Evaluation and training of Executive Functions in genocide survivors. The case of Yazidi children

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Abstract

Executive Functions (EFs) development is critically affected by stress and trauma, as well as the socioeconomic context in which children grow up (Welsh, Nix, Blair, Bierman, & Nelson, 2010, Journal of Educational Psychology, **102**, 43–53). Research in this field is surprisingly lacking in relation to war contexts. This study represents a first attempt at addressing this topic by evaluating EFs in Yazidi children. The Yazidi community is an ethnic and religious minority living in Iraq. From August 2014 onwards, the Yazidi community has been the target of several atrocities perpetrated by ISIS and described as genocide by the international community at large. The University of Trieste, thanks to a program financed by the Friuli Venezia Giulia Region, developed a study aimed at (a) evaluating hot and cool EFs in children living in a war context and (b) developing a specific training method to enhance hot and cool EFs in Yazidi children of preschool age (N = 53). Data related to this group of children were compared with a sample of typically developing Italian children randomly assigned to either an EFs training group (N = 55) or a passive control group (N = 51). Results indicate different baselines in EFs in Yazidi and Italian samples and a significant effect of the program on both trained groups, especially in tasks measuring hot EFs. Data are discussed in terms of hot and cool EFs in children growing in adverse environments, as well as the evaluation of educational and developmental opportunities to prevent children who survived genocide from becoming a 'lost generation'. A video abstract of this article can be viewed at https://youtu.be/7t_08TbxR_8.

KEYWORDS
cognitive control, genocide, hot and cool executive functions, war context, war trauma, Yazidi minority

1 | INTRODUCTION

According to recent surveys, approximately one in six children today lives in a war context (Save the Children International, 2018) characterized by continuous life-threatening conditions, loss of close family members, violence, lack of social and cognitive stimulation, and, in some cases, inadequate physical resources. Their experience may severely compromise these children's adaptive, cognitive and healthy development.

Executive Functions (EFs) are a set of abilities involved in the regulation of thoughts, emotions and behaviours (Diamond, 2013) that are profoundly altered in children who experience prolonged stressful conditions, such as trauma (DePrince, Weinzierl, & Combs, 2009), maltreatment (Rogosch, Dackis, & Cicchetti, 2011) and institutionalization, with specific repercussions on inhibition and working memory (WM) abilities (Merz, Harlé, Noble, & McCall, 2016). Surprisingly, studies on EFs in children growing up in war contexts are quite scarce and focus exclusively on emotional control and trauma (Betancourt et al., 2012; Pat-Horenczyk et al., 2013).

This state of art calls for an urgent need to reach a deeper understanding of EFs development in adverse contexts. To the best

of our knowledge, this work represents the first attempt at evaluating hot and cool aspects of EFs in a group of preschool Yazidi children, whose community is constantly exposed to extreme trauma and violence, defined by the UN as genocide (United Nations Human Rights Council, , June 15, 32nd session). Given the lack of literature on these extreme forms of vexation, the aim of this study was twofold: (a) evaluating hot and cool EFs (with specific reference to WM and inhibition) in a sample of children who survived genocide, and (b) developing a training to increase these functions, given their relevance for development.

Development in critical environmental conditions, and the relevant increased risk of long-term negative repercussions, is a broad theme that has profoundly influenced developmental psychology, psychiatry, public health and education. Increased knowledge of the effects of war on specific abilities related to EFs may promote a better understanding of how and to what extent toxic and prolonged stress conditions are associated with crucial developmental skills that support flexible, goal-directed behaviour controlled by areas of the Prefrontal Cortex (PFC) (McEwen & Morrison, 2013). Furthermore, investigation of specific aspects of EFs may help design effective and targeted interventions on the above-mentioned skills that could promote positive outcomes in children growing in critical contexts. Finally, and in specific relation to the Yazidi genocide, this research may provide a significant contribution to preventing Yazidi children who survived genocide from becoming a 'lost generation', and to supporting specific actions in countries hosting Yazidi refugees.

2 | EFS: THE HOT AND COOL MODEL

EFs are a set of cognitive abilities (Miyake & Friedman, 2012) that allow individuals to control thoughts and actions when new or complex situations must be processed. In other words, they serve to: inhibit inappropriate responses (inhibitory control); show flexibility in strategies, ideas and activities (shifting); hold, update and actively manipulate information in one's mind (working memory). These functions have been extensively investigated in children (Garon, Bryson, & Smith, 2008), showing their connection with developmental outcomes related to children's learning abilities in terms of both literacy and math achievement (Blair & Razza, 2007; Clark, Pritchard, & Woodward, 2010). As highlighted by Wass (2015), the effect of such developmental outcomes may even extend to an individual's academic life and relevant achievements. Furthermore, the development of these abilities seems to be associated with social success with peers (Eisenberg et al., 2003). Although EFs are traditionally defined through a purely cognitive perspective, Zelazo and Müller (2002) have further developed existing views, proposing the distinction between 'hot' emotional and 'cool' cognitive aspects of EFs. Cool EFs are involved in abstract and context-free tasks, while hot EFs are involved in situations requiring the regulation of motivations and affective challenges.

Research Highlights

- Research on children who survived genocide
- Early assessment of hot and cool EFs in war trauma victims;
- Evaluation of effects of EFs training.

3 | DEVELOPMENT OF HOT AND COOL EFS IN DIFFERENTIAL STRESSFUL ENVIRONMENTS

Research shows that stress, experienced early in life, has deleterious effects on the development and functioning of the PFC, namely the brain system that mediates EFs (McEwen, 2008; McEwen & Morrison, 2013). Shonkoff et al. (2009) identify three levels of stress that may be experienced during childhood. The first level of stress concerns normative and routine life challenges that include the need to face daily problem-solving tasks and promote positive coping skills. The second level of stress concerns time-limited stressful situations experienced within a context of protective factors. The third level of stress concerns toxic stress conditions in which children are exposed to severe, chronic and prolonged stress and in the total absence of protective factors. Possible examples are abuse and family violence, neglect, parental substance abuse or growing up in a war zone. This classification has been applied to a variety of conditions that range from lesser forms of deprivation, such as disadvantaged socioeconomic positions (Welsh, Nix, Blair, Bierman, & Nelson, 2010) to extreme forms of deprivation such as trauma (DePrince et al., 2009), institutionalization (Merz et al., 2016) and maltreatment (Rogosch et al., 2011). The present study focuses on the third level of stress.

Current research on children diagnosed with maltreatment-related Post-Traumatic Stress Disorder indicates that they perform poorly on several EFs measures, for example, distractibility and sustained visual attention tasks, compared to the control sample (Beers & De Bellis, 2002). Furthermore, a moderate effect size was observed between familial trauma and EFs' composite score, including WM, inhibition, auditory attention and processing speed tasks (DePrince et al., 2009). A recent review of the studies on formerly institutionalized children shows that they are at greater risk of EFs deficiency: analyses confirm that EFs difficulties mainly affect inhibitory control and WM, but have limited repercussions on planning and, to a certain extent, shifting (Merz et al., 2016). These differences in the effects of stress on single EFs processes could be due to differential developmental trajectories related to specific components. More specifically, inhibitory control and WM are thought to develop at an earlier stage with respect to the other components, which may be the reason why they are susceptible to early deprivation (Garon et al., 2008). While studies on cool EFs seem more consistent, research on specific effects of hot EFs on development is still limited. In this regard, McIntyre et al. (2006)

showed that high hot EF such as the ability to delay gratification upon school entry predicts teacher-reported prosocial skills and more positive overall student–teacher relationships in children with and without intellectual disability in kindergarten. Moreover, hot EF has been found to be uniquely related to inattentive-overactive behaviours in low-income preschoolers aged 3–5 years old (Willoughby, Kupersmidt, Voegler-Lee, & Bryant, 2011). From a more clinical perspective, a recent study shows a specific relation between hot EFs and emotional dysregulation in adolescents (Poon, 2017), as well as hyperactivity/inattention symptoms and conduct problems in extremely pre-term children (Walczak & Chrzan-Dętkoś, 2018).

4 | EFS TRAINING IN PRESCHOOL CHILDREN

Since EFs are central to many developmental tasks, children need to perform — from navigating peer relationships to tackling setting — and behavioural control (Jacobson, Williford, & Pianta, 2011), the development of systematic studies on EFs in children exposed to war trauma is crucial and deserves the undivided attention of the scientific community. There are various types of training aimed at promoting EFs. In particular, Table 1 summarizes the results obtained with training specifically targeted at EFs in typically developing preschool children from middle-class, low-income backgrounds. Previous studies have consistently recorded positive effects of EFs training on cool EFs in preschoolers. However, there are no consistent data concerning their effects on inhibition skills: while some studies report positive effects, others yielded little or no effect at all. Moreover, training programs including hot EFs are still under-researched, and there are only two cases in the relevant literature that provide evidence of positive effects of these programs on EFs in children's delay gratification ability. Existing training methods developed in war contexts tend to focus mainly on first aid support (Kar, 2009) and emotional control (Pat-Horenczyk et al., 2009), but, to the best of our knowledge, no training method specifically focusing on EFs has been developed yet.

5 | THE STUDY

Considering the crucial role of EFs in development, our study focuses on EFs abilities in children from war contexts through two different evaluations: (a) assessment of EFs cool and hot components in children living in a war context, (b) implementation of a training program to improve these children's EFs. This study, in particular, evaluates hot and cool EFs in a group of 5-year-old Yazidi children living in refugee camps in Kurdistan, comparing them to a sample of Italian preschoolers living in a typical environmental context.

Regarding the training we implemented in this research-project, we referred to the literature confirming the importance of school-based training methods in relation to war contexts (Pat-Horenczyk et al., 2009), by designing a tailored intervention that may contribute to the still limited number of programs involving scientifically valid methods, such as randomized assignment and blind evaluators.

In line with previous studies, our rationale is based on the assumption that child survivors of genocide show worse EFs competence compared to their peers in the control group (i.e., typically developing 5-year-old children). More specifically, we intend to verify the following hypotheses: (a) children who live in a traumatic context show impairment of cool components of EFs, specifically in relation to inhibition and WM; (b) war contexts have an impact on hot EFs, in line with research indicating that socioeconomic contexts may affect the development of delayed gratification; (c) specific training target at both cool and hot EFs can have a positive impact on the participants of both groups.

6 | METHOD

6.1 | Participants

Participants are 5-year-old children, divided into two groups, Yazidi and Italian respectively. Yazidis are a minority group living in an Islamic cultural surrounding. Since August 3, 2014, they have been targeted by militants of the Islamic State of Iraq and the Levant as part of a religious campaign to rid Iraq of non-Islamic influences. ISIS' assaults resulted in the death of 5,800 Yazidis, while another 4,000 were displaced, with numerous atrocities perpetrated against children, as described by Salloum (2016). In March 2015, the Office of the United Nations High Commissioner for Human Rights identified the atrocities perpetrated against the Yazidi minority as genocide (United Nations Human Rights Council, , June 15, 32nd session). The training method applied in this study was part of an international cooperation program implemented by the Friuli Venezia Giulia Region and developed in collaboration with local NGOs' partners. One hundred and twenty-six Yazidi children in the care of four different NGOs took part in the study, but only 53 of them attended at least 80% of the program and could therefore be evaluated. A multivariate analysis of variance (MANOVA) was conducted on the total sample of Yazidi children taking part in the preliminary evaluation phase, to exclude the presence of a possible selection bias related to EFs in those who completed the program. Table 2 shows that there are no differences in hot and cool EFs between the two groups of Yazidi children at this stage.

Italian children were selected among attendees of four different kindergartens located in Northern Italy. Consent to participate in the training was obtained by both the schools and the parents of 112 children. Three children displaying developmental delay were preventively excluded from the initial sample, while other three attended less than 80% of the program. The remaining, typically developing 106 Italian children were randomly assigned either to the training group (n = 55) or to the control sample (n = 51). The participants were divided into the following three groups: 53 Yazidi children taking part in informal activities in the refugee camps in Sinjar (Kurdistan region, Iraq) (M_{age} = 64.67 months, SD = 2.9, 26 girls,

TABLE 1 Training interventions on EFs in typically developing preschoolers from middle-class, low-income backgrounds

Authors	Sample	Training program (duration, materials and activities and setting)	Investigated EFs skills	Results: training effect	Effect size
Dowsett and Livesey (2000)	*N* = 49 lower-to-middle income preschoolers, M_{age} = 3.98 years	*Duration:* A short-term intervention with three sessions lasting approximately 15–20 min on three successive days of the child's attendance at the preschool. *Materials and Activities:* The training program involves the use of pencil paper materials (e.g., cards, coins and sheets of cardboard), and includes a modified version of the Wisconsin Card Sorting task, and a simplified version of the Stop Signal paradigm, that is the change task. *Setting:* Individualized intervention.	–Inhibition	Inhibition: Positive effect	Not reported
Kloo and Perner (2003)	*N* = 44 (22 F), M_{age} = 3.76 years (*SD* = 0.41)	*Duration:* A short-term intervention with 15-min sessions, for approximately 8 days. *Materials and Activities:* The Card Sorting Task training involves the use of pencil paper materials and each session consists of a card-sorting task with three dimension switches and two transfer-sorting tasks. *Setting:* Individualized intervention.	–Shifting	Shifting: Positive effect	Not reported
Rueda, Rothbart, McCandliss, Saccomanno, and Posner (2005)	1° and 2° Exps. *N* = 49 (25 F), M_{age} = 4.33 years (*SD* = 0.18) 3° Exp. *N* = 24 (12 F), M_{age} = 6.42 years (*SD* = 0.27)	*Duration:* A short-term intervention lasting 5 days over a 2- to 3-week period. *Materials and Activities*: A total of 9 (Exps. 1 and 2) or 10 (Exp. 3) computerized exercises designed to train attention in general, with a special focus on executive control. *Setting*: Individualized intervention.	–Inhibition	Inhibition: No effect	Not reported
Lillard and Else-Quest (2006)	*N* = 55, M_{age} = 5 years	*Name:* Montessori curriculum for infancy to grade 12 (0–18 years). *Duration*: A long-term education program implemented in primary level (3- to 6-year-olds). *Materials and Activities*: The curriculum-based program is characterized by a special set of educational materials, student-chosen work in long time blocks, collaboration, the absence of grades and tests and individual and small groups instruction in both academic and social skills. *Setting*: Both individualized and group-based program in multi-age classrooms.	–WM –Inhibition –Shifting –Delay of gratification (Hot EF)	WM, Inhibition and Shifting: Positive effect Delay of gratification (Hot EF): No effect	Not reported
Diamond, Barnett, Thomas, and Munro (2007)	*N* = 147 low-income preschoolers, M_{age} = 5.1 years	*Name*: Tools of the Mind (Tools) curriculum for preschool and kindergarten. *Duration*: A long-term intervention provided for 1 or 2 years of preschool. *Materials and Activities*: The classroom curriculum-based program improves EFs through 40 EF-promoting daily activities, including telling oneself out loud what one should do (17), dramatic play (18), and aids to facilitate memory and attention (19). Games targeted to teach reflective thinking and self-regulation comprise inhibitory control, turn-taking and reminding and carrying out pre-planned behaviours. A central part of Tools is social pretend play, during which children must remember their own and others' roles, inhibit acting out of character and flexibly adjust as their friends improvise. *Setting*: A group-based intervention in regular public school classes with regular teachers.	–WM –Inhibition –Cognitive flexibility (Shifting)	WM, Inhibition and Cognitive flexibility (Shifting): Positive effect	Not reported

(*Continues*)

TABLE 1 (Continued)

Authors	Sample	Training program (duration, materials and activities and setting)	Investigated EFs skills	Results: training effect	Effect size
Domitrovich, Cortes, and Greenberg (2007)	*N* = 246 (126 F) disadvantaged preschoolers, M_{age} = 4.28 years (*SD* = 0.49)	*Name*: Preschool 'PATHS' (Promoting Alternative Thinking Strategies) Curriculum for preschool to grade 6 (3–12 years). *Duration*: A long-term curriculum-based program across a 9-month period. *Materials and Activities*: It is a social-emotional curriculum-based on the ABCD (Affective-Behavioral-Cognitive-Dynamic) model of development and designed to improve children's competencies in self-control, managing and recognizing feelings, and social, behaviour, emotional and interpersonal problem-solving. It includes weekly lessons and extension activities integrated effectively with common early childhood programs. *Setting*: A classroom-based teacher-taught program that intends to complement existing curriculum.	–Inhibition	Inhibition: No effect	Not reported
Bierman et al. (2008)	*N* = 356 (192 F) socioeconomically disadvantaged preschoolers, M_{age} = 4.49 years (*SD* =0.31)	*Name*: Head Start REDI (Research-Based, Developmentally Informed) program. *Duration*: A long-term intervention delivered over the course of the prekindergarten year. *Materials and Activities*: It included curriculum-based lessons, centre-based extension activities, and training in "coaching strategies" to promote language/emergent literacy and social-emotional skills associated with school readiness. More specifically, it comprises an interactive reading program targeted to four skills: vocabulary, syntax, phonological sensitivity, and print knowledge. Regarding social-emotional skill enrichment, it is used a 33-lesson curriculum targeted four domains: prosocial friendship skills, emotional understanding and expression skills, self-control and social problem-solving skills. *Setting*: A group-based interactive intervention, delivered by classroom teachers.	–WM –Inhibition (cognitive and behavioural) –Shifting	WM, cognitive Inhibition and Shifting: Positive effect Behavioural Inhibition: No effect	WM, cognitive Inhibition, and Shifting 0.20
Thorell, Lindqvist, Bergman Nutley, Bohlin, and Klingberg (2009)	*N* = 65 (33 F), M_{age} = 4.17 years	*Duration:* A short-term intervention for a total of 15-min sessions carried out every school day over a period of 5 weeks. *Materials and Activities:* The computerized intervention comprises two different types of training: the inhibition and WM training programs. Each training includes five different computer games but only three tasks are administered to the child daily using a rotating schedule. The WM training focuses specifically on visuospatial WM (remember location and order of visuospatial stimuli), when the inhibition program is related to inhibition of a prepotent motor response, stopping an ongoing response and interference control. *Setting:* Individualized intervention.	–WM –Inhibition	WM: Positive effect Inhibition: No effect	Spatial WM 0.89 Verbal WM 1.15
Bergman Nutley et al. (2011)	*N* = 112 (68 F), M_{age} = 4.27 years (*SD* = 0.25)	*Duration:* A short-term intervention lasting around 15 min/day, 5 days/week for 5–7 weeks, until 25 sessions have been performed. *Materials and Activities:* It is a computerized training of either non-verbal reasoning, WM, a combination of both, or a placebo version of the combined training. The WM program is the same described in Thorell et al. (2009) and it includes seven visuospatial tasks, out of which three are trained daily on a rotating schedule. *Setting:* Individualized intervention.	–WM	WM: Positive effect	Not reported

(*Continues*)

TABLE 1 (Continued)

Authors	Sample	Training program (duration, materials and activities and setting)	Investigated EFs skills	Results: training effect	Effect size
Raver et al. (2011)	*N* = 543 low-income preschoolers, M_{age} = 4.12 years (*SD* =0.67)	*Name*: Chicago School Readiness Project (CSRP) for preschool (3–5 years). *Duration*: A long-term intervention implemented from fall to spring of the Head Start year. *Materials and Activities*: The curriculum-based program provided teachers with training in new techniques and strategies (e.g., reward positive behaviour and redirect negative behaviour, apply clearer routines and rules) that they could employ to improve children's school readiness by increasing their emotional and behavioural adjustment. *Setting*: A group-based intervention implemented in classroom that intends to complement existing curriculum.	–WM –Inhibition –Delay of gratification (Hot EF)	WM and Inhibition: Positive effect Delay of gratification (Hot EF): No effect	WM and Inhibition 0.37
Röthlisberger et al. (2011)	1° Exp. (prekindergarten) *N* = 71 (33 F), M_{age} = 5.04 years (*SD* = 0.30) 2° Exp. (kindergarten) *N* = 64 (24 F), M_{age} = 6.08 years (*SD* = 0.32)	*Duration:* A short-term intervention including a sequence of 30 daily sessions of approximately 30 min carried out twice a week spread over 6 weeks. *Materials and Activities:* Each training session includes three different tasks: one task for the whole intervention group, one for a couple of children, and one individual task. Regarding the content, the program comprises pencil paper activities and games based on well-known EFs tasks to improve specifically working memory, inhibition (interference control), and cognitive flexibility processes. *Setting:* A mixed individual and small group training (individual, couple and group setting) implemented in regular pre-kindergarten and kindergarten settings.	–WM –Cognitive flexibility (Shifting) –Inhibition	WM and cognitive flexibility (Shifting): Partially positive effect in pre-kindergarten children Inhibition: Partially positive effect in kindergarten children	WM 0.42 Cognitive flexibility (Shifting) 0.59 Inhibition 0.43
Rueda et al. (2012)	*N* = 37 (17 F), M_{age} = 5.39 years (*SD* = 0.27)	*Duration*: A short-term intervention for a total of ten 45-min sessions carried out over a period of 5 weeks (two sessions per week). *Materials and Activities*: A total of 11 computerized exercises divided in five general categories: (1) Tracking/Anticipatory; (2) Attention Focusing/Discrimination; (3) Conflict Resolution; (4) Inhibitory Control; (5) Sustained Attention. *Setting*: Individualized intervention.	–Inhibition –Delay of gratification (Hot EF)	Inhibition: No effect Delay of gratification (Hot EF): Partially positive effect	Not reported
Traverso et al. (2015)	*N* = 75 (40 F) lower-to-middle income preschoolers, M_{age} = 5.72 years (*SD* = 0.29)	*Duration:* A short-term intervention including a total of 12 sessions of approximately 30 min, carried out three times a week over about 1 month during the regular kindergarten day. *Materials and Activities:* It is a play-based group training including a series of small group (five children) game activities which require increasing levels of active participation and cognitive control on the part of each child. More specifically, the children are asked to help Chicco and Nanà, two little goblin friends attending kindergarten, in order to face 10 different challenges (intervention activities) that involve EFs. In this way, children will help Chicco and Nanà become more regulated and finally attend primary school. Each activity requires progressively higher levels of inhibitory control, cognitive flexibility, and WM. Moreover, each game requires that children resolve conflicts respecting the rules and the roles they are assigned in order to reach the fixed goals. Every training session finishes with a metacognitive activity in which children have to report their self-perception of their EFs and to share with the whole group strategies that they retain useful in facing the challenges. The training involves low-cost and readily available pencil paper and physical materials (without using either computers or other technical equipment). *Setting:* A small-group school-based intervention implemented within the daily schedules of standard preschool setting.	–Delay of gratification (Hot EF) –Inhibition –Shifting –WM	Delay of gratification (Hot EF): Partially positive effect Inhibition, Shifting, and WM: Partially positive effect	Delay of gratification (Hot EF) 0.70 Inhibition 0.35, 0.45, 0.61 Shifting 0.53 WM 0.43, 0.65

TABLE 2 Mean pre- and post-test scores in the different tasks and Univariate Test results (from MANOVA) on total Yazidi sample

	Total Yazidi sample (pre-training)					
	Training (n = 53)		No Training (n = 73)			
	M	*SD*	*M*	*SD*	*F*	Effect size
Delay gratification						
Delay time	37.2	16.4	35.9	15.6	F (1, 124) = 0.17, p = 0.68 ns	0.08
Gift wrap time	23.5	11.3	21.8	11.1	F (1, 124) = 0.34, p = 0.56 ns	0.15
Gift wrap violations	1.8	1.4	2.1	1.5	F (1, 124) = 2,07, p = 0.15 ns	0.21
Inhibition						
Circle drawing time	0.3	0.2	0.3	0.2	F (1, 124) = 0.35, p = 0.56 ns	0.00
Day and night Stroop accuracy	10.1	1.9	9.8	2.2	F (1, 124) = 0.33, p = 0.57 ns	0.15
STM and WM						
Forward word span (sequences)	2.0	1.3	2.1	1.1	F (1, 124) = 0.02, p = 0.89 ns	0.08
Backward word span (sequences)	1.5	1.0	1.4	1.0	F (1, 124) = 0.35, p = 0.55 ns	0.10

Note. The MANOVA results for hot EFs do not show a significant main effect for group factor (Wilks' Lambda = 0.98, F(3, 122) = 0.75, p = 0.53, η_p^2 = 0.02), since the two groups did not significantly differ from each other.
The MANOVA results for cool EFs do not show a significant main effect for group factor (Wilks' Lambda = 0.99, F(5, 120) = 0.23, p = 0.95, η_p^2 = 0.01), since the two groups did not significantly differ from each other.
To verify the relative magnitudes of the differences, effect sizes were calculated using Cohen's (1988) effect size formula (d). Based on Cohen's effect size formula (d), an effect size of 0.20 is considered small, an effect of 0.50 is considered medium, and an effect of 0.80 is considered large.

age range: 61.77–67.57 months), who were administered the cognitive training; 55 Italian children (M_{age} = 65.8 months, SD = 2.1, 24 girls, age range: 63.7–67.9 months), who were administered the cognitive training; 51 Italian children (M_{age} = 64.4 months, SD = 3.2, 29 girls, age range: 61.2–67.6 months), who were assigned to a passive control group and performed usual classroom activities. No passive control group was formed in the Yazidi sample due to the extremely difficult situation these children were living in. The extremely urgent need to provide an intervention program to enhance emotional control and cognitive abilities prevailed over methodological issues.

6.2 | Training program

Intervention focused on cognitive strategies to recognize and control emotions — a well-established intervention method that has already been extensively tested in war environments (Pat-Horenczyk et al., 2009), in combination with a specific training targeting EFs as crucial aspects of children's cognitive development.

The program was administered in class with a game-like approach for a total of 20 sessions (10 weeks of sessions taking place twice a week, each with a duration of about 40 min). Ten activities were related to EFs and 10 related to emotional control. Pre- and post-assessment took place individually in a quiet room inside the schools or camps, and each assessment session lasted about 30 min.

The first set of activities (n = 10) involved cognitive tasks administered in the form of games. These were based on the test battery developed by Usai et al. (2017) and concern short-term memory (STM) and WM (n = 5), and Inhibition (n = 5) abilities. WM- and STM-related activities required children to memorize poetries, song lyrics and sequences of objects, and then repeat them forward and backward. The five games on Inhibition required children to switch behaviour following suggestions (e.g., modulating their voice volume or facial movements), sometimes applying the dominant or habitual response pattern (e.g., the colour red indicating 'stop' and the colour green indicating 'move'), and sometimes changing the response pattern they have previously learned (e.g., the colour green for 'stop' and the colour red for 'move').

The second group of activities (n = 10) was based on the approach pertaining to Rational Emotional Behavioral Therapy (Di Pietro, 2014). These tasks promote self-regulation identification and verbalization of emotions. The activity set included two games related to knowledge and awareness of emotions and two tasks for each primary emotion (fear, anger, sadness and happiness). At the end of each activity, applied strategies were shared and discussed by children and teachers. A schematic representation of the intervention protocol is illustrated in Figure 1.

6.3 | Procedure

The training for teachers, social workers or master students, both in Kurdistan and in Italy, was organized in the form of a workshop that lasted one day and a half, and it addressed the following topics: effects of trauma on emotional and cognitive development, impact of school-based training activities on development, methods to assess EFs and activities promoting emotional and cognitive control. In Kurdistan, the trainer illustrated all activities in English, with simultaneous translation into Kurdish. Activities involving training and assessment were illustrated in the local language spoken by the two educators involved,

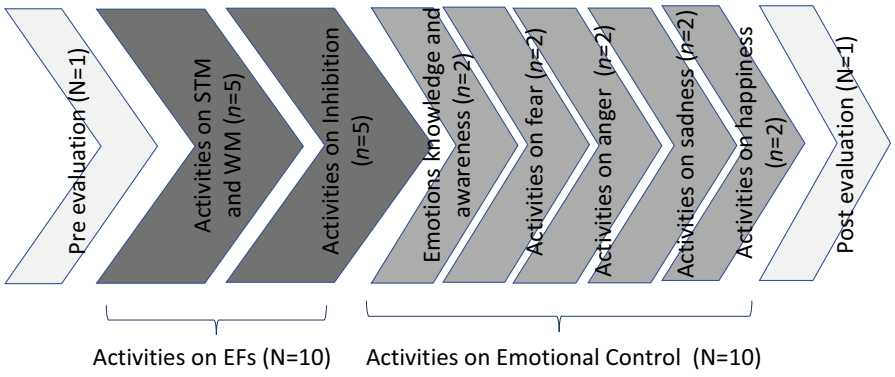

FIGURE 1 Study design: representation of the intervention protocol

one male and one female, and training sessions were guided by two social workers, one male and one female. Training implementation was monitored via video connection. Pre- and post-assessment in the Italian sample was carried out by two experimenters (female Italian master students), while a third blind experimenter was in charge of the evaluation of both Italian programs. Fidelity of implementation was ensured by requiring all trainers to prove their knowledge of the program's aims, activities organization and performance and situation management through the training schedule.

6.4 | Pre- and post-test assessments

6.4.1 | EFs tasks

Hot EFs

Delay task. Children were presented with a gift box and were asked to wait as long as they could before opening it, while latency was recorded. This task (adapted from Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996) is a version of the standard delay paradigm used to assess the ability of children to delay gratification (Delay Task Time, expected range 0-no limit). The test–retest reliability is 0.99.

Gift Wrap Delay. This task is used to evaluate the ability to delay gratification and inhibit undesirable behaviours in children (Carlson & Moses, 2001). Children were told that the examiner would wrap a present behind their back and that they should not peek until the examiner says they were allowed to do so. The examiner spent 60 s wrapping the gift. Latency to the first peek (Gift Wrap Task Time, expected range 0–60 s) and the total number of peeks during the 1-min interval were recorded (Gift Wrap Violations, expected range 0–no limit). The test–retest reliability is 0.97 for the latency, and 0.88 for the violations.

Cool EFs

Inhibition **Circle drawing task**. This task (Bachorowski & Newman, 1985) measures inhibition of on-going responses and is typically used for childhood assessments. Children must use their finger to trace a circle with a 17-cm diameter from a given starting point to a given ending point. The task was administered twice. The first time the researcher provided neutral instructions, such as 'trace the circle'; the second-time, inhibition instructions were provided, such as 'trace the circle again but this time as slowly as you can.' Larger time differences indicate better inhibition (slowing down) on the part of the participant in continuous tracing response. Time in seconds was recorded for each trial. Scores were calculated as the speed relative to the total time using the following formula: T2−T1/T2+T1, where T1 and T2 are the times recorded for the first and second trials (Circle drawing task, expected range negative to positive values-no limit). The test–retest reliability is 0.93.

Day and night stroop task. This task (Gerstadt, Hong, & Diamond, 1994) consists of a congruent and an incongruent (or stroop) condition. In each condition children were presented with a sequence of 16 pictures: eight of them depicted the sun and the other eight depicted the moon. In the congruent condition, children were required to say either 'day' or 'night' whenever a picture of the sun or the moon was presented. In the incongruent condition, they were required to say 'day' for the picture of the moon and 'night' for the picture of the sun. The pictures were always presented one at a time in a pseudo-random order. Scores were based upon the total number of trials correctly performed in each condition (expected range 0–16). The test–retest reliability is 0.96 for the incongruent condition.

STM and working memory STM and WM are two distinct temporary memory systems. More specifically, whereas WM refers to the capacity of information storage and processing, STM involves purely temporary storage of material without any form of manipulation (Alloway, Gathercole, & Pickering, 2006).

Short-term memory **Forward word-span task**. In this task (Lanfranchi, Cornoldi, & Vianello, 2004), children were read sequences of two to five words and were then asked to repeat each list immediately after the presentation and in the same order as the examiner. The task included four different difficulty levels, depending on the length of the lists. Each level comprised two different lists, for a total of eight trials. The span was considered correct if the child could recall all the items of a sequence in the right order. A score of one was given if one of the two lists of the same difficulty level was recalled correctly (expected range 0–4). The task was administered with a self-terminating procedure. The test–retest reliability is 0.88.

Working memory Backward word-span task. In this task, adapted from Lanfranchi et al. (2004), children were once again asked to memorize a list of spoken words (uttered approximately once per second), but were then required to recall it in reverse order. The test included an illustration trial and it began with three trials of two words. The number of words increased by one every three trials until three lists of the same difficulty level were recalled incorrectly. A score of one was given if one of the three lists of the same difficulty level was recalled correctly (expected range 0–4). The test–retest reliability is 0.85.

7 | RESULTS

Means and standard deviations of pre-test and post-test scores of the three groups are presented in Table 3. There was no difference between the three groups in terms of chronological age, $F(2, 156) = 1.06$, $p = 0.35$, $\eta_p^2 = 0.04$, and gender, $F(2, 156) = 0.84$, $p = 0.57$, $\eta_p^2 = 0.04$, nor was there a significant difference between the two training groups in the amount of intervention sessions received, $F(1, 106) = 0.70$, $p = 0.41$, $\eta_p^2 = 0.02$. Therefore, these parameters were not further included as covariates in the analyses.

7.1 | Pre-training evaluation

A review of the topic of hot and cool EFs in preschoolers shows that both Exploratory and Confirmatory factorial analyses distinguishes between these two aspects, thus indicating that hot and cool EFs tasks allow for the assessment of two different sets of abilities (Garon et al., 2008). In order to evaluate possible differences in the sample, therefore, we run two different MANOVAs with the three groups (Yazidis Training, Italian Training and Italian Control) as fixed factors, and the hot EFs (Delay and Gift Wrap Delay tasks) or cool EFs factors (Inhibition and STM and WM tasks) as dependent variable.

To compare pre-test score differences between groups, η_p^2 was used as a measure of effect size. The criteria of Cohen (1988) were used to classify the effect sizes: small effect: $\eta_p^2 = 0.01$; medium effect: $\eta_p^2 = 0.06$; and large effect: $\eta_p^2 = 0.14$. Effect sizes (Cohen's *d*) for post hoc pair-wise comparisons are also reported; small effect $d = 0.20$; medium effect $d = 0.50$; large effect $d = 0.80$.

7.2 | Pre-training: hot EFs

As shown in Table 3, mean differences emerged between the Yazidi children and the two Italian groups (training and control) in a number of hot EFs tasks. More specifically, the MANOVA results reveal a significant main effect for group factor (Wilks' Lambda =0.75, $F(6, 308) = 5.21$, $p = 0.000$, $\eta_p^2 = 0.99$), since the three groups (Yazidi training group – YTG, Italian training group – ITG and Italian control group – ICG) significantly differ from each other.

Univariate test results show significant differences in the Delay Task, $F(2, 156) = 4.94$, $p = 0.009$, $\eta_p^2 = 0.79$. Bonferroni's adjusted post hoc pair-wise comparisons indicate that the YTG waited less time before opening the present compared to the ITG ($M_{diff} = -18.66$, $p = 0.033$, $d = 0.64$) and the ICG ($M_{diff} = -20.09$, $p = 0.024$, $d = 0.77$). No difference was recorded between the two Italian groups ($M_{diff} = -6.32$, $p = 0.43$, $d = 0.04$). Significant differences emerged from the Gift Wrap task — latency, $F(2, 156) = 5.70$, $p = 0.005$, $\eta_p^2 = 0.85$. Bonferroni's adjusted post hoc pair-wise comparisons indicate that the YTG committed the first violation before

TABLE 3 Mean pre- and post-test scores in the different tasks and Univariate Test results (from MANCOVA) for gain differences between the conditions

	Yazidi training group				Italian training group				Italian control group				
	Pre-training		Post-training		Pre-training		Post-training		Pre-training		Post-training		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Delay gratification													
Delay time	37.2	16.4	60.0	21.9	55.8	37.5	75.1	46.4	57.3	33.1	56.7	37.7	6.74**
Gift wrap time	23.5	11.3	31.9	11.4	33.0	12.2	40.7	10.9	30.4	15.1	33.6	10.6	5.35**
Gift wrap violations	1.8	1.4	0.8	0.6	0.9	0.9	0.5	0.6	1.0	1.9	0.9	1.0	4.69*
Inhibition													
Circle drawing time	0.3	0.2	0.4	0.2	0.4	0.2	0.5	0.2	0.4	0.2	0.4	0.2	ns
Day and night stroop accuracy	10.1	1.9	10.4	1.8	12.1	2.7	13.6	2.1	11.5	2.6	11.8	2.6	18.32***
STM and WM													
Forward word span (sequences)	2.01	1.3	2.6	1.1	2.4	1.3	2.9	1.1	2.1	1.5	2.9	1.3	ns
Backward word span (sequences)	1.5	1	1.6	0.9	1.7	1.0	1.6	1.0	1.7	1.0	1.6	1.2	ns

*p <0.05, **p <0.01, ***p <0.001.

the ITG (M_{diff} = −9.48, p = 0.002, d = 0.81), but not before the ICG (M_{diff} = −6.9, p = 0.07, d = 0.52). No difference was recorded between the two Italian groups (M_{diff} = 2.57, p = 0.42, d = 0.19). Differences related to the Gift Wrap task also concern the number of violations in the three groups, F(2, 156) = 10,70, p = 0.00, η_p^2 = 0.98. The YTG was statistically different from both the ITG (M_{diff} = 0.92, p = 0.000, d = 0.76) and the ICG (M_{diff} = −0.85, p = 0.001, d = 0.48). No difference was observed between the two Italian samples (M_{diff} = 0.076, p = 1, d = 0.07).

In brief, as regards hot EFs, results indicated that the YTG waited less time before opening the present and committed more violations earlier in time in the Gift Wrap Delay task, particularly compared to the ITG.

7.3 | Pre-training: cool EFs

The MANOVA results show a significant main effect for group factor (Wilks' Lambda = 0.81, F(10, 304) = 3.14, p = 0.001, η_p^2 = 0.95), since the three groups (YTG, ITG and ICG) significantly differ from each other. As regards the univariate test, the Circle Drawing MANOVA analysis showed a significant difference between the groups, F(2, 156) = 4.13, p = 0.018, η_p^2 = 0.72. Bonferroni's adjusted post hoc pair-wise comparisons indicate that YTG's slowdown time was shorter than of the ITG (M_{diff} = −0.09, p = 0.016, d = 0.50) and ICG (M_{diff} = −0.1, p = 0.011, d = 0.50). Again, no difference was observed between the two Italian groups (M_{diff} = 0.006, p = 0.88, d = 0.00).

In relation to the Day and Night task, significant differences were found between the groups in the number of correct answers in the stroop condition, F(2, 156) = 9.16, p = 0.000, η_p^2 = 0.97. Bonferroni's adjusted post hoc pair-wise comparisons indicate that the YTG provided a lower number of correct answers than the ITG (M_{diff} = −2.03, p = 0.000, d = 0.86) and the ICG (M_{diff} = −1.38, p = 0.02, d = 0.61). No difference was found between the two Italian groups (M_{diff} = −0.65, p = 0.17, d = 0.23).

As regards STM and WM, no significant difference was found between the three groups, either in the forward word-span task, F(2,156) = 1.06, p = 0.34, η_p^2 = 0.23, or in the backward word-span task, F(2, 156) = 1.07, p = 0.35, η_p^2 = 0.24.

In short, concerning cool EFs, the YTG provided a lower number of correct answers in the Day and Night stroop condition and, in the Circle Drawing Task, the YTG's slowdown time was shorter. Moreover, no significant difference was found between the groups with respect to STM and WM.

7.4 | Training evaluation: hot EFs

After the preliminary comparisons between the three experimental conditions, performance gains between the pre- and post-test sessions of all tasks were examined. Use of the gain parameter to compare the pre- and post-training evaluations is a common procedure, as witnessed by various studies (e.g., Alloway, Bibile, & Lau, 2013; Brehmer, Westerberg, & Bäckman, 2012; Passolunghi & Costa, 2016). In particular, we conducted multivariate analyses of covariance (MANCOVA), with the Group (either YTG, ITG or ICG) used as factor, pre-test scores used as covariate and gain scores (post-test minus pre-test scores) examined as the dependent variable. Bonferroni's adjusted post hoc pair-wise comparisons of gain scores were also applied. For the comparison of gain differences between groups, η_p^2 and effect sizes (Cohen's d) for post hoc pair-wise comparisons were used.

MANCOVA results reveal a significant main effect for group factor (Wilks' Lambda = 0.72, F (6, 302) = 4.8, p = 0.000, η_p^2 = 0.98), since the three groups (YTG, ITG and ICG) significantly differ from each other. More specifically, the univariate analysis carried out on the Delay task indicate a significant difference between the groups, F(2, 153) = 6.74, p = 0.002, η_p^2 = 0.90, reflecting differential treatment effects. Indeed, the YTG (M_{diff} = 19.89, p = 0.02, d = 0.11) and ITG (M_{diff} = 27.45, p = 0.002, d = 0.44) show better ability to delay gratification in this task compared to the ICG. No difference was observed between the YTG and the ITG in this task (M_{diff} = 0.02, p = 1, d = 0.44).

The analysis performed on the Gift Wrap task latency shows a significant difference between the groups, F(2, 153) = 5.35, p = 0.006, η_p^2 = 0.82, reflecting differential training effects. Bonferroni's adjusted post hoc pair-wise comparisons indicate a significant effect of the training on the latency performance in the ITG compared to the ICG (M_{diff} = 8.4, p = 0.005, d = 0.66), but not compared to the YTG (M_{diff} = 3.7, p = 0.42, d = 0.79). No differences were found between the YTG and the ICG (M_{diff} = 4.6, p = 0.16, d = 0.15).

The MANCOVA analysis also shows a difference between the groups in Gift Wrap task violations, F(2, 153) = 4.69, p = 0.012, η_p^2 = 0.77. Bonferroni's adjusted post hoc pair-wise comparisons indicate a lower number of violations in the ITG compared to the YTG (M_{diff} = −0.25, p = 0.029, d = 0.50) and the ICG (M_{diff} = −0.27, p = 0.022, d = 0.49). No difference was observed between the YTG and the ICG (M_{diff} = 0.018, p = 1, d = 0.12).

In short, as regards hot EFs training in relation to the Delay Task, our results indicated an increase in waiting time before opening the gift in both trained groups (YTG and ITG). Furthermore, in the Gift Wrap Delay task, latency time before the first violation was longer and the number of violations was lower in the ITG, particularly compared to the ICG.

7.5 | Training evaluation: cool EFs

The MANCOVA results reveal a significant main effect for group factor (Wilks' Lambda = 0.77, F(10, 292) = 3.09, p = 0.000, η_p^2 = 0.99), since the three groups (YTG, ITG and ICG) significantly differ from each other. The univariate analysis does not show any significant difference between the groups in the Circle Drawing task, F(2, 150) = 0.94, p = 0.39, η_p^2 = 0.21. In relation to the Day and Night task, univariate analysis shows a sizeable difference between the groups in the number of correct answers given in the stroop condition, F(2, 150) = 18.32, p = 0.000, η_p^2 = 1. Bonferroni's adjusted post hoc pair-wise comparisons indicate that the ITG displayed a significant improvement in the task, with considerable increase in

the number of correct answers in the stroop condition, higher than the ICG (M_{diff} = 1.39, p = 0.000, d = 0.76) and the YTG (M_{diff} = 2.2, p = 0.000, d = 1.64). There is no significant difference between the YTG and the ICG (M_{diff} = −0.81, p = 0.44, d = 0.63). In relation to STM and WM no difference was found between the three groups, either in STM, $F(2, 150) = 1.18$, $p = 0.30$, $\eta_p^2 = 0.25$, or in WM, $F(2, 150) = 0.06$, $p = 0.94$, $\eta_p^2 = 0.06$.

In a nutshell, with respect to cool EFs training, the ITG showed significant improvements in the number of correct answers in the Day and Night stroop condition. No other differences were observed.

8 | DISCUSSION

The present work focuses on specific cognitive aspects known as EFs. A careful literature review indicates that this study may be the first research effort aimed at (a) evaluating hot and cool EFs in 5-year-old children living in a critically adverse context (Yazidi minority group) compared to children living in a typical context (Italian children); and (b) estimating the effect of a cognitive training method on hot and cool EFs in children who survived genocide.

Concerning the first aspect, hot and cool EFs in child survivors of genocide are still an under-researched topic in literature, to which we intend to contribute. Our data indicate that 5-year-old children living in a critically adverse context show lower scores in tasks concerning delay of gratification. This outcome corroborates results presented in previous studies indicating the impact of low SES environmental contexts on the development of the hot aspects of EFs (Raver et al., 2011). This is a crucial evidence when considering the link between EFs, specific educational achievement and emotional regulation later in life (Poon, 2017). Furthermore, Yazidi children show lower ability in tasks requiring both motor inhibition (Circle Drawing) and the control of prevalent response (Day and Night Stroop) compared to their Italian counterpart. This aspect seems to confirm previous research carried out on the effect of trauma and institutionalization on cool EFs (DePrince et al., 2009; Merz et al., 2016).

It is worth noticing that tests on both STM and WM (measured as forward and backward word span) yielded equal results from the three groups. These data are consistent with recent findings showing that WM does not seem to depend on financial background/SES and mothers' educational level (Alloway et al., 2017).

Our research provides for a significant contribution to the literature on cool (in particular inhibition-related) and hot (delay gratification) EFs, clearly indicating that both are affected by the extremely violent environmental situation Yazidi children were exposed to when they were about 1-year-old, confirming possible stress-related neurocognitive effects on brain areas connected with the control of EFs (McEwen & Morrison, 2013). In this critical situation, Yazidi children are at risk of social, educational, psychological and behavioural problems. Our data highlight the need to implement programs to reduce the risk of long-term cognitive damage, while enhancing resilience in children who live in contexts of war and terrorism.

Our preliminary survey showed an extremely difficult starting-point situation, requiring the development of a targeted training program. This training method was specifically designed to address the development of hot and cool EFs, promoting their enhancement through specific games illustrated in the relevant literature (Traverso, Viterbori, & Usai, 2015). The program focused on cognitive aspects of EFs, but it also included activities related to cognitive strategies to control emotions (Ellis & Bernard, 2006; Di Pietro, 2014). Compared to the control sample, Yazidi and Italian training groups showed a significant improvement in hot EFs (Delay Gratification). This particular finding is pivotal, as hot EFs abilities appeared to be impaired during our preliminary assessment. More specifically, by the end of the program, Yazidi children's performance has reached the mean levels of their Italian peers belonging to the control sample. The current literature suggests that EFs are strong predictors of school readiness, academic achievement and behavioural and social competence (Jacobson et al., 2011), showing that hot EFs components may be relevant in daily life activities, academic performance, social relationships and psychological well-being (Poon, 2017). Therefore, we consider a very encouraging result the fact that, after training, Yazidi children improved their ability to delay gratification.

Contrary to the training proposed by Traverso et al. (2015), that showed mixed results on hot EFs, our data on Italian children yielded evidence of the positive effect of our program on these aspects. This may be related to the program's specific sections devoted to the cognitive management of feelings during the training. These emotional control activities, together with a specific tailoring of the program to the development of EFs and a higher number of sessions (N = 12 in Traverso et al., 2015, N = 20 in the present training), may have been the main factors promoting the improvement of delayed gratification abilities. Only one study conducted in this field and involving a purely cognitive computer-based training indicated permanent improvements of hot EFs without a specific training on emotional control (Rueda, Checa, & Còmbita, 2012).

In line with other studies that promote basic components of EFs, our program showed improvements in inhibition abilities (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Raver et al., 2011; Röthlisberger, Neuenschwander, Cimeli, Michel, & Roebers, 2011), but not in STM and WM abilities in Italian children. The same could not be observed in the Yazidi children, whose impaired inhibition abilities did not benefit from the training. We think this result could be attributed to both the highly traumatic experience suffered by Yazidi children and the adverse conditions in which they are living. Perhaps, a longer training could prove more effective in improving EFs in these particular conditions. Our data, however, seem to point to a specific effect of the training on inhibition in salient emotional contexts.

Our study is limited in several ways. First of all, from a methodological point of view, the absence of a Yazidi control group may represent a problem. Research in this field underlines the need to recruit a control sample in the same country of the training sample (Bos, Fox, Zeanah, & Nelson, 2009), based on the differences emerged in studies that compare EFs in different countries (Lan, Legare, Ponitz, Li,

& Morrison, 2011). However, as mentioned above, the situation we observed and the context in which we were working called for immediate intervention. Secondly, the specific environmental and political situation experienced by Yazidi children may not be representative of other different forms of deprivation. A third limit of this study concerns duration: while an increment in hot EFs was observed immediately after the training, it was not possible to verify the program's long-term effects, or its repercussions on school performance once children enter formal education. Future longitudinal perspectives could provide further insight into these matters. As a last point, Yazidi children who could follow the entire program may be living in a better family environment than those who could not, which could have been the reason why they were more motivated and less affected by the traumatic consequences of war. Notably, developmental trajectories of EFs may vary on the basis of various mediating and moderating factors: genetic background (Brett et al., 2015), age-related differences involved in the degree of PFC vulnerability to stressors, individual neuronal resilience, recovery-related plasticity mechanisms (McEwen & Morrison, 2013), severity, timing and duration of deprivation (Beckett, Castle, Rutter, & Sonuga-Barke, 2010).

It is our belief that this study contributes the literature in numerous ways: firstly, it is a first attempt to evaluate cognitive consequences of war trauma, providing important insight into EFs current knowledge through the close observation of specific detrimental consequences of war on EFs. Secondly, and consistently with the literature, this research shows a higher level of hot cognitive control, in both the Italian and the Kurdish educational setting, thereby confirming the importance of school-based activities for specific interventions. Considering the specificity of our program, follow-up research is required in order to test its validity in other different cultural contexts, or in the case of migrant children fleeing their home countries with their families after experiencing traumatic events there. The possibility of exporting and applying our training in contexts related to other current social phenomena may validate its usefulness as research tool in the investigation of cool and hot EFs, to acquire a more comprehensive perspective on child development, while helping future adults deal with the scourge of war.

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CONFLICT OF INTEREST

We have no conflict of interest to disclose.

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