguese [ $n=1$ ], Turkish [ $n=11$ ], and Spanish-Portuguese-German background [ $n=1$ ]). One mother had no educational qualification ( $n=1$ ), three completed secondary school ( $n=3$ ), and the majority had either a vocational training qualification ( $n=6$ ) or a university degree ( $n=5$ ). The children were 5–11 years old ( $M_{Age} = 7.15$ ;  $SD_{Age} = 1.84$ ) in the pre- and post-survey, but mostly aged 5–8 ( $n=16$ ). Seven (one Albanian and six Turkish) mothers participated in post-training interviews to assess their acceptance of the training and exercises.

## 2.2 Pilot intervention procedure

For our pilot intervention with two groups (children aged 5–8 and 9–11 years), we adapted exercises from interventions, covering EFs, BSR, and ESR for collectivistic-oriented children (Diamond et al., 2007; Domitrovich et al., 2007; Gollwitzer, 1999; Hillenbrand et al., 2018; Neuenschwander et al., 2022; cf. supplementary material). Our exercises were assigned to one of three topics: “planning and goal setting,” “memory and concentration,” and “emotion regulation” (Table 1). The participating mothers were divided into groups based on their language background and residential location. To eliminate language barriers, the training was conducted by a primary trainer speaking the mothers' native languages. An additional trainer with expertise in self-regulation and educational psychology addressed questions.

The 6-week “FELMAS” (i.e., “Förderprogramm für Eltern mit Migrationshintergrund zur Verbesserung der Selbstregulation bei Kindern”) training program began with an introductory session on planning and goal setting, in which brief theoretical input and practical exercises were provided (all materials were printed and distributed in the session). This was followed by a two-week self-learning phase, supported

**Table 1** Overview of exercises in the pilot intervention

| Main topic                 | Exercises for children aged 5–8 years   | Exercises for children aged 9–11 years  |
|----------------------------|---|---|
| 1) Planning & goal setting | <ul style="list-style-type: none"> <li>· Action plan</li> <li>· Setting goals and time schedule</li> </ul>  | <ul style="list-style-type: none"> <li>· Action plan</li> <li>· Setting goals and time schedule</li> </ul>                                |
| 2) Memory & concentration  | <ul style="list-style-type: none"> <li>· Memory cards (“ear and mouth”)</li> <li>· Thinking aloud and changing rules</li> <li>· Pattern correction (“buttons”)</li> </ul> | <ul style="list-style-type: none"> <li>· Memory cards (“ear and mouth”)</li> <li>· Thinking aloud and changing rules</li> </ul>           |
| 3) Emotion regulation      | <ul style="list-style-type: none"> <li>· Learning emotions</li> <li>· Your own feelings and feelings of others</li> <li>· Strategies for emotion regulation</li> </ul>    | <ul style="list-style-type: none"> <li>· Your own feelings and feelings of others</li> <li>· Strategies for emotion regulation</li> </ul> |

by videos and online materials<sup>1</sup>, during which mothers had to practice exercises with their children three to four times. The second session focused on reflecting upon the mothers' experiences, including discussing challenges. The second session introduced the topic of memory and concentration, followed by another self-learning phase and practice phase with their children. The final session reviewed the second unit and introduced emotion regulation, with another self-learning and practice phase.

### 2.3 Measures and analyses

To measure mothers' adherence, we calculated the percentage of mothers who attended all training sessions and the number of exercises used. To assess the acceptability of the pilot intervention, we used qualitative interview data. Using different scales, we measured the following quantitative data: MSE-SR (adapted from the BPSES, Woolgar et al., 2025), children's EFs scores (German Brief-P instrument; Daseking & Petermann, 2013; lower composite scores indicated improved EFs), and BSR (i.e., adapted from the Brief Self-Control Scale; Bertrams & Dickhäuser, 2009; Mang et al., 2021; Tangney et al., 2004). We have developed seven new items to assess MSE-SR. These items are closely aligned with the content of the intervention and inspired by Woolgar et al.'s (2025) suggestions, using formulations such as "I know what to do" to ensure that the answers reflected belief in the ability to use the strategy and were easily understandable for participating mothers. Additionally, to validate our assumptions, we assessed the mothers' collectivism (Germani et al., 2020) regarding the collectivism value orientations of the participants. Detailed descriptions of all measures and internal consistencies can be found in the supplementary material. The pre-post data were analyzed using a Wilcoxon test in SPSS Version 27. Regarding the qualitative data, we analyzed the transcripts following a thematic analysis with a deductive approach (Clarke & Braun, 2017).

## 3 Results

### 3.1 Adherence

Regarding adherence of the participants (*RQ1a*), 15 out of 16 mothers attended all training sessions (93.75% retention). The mothers also reported using each exercise three to four times during the two-week training period.

### 3.2 Acceptability

Most of the mothers were satisfied with the training, and the exercises "thinking aloud and changing rules (buttons)" (supplementary material) and "emotion cards" were often named the most useful (*RQ1b*). The usefulness of the button exercise was reported by mother number 6 (Turkish mother with a daughter aged 8): "That thing with the buttons [exercise] is very useful. [...] Red means it's red, and then

<sup>1</sup> The online materials in the FELMAS program are available on the website: [www.felmas.ch](http://www.felmas.ch).

**Table 2** MSE-SR

|        | Pre-test |           |            | Post-test |           |            | <i>n</i> | <i>z</i> | <i>p</i> | <i>r</i> | Effect size <sup>1</sup> |
|--------|----------|-----------|------------|-----------|-----------|------------|----------|----------|----------|----------|--------------------------|
|        | <i>M</i> | <i>SD</i> | <i>Mdn</i> | <i>M</i>  | <i>SD</i> | <i>Mdn</i> |          |          |          |          |                          |
| MSE-SR | 4.02     | 0.73      | 4.29       | 4.73      | 0.45      | 4.57       | 15       | -2.928   | 0.002    | 0.76     | Large                    |

*M*=mean, *SD*=standard deviation, *Mdn*=Median. We used a one-sided hypothesis test

<sup>1</sup>According to Cohen (1988),  $r = 0.10$  or higher equals a small effect,  $r = 0.30$  or higher equals a medium effect, and  $r = 0.50$  or higher equals a large effect.

**Table 3** BSR and EF scales of children

|                         | Pre-test |           |            | Post-test |           |            | <i>n</i> | <i>z</i> | <i>p</i> | <i>r</i> | Effect size <sup>1</sup> |
|-------------------------|----------|-----------|------------|-----------|-----------|------------|----------|----------|----------|----------|--------------------------|
|                         | <i>M</i> | <i>SD</i> | <i>Mdn</i> | <i>M</i>  | <i>SD</i> | <i>Mdn</i> |          |          |          |          |                          |
| BSR                     | 3.52     | 0.77      | 3.23       | 3.46      | 0.55      | 3.27       | 20       | -0.141   | 0.444    | 0.03     | No effect                |
| Inhibitory self-control | 25.67    | 5.27      | 26         | 23.53     | 4.97      | 24         | 15       | -1.910   | 0.028    | 0.49     | Medium                   |
| Cognitive flexibility   | 18.67    | 4.15      | 19         | 16.73     | 3.26      | 17         | 15       | -2.447   | 0.007    | 0.63     | Large                    |
| Emergent metacognition  | 16.20    | 3.05      | 16         | 15.47     | 3.72      | 14         | 15       | -0.955   | 0.170    | 0.25     | Small                    |

*M*=mean, *SD*=standard deviation, *Mdn*=Median. We used a one-sided hypothesis test

<sup>1</sup>According to Cohen (1988),  $r = 0.10$  or higher equals a small effect,  $r = 0.30$  or higher equals a medium effect, and  $r = 0.50$  or higher equals a large effect.

*you're changing [the color assigned to the movement]? So, it facilitates how the brain responds to change." Mother number 7 (Turkish mother with a daughter aged 8) found the emotion cards very helpful: "The children are laughing [in the picture]. It was a very nice thing for her to talk about, like I have experienced these things [...]. It is a little more difficult to talk because it's one-on-one, but it's on a paper (picture). You're talking about someone else, then you're talking with the help of a picture."*

### 3.3 Pre-post changes in the pilot intervention

In line with our hypothesis, the mothers showed a significant increase in MSE-SR ( $Median_{Pre-test} = 4.29$ ,  $Median_{Post-test} = 4.57$ ,  $z = -2.298$ ,  $p = .002$ ,  $n = 15$ ;  $r = .76$ , larger effect; Table 2; *RQ2a*). Regarding EFs scores, we found a significant decrease in inhibitory self-control ( $r = .49$ ;  $p = .028$ ,  $n = 15$ ; medium-sized effect) and cognitive flexibility ( $r = .63$ ;  $p = .007$ ,  $n = 15$ ; large effect; Table 3; *RQ2b*); thus, both improved after the intervention. For emergent metacognition, we did not find a significant pre-post change ( $r = .25$ ;  $p = .170$ ;  $n = 15$ ). Unfortunately, in the pre- and post-test, the items related to the three EF scores were only answered for 15 children. We found no significant change in children's BSR ( $r = .03$ ;  $p = .444$ ,  $n = 20$ ; Table 3; *RQ2c*).

## 4 Discussion

In this pilot study, we developed an intervention for collectivistic-oriented immigrant mothers and children living in an individualistic-oriented country. The intervention aimed to explore the feasibility of a specifically designed training to improve self-regulation (i.e., BSR and EFs). The mothers' adherence to the intervention was very

good (*RQ1a*) and the interviewed mothers were overall satisfied with the intervention (*RQ1b*). Regarding the quantitative results, the pre-post changes in MSE-SR (*RQ2a*) and in most of the children's EFs index scores were as expected (i.e., significant changes in inhibitory self-control and cognitive flexibility but not in emergent metacognition; *RQ2b*). Surprisingly, we did not find a significant change in children's BSR (*RQ2c*).

Our pilot study is the first intervention for collectivistic-oriented immigrant mothers with children in Switzerland, as a more individualistic-oriented country. This research aims to improve children's self-regulation, including EFs. The results of our pilot intervention are pivotal for three reasons. First, supporting self-regulation and EFs is crucial, because they both positively influence behavior, social competencies, and academic achievement (Blair & Raver, 2015; Eisenberg et al., 2000; McClelland et al., 2007; Pandey et al., 2018; Spiegel et al., 2021). It is particularly important to foster BSR and EFs in immigrant children, who often have a lower socioeconomic status, because they benefit the most from interventions that promote these skills (Diamond & Ling, 2016; Spiegel et al., 2021). Second, our pilot intervention encompasses culturally specific training by considering typical situations and behaviors of immigrant families at home and in learning or social situations outside the home. Through our training, mothers and children learn the benefits of applying different kinds of self-regulation strategies and supporting EFs in diverse contexts. Third, our study contributes to the limited number of family intervention studies within self-regulation intervention research using an applied context (Pandey et al., 2018).

#### 4.1 Adherence and acceptance of the pilot intervention

Our pilot study achieved strong adherence to the training, indicating that the content and length is manageable for participants (*RQ1a*). A high level of adherence is crucial to ensure successful transfer of the training content into the context of the family home. Participating mothers expressed satisfaction with the training, which contributed to positive acceptance of the pilot intervention (*RQ1b*).

#### 4.2 Improvements for collectivistic-oriented immigrant mothers

MSE-SR is another factor that may have facilitated the mothers' motivation to perform the exercises with their children. We found a significant pre-post increase in mothers' MSE-SR (*RQ2a*). This finding is important, because parents often face challenges in involving themselves in activities that can support their children's development and learning (Liu et al., 2020; Yamamoto & Holloway, 2010). Parental involvement in immigrant children's learning activities, including self-regulation, is needed, because it has positive effects on children's motivation and achievement (Jaramillo et al., 2017; Kim et al., 2020).

#### 4.3 Improvements of children's self-regulation

Our results showed significant changes in two EFs index scores (i.e., inhibitory self-control index, consisting of the inhibition and emotional control subscales, and flex-

ibility index, consisting of the attention switch and the emotional control subscales; supplementary material; *RQ2b*). Given that higher composite EF scores reflect poorer functioning, the observed decrease in inhibitory self-control and flexibility indicates improvement. These results are partially in line with previous interventions conducted in Switzerland. An intervention study by R othlisberger et al. (2012), conducted with 5- and 6-year-old children in (pre)kindergarten, found significant effects on working memory and cognitive flexibility in the 5-year-old prekindergarten children, and a significant effect on inhibition in 6-year-old kindergarten children. However, we did not find a significant pre-post change for the emergent metacognition score, which included working memory (*RQ2b*). Sixteen of the 20 participating children were 5–8 years old, including nine aged 5–6. This age profile likely contributed to the observed pattern, namely missing change in emergent metacognition, because metacognitive skills show steeper gains in older primary school years (nine-year-old children) than in early childhood (van Loon & Roebbers, 2024).

Surprisingly, we did not find a significant pre-post change in children’s BSR (*RQ2c*). This finding is unexpected, as some studies found positive effects in self-regulation (Pandey et al., 2018). A possible explanation for the lack of improvement is that the intervention may have increased parents’ sensitivity to the demands of BSR and their related knowledge, which could lead to a shift in perspective, whereby parents evaluate their children’s competences more critically after the intervention than they did at the outset. Another explanation is that our BSR measure focuses strongly on self-control and inhibition (Bertrams & Dickh user, 2009), and our exercise “action plan” is based on implementation intentions, which is a motivational and behavioral strategy to achieve a goal and initiate an action. Thus, in future studies, the intervention should include more self-control and inhibition-oriented BSR exercises. Some studies have found that kindergarten children’s EFs in particular predict BSR (Compagnoni et al., 2019; Vernon-Feagans et al., 2016). Researchers have also suggested that EF processes are basic skills that need to be developed before they can contribute to BSR (Hofmann, et al., 2012). The effect of the intervention on BSR might possibly be transmitted via EFs (Hofmann, et al., 2012) and only manifest later. However, we had only a short training period, of six weeks. Thus, larger samples with more upper elementary school immigrant children and longer training phases would be necessary to explore whether the pre-post changes in our pilot intervention are significant for both EFs and BSR.

#### 4.4 Practical implications

The results of our pilot study have two practical implications. First, our findings suggest that a brief, culturally tailored, blended-learning intervention conducted in participants’ native language shapes MSE-SR; this has direct relevance for designing scalable support programs for immigrant families, who often face language difficulties. Second, our results underscore the importance of enabling especially collectivistic-oriented immigrant mothers to strengthen their children’s EFs (especially inhibitory self-control and cognitive flexibility) through simple exercises at home. As these EFs are essential for academic learning (Takaes & Kassai, 2019), mater-

nal domain-specific support can meaningfully contribute to children's educational success.

#### 4.5 Limitations

Our pilot study had three limitations. First, we did not have a control group, as the pilot study data focused primarily on training feasibility. Consequently, we tested the intervention on a small sample of 15 mothers and 20 children to, firstly, explore the adherence to and acceptance of the intervention, and, secondly, to investigate potential pre-post changes. Due to the lack of a control group and the small sample size, our findings cannot be generalized. However, positive changes in the expected direction were visible with the small sample. A follow-up study should include a larger sample and add a control group to enhance the intervention's validity. Second, to minimize the questionnaire burden, we only used a BSR measure (Bertrams & Dickhäuser, 2009), even though we also trained the mothers on ESR. Two EF scales (inhibitory self-control and cognitive flexibility scale) however addressed some emotion-suppression items (Daseking & Petermann, 2013). Future studies should incorporate separate ESR measures, as emotion regulation is crucial for collectivistic-oriented families in individualistic-oriented contexts (Hu et al., 2014). Third, given the mothers rated their children's EFs, employing observational measures such as the Head-Toes-Knees-Shoulders Task (McClelland et al., 2014) would provide more objective data in this respect.

## 5 Conclusion

This pilot study developed a blended-learning intervention to improve self-regulation, including EFs, among children aged 5–11 years in collectivistic-oriented immigrant families living in an individualistic-oriented country (i.e., Switzerland). Our results showed significant increases in children's EFs index scores (inhibitory self-control and cognitive flexibility) and in MSE-SR, suggesting that collectivistic-oriented immigrant mothers can be successfully trained to increase children's EFs at home.

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## Declarations

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