TESIS DOCTORAL

Development of executive function and social cognition and its relation with prejudice toward minority groups

(Desarrollo de la función ejecutiva y la cognición social y su relación con el prejuicio hacia grupos minoritarios)

DOCTORANDA

Ángela Victoria Hoyo Ramiro

DIRECTORAS

Dra. Mª Rosario Rueda Cuerva

Dra. Rosa Mª Rodríguez-Bailón

Laboratorio de Neurociencia Cognitiva del Desarrollo
Dpto. Psicología Experimental
Programa de Doctorado en Psicología

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Nunca se ha de pensar en toda la calle de una vez. Sólo hay que pensar en el paso siguiente. Nunca nada más que en el siguiente.

Michael Ende. Momo

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CONTENTS

INDEX OF FIGURES AND TABLES

FIGURES

TABLES

Chapter 1.

Introduction

CHAPTER 1: INTRODUCTION

1.1. Executive function

1.1.1 Concept

Humans' success when coping with challenging environmental demands fundamentally lies in their capacity to unfold adaptive behavior and to adjust it to the current environmental demands. This is broadly encompassed under the construct of self-regulation, which can be defined as the set of skills that enable people to use feedback to adjust their behavior for goal achievement. This definition assumes that behavior is goal-directed and is adjusted in order to reduce the discrepancy between the current and the desired state (Carver & Scheier, 2000). Behavioral regulation is a task assumed to rely upon a variety of cognitive skills. The study of factors underlying behavioral regulation has been a core research question in different fields in psychology, including cognitive psychology, as well as social and personality psychology (Hofmann et al., 2012). Here we focus on the theoretical framework of executive functions (EFs).

Self-regulation has been proposed to be based on a set of cognitive skills named EFs (Rueda et al., 2011). Moreover, EFs are the basis for higher-order functions, like planning, reasoning and problem solving (Diamond, 2013). EF allows for planning, the flexible use of strategies, the control of impulses and the organization of speech (Welsh et al., 1991). According to Blair (2016), EFs are cognitive skills relevant for organizing information, for planning and problem solving, and for coordinating thoughts and actions underlying goal-directed behavior. Diamond (2013) points that the use of EFs is marked by effort. In fact, EFs are involved in deliberate guidance of controlled behavior, which is far more difficult than, for instance, persisting in response tendencies and overcoming temptations. Given their role in goal-directed behavior, EF processes serve a "self-control" function, which has important implications for a broad range of aspects in life, including health, socio-emotional development and social adjustment (Moffitt et al., 2011).

Traditionally, inhibitory control, working memory and cognitive flexibility/shifting have been the core EF skills (Miyake et al., 2000). Working memory is recruited when environment demands to hold and manipulate information in mind; cognitive flexibility entails the flexible allocation of attention and shifting between mental representations in a context-appropriate manner; and inhibitory control is responsible for overriding automatized responses in favour of more deliberate and adjusted behavior. More recently, Miyake and Friedman have reconceptualized the EF model, proposing the unity-diversity framework (Miyake & Friedman, 2012; Friedman & Miyake, 2017). It claims that there are two specific and distinct EF factors: shifting, which comprises the flexible switch between rules and mental sets; and updating, which is responsible for adding and suppressing contents from working memory. Both EF components share variance with a third common EF factor, namely inhibition. Each factor's variance implies specific variance and shared variance with the other ones. Empirical evidence points that the structure of EF varies along the development, with a single factor being able to explain performance on EF tasks in preschool-age children (Wiebe et al., 2008), and different factors explaining performance from middle childhood on (e.g., Huizinga et al., 2006; Lehto et al., 2003; Welsh et al., 1991).

1.1.2 Measures of executive functions

1.1.2.1 Measures of inhibitory control

Among the tasks typically used to assess inhibitory control, we find, for instance, the Flanker task (Eriksen & Eriksen, 1974), the Simon task (Hommel, 2011), the Go – No go task (Verbruggen & Logan, 2008), and the Stop – Signal task (Verbruggen & Logan, 2008). In the Flanker task, participants are to respond to a central stimulus surrounded by flanking stimuli that elicit the same (i.e., compatible) or opposite (i.e., incompatible) response as the central stimulus. Thus, individuals must inhibit the incompatible, opposite response elicited by the flanking stimuli. The Simon task requires to inhibit the tendency to respond to the side where the stimulus appears when it is required to press the opposite-side key (i.e., the spatial incompatibility effect; Craft & Simon, 1970). Another measure of inhibition is the Go – No go task, which demands individuals to emit response to a stimulus and withdraw responses to other stimuli. In the Stop – Signal task, individuals must perform a response until a signal indicates response withdrawal.

1.1.2.2 Measures of working memory

Measures of working memory are usually span tasks requiring to hold and manipulate information in mind. For instance, the Backward Digit Span task demands individuals to remember a series of digits in reverse order. Other tasks require online mental manipulation, for instance, by ordering a series of numbers from lowest to highest. The Corsi Block test (Lezak, 1983) is a visuo-spatial measure of working memory where an experimenter touches a series of blocks, and then the participant must touch them in the same order. Another example of span task is the Self-ordered Pointing task (Petrides et al., 1993), where participants must sequentially point to all items presented, so they must hold information about the items they have already pointed toward in order not to repeat them.

1.1.2.3 Measures of cognitive flexibility

Card sorting tasks, like the Wisconsin Card Sorting task (Milner, 1964; Stuss et al., 2000) and the Dimensional Change Card Sort test (Zelazo et al., 1996, 2003) for children, are usually used to assess cognitive flexibility. Sorting tasks measure the ability to flexibly change and select the grouping criterion when sorting a series of cards. Computerized switching tasks usually involve two-dimension stimuli that consist in, for instance, letters and numbers (e.g., A6) and that have incompatible associated response rules (e.g., to press the left key if the letter is a vowel and to press the right key if the number is even). Another example of switching measure is the Dots task (Davidson et al., 2006). This is a spatial conflict task that combines randomly presented congruent trials (i.e. spatial compatible trials where stimulus and response locations are ipsilateral) and incongruent trials (i.e. spatial incompatible trials where stimulus and response locations are contralateral), and thus requires to switch back and forth between stimuli-associated answering rules.

1.1.3 Development of executive functions

As already argued, EFs are distinguishable aspects of cognitive control that partly overlap. Literature informs that inhibitory control, working memory and cognitive flexibility present differentiated developmental trajectories (Best & Miller, 2010). Below we review evidence on peculiarities about developmental changes in each cognitive skill.

1.1.3.1 Development of inhibitory control

Evidence shows that a significant amount of inhibitory control development takes place in early childhood (Best & Miller, 2010). Particularly, it is observed an improvement in inhibition and activation of hand motor responses in the early preschool period, specifically between 3 and 4 years of age (Hughes, 1998). Moreover, between the ages of 3 and 4 it is observed an improvement in children's ability to overcome a learned tendency to group cards into one dimension in order to group them according to a new dimension (Carlson, 2005; Zelazo et al., 2003). Improvements between the early preschool period and middle childhood are observed when tapping inhibition and activation of verbal responses through a task requiring to hold in mind two answering rules (that is the case of, for instance, the day-night task). Between 3 and 4 years of age, children increase their efficiency (i.e., children give accurate responses taking less time) when performing the task. Children from 5 years of age on showed better global performance in the task, with improvements being observed until 7 years of age (Gerstadt et al., 1994).

Improvements in inhibitory control beyond early childhood are also observed by making use of computerized tasks. Mainly changes in accuracy account for developmental decreases in the spatial incompatibility effect, also called the Simon effect, by which it is easier to make a response when there is a match between response site and stimulus position (congruent trials) than when there is a mismatch between them (incongruent trials). From 6 years of age on, children start to reduce significantly the difference in accuracy between congruent and incongruent trials (Davidson et al., 2006). On the other hand, in tasks where no alternative response to the inhibited one is required (as in the Go – NoGo task and in the Continuous Performance Task), significant improvements in inhibitory control measured as a reduction in commission errors are observed along childhood, between middle and late childhood (Brocki & Bohlin, 2004) and also between middle childhood and young adulthood (e.g., Jonkman et al., 2003). Empirical evidence also suggests that, with age, children improve their ability to inhibit a response that is being executed. When measuring partial commission errors in a Go – NoGo task, that is, when the response was to be performed in two stages (release the home button and press the target button), it was found that older children inhibited earlier a planned response to a No go trial, that is, they were able to inhibit a planned response in the early stage of commission error in greater extent than younger children. Response inhibition during a Stop – signal task in which an ongoing response is inhibited under certain condition (i.e., a clue indicating to withhold a response) significantly improves between 7 and 12 years of age (Johnstone et al., 2007).

1.1.3.2 Development of working memory

With regard to working memory development, it is suggested that it follows a linear development that extends, at least, from childhood to adolescence. When varying the difficulty posed by working memory tasks, it is found that tasks tapping maintenance of information are easier (and mastered earlier in the development) than tasks requiring updating and active manipulation of information (Luciana et al., 2005). By making use of digit or word span tasks, and of object or spatial span tasks, it is shown an improved ability to hold items in mind between 3 and 5 years of age (e.g., Bull et al., 2004; Ewing-Cobbs et al., 2004). Beyond the preschool-age period, improvements are observed in the most complex form of working memory (i.e., active updating and manipulation of information; Diamond et al., 1997; Gathercole, 1998; Gathercole et al., 2004), and an adult-like level is reached by late childhood and adolescence (Welsh et al., 1991). However, there is also evidence of further improvements in adulthood when complexity of working memory tasks is gradually increased and thus several operations are required to be simultaneously performed (Luciana & Nelson, 2002). For instance, Luciana et al. (2005) studied a sample ranging from 9 to 20 years of age. In a delayed working memory task, by age 11 children are able to, after a short delay, accurately locate the position where a target briefly appeared. Moreover, performance was worse the younger the participants and the longer the delay between the target and the response. By 13 years of age, children showed an adult-like level in non-verbal memory span tasks, with no differences in the developmental course for forward and backward tasks. Similarly, from 13 years of age on, participants showed a better performance than the younger participants in a self-ordered search task. Specifically, 13-year-old and older participants were more advantageous than younger children in the most difficult trials, where participants must organize their search for tokens by keeping information in mind about six and eight locations. However, the strategy employed to organize the search continued to improve by late adolescence, up to 16 years of age.

1.1.3.3 Development of cognitive flexibility

Shifting/cognitive flexibility skills are presumably built on inhibition and working memory (Best & Miller, 2010). Accordingly, being able to flexibly handle and select the appropriate answers in accordance with the rules associated with the mental set requires to be able to inhibit the behavior associated with a previous mental set and to keep in mind the diverse answering rules at play (Garon et al, 2008). Failures of the type of perseveration errors (that is, to keep in a response tendency that is no longer useful as the task set changes) are one instance of such inhibitory control involvement in task switching paradigms (Anderson, 2002). Simple measures of cognitive flexibility demanding to switch between two answering rules (Hughes, 1998; Zelazo, 2006) or having reduced inhibitory control demands (Rennie et al., 2004) show age-related improvements in preschoolers. Moreover, it is suggested that shifting totally overlaps with working memory and inhibition in preschool years, and thus it does not make a unique and separable contribution to performance (Senn et al., 2004). By studying children between 4 and 8 years of age, as well as a group of young adults, Luciana and Nelson (1998) accounted for the protracted development of shifting skills by making use of a set-shifting task characterized by several stages of increasing difficulty where children progressed through nine stages. Four-year-old children completed less stages than the other age groups and performance in the task continued to improve through childhood and up to young adulthood. Huizinga et al. (2006) studied the development of EF components in 7-, 11-, 15- and 21-year-old participants. In order to specifically assess cognitive flexibility, they utilized computerized shifting tasks, concretely, a version of the Local - Global task (Miyake et al., 2000), and two tasks adapted from Rogers and Monsell (1995): Dots-Triangles task and Smiling Faces task. They accounted for developmental changes in shifting cost in reaction time, that is, the greater cost entailed by trials where the answering rule changes (switch trials) than by trials where the answering rule is the same as in the previous trial (non-switch trials). They found an age-related, linear developmental tendency to reduce the switch cost between 7 and 11 years of age. Furthermore, adult-like shifting level is achieved by age 15. Davidson et al. (2006) informed that, from 6 years on, whereas the cost of switching between answering rules does not diminish in terms of reaction time, it decreases over age in terms of accuracy. Moreover, when performance in a rule switching context is compared with performance in a non-switching context, from 10 years of age on it is observed a speed-accuracy tradeoff by which participants decrease speed of response in order to preserve accuracy.

1.1.4 Electrophysiological correlates of inhibitory control and cognitive flexibility: the N2 and P3 event-related potentials

The register of electroencephalographic (EEG) activity during cognitive control tasks allows the study of the electrophysiological responses linked to cognitive operations. These responses are denoted as event-related potentials (ERPs). EEG activity can be decomposed in components which are related to specific cognitive processes and that have specific neural substrates (Luck, 2014). Components can be defined according to their polarity (i.e., positive or negative) and to the order in which the peak onsets. Thus, the N2 is the second negative peak, and the P3 is the third positive peak observed in an EEG segment.

The N2 and P3 components have been traditionally studied as indices of EFs. The N2 is an ERP of negative polarity that is observed at medial-frontal sites approximately 200-400 milliseconds post-stimulus (Abundis et al., 2014; Lamm et al., 2006), and that is generated in the anterior cingulate cortex (ACC; Botvinick et al., 2004; Jonkman et al., 2007a; van Veen et al., 2001) and the orbitofrontal cortex (Bokura et al., 2001; Lamm et al., 2006). The N2 has been related to diverse aspects of cognitive control and self-regulation, including response inhibition (e.g., Jonkman et al., 2003), the temperament-related construct of effortful control (e.g., Buss et al., 2011) and conflict monitoring skills (e.g., Donkers & Van Boxtel, 2004; Espinet et al., 2012; Jonkman et al., 2007b). Increased N2 amplitude is observed, for instance, in successful response withdrawal in the no go trials of the Go – NoGo task (e.g., Jonkman et al., 2003), and in the resolution of the conflict elicited by the spatial incompatibility effect in Simon tasks (Lo, 2018). There is mixed evidence concerning the link between N2 and EF performance. Previous research informs that small N2 amplitudes associate with better EF performance (Espinet et al., 2012; Lamm et al., 2006). However, other research has not found significant correlation between N2 and behavioral performance (Jonkman et al., 2003; Larson & Clayson, 2011). Some research suggests a positive association between activity in the ACC region (i.e., a generator of the N2 component) and the recruitment of cognitive resources for behavioral adjustment (Kerns et al., 2004). Similarly, N2 has been related to response activation processes (Bruin et al., 2001). Accordingly, Larson and Clayson (2011) suggested that decreased N2 amplitude may associate with reduced recruitment of cognitive resources and thus with impaired performance. Developmental research informs that, in preschoolers, there is evidence of N2 activity, but its conflict-related modulation is still weak (e.g., Abundis-Gutiérrez et al., 2014; Espinet et al., 2012; Ladouceur et al., 2007; Rueda et al., 2004). With age, the amplitude and latency of N2 decrease (Johnstone et al., 2005; Jonkman, 2006; Lamm et al., 2006; Lewis & Todd, 2007; Rueda et al., 2004). A recent meta-analytical revision informs that the N2 amplitude progressively decreases through childhood and adolescence (Lo, 2018).

The P3 component is a positive deflection that onsets at about 300 – 500 milliseconds after the stimulus presentation (Bruin & Wijers, 2002; Pfefferbaum et al., 1985). Whereas P3 amplitude informs the amount of attentional resources devoted to processing, P3 latency links to the efficiency of processing (Polich, 2007; Scisco et al., 2008). In adults, activity in P3a and P3b subcomponents has been observed in frontal and parietal areas (e.g., Bledowski et al., 2004; Friedman et al., 2008; Volpe et al., 2007). In middle childhood P3 activity is most prominent in central and parietal areas (Jonkman et al., 2003). In both children and adults, P3 is involved in a variety of cognitive operations, such as response inhibition (Bruin et al., 2001; Brydges et al., 2014; Gajewski & Falkenstein, 2013; Jonkman et al., 2007b; Wessel, 2018), task-set switching (Brydges et al., 2014; Duan & Shi, 2014; Gajewski & Falkenstein, 2011; Gajewski et al., 2008, 2010; Hsieh, 2006; Hsieh & Yu, 2003; Hung et al., 2016; Kieffaber & Hetrick, 2005), and updating and behavioral adjustment (Dai et al., 2013; Donchin & Coles, 1988). Shorter latencies and increased P3 amplitudes link to enhanced cognitive processing and better performance due to increased efficiency and task-relevant allocation of cognitive resources (van Dinteren et al., 2014).

Amplitude of P3 increases between middle childhood and late adolescence (Overbye et al., 2018; van Dinteren et al., 2014).

1.2 Theory of mind

1.2.1 Concept

Premack and Woodruff (1978) defined ToM as the ability to attribute mental states to oneself and others. Then, ToM entails the skill to infer and understand mental states like beliefs, knowledge, desires and intentions (Apperly, 2011). According to Shamay-Tsoory et al. (2010), mental states can draw on beliefs (i.e., cognitive ToM) and / or emotions (i.e., affective ToM). Cognitive ToM is a pre-requisite for affective ToM, as it is necessary to understand first the belief behind the emotion (Miller, 2013). Together with cognitive ToM, cognitive and affective empathy contributes to affective ToM. Whereas affective empathy entails experience of another's emotion through a philogenetically-established emotion contagion mechanism, cognitive empathy involves emotion ascription by taking another's perspective (Shamay-Tsoory et al., 2009).

1.2.2 Measures

False belief tasks have been widely used to assess ToM in preschool-age children (e.g., Beaudoin et al., 2020; Wimmer & Perner, 1983). A typical instance of false-belief task is the Sally-Anne task (Baron-Cohen et al, 1985). In the Sally-Anne task, Sally places a marble in a basket. While Sally is outside the room, Anne takes the marble from the basket and puts it into a box. After a while, Sally comes back and looks for her marble. The task accounts for children’s ability to understand that Sally has a wrong belief about the location of the marble and that accordingly she will search the marble in the wrong location.

In middle and late childhood, it is common the use of second-order false-belief tasks (Miller, 2009) and tasks focusing on the understanding of advanced mental states, like faux pas, white lie, irony, double-bluff, persuasion and misunderstanding (e.g., Baron-Cohen et al., 1999; Kaland et al., 2002; Lecce & Bianco, 2018; White et al., 2009). Attribution of second-order mental states entails recursive thinking about mental states. Second-order tasks require children to infer a character's belief about another character's belief or emotion. An example of advanced ToM task is the Strange Stories task initially devised by Happé (1994). In this task, children are requested to make contextual-appropriate mental state inferences on the basis of non-literal statements in the story. For instance, in the white lie story, a character says something that is not true, just in order not to hurt another character's feelings. The story assesses children's ability to justify the character's false statement on the basis of the intention of not making the other character feel upset. Other tasks, like the Test of Emotion Comprehension (Pons et al., 2004) and the Reading the Mind in the Eyes test (Baron-Cohen et al., 2001) have been used to account for aspects of emotion understanding in childhood.

The Imposing Memory Task (IMT; Kinderman et al., 1998) is an advanced ToM task that has been used in adolescence and adulthood (e.g., Valle et al., 2015). The IMT is a recursive thinking measure that involves third-order false belief inferences (i.e., a character "A" thinks that a character "B" thinks that a character "C" thinks…) and even higher orders and thus more complex recursive thinking. Other researchers have made use of tasks about complex emotions involved in film clips depicting near-to-real-life interactions (e.g., the facial scale of the Cambridge Mindreading Face-Voice Battery; Golan et al., 2006; Vetter et al., 2013). Moreover, researchers have accounted for adolescents' and adults' understanding of the interpretive nature of mental states, also known as constructivist ToM (e.g., Weimer et al., 2017).

1.2.3 Development

Wellman and Liu (2004) documented the development of the understanding of ToM concepts throughout the preschool-age period by using a ToM scale. In accordance to their results, at age 3 children understand that people can have diverse desires and beliefs. By age 4, children consistently perform well false belief tasks, and it is by 5 years of age when children begin to understand the distinction between real and outwardly expressed emotions. Thus, around 5 years of age children understand that people can hold incorrect beliefs about the world (Miller, 2013; Wimmer & Perner, 1983).

During middle childhood, it has been argued that ToM development may take place in terms of increasing ability to flexibly use ToM skills (Devine et al., 2016). Studies using more complex ToM tasks that focus on cognitive and affective aspects account for further ToM development beyond early childhood. Perner and Wimmer (1985) found that 7-to-9-year-old children consistently performed well second-order false belief tasks where children must infer a character's false belief about another character's belief or emotion. More recently, Miller (2013) found that by 7 years of age children improve performance in predicting second-order false beliefs, but still find difficult to give reasons in order to justify second-order false belief. Devine and Hughes (2013) utilized the Strange Stories task (Happé, 1994; White et al., 2009) and devised the Silent Film task to account for age-related ToM improvements between 8 and 13 years of age. Whereas the Strange Stories task requires to apply ToM knowledge to understand beliefs embedded in complex social scenarios, in the Silent Film task children are presented with brief silent clips and must infer desires and beliefs behind the characters' behaviors. Between middle childhood and early adolescence, children significantly improved performance especially in the Silent Film task. Concerning the development of emotion-related ToM aspects, research has shown that from early to late childhood children progressively acquire a more complex understanding of emotions (Pons et al., 2004). By 5 years of age, children are able to recognize emotional expressions and to identify external causes of emotions, as well as to comprehend how reminders impact on emotions; by age 7, children understand the influence of desires and beliefs on emotions, and that emotions can be hidden; by late childhood (between 9 and 11 years of age), children display understanding of advanced aspects of emotions, like emotional ambivalence, emotional regulation, and the effect of morality on emotions. Further improvements in ToM skills through adolescence and early adulthood are documented by, for instance, developmental research that uses advanced ToM tasks based on recursive thinking (Valle et al., 2015), brain image studies on neural basis of cognitive and affective ToM (Sebastian et al., 2012), and perspective-taking tasks that require online use of ToM (Dumontheil et al., 2010). Research on adolescents and adults suggests that growing reasoning skills (Valle et al., 2015), as well as the development of affective ToM (Sebastian et al., 2012) and

EFs (Dumontheil et al., 2010) account for ToM improvements beyond late childhood

1.3. Prejudice

1.3.1 Concept

The original definition of Allport (1954) underlied that prejudice is based on an inflexible and mistaken generalization made about an out-group as a whole or a group member. Brown (2010) defined prejudice as a negative attitude that people hold toward out-group members. Prejudiced behaviors are likely when people evaluate out-group members on the basis of endorsed negative stereotypes about them, and may be overtly or subtlely expressed (e.g., Conner et al., 2007; Kovel, 1970; Wolfe & Spencer, 1996; Pearson et al., 2009). Prejudice entails an evaluation including cognitive, affective and behavioral components (Al-Issa, 1997).

1.3.2 Measures of prejudice in childhood

1.3.2.1 Measures of explicit prejudice

Initial efforts to assess children's explicit prejudice (i.e., the overt expression of attitudes) focused on the development of measures of social categorization that account for the extent to which children are conscious about social categories like sex, ethnicity and socioeconomic status. Horowitz and Horowitz (1938) designed a procedure that let account for the predominant criterion by which children grouped a set of stimuli. Researchers presented drawings (e.g., three White boys, one White girl and one Black boy) that could be grouped in accordance with two categories (in this example, ethnicity and sex), and asked children to group drawings that went together and to point to the drawing that was different. Posterior social categorization procedures have included variations on the original procedure of Horowitz and Horowitz (1938), like the no imposition of a limit of groups to be made (Aboud, 1988; Davey, 1983). Together with social categorization tasks, original studies of children's explicit prejudice drew on preference tasks like the Clark Doll test (Clark & Clark, 1947). In this task, children were shown a blonde-haired and white-skinned doll and a black-haired and black-skinned doll. The experimenter made requests to assess children's preference for one of the dolls (e.g., "give me the doll you would like to play with more").

More recently, together with tasks assessing preference and rejection (e.g., Guerrero et al., 2011), researchers have made use of trait attribution tasks designed for preschoolers (the Preschool Racial Attitudes Measure; Williams et al., 1975), and older children (Multiresponse Racial Attitude measure; Doyle et al., 1988), as well as of contextualized measures of prejudice (Killen et al., 2008; Killen & Stangor, 2001). Trait attribution tasks present drawings depicting children from different ethnic groups and request to assign positive and negative attributes on the basis of children's ethnicity. Contextualized measures of prejudice present, for instance, situations where children are excluded and ask participants to justify their opinion about the exclusion. Research using contextualized tasks informs that children's reported attitudes vary as a function of contextual elements like the familiarity and relationship with the target of exclusion (Killen et al., 2002).

1.3.2.2 Measures of implicit prejudice

The first measure that was used to assess the subtle, implicit expression of prejudice (i.e., non-intentional behavior that is driven by automatically activated attitudes) was the Projective Prejudice Test; Katz et al., 1975), where White and Black children were involved in ambiguous situations that enabled positive and negative interpretations. Participants' interpretations were assumed to inform their prejudiced attitudes (e.g., if the actor is a Black child, more negative than positive interpretations of his / her behavior would be informing about prejudice toward Blacks). Posterior measures have entailed the adaptation to children of implicit prejudice measures typically used in adults. An instance is the Implicit Association Test (IAT; Greenwald et al., 1998), which assumes that the time that participants take to categorize stimuli indexes the intensity of the association between targets and attributes. In adults, it has been found that individuals respond faster to Black targets associated with unpleasant stimuli than to Black targets associated with pleasant stimuli (Greenwald et al., 1998). Child-friendly IAT versions have accounted for attitudes toward gender and usually liked objects (the Preschool Implicit Association Test (PSIAT); Cvencek et al., 2011), as well as for ethnic attitudes (Banaji et al., 2008; Baron & Banaji, 2006; Rutland et al., 2005; Sinclair et al., 2005). Other kind of measure named priming task briefly presents the target of prejudice followed by positive and negative adjectives, and addresses the speed of response to adjectives as an index of the spontaneous activation of attitudes induced by the prime (i.e., the target of prejudice; Collins & Loftus, 1975; Fazio et al., 1995). Another example of child-friendly measure is the Ambiguous Situation Task (McGlothlin et al., 2005). This task assesses the influence of ethnic categories in children's decision making processes in situations about, for instance, moral transgressions and peer relationships. It contains subtasks consisting in ambiguous drawings and perception of similarities. In the ambiguous drawings, participants are shown cards that depict the same moral transgression committed by a White and a Black child. The aim is to evaluate whether participants draw on child's ethnicity in their interpretations about the White and Black children's intentionality. Perception of similarities subtask presents participants with pairs of children that are defined according to two dimensions (ethnicity and sport interests) that can partly or totally match, and let know whether the ethnicity is predominant in comparison with the sport interests dimension in participants' similarity judgments.

1.3.3 Development of prejudice: theories and studies on developmental trajectory

The cognitive and environmental factors underpinning prejudice's origins and development have been mainly accounted for by three theoretical approaches: the Sociocognitive theory (Aboud, 1988), the Social identity theory (Nesdale & Flesser, 2001), and the Developmental intergroup theory (Bigler & Liben, 2007). These approaches differ in the importance given to cognitive and contextual factors, but share the assumption that the acquisition and development of the ability to make social categories underlie origins of prejudice in childhood (Aboud, 2008).

The Sociocognitive approach (Aboud, 1988) poses that prejudice is a phenomenon that results from the interplay of cognitive, contextual and sociocultural factors. Prejudice arises as children understand that they belong to a group. Until about 7 years of age, children have cognitive limitations to use multiple classifications and to flexibly select and change the attention focus, so they tend to stress differences between the in-group and the out-groups. At about 7 years of age, children start to pay more attention to individuals, and consequently their perception of differences between same-group members increases. In line with the Sociocognitive approach, Enesco et al. (2009) argued that cognitive rigidity and simple attribution processes underpin exacerbated prejudice in early childhood (until about 7 years of age), and that the posterior acquisition of cognitive flexibility skills may allow a more refined processing of social information.

For the Social identity theory (Nesdale & Flesser, 2001), the emergence of ethnic prejudice requires children to have acquired the notion of ethnic constancy (i.e., that ethnicity is an immutable feature. This notion is acquired at around 7 years of age). Other factors underlying the emergence of ethnic prejudice are the presence of deficits in sociocognitive skills like perspective taking and empathy, and children's personal endorsement of in-group prejudiced attitudes. Together with high in-group identification, intergroup conflict and threat perception fuel children's prejudice.

The Developmental intergroup theory (Bigler & Liben, 2007) claims that prejudices originates because children engage in constructivist cognitive processes by which they actively elaborate social stereotypes and develop affective attitudes toward salient social groups. The process of acquisition of stereotypes and affective attitudes is triggered by the categorization of individuals on the basis of psychologically salient attributes. The acquisition of classification skills enables young children to categorize people and promotes prejudice because young children tend to draw on perceptually salient features like race and gender when perceiving and categorizing people. The psychological salience of perceptual features is in turn enhanced by environmental factors (e.g., when adults use features like gender or race to label groups). Internally and externally driven processes play a role in children's prejudice acquisition, as children engage in an active cognitive processing of the information that they receive on the links between social categories and attributes.

A significant amount of research has been devoted to document developmental changes in explicit and implicit prejudice along childhood and adolescence. Raabe and Beelmann carried out a meta-analytical revision on results from 113 studies accounting for developmental changes in ethnic, racial or national prejudice in childhood and adolescence. Concerning explicit prejudice, a significant increase in prejudice, especially toward low status out-group members that are perceptually different (e.g., White children's attitude toward Black children), was found between ages 2 to 4 and 5 to 7. A significant decrease in prejudice held by high-status members (e.g., White children) toward low-status members (e.g., Black children) starts by 8 years of age and continues up to 10 years of age. In early and middle childhood, contact opportunities moderate age-related changes, so less prejudice is observed when children had contact opportunities with the out-group. Though changes beyond middle childhood entail a slight rise in prejudice by late adolescence (in individuals between 17 and 19 years of age), overall heterogeneous effects are observed beyond 10 years of age. Accordingly, results do not allow to draw a general age-related trend in adolescence, what suggest that other factors distinct to age are at play. With regard to implicit prejudice, the meta-analytical revision of Raabe and Beelmann (2011) was based on a limited number of studies (37), so less strong conclusions may be drawn. They found that, similarly to explicit prejudice, implicit prejudice rises between 2 to 4 and 5 to 7 years of age. However, no significant decrease in implicit prejudice was found between middle and late childhood, and decline is not observed until adolescence, between 11 to 13 and 14 to 16 years of age. More recently, Williams and Steele (2019) pointed that, by preschool age but not in middle childhood, positive implicit bias toward the in-group is evident in White Canadian children in a task targeting automatic associations; however, no evidence of negativity toward the out-group was found in neither of the age groups.

Empirical evidence points a slightly different developmental path of prejudice in Spanish children. Studies conducted in Spain that aimed to account for the origins of racial awareness, as well as explicitly expressed race-based preferences and rejections inform that by 3 to 4 years of age children are able to classify themselves according to racial cues, but do not take into account skin color as a criterion to sort people. At about 7 years of age children show ability to consider skin color as a classification criterion to sort people and present the strongest in-group preference and out-group rejection (Enesco et al. 1999; Guerrero, 2006; Guerrero et al., 2011). Enesco et al. (1999) also reported that children increase the allusion to ethnicity as a reason for their preference from 8 years of age on. In another study that focused on children in second, four and sixth grades, Enesco et al. (2005) reported knowledge about and endorsement of stereotypes toward different ethnic groups on the part of

Spanish and Latin American children living in Spain. Concerning stereotype endorsement (i.e., children's informed level of agreement with stereotypes held by society), they found a significant age-related decrease in the agreement with negative stereotypes attributed to Romany people between second and sixth grades. Altogether, results suggest that the rise and decline of explicit prejudice in Spanish children is somehow delayed in comparison with the developmental trajectory shown by children from traditional multi-ethnic countries.

Evidence on developmental trend of Spanish children's subtle, implicit expression of prejudice is still limited. Callejas et al. (2011) designed a computerized, decision-making task that depicted a simulated game dynamic with children from the in-group (i.e., Spanish) and two out-groups (Latin-American and Moroccan). In this procedure, participants between 7 and 8 years of age and between 12 and 13 years of age were requested to decide whether a rule violation committed by a player was an intentional or unintentional mistake, and to administer a sanction to the player that varied in severity. Results showed that participants from both age groups sanctioned significantly more the Latin-American player than the Spanish player, so no developmental decrease in this biased behavior was found; moreover, no ethnicity-related effect on intentionality attribution to rule violation was found. In a recent study (Chas et al., 2018) that focused on a special type of prejudice named dehumanization (i.e., the consideration that out-group members are less human than in-group members; e.g., Haslam, 2006), it was utilized an implicit measure of prejudice toward Arab people that, similarly to the IAT, accounted for the response latency in a task that combined compatible trials (i.e., trials where Arab names and animal-related words were to be performed by pressing the same key) and incompatible trials (i.e., trials where Arab names and human-like words were answered by pressing the same key). By administering the task to children between 10 and 13 years of age, researchers did not found age-related decrease in the latency response pattern (i.e., participants at all ages were quicker in compatible than incompatible trials). Accordingly, studies with Spanish children, though are still scarce, point the presence of implicit bias by middle childhood and the absence of developmental changes at least until early adolescence, what is more in consonance with the meta-analysis reported by Raabe and Beelmann (2011).

1.4. The relation between executive function and theory of mind in childhood

Two accounts have been proposed to explain the relation between EF and ToM observed along childhood. Within the emergence account, it has been proposed that EF underpins ToM's origins and development (Russell, 1996), but also that ToM plays a role in EF development (Perner & Lang, 1999, 2000). The expression account underlines that there is a superficial link between EF and ToM that is due to the EF demands that ToM tasks pose. Thus, the role of EF is limited to enable the use of ToM skills in mentalizing tasks (e.g., Perner et al., 2002b).

As argued by Devine and Hughes (2014), empirical evidence provides support for both frameworks. Devine and Hughes (2014) reviewed 102 studies on the link between EF and ToM in preschool-age children (from 3 to 6 years of age), and found that whereas early EF predicted later ToM performance, the inverse relation (i.e., early ToM predicting posterior EF performance) was not significant. The effect extended across cultures and persisted after controlling for age and verbal ability. Moreover, they found that the degree of the association between EF and ToM depends on the type of false belief task used to assess ToM. In middle childhood, Devine et al. (2016) examined concurrent and longitudinal associations of EF with ToM and social competence, by collecting data in two time points (concretely, at about 6 years of age in time 1 and at about 11 years of age in time 2). In their data, EF and ToM kept concurrent but no longitudinal associations. By making use of a cross-lagged longitudinal design where data from 9.5 to 10.5 year-old children were collected in three time points (concretely, with an approximate 6-month interval between assessments), Lecce et al. (2017) reported that working memory in times 1 and 2 predicted later ToM in times 2 and 3 respectively. By focusing in a sample of children of about 10 years of age, Lecce and Bianco (2018) examined whether working memory skills predicted ToM fostering by training. As expected, they found that individual differences in working memory moderated the extent to which children capitalized on ToM training. Beyond childhood, Vetter et al. (2013) found that, in adolescents and young adults, individual differences in inhibition predicted performance in affective ToM.

1.5. The regulation of prejudice in adults and children: roles of executive function and motivation

Legislations of modern societies encourage non-discrimination and egalitarianism, what entails that prejudiced behaviors are socially disapproved. Most people are motivated to behave in accordance with social standards and thus to unfold socially approved behavior. In the context of ethnic / racial prejudice, this prosocial motivation may conflict with people's implicit prejudiced attitudes that automatically arise and may exert influence on people's behavior in interracial interactions (Amodio, 2014).

Researchers have drawn on cognitive control models in order to formulate hypotheses concerning the role of cognitive control (and thus of cognitive skills encompassed by the concept of EFs) in prejudice regulation. On the basis of the conflict monitoring theory (Botvinick et al., 2001), Amodio et al. (2008) argued that when people detect the conflict between their attitudes and their goal to unfold prosocial behavior, they may engage cognitive control in order to avoid the influence on behavior of automatically activated implicit prejudiced attitudes. Bartholow et al. (2006) claimed that prejudice regulation involves the initial detection of the conflict between the automatic prejudiced and the controlled non-prejudiced responses, and the posterior recruitment of cognitive resources for response inhibition and adjustment. This claim fits with the cognitive control proposal made by Dosenbach et al. (2008). Moreover, setting from the process dissociation procedure (Jacoby, 1991), Payne (2001, 2005) argued that control of prejudiced responses is the result of the contribution of both automatic and controlled processes to behavioral regulation. Thus, stereotype-consistent responses would result from automatic stereotype activation together with unsuccessful cognitive control.

The vast majority studies on cognitive control applied to prejudice regulation have been carried out in adults and have accounted for neural and / or behavioral indices of cognitive control. In one of the first studies about this issue, Amodio et al. (2004) tested the role of neural activity signaling the need for behavioral adjustment in the expression of implicit prejudice. With this aim, they administered a version of the Weapons Identification task on the basis of Payne's (2001) procedure. In this priming task, participant were presented faces from the target social groups (concretely, White and Black faces) and were asked to indicate if the subsequent presented stimulus was a gun or a tool. Neural activity associated to error detection (specifically, activity in the error related negativity (ERN) electrophysiological component) was utilized as index of conflict detection and subsequent cognitive control engagement for behavioral regulation. As Amodio et al. (2004) expected, participants showed implicit bias in performance, as they were faster in tool trials preceded by White than in tool trials preceded by Black faces, as well as in gun trials preceded by Black faces than in gun trials preceded by White faces. Moreover, participants committed more errors in tool trials preceded by Black faces than in tool trials preceded by White faces. As evidence on the role of neural activity in signaling the need for behavioral regulation, Amodio et al. (2004) also found that greater ERN (i.e., more negative ERN peak amplitude) in erroneously answered tool targets following Black faces was associated with increased accuracy in subsequent trials of that condition.

Other studies using functional Magnetic Resonance Imaging (fMRI) technique have reported the neural basis of conflict monitoring / detection and behavioral adjustment functions in prejudice regulation. In accordance with evidence, whereas activity in anterior cingulate cortex (ACC) indexes successful inhibition of prejudice due to conflict detection and the indication of the need of implementing cognitive control, activity in lateral prefrontal cortex (lPFC) informs conflict processing and implementation of behavioral control (Amodio, 2014).

For instance, Beer et al. (2008) found that whereas ACC activity associated with the ability to detect the non-prejudiced response in those trials of the IAT eliciting implicit automatic associations, activity in dorsolateral prefrontal cortex was related to better control of the influence of stereotypes on behavior. Fourie et al. (2014) reported that ACC activity increases in response to false feedback informing about prejudiced behavior in an IAT. Moreover, activity in a region of the lPFC linked to behavioral inhibition (the inferior frontal gyrus) in respose to Black faces suggests that the mere exposition promotes the engagement of cognitive control to inhibit prejudiced reactions (Knutson et al., 2007).

Together with studies that account for neural activity as an indicator of cognitive control functions involved in the regulation of prejudice, cognitive control depletion studies (e.g., Richeson & Shelton, 2003, Richeson & Trawalter, 2005; Richeson et al., 2005; Bartholow et al., 2006) and studies that consider the potential influence of motivation on cognitive control engagement (e.g., Amodio et al., 2008; Payne, 2005) provide further support for the link between cognitive control and prejudice regulation. Cognitive control depletion account assumes that interracial interactions demand cognitive control resources and then impair performance in subsequent neutral cognitive control tasks. In line with this assumption, for instance, Richeson et al. (2005) observed cognitive control impairment after an interracial interaction, but not after an intraracial interaction. Concerning the interplay between motivation and cognitive control, literature suggests that both concern about not appearing as prejudiced to others (i.e., external motivation) and personal endorsement of egalitarian values (i.e., internal motivation) link to the extent to which people engage cognitive control to avoid prejudiced attitudes. For instance, Payne (2005) found that both enhanced inhibitory control skills and concern about acting prejudiced correlated with adults' better control of automatically activated implicit attitudes in several implicit prejudice tasks. By focusing in low-prejudiced adults, Amodio et al. (2008) found that sources of motivation to control prejudice associate with the efficacy to regulate prejudice. Specifically, people who were primarily internally motivated to control prejudice were better at prejudice regulation than primarily externally motivated people and than people with mixed internal and external motivations.

In comparison with evidence on the link between cognitive control and prejudice regulation in adults, much scarcer research has examined this association in developmental samples. Developmental studies have pointed to the role of categorization skills in the emergence of in-group and out-group attitudes (e.g., Aboud, 2008; Enesco et al., 2011; Guerrero et al., 2011; Patterson & Bigler, 2006), but have barely examined whether individual differences and / or developmental changes in cognitive skills contribute to prejudice regulation and / or decline. Enesco et al. (2009) posed that increasing age-related cognitive flexibility would entail refinement of children's ability to construct flexible social categories and in turn might play a role in the developmental decline in prejudice. Furthermore, research is needed to address whether age-related decreases in prejudice can be attributed to enhanced children's ability to flexibly use social categories or to children's improved ability to inhibit their prejudiced attitudes (Enesco et al., 2005). Thus far, few studies (Bigler & Liben, 1993; Lapan & Boseovski, 2015) have attempted to analyze the link between behavioral indices of inhibitory control and cognitive flexibility skills and prejudice.

Moreover, to date, no study has accounted for neural activity indexing cognitive control of prejudice. By focusing on Euro-American children between 4 and 9 years of age, Bigler and Liben (1993) analyzed the relation between cognitive flexibility (indexed by classification skills) and prejudice (indexed by a trait attribution task), as well as the influence of cognitive flexibility and prejudice in the recall of trait-related or interaction-related stereotype-consistent and stereotype-inconsistent information about traits and social interactions. Though the correlation between cognitive flexibility and prejudice did not reach significance, results showed that children that presented better sorting skills and expressed less prejudice in the trait attribution task were also better at remembering information from stories containing stereotype-inconsistent information about interracial interactions. More recently, Lapan and Boseovski (2015) examined whether individual differences in inhibitory control and ToM skills play a role in prejudiced attitudes of 3-to-6-year-old children toward children from stigmatized groups (concretely, obese children, children with foreign accents, and children with physical disabilities). In their results, inhibitory control did not contribute to predict children's prejudiced attitudes. Findings of Lapan and Boseovski (2015) concerning ToM will be presented in the next section.

1.6. Theory of mind and prejudice: studies in adults and children

In adult samples, evidence on the putative link between ToM and prejudice mainly comes from intervention studies based on intergroup contact that aim to analyze which factors underpin the decrease of prejudice (Pettigrew & Tropp, 2008; Vescio et al., 2003). Studies about intergroup contact highlight the role of perspective-taking and empathy; those skills are related to ToM, in the extent to which perspective-taking entails the only usage of ToM (Dumontheil et al., 2010) and empathy contributes to ToM (e.g., Shamay-Tsoory et al., 2009, 2010). For instance, studies show that adults improve out-group attitudes if they are encouraged to adopt the perspective of out-group members (Vescio et al., 2003). Moreover, a meta-analytical revision showed that gains in empathy and perspective-taking mediate the relation between intergroup contact and prejudice decline (Pettigrew & Tropp, 2008).

In children, studies have accounted for the role of individual differences in ToM and empathy skills, and for how factors like in-group norms and prejudice's accountability modulate the role of ToM and empathy skills in prejudice or in concepts related to prejudice like the confrontation of stereotypes and the expression of liking toward out-group members (e.g., Fitzroy & Rutland, 2010; Mulvey et al., 2016; Nesdale et al., 2005). Preschool-age children that perform better false belief tasks evaluate more positively peers that confront gender stereotypes and are also more likely to propose the engagement of the group in a non-stereotypic activity (Mulvey et al., 2016). In a sample of 5-to-12-year-old White children, Nesdale et al. (2005) found that children higher in emotional empathy expressed more liking for out-group Pacific Islander children. Moreover, there was an interplay between in-group's norms and emotional empathy, such that when children were informed that the in-group endorsed exclusion of the out-group, emotional empathy did not account for liking; in contrast, if the in-group norm entailed inclusion, liking for out-group members increased as emotional empathy increased. Fitzroy and Rutland (2010) investigated the role of individual differences and developmental changes in children's experience with social emotions and ability to make second-order inferences about feelings in a situation depicting a social transgression. They also manipulated prejudice's accountability (concretely, some children were informed that their responses would be made public, and the remaining children were told that responses would remain private). By comparing performance of two age groups (specifically, 6-to-7- and 8-to-9-year-old children), they found decreased expression of explicit prejudice in older children that scored lower in social emotions and were informed that their responses to the explicit prejudice measure would be made public. Moreover, individual differences modulated the effect of accountability manipulation, such that whereas children with higher social emotion and ToM scores showed decreased prejudice irrespectively of its accountability, children with low ToM scores only decreased prejudice when informed that responses would be made public. In the already commented study of Lapan and Boseovski (2015), whereas EF did not play a significant role in prejudice, individual differences in ToM were relevant. Specifically, children with higher ToM skills expressed more favorable or neutral trait attributions and predicted helping behavior on the part of characters from stigmatized groups to a greater extent than low-ToM children.

1.7. Cognitive training: definition, modalities and transfer effects

Evidence informs it is possible to improve cognitive skills by making use of structured programs based on intensive and repetitive practice entailing the recruitment of brain networks that underpin the trained cognitive skills (e.g., Olesen et al., 2004; Hsu et al., 2014). According to Simons et al. (2016), the training can improve the trained cognitive skills (i.e., it can have a near transfer effect), or can impact on non-trained skills and / or on tasks that substantially differ in content (i.e., it can have a far transfer effect) but share the same cognitive processes and / or neural basis (Morrison & Chein, 2011; Dahlin, 2013).

As argued by Simons et al. (2016), cognitive training literature reports near transfer effects to a greater extent than far transference from the trained cognitive domains to related but untrained cognitive domains. We focus here on near and far transfer effects of training modalities implemented to foster attention and EFs, and of those modalities aiming to improve ToM skills. Training procedures that have focused on working memory fostering, like the Cogmed Working Memory Training program (Klinberg, 2010), and the n-back training (Jaeggi et al., 2011) inform about near transfer to working memory and some far transfer to domains like fluid intelligence, reasoning and academic achievement (e.g., Bergman-Nutley et al., 2011; Bergman-Nutley & Klingberg, 2014; Jaeggi et al., 2011). In children and adolescents, cognitive flexibility training that makes use of switching tasks reports foster of the trained domain and far transfer to processing speed and working memory (Zinke et al., 2012), as well as to inhibitory control (Dörrenbächer et al., 2014). Procedures aiming to train several components of attention and EF report preschool-age children's improvements in fluid intelligence (Pozuelos et al., 2019; Rueda et al., 2005, 2012), as well as increased efficiency of executive control of attention and conflict resolution indexed by neural activity (Pozuelos et al., 2019; Rueda et al., 2012). Some near transfer, as well as far transfer to mathematical reasoning has been found in preschoolers engaged in working memory and inhibitory control training (Blakey & Carroll, 2015). Efforts to integrate cognitive training in the school curriculum have informed that preschoolers engaged in cognitive training activities that promote cooperation with classmates and make use of teacher scaffolding improve EF and reasoning skills in the short term and show better academic achievement in the long term (Blair & Raver, 2014).

Concerning effects of ToM training modalities, research from early childhood to late adolescence consistently reports the fostering of the trained ToM skills (Hofmann et al., 2016). For instance, ToM training procedures based on metacognitive scaffolding (Carbonero Martín et al., 2013) and sentential complement constructions (Hale & Tager-Flusberg, 2003) report preschool-age children's fostered performance in first-order false belief tasks involving unexpected content or transfer. Near transfer to children's advanced ToM skills applied to make contextually-relevant mental state inferences is widely reported in middle childhood (Bianco & Lecce, 2016; Bianco et al., 2016; Lecce et al., 2014). In comparison with evidence on near transfer, we know relatively very little about far transfer effects of ToM training. In preschool-age children, some evidence points that improvement of mentalizing skills transfer to cognitive flexibility (Kloo & Perner, 2003) and social competence (Ding et al., 2015). Certain transfer to non-trained ToM is reported in middle childhood (Bianco et al., 2016).

1.8. Aims, research questions and hypotheses

The main aim of the present dissertation was to analyze the relation between cognitive skills and explicit and implicit forms of prejudice along childhood. Given that children's intelligence covariates with cognitive skills (e.g., Arffa, 2007; Carlson & Moses, 2001), and that we found some age-related differences in children's intelligence scores, the composite intelligence quotient (IQ) score was included as a control variable in analyses on individual differences. Together with analyses focusing on individual differences, the relation between cognitive skills and prejudice was also explored in terms of developmental changes. Specifically, we intended to shed light on the cognitive skills that are associated with and predict children's prejudice regulation and decline. Moreover, we investigated whether prejudiced attitudes could be reduced by fostering children's cognitive skills that underpin prejudice's regulation.

This dissertation also aimed to provide further evidence on other issues, like the developmental trajectories of EF, ToM and prejudice, the relation between EF and ToM in childhood, and the neural activity linked to cognitive control and prejudice regulation in middle childhood. In accordance with the aims, we pose the research questions in the next paragraphs.

1.8.1 Do individual differences in executive function, theory of mind and motivation relate to prejudice?

In order to answer this question, we carried out two cross-sectional studies where children from early, middle and late childhood age groups participated. Preschoolers and third-grade children took part in the first study. We aimed to account for the contribution of EFs, as well as of cognitive and affective ToM components to children's regulation of explicit prejudice toward Romany children. The second cross-sectional study included a third age group of sixth-grade children, and administered children a wider battery of ToM tasks, a computerized measure of implicit prejudice, and a measure about children's motivations to control prejudice. In light of evidence with adults (e.g., Amodio et al., 2004; Pettigrew & Tropp, 2008) and children (e.g., Bigler & Liben, 1993; Lapan & Boseovski, 2015), we hypothesized that individual differences in EF and ToM would associate with explicit and implicit prejudice, so that children with higher EF and / or ToM skills would score lower in prejudice measures. We also expected that motivation to control prejudice would contribute to prejudice regulation, as shown in studies with adults (e.g., Devine et al., 2002; Payne, 2005). We explored the roles of internal and external motivations to control prejudice. In order to account for possible developmental peculiarities, we also explored in each age group the link between cognitive skills and prejudice, and between motivation and prejudice, but we did not pose hypotheses in this regard.

1.8.2 Is there a significant relation between executive function and theory of mind in early and middle childhood?

This question was addressed in the first cross-sectional study. We expected to replicate the previously reported significant relation between EF and ToM in both early (Carlson et al., 2015; Devine & Hughes, 2014) and middle childhood (Lecce et al., 2017).

1.8.3 Do cognitive skills and prejudice present developmental changes from early to late childhood?

We accounted for this question in the two cross-sectional studies. In light of previous findings (e.g., Best & Miller, 2010; Carlson & Moses, 2001; Devine & Hughes, 2013; Enesco et al., 1999, 2005; Raabe & Beelmann, 2011; Vetter et al., 2013), we expected to find significant age-related improvements in EF and ToM along childhood. Concerning the developmental trajectory of prejudice, data obtained from Spanish children somehow suggest that children's explicit negative out-group attitudes arise and decline slightly later than in the case of children from countries traditionally inhabited by population coming from diverse ethnic origins (e.g., Enesco et al., 2005). Then, we regarded the possibility that explicit prejudice decline would not be evident until late childhood. Conceivably, implicit prejudice might also present a delayed developmental path.

1.8.4 Are electrophysiological brain activity and behavioral performance modulated by the combination of executive function demands?

Concretely, we aimed to shed some light on dynamics of cognitive control by using a task that demanded diverse cognitive control functions. We focused on middle childhood because in this stage the structure of EF becomes increasingly complex and diverse (e.g., Huizinga et al., 2006; Lehto et al., 2003). We investigated electrophysiological brain activity underlying task-set maintenance and adjustment demands in a version of the Dots task (Davidson et al., 2006). We specifically measured activity in N2 and P3 ERPs as indices of the involvement of inhibition and flexibility skills. We expected that mean amplitude of N2 and P3 components and behavioral performance would be modulated by the manipulations of the task. Thus, increased mean amplitudes and poorer performance in terms of accuracy and reaction time were expected in the most difficult conditions. Specifically, we hypothesized greater difficulty when performing spatial incompatible than spatial compatible responses, when performing a condition that combined spatial compatible and spatial incompatible responses in comparison with single-task conditions, and when performing rule-switching trials than rule-repeated trials. Given that the global context affects performance in a single trial (Davidson et al., 2006), and that previous findings inform that the greater difficulty to perform spatial incompatible than spatial compatible responses attenuates if spatial compatible and spatial incompatible trials are presented in intermixed order (Vu & Proctor, 2004), we expected that the combination of inhibition and cognitive flexibility demands posed by the condition combining two response rules would impact children's performance and neural activity even in trials requiring the easiest, spatial compatible responses, and as a result differences in performance and neural activity between trials requiring spatial compatible responses and those ones requiring spatial incompatible responses would be attenuated. When exploring the association between behavioral indices of conflict resolution and cognitive flexibility and mean amplitudes in N2 and P3 locked to correct targets, we assumed that N2 amplitude in childhood indexes the extent to which children monitor performance and detect the need of carry out behavioral adjustments by implementing cognitive control (Best & Miller, 2010). Accordingly, we expected that more negative N2 amplitudes would associate with better performance in terms of accuracy. As the literature posits that more positive P3 amplitudes associate with better processing and allocation of task-relevant cognitive resources in childhood (e.g., Brydges et al., 2014), we expected a positive association between P3 amplitude and accuracy. We also explored the link of N2 and P3 with reaction time.

1.8.5 Is there a relation between indices of electrophysiological brain activity and behavioral performance linked to cognitive control and implicit prejudice regulation?

We mainly aimed to address the role played by individual differences in electrophysiological indices of cognitive control in relation to implicit prejudice in middle childhood. Moreover, we also accounted for the link between behavioral indices of cognitive control and implicit prejudice. We utilized the electrophysiological and behavioral indices of conflict monitoring, inhibition and response selection/flexibility obtained from the administration of a version of the Dots task (Davidson et al., 2006) to a sample of third-grade children. On the basis of evidence suggesting that trust may be an indirect index of prejudice (e.g., Freeman et al., 2016), we accounted for children's implicit prejudice toward Romany peers by using a computerized Trust game that assessed participant's trust patterns when playing with in-group Caucasian and out-group Romany members. We expected that N2, and ERP that indexes conflict processing activity and the subsequent engagement of cognitive control (Amodio et al., 2008; Bartholow et al., 2006) would associate with implicit prejudice (i.e., a more negative N2 was expected to link to better regulation of implicit prejudice). Although studies with adult samples have not addressed the role of P3 in prejudice regulation, we explored its role here. In the extent to which literature reports that P3 is involved in response inhibition (e.g., Brydges et al., 2014; Gajewski & Falkenstein, 2013), in task-set switching (e.g., Brydges et al., 2014; Duan & Shi, 2014; Gajewski & Falkenstein, 2011), and in updating and behavioral adjustment (Dai et al., 2013; Donchin & Coles, 1988), and that more positive P3 amplitude indexes better cognitive control

(Brydges et al., 2014; van Dinteren et al., 2014), we expected that more positive P3 amplitude would associate with less implicit prejudice. Concerning behavioral performance, we made a similar prediction to that of the cross-sectional studies: better performance (i.e., increased accuracy and efficiency in conflict resolution and cognitive flexibility) would associate with less implicit prejudice.

1.8.6 Can prejudiced attitudes be reduced by fostering children's cognitive skills underpinning prejudice's regulation?

In this regard, we analyzed whether cognitive training improves children's explicit and implicit attitudes toward Romany children. In order to address this research question, we implemented two modalities of cognitive training (specifically, and EF training and a ToM training) in a sample of third-grade children. We carried out pre and post assessment of cognitive skills and prejudice, and assessed motivation to control prejudice in the pre session. We expected that both modalities of training could potentially impact on both explicit and implicit prejudice. We also explored whether motivation to control prejudice moderated the extent to which trained children showed a decline in explicit and implicit prejudice.

1.8.7 Does cognitive training present near and far transfer effects to cognitive skills?

We aimed to analyze whether the training improves the trained but also the non-trained cognitive skills. This research question was addressed by measuring effects of both training modalities on EF, ToM and intelligence. We expected to find near transfer effects, such that the EF training would improve EF, and the ToM training would improve

ToM. On the basis of previous findings (e.g., Kloo & Perner, 2003; Pozuelos et al., 2019), we expected transfer from the EF training to fluid intelligence and to ToM; in contrast, we did not expect transfer from ToM training to intelligence. We also examined whether the ToM training improved EF.

Chapter 2.

Children's individual differences in executive function and theory of mind in relation to prejudice toward social minorities

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2.1 Introduction

In an increasingly globalized world, we live and interact with people coming from diverse ethnic, social and cultural origins. Stereotypes and prejudices toward particular social groups may bias these interactions. In studies with adults, there is evidence that some cognitive skills may help promoting healthy social relationships based on an egalitarian and non-discriminatory behavior (e.g., Bartholow et al., 2006; Lapan and Boseovski, 2015). In this context, abilities necessary to implement goal-directed behavior and understanding others' thoughts and feelings may strengthen positive interracial interactions. The present study pretends to fill the gap in the existing developmental literature concerning the role played by cognitive skills in the developmental course of prejudice in childhood. The main goals of the current study were: a) to examine developmental changes in executive function (EF), theory of mind (ToM) and prejudice, and b) to test relationships between individual differences in EF, ToM and prejudice in childhood. Moreover, we explored the age-related contributions of those cognitive skills to the expression of prejudice.

2.1.1 Executive function, theory of mind and prejudice: conceptualization

Different constructs have been proposed to define cognitive skills underlying behavioral regulation, being EF, executive control and cognitive control examples of them (Diamond, 2013). EF refers to cognitive processes underlying the regulation of thoughts and behavior. EF comprises cognitive flexibility (shifting between rules and mental sets), working memory (WM; updating), and inhibitory control skills (Friedman and Miyake, 2017; Miyake and Friedman, 2012). EFs conform the basis for higher-order cognitive skills contributing to superior functions such as planning, reasoning, and problem-solving (Diamond, 2013) and for what is known as self-regulation (Rueda, Posner, and Rothbart, 2011). A quite established account of executive control considers that two dissociable but intertwined components intervene to implement cognitive control that supports behavior regulation (Bartholow et al., 2006). On the one hand, a conflict detection system, involved in steadily supervision of the ongoing action, detects and signals the need for behavioral adjustment in relation to current goals. On the other hand, a regulatory system directly accounts for behavioral regulation by activating the planned response while inhibiting non-desirable competing responses. Complementarily, it has been shown that, at the neural level, behavior regulation results from two brain networks working with relative independence (Dosenbach et al., 2008; Petersen and Posner, 2012). The cingulo-opercular network is involved in task set maintenance, while the frontoparietal network is engaged in the flexible adjustment of behavior on a trial-by-trial basis. In the present study, we follow Friedman and Miyake's framework with the aim of disentangling the distinctive contributions of WM, inhibition and cognitive flexibility to behavior regulation in the context of the expression of prejudice.

Concerning ToM, it is a social cognition skill that refers to the ability to attribute mental states to oneself and others (Premack and Woodruff, 1978). It enables people to reason about mental states of other people, as well as to infer the causes of people's behavior on the basis of the inferred mental states (Wimmer and Perner, 1983). A relatively recent theoretical approach has argued the need of distinguishing between cognitive and affective mental states (Shamay-Tsoory et al., 2010). The relevance of this approach lies in that it has implications for ToM concept and development. Cognitive ToM is the ability to infer people's beliefs and knowledge. It is also a pre-requisite for affective ToM. Indeed, ascribing an emotion requires a previous understanding of the belief behind that emotion (Miller, 2013). Affective ToM is the ability to infer people's emotions, and is supported by cognitive and affective empathy. Support for the cognitive-affective ToM division comes from studies finding dissociable brain structures for cognitive and affective empathy (Dapretto et al., 2006; Frith and Frith, 2003; Samson et al., 2004; Schulte-Rüther et al., 2007; Shamay-Tsoory et al., 2009), and for cognitive and affective ToM (Shamay-Tsoory and Aharon-Peretz, 2007). Sebastian et al. (2012) showed evidence that affective ToM is more complex and presents a more protracted development than cognitive ToM, that is, whereas adolescents made more errors in affective ToM tasks than did adults, no differences were found in cognitive ToM performance.

Finally, in intergroup relations, people unfold expectancies in the form of stereotypes about other's behavior. In fact, stereotypes are often used to judge other people's actions and they underlie the emergence of negative attitudes towards others because their group membership, that is, the emergence of prejudice (Brown, 2010). Different theories have accounted for the cognitive and environmental factors that underlie the origins and development of prejudice (the *Sociocognitive* approach: Aboud, 1988; the *Social identity Theory* approach: Nesdale & Flesser, 2001; and the *Developmental Intergroup Theory*: Bigler & Liben, 2007). Although they differ each other in the importance given to cognitive and contextual factors, they all claim that prejudice originates as an event linked to the development of skills to group people as a function of social categories.

2.1.2 Regulating prejudice expression: the role of executive function and theory of mind

Egalitarian and non-discriminatory behaviors are encouraged and considered socially desirable. Thus, despite most people may be motivated to show prosocial and non-discriminatory behavior during an interracial interaction, they may simultaneously experiment a conflict between their implicit negative beliefs and their motivation to have a non-biased behavior toward people of the outgroup (Amodio, 2014). In this case, people may need to draw on cognitive control as a regulatory mechanism for conflict resolution. Consequently, the engagement of cognitive control in prejudice regulation conveys the executive function (EF) role in prejudice.

Research on adults has shown that better skills for monitoring the conflict elicited by stereotype-consistent trials (Amodio et al., 2008) and overriding prejudiced impulsive responses (Beer et al. 2008; Payne, 2005) prevent people from expressing automatic bias while performing implicit stereotyping tasks like the Implicit Association Task (IAT; Greenwald et al., 1998). Research manipulating self-regulation demands posed by interracial interaction and including other manipulations that induce cognitive control depletion give additional support to the EF role in prejudice (Bartholow et al., 2006; Richeson and Shelton, 2003; Richeson and Trawalter, 2005; Richeson et al., 2005). Importantly, Bartholow et al. (2006) found that experimenting greater conflict during stereotype-consistent trials in a go-stop stereotype inhibition task was associated with more inhibition errors when stereotype-consistent associations were presented and it was required to withhold the answer. On the contrary, participants that implemented cognitive control in greater extent were better at inhibiting stereotype-consistent answers.

Concerning children, empirical evidence linking EF skills and regulation of prejudice is much scarcer. As a matter of fact, research has mainly focused on the role played by the emergence of early categorization skills in the preschool period in the formation of ingroup and outgroup attitudes (e.g., Aboud, 2008; Enesco et al., 2011; Guerrero et al., 2011). In contrast, significant less research has been devoted to link cognitive skills to reduced racial bias. One instance of these few research is the one by Bigler and Liben (1993). They studied classification skills' involvement in how Euro-American children aged 4 to 9 years process race-related information. Children's task was to recall the content of stories that were stereotype-consistent or inconsistent with respect to attributed traits or to the nature of social interactions (intraracial vs. interacial). As predicted, recall for stereotype-inconsistent stories was greater for children that expressed less racial stereotypes and displayed more flexible sorting skills. However, in a more recent study, Patterson and Bigler (2006) found no evidence of classification skills being linked to intergroup attitudes in the preschool period.

Thus, the above-cited literature supports the role of EF in adults' prejudice regulation, but it is still limited in providing evidence about EF's involvement in the regulation of prejudice on children samples. Concerning the relationship between theory of mind (ToM) and prejudice, research on adults has mostly linked empathy, which is a ToM-related skill, to prejudice. Studies with adults evidence that people improve attitudes towards outgroups if they are encouraged to use their

ToM skills and to take the perspective of outgroup members (e.g., Vescio, Sechrist, and Paolucci, 2003). Pettigrew and Tropp's (2008) meta-analytical revision confirmed that increased empathy and perspective-taking towards the outgroup mediates the relationship between intergroup contact and decrease of prejudice. In the same line, but with children, better false-belief understanding has been linked to preschoolers' more positive attitudes towards peers that confront gender stereotypic norms (Mulvey et al., 2016). In a sample of White children belonging to two age groups (6-to-7- and 8-to-9-year-old children), Fitzroy and Rutland (2010) found that higher abilities to perform a second-order false belief task about emotions following a social transgression (Abrams et al., 2009) were related to children's better control of explicit prejudice irrespective of whether the ingroup norm was for or against prejudice expression. Another ToM-related skill, the so-called self-presentation ToM, is understood as the concern about and regulation of the impression caused on other people, and has been linked to the tendency to make positive trait attributions to outgroup members (Aboud, 2013; Nesdale, 2013; Rutland, 2013). The research by Lapan and Boseovski (2015) is, to our knowledge, the only study that analyzed the role of skills related to both EF and ToM in trait attributions and behavioral predictions held by children 3 to 6 years of age towards typical peers and peers belonging to certain stigmatized social groups (obese children, children with disabilities, and children with foreign accents). They found that only ToM played a role in assessments of characters from stigmatized groups. Better ToM skills were related to more favorable or neutral trait attributions, as well as to more predictions of helping behavior on the part of characters from stigmatized groups.

2.1.3 Executive function and theory of mind: development and developmental relationships

Different EF components present distinct developmental trajectories. The development of inhibitory control and cognitive flexibility, as well as the contribution of WM development to both abilities, have been studied by Davidson et al., 2006. In their cross-sectional study, different age groups ranging from 4 to 13 years old children and adolescents, as well as a group of 26-year-old young adults were tested on a battery of EF tasks tapping WM, as well as inhibition and cognitive flexibility under different WM demands. In the Dots task, inhibitory control and cognitive flexibility were assessed under high WM demands. In each trial of the Dots task, a single (stripped or gray) dot appeared on the left or on the right side of the screen. Participants' task was to press as quickly and accurately as possible the same- or opposite-side key to the dot location. Three blocks of 20 trials each were presented. The first two blocks were simple, with one answering rule each. The first simple block required a congruent response, as participants were instructed to press same-side key to the dot location. In the second block, opposite-side (i.e., incongruent) response was required. The third, mixed block, randomly presented 20 congruent and incongruent trials, thus requiring to switch back and forth between congruent and incongruent answering rules. The congruency effect, also called the spatial incompatibility effect (Craft and Simon, 1970), compares performance in congruent and incongruent trials. Thus, it accounts for inhibitory control skills through the cost of inhibiting a dominant response (i.e., press same-side key) when the rule is to press opposite-side key. Cognitive flexibility informs about the differences between simple and mixed blocks, thus comparing performance in single-rule with switching-rule contexts. Results revealed that when inhibitory control is exerted under high memory demands, adults did not show differences in accuracy and reaction time (RT) between congruent and incongruent trials. In children, a reduction of the congruency effect is observed when using accuracy as dependent variable, but not when measured through RT. Regarding cognitive flexibility, a developmental tradeoff tendency between accuracy and RT was found. Accuracy significantly increases from 10 years old children on, as well as RT. This result indicates that, with the development, there is a tradeoff between RT and accuracy in order to preserve a good performance in tasks assessing cognitive flexibility under WM demands.

The findings of Davidson et al. (2006) are in accordance with other studies showing the development of inhibitory control during preschool years (Best and Miller, 2010), as well as further development between early childhood and young adulthood when using fine-grained computerized tasks to assess inhibitory control (e.g., Brocki and Bohlin, 2004; Steinberg et al., 2008). In the same vein, there is evidence of a protracted development of cognitive flexibility, spanning from childhood to early adulthood (e.g., Cepeda et al., 2001; Gupta et al., 2009; Roberts et al., 1988; Zelazo et al., 2003). On the other hand, studies using WM tasks requiring manipulation and updating of information suggest that WM improvement spans from early childhood to middle adolescence (Gathercole et al., 2004; Luciana et al., 2005) and continues until young adulthood (Luciana and Nelson, 1998). Thus, whereas inhibitory control greatly improves in early childhood, WM and cognitive flexibility appear to present a more protracted and linear development (Best and Miller, 2010).

Concerning ToM, developmental studies initially focused on preschoolers' false-belief understanding, that is, their capacity to understand that people can have wrong beliefs about the world (Miller, 2013). For instance, Wimmer and Perner (1983) found that by 4 years old children started to predict above chance a character's searching behavior in a transfer task where the character's belief about the location of an object was wrong. Moreover, by 5 years old, children were able to infer a character's intention of lying in a situation where different characters have conflicting goals. More recently, Wellman and Liu (2004) informed of a progressive development of understanding the desires, diverse beliefs, false beliefs, beliefs on emotions and real-apparent emotions distinction throughout the preschool period. At age of 3, children consistently start to show understanding of diverse desires and diverse beliefs. Children improve substantially performance on false beliefs when they are 4 years old, and it is at 5 years old when children start to be consistently able to distinguish between real and apparent emotions. However, the understanding of ToM development cannot be constrained to the preschool period, as mastery of false belief understanding does not fully account for ToM development. Other researchers analyzed ToM development beyond the preschool period by using second-order false belief tasks, which test the awareness that someone can hold a false belief about, for instance, another person's belief. Improvements in the ability to make second-order inferences are observed by 7-8 years old (Perner and Wimmer, 1985; Miller, 2013). It has also been suggested that ToM advances in middle childhood may inform children's increased flexibility to apply their ToM skills when reasoning about mental states involved in complex social interactions (e.g., Apperly et al., 2011; Devine et al., 2016; Miller, 2009; Perner, 1988). Moreover, conceptual development is probably underpinning ToM improvements as well. In this vein, there is evidence of development of ToM concepts linked with social reasoning and reasoning about ambiguity along middle childhood (Osterhaus et al., 2016). Finally, research using more advanced ToM tests that assess higher orders of recursive thinking has shown further improvements between 14 and 20 years of age (Valle et al., 2015). This result suggests that ToM improvements beyond middle childhood may manifest a more sophisticated use of reasoning skills.

The developmental trajectory of cognitive and affective ToM has also been studied in children. Miller (2013) employed cognitive and affective second-order false belief stories to analyze the development of second-order false belief inference in preschoolers and first-grade children, as well as the effect of content (cognitive vs. affective) on performance. They found a main effect of age: first-grade children outperformed preschoolers when judging the belief of a character about another character's belief or emotion. Moreover they also found that children found harder to infer second-order beliefs on emotions than on beliefs.

Two main theoretical approaches have been formulated to account for the developmental relationship between EF and ToM. The *emergence* account highlights the EF role in the rise and development of ToM (e.g., Russell, 1996), and the ToM role in EF development (e.g., Perner and Lang, 1999, 2000). The *expression* account stresses that EF is involved in ToM in the extent to which performance in ToM tasks demands the use of cognitive control skills just in order to unfold ToM knowledge (e.g., Perner, Lang, and Kloo, 2002). Therefore, overall, existing research supports the role of EF in the emergence of ToM.

In preschoolers, earlier EF predicts later ToM performance across cultures and after controlling for age and verbal ability (Devine and Hughes, 2014). In middle childhood, whereas Devine et al. (2016) did not find longitudinal association between EF and ToM, Lecce et al. (2017) showed that early WM predicted later ToM performance in a longitudinal study following children aged 9.5 to 10.5 years old, providing further support for the emergence account.

2.1.4 Origins and development of prejudice in childhood

Different approaches (e.g. Aboud, 1988; Nesdale and Flesser, 2001; Bigler and Liben, 2007) claim that the emergence of prejudice is linked to the development of categorization, a skill necessary to group people as a function of social categories. As children are able to distinguish between the ingroup and differentiate it from the outgroups, they tend to display ingroup favoritism and outgroup rejection, especially towards minority groups. Concerning developmental changes in prejudice, there is evidence indicating some differences between the developmental course of Spanish children and children who grow up in societies that more ethnically diverse for longer time. The first studies carried out in the 90's showed that whereas children from traditional multi-ethnic societies unfold abilities to categorize people on the basis of race when they are 3-4 years old (Holmes, 1995), it is only at age 7 when Spanish children consistently show ability to classify people according to the skin color (Enesco et al., 1999). Studies that account for changes in prejudice and have been carried out in traditionally multi-ethnic countries have found a significant counter-bias increase between preschoolers and third-graders, as well as no changes in prejudice (e.g., Doyle and Aboud, 1995). Raabe and Beelmann (2011) meta-analytical revision documented a peak in explicit racial prejudice between 5 and 7 years old, followed by a significant decrease in late childhood, between 8 and 10 years old. In the Spanish context lately the Spanish population has become more and more multi-ethnic due to immigration. This fact is likely to have impacted on the developmental course of prejudice. In fact, more recently it has been found that Spanish children show the peak of prejudice at around age 6, similarly to children coming from multiethnic societies (Enesco et al., 2008). However, it has also been suggested that Spanish children's developmental decreases in prejudice may still not be evident until early adolescence (Enesco et al., 2005).

2.1.5 The present study

As it has been shown, the vast majority of research on the relationship between EF and prejudice has focused on adult samples. Empirical evidence about the distinctive contribution of inhibitory control, cognitive flexibility and working memory skills to regulation of prejudice is needed. In fact, it is necessary to elucidate whether developmental decrement in prejudice is due in greater extent to age-related improvement in cognitive flexibility skills, that enable children to question stereotypes and limit their use, or to older children's ability to inhibit their stereotypes and give socially desirable answers instead (Enesco et al., 2005). In line with what Enesco et al. (2009) suggest, there is a chance that the age-related enhancement of cognitive flexibility skills allows a more refined social information processing, and therefore is likely to play a role in regulation of prejudice. Hence, additional research with children samples is needed. Additionally, research linking ToM and prejudice is still scarce in children. Research on prejudice with both adults and children (e.g., Nesdale et al., 2005; Pettigrew and Tropp,

2008) has given a central role to empathy. To our knowledge, only Fitzroy and Rutland (2010) investigated children's affective mental state understanding in connection with the expression of prejudice. Therefore, the distinctive contribution of cognitive versus affective ToM components to prejudice remains unknown. In the present study, we assessed preschool and third-grade children. The election of these age groups was done on the basis of empirical evidence showing that developmental changes in EF and ToM are expected between early and middle childhood, Moreover, according to previous studies on children’s categorization skills and stereotypic attributions using Spanish samples, we considered that developmental changes in prejudice may presumably take place between early and middle childhood. Therefore, the first goal of the present research was to explore developmental changes in EF, ToM and prejudice, while controlling by intelligence. We expected age-related improvements in all cognitive skills. According to previous studies (e.g., Raabe and Beelmann, 2011), we also expected to find an age-related decrease in explicit prejudice. Secondly, we examined the relationship between EF and ToM, and whether individual differences in EF and ToM significantly relate to prejudice. We aimed at exploring distinctive contributions of inhibitory control, cognitive flexibility and WM, as well as of cognitive and affective ToM. In light of previous findings (e.g., Amodio et al., 2008; Carlson et al., 2015; Fitzroy and Rutland, 2010), we expected a positive relation between EF and ToM, a negative relation between EF and prejudice, and a negative relation between ToM and prejudice. Finally, we explored age-related differences in the contribution of cognitive skills to the expression of prejudice.

2.2 Method

2.2.1 Participants

A total of 86 children, divided into two age groups (preschool and third-grade children), participated in the study. Preschool children aged 5 to 6 years (*N* = 43, mean age = 69.86 months, *SD* = 4; 21 girls), and third-grade children aged 8 to 9 years (*N* = 43, mean age = 107.54 months, *SD* = 4.22; 25 girls), participated in the study. Two third-grade children presented data missing in the IQ score. Children were recruited from two schools located in middle socioeconomic status districts of Granada (Spain). They were all Caucasian and did not have learning difficulties or history of psychological disorders.

2.2.2 Procedure

The study obtained approval from the University of Granada Ethics Committee. All participants had informed parental consent. Participants were assessed in two different sessions, each one lasting 30 minutes approximately. Participants performed intelligence and executive function tasks in the first session, and theory of mind and prejudice tasks in the second. The assessment sessions were carried out individually in a separated and quiet room of the school.

2.2.3 Measures

2.2.3.1 Intelligence

We used the Spanish adaptation of the K-BIT (Kaufman Brief Intelligence Test; Cordero and Calonge, 2009). This test provides vocabulary, matrices, and the composite intelligence (IQ) scores. Vocabulary is a measure of crystallized intelligence, whereas matrices is a measure of fluid intelligence. The composite IQ score was included as a control variable in correlational analyses.

2.2.3.2 Executive function

A new version of the Dots spatial conflict task (Davidson et al., 2006) was used to measure conflict resolution and cognitive flexibility EF components (see Figure 2.1). Our Dots task differed from that of Davidson et al. (2006) as follows: a) the stimulus-response mapping was the same for all participants; b) blocks of trials where presented in a fixed order. First, two simple blocks of 24 trials each were presented, the first with congruent trials and the second with incongruent trials, followed by two mixed blocks of 24 trials each, containing half congruent and half incongruent trials randomly selected; c) instructions and practice were provided at the beginning of the task and before starting the mixed blocks; and d) we established the same trial duration for both age groups. Each trial started with a fixation point (1000 milliseconds) on the center of the screen. Next, the stimulus appeared randomly on the left or on the right side of the screen during 2500 milliseconds. Stimuli were white dots and dots with horizontal white and black stripes. In congruent trials, children were instructed to press as quickly and accurately as possible the key in the same side of the white dot, whereas in incongruent trials, children had to press the key in the opposite side to the striped dot. Children had to press one of two possible keys (d or l), identified with stickers. Children performed three blocks of trials in a fixed order. Firstly, a congruent block required pressing the key that matched the stimulus position. Next, an incongruent block asked children to press the opposite key to the stimulus position. Finally, the mixed block combined random congruent and incongruent trials. There were breaks between blocks, and one break after half of the trials in the mixed block. Duration of breaks was flexible and long enough to let children rest but also keep their engagement in the task. Congruent and incongruent were simple, non-switch blocks, with one answering rule each. The mixed block was a switch block requiring children to flexibly select the appropriate response according to the dot pattern presented in each trial. The response rule was remembered at the beginning of each block. Each block had four practice trials. Simple (congruent and incongruent) blocks had 24 trials each, and the mixed block had 48 trials. We calculated three scores on the basis of participants' RT:

Simple conflict resolution = Incongruent Block Median RT – Congruent Block Median RT

Mixed conflict resolution = Mixed Incongruent Trials Median RT – Mixed Congruent Trials Median RT

Cognitive flexibility = Median Mixed Block – Mean (Incongruent Block Median RT + Congruent Block Median RT)

Conflict resolution scores are a measure of children's ability to inhibit a prepotent response (press same-side key) in favor of non-automatized, goal-directed behavior (press the opposite-side key in incongruent trials). Thus, conflict resolution indexes children's ability to deal with the spatial incompatibility effect (Craft and Simon, 1970), with greater scores indicating less conflict resolution skills. Simple conflict resolution (without flexibility load) accounts for the child’s ability to overcome the automatic tendency to press same-side key by comparing single-task blocks (that is to say, two blocks with one answering rule each and, hence, one task set each), so no flexibility demands are posed. Mixed conflict resolution (with flexibility load) tests performance under flexibility demands. Then, it accounts for the size of the spatial incompatibility effect in a set-switching context, i.e., the context of the mixed block requiring to sometimes switching between two task sets. Finally, the cognitive flexibility score is an index of the task switching cost. It compares performance in contexts that require task set maintenance (i.e., the single-rule, simple blocks) with performance in a context that, on a trial-by-trial basis, demands the flexible selection and use of two task rules (i.e., the mixed block). Then, greater cognitive flexibility scores indicate more task switching costs. To ease interpretation in correlational analysis, conflict resolution and cognitive flexibility scores were reversed to indicate better EF skills.

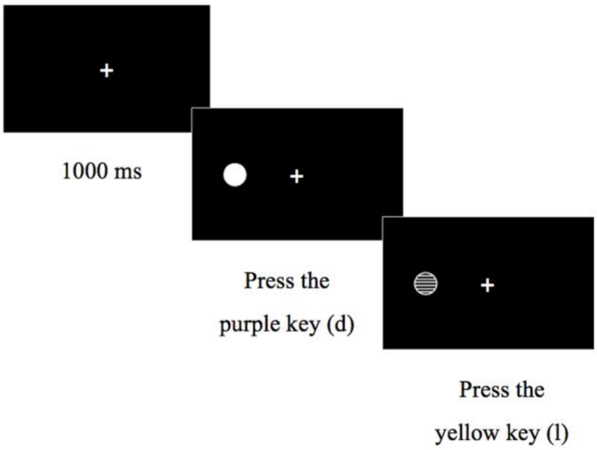


Figure 2.1. *Dots task*

2.2.3.3 Working memory

We assessed working memory (WM) with the digit span task from the Wechsler Intelligence Scale for Children (WISC-IV; Corral et al., 2005). Children first listened to series of numbers, and then repeated them aloud in direct (forward) and reverse (backward) order. There were eight elements in each order. Children were presented two series per element. Series gradually increased in length. The test finished if the child failed the two series of a particular length. Children received one point for each correctly repeated series. WM score was the sum of correctly repeated backward series.

2.2.3.4 Cognitive theory of mind

Cognitive ToM tasks consisted of deceptive container tasks, a first-order false belief task (Sally-Anne task from Baron-Cohen, Leslie and Frith, 1985), and cognitive second-order false belief stories from Miller (2013).

For the deceptive container tasks, a piggy bank with marbles and a pencil case with candles were used. Children saw the container and were asked about the expected content. Then, the experimenter showed the real content and saved it again. Now the experimenter asked what a new child would think that there was inside. Children received one point if the comprehension and the ToM questions in each task were correctly answered. Score ranged from 0 to 2.

In our Sally-Anne task, the characters were Silvia and Ana. Silvia puts a red ball inside a basket. Then, she goes out, and in the meantime Ana puts the ball in a box. Then, Ana goes out and, after a while, Silvia comes back. Children were asked comprehension ("Where is the ball hidden?") and ToM questions ("Where does Silvia think that the ball is hidden?"). Children received one point if they correctly answered both questions. Score ranged from 0 to 1.

Cognitive second-order beliefs are beliefs about others' thoughts. We made use of two cognitive second-order false belief stories from Miller (2013; see Appendix, S.1.1). With the help of vignettes, the experimenter read aloud the stories. Next, children were asked two comprehension questions and two ToM questions. The first ToM question requires a judgment of a character's belief about the thought of another character (e.g., "Where does Ana think Juan has gone?"). In case the child did not answer that question, judgment was assessed with a forced choice question (e.g., "Does Ana think Juan has gone to the soccer field or to the park?"). The second ToM question targets at the justification of that character's belief (e.g., "Why does Ana think Juan is there?"). Two points were awarded if both judgment and justification questions were correctly answered, one point if children only failed the justification, and zero if they failed both ToM questions.

2.2.3.5 Affective theory of mind

To assess affective ToM, we designed a hidden emotion task to examine real and apparent emotion distinction, and also included the affective second-order false belief stories from Miller (2013; see Appendix, S.1.1).

In the hidden emotion task, the experimenter presented the story by using vignettes. In the story, Pablo is going to celebrate his birthday next Friday. In the way to school, he sees several toys in a toys shop's window, and thinks of the toy he would like to receive (a racing car). Finally, his grandmother gifts him a fluffy toy. Pablo smiles and thanks his grandmother. The comprehension questions were: "Which gift did Pablo want?" and "Which gift did Pablo receive?" Then the experimenter introduced Pablo's real emotion ToM question: "When Pablo receives the fluffy toy, he smiles. How do you think that Pablo feels?" Afterwards, children rated Pablo's emotion according to a scale of faces (see Appendix, S.1.2). The scale consisted in 7 schematic faces depicting subtle changes in facial expressions depicting sad (faces 1-3), neutral (face 4) and happy (faces 5-7) emotions. If children had correctly answered the ToM question and had chosen a face that properly identified Pablo's real emotion (that is, sadness), the experimenter asked: "If Pablo does not feel well, why do you think that he smiles?" Children received one point for each correct answer (ToM question, scale of faces, and justification), so scores ranged from 0 to 3.

Beliefs about others' emotions were assessed with two affective second-order false belief stories (Miller, 2013; see Appendix, S.1.1). Similarly to the cognitive stories, after reading each story children were asked two comprehension questions and two ToM questions. Now the first ToM question requires a judgment of a character's belief about the emotion of another character (e.g., " How does Antonio think María is feeling before he finds her?"), and in case of no answer, the forced choice question was made (e.g., "Does Antonio think María is feeling happy or sad?"). In the justification question, children were asked to give reasons for that character's belief (e.g., " Why does Antonio think that María is feeling that way?"). Two points were awarded when children gave correct answers to judgment and justification questions. Children received one point if they only failed the justification. Zero points were given to children failing both ToM questions.

2.2.3.6 Prejudice

In order to assess prejudice we used the Multi-response Racial Attitude task (MRA; Doyle and Aboud, 1995). We employed drawings depicting ingroup (Caucasian) and outgroup (Romany) children members. We chose the Romany outgroup given that the Romany group is one of the most prominent minority groups in Spain (Enesco et al., 2005). Twenty adjectives and behavioral descriptions for each one were presented. Ten adjectives described positive traits (clean, wonderful, healthy, good, nice, happy, friendly, kind, helpful and smart), and the other ten described negative traits (unfriendly, mean, dirty, cruel, stupid, selfish, sick, naughty, sad and bad). The adjectives, along with behavioral descriptions, were read aloud to children. After reading each adjective, children were asked to point at the child they thought that could be or behave in that way. Children could point at one, both, or any of the drawings. This procedure ensured children did not make a forced assignation of traits. We obtained ingroup and outgroup attitude scores. They were calculated by subtracting negative from positive assigned traits. Thus, the resulting score would range from -10 to 10. Negative scores indicated more attribution of negative than positive traits, whereas positive scores indicated more attribution of positive than negative traits. A composite prejudice score was calculated by subtracting outgroup from ingroup attitudes. This composite score ranged from -20 to 20. Positive scores informed more negative attitudes towards the outgroup than to the ingroup. In line with Doyle and Aboud (1995), we also calculated a counter-bias score by summing positive outgroup and negative ingroup assigned traits.

2.3 Results

All third-grade children correctly answered to the deceptive container task, so this score was removed from the analyses. Correlation between Silvia-Ana and cognitive second-order false belief was moderate (r = .34, p = .001). In order to obtain a total cognitive ToM score, we calculated the mean of the z scores for each task.

Correlation between affective ToM tasks was moderate (r = .40, p < .001). A total affective ToM score was obtained by calculating then mean of the z scores for each task. Means and standard deviations of the raw scores in ToM tasks and in the Dots task for each age group are shown in Tables 2.1 and 2.2, respectively.

Table 2.1.
Means and (standard deviations). ToM tasks.

Age group	Content				
	Cognitive			Affective	
	Deceptive container	Silvia-Ana	Cognitive ToM second-	Real-Apparent Emotion	Affective ToM second-
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
5-6	1.44	0.70	1.23	0.81	1.19
8-9	2.00	0.95	2.72	1.65	2.35

Table 2.2.
Means and (standard deviations). Dots task.

Age group	Condition							
	Simple				Mixed			
	Congruent		Incongruent		Congruent		Incongruent	
	Reaction time	Errors (%)	Reaction time	Errors (%)	Reaction time	Errors (%)	Reaction time	Errors (%)
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
5-6	671.92	2.71	969.58	9.30	1178.47	11.43	1206.64	14.24
	(149.69)	(4.71)	(228.74)	(7.87)	(210.63)	(10.95)	(216.73)	(12.44)
8-9	529.00	0.97	703.02	5.43	908.15	9.50	938.05	5.23
	(163.29)	(2.00)	(209.62)	(6.90)	(220.62)	(10.62)	(245.36)	(6.31)

Regarding the Dots task, we ran a repeated measures ANOVA on reaction time, with Congruency (congruent vs. incongruent) and Block (simple vs. mixed) as within-subject factors and Age group as the between-subject factor. Anticipatory responses (> 200 milliseconds) and errors were filtered out. For greater clarity, only relevant results for our purposes will be reported. All main effects were significant (Congruency (F(1, 84) = 188.08, p < .001, η_p^2= .69); Block (F(1, 84) = 517.40, p < .001, η_p^2= .86); Age group (F(1, 84) = 35.09, p < .001, η_p^2= .30). Participants took more time to respond to incongruent than congruent trials (d = 132.44, p < .001), and in the mixed block compared to the simple blocks (d = 339.45, p < .001). In addition preschoolers showed longer reaction times than third-graders (d = 237.10, p < .001). The three-way interaction of Congruency × Block × Age group was also significant, F(1, 84) = 10.79, p < .01, η_p^2= .11. To breakdown this three-way interaction, two repeated measures ANOVAs were performed with each age group (see Figure 2.2). For preschoolers the interaction between Congruency and Block was significant, F(1, 42) = 63.66, p < .001, η_p^2= .60. The difference in reaction time between incongruent and congruent trials was significant in the simple blocks (d = 297.66, p < .001) but not in the mixed one (d = 28.17, p = .26). For third-graders the interaction between Congruency and Block was also significant, F(1, 42) = 65.68 , p < .001, η_p^2= .61. The difference in reaction time between incongruent and congruent trials was significant in the simple blocks (d = 174.04, p < .001) and also in the mixed one (d = 29.91, p < .05). Consequently, significant main and interaction effects of Congruency, Block and Age group make feasible to include conflict resolution and cognitive flexibility scores in analyses aimed at testing our hypotheses. For that purpose we calculated the scores mentioned in the Method section.

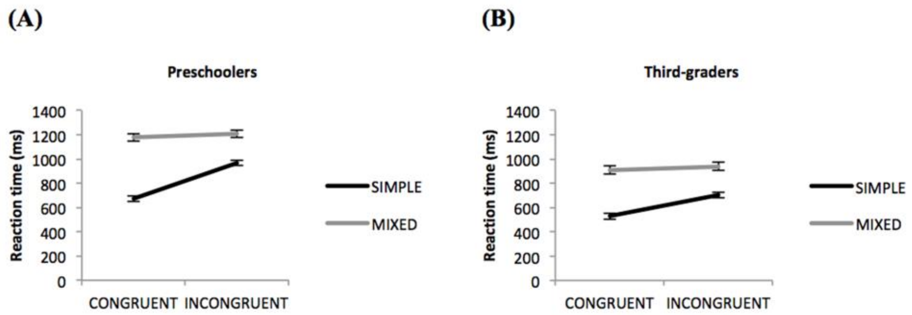


Figure 2.2. *(A) Preschoolers' reaction time in Dots task as a function of Block, Congruency and Age group. (B) Third-graders' reaction time in Dots task as a function of Block, Congruency and Age group.*

2.3.1 Developmental changes in cognitive skills

In order to analyze age-related changes in the studied cognitive skills, we performed t-tests for independent samples. As it was expected, third-graders outperformed preschoolers in EF and ToM measures. However, contrary to expected, no age-related differences in prejudice were found (see Table 2.3). The post hoc statistical analyses revealed an achieved power of 1 for each of the following scores: simple conflict resolution, WM, cognitive ToM and affective ToM. For mixed conflict resolution, the difference was not significant (achieved power = .05). For the cognitive flexibility score, the difference was marginal (p = .053; achieved power = .49). Contrary to what we expected, no significant age-related decrease in prejudice and increase in counter-bias were found (achieved power = .07 and .26 respectively). We also calculated the effect size of the differences between age group means using Cohen's d. Regarding EF, small effect sizes were found in the Dots task (simple conflict resolution = .01; mixed conflict resolution = .02; cognitive flexibility = .42), and a large effect size on the WM score, d = 1.57. For differences between age groups on ToM performance, all effect sizes were large (cognitive ToM = 1.66; affective ToM = 1.09). Small effect sizes were found for the prejudice scores (prejudice = .1; counter-bias = .29). Finally, there were significant differences between age groups in matrices and composite IQ scores. We accounted for age-related IQ differences by including the composite IQ as a control variable in subsequent analyses.

Table 2.3.
Results of t-test comparing age groups in all measures. $p < .05$; $p < .01$**; $p < .001$***; $p > .05$#.[1]The reported Student's t and degrees of freedom when the Levene's test is significant is the corrected t. Cognitive ToM = Cognitive Theory of Mind; Affective ToM = Affective Theory of Mind*

		GROUP							
		Preschoolers	Third-graders	Mean Difference	Standard Error Difference	95% CI for Mean Difference	Levene's test		
		M (*SD*)	*M* (*SD*)				*F*	t^1	df^1
INTELLIGENCE	Vocabulary	108.05 (11.67)	107.07 (10.82)	.98	2.33	-3.65, 5.60	.02	.42	84
	Matrices	112.28 (12.06)	98.44 (20.31)	13.84	3.62	6.63, 21.05	2.24	3.82***	82
	Composite IQ	109.23 (9.72)	102.17 (12.90)	7.06	2.49	2.12, 12.01	3.57#	2.84**	82
EJECUTIVE FUNCTION	Simple conflict resolution	285.65 (127.68)	174.03 (98.90)	111.61	24.63	62.64, 160.59	2.62	4.53***	84
	Mixed conflict resolution	28.17 (160.91)	29.91 (87.11)	-1.74	27.90	-57.47, 53.99	11.80***	-.06	65
	Cognitive flexibility	362.64 (141.32)	303.62(137.62)	59.02	30.08	-.80, 118.85	.12	1.96#	84
	Working memory	4.60 (.90)	6.26 (1.20)	-1.65	.23	-2.11, -1.20	2.79#	-7.22***	84
THEORY OF MIND	Cognitive ToM	-.45 (.77)	.45 (.59)	-.90	.15	-1.19, -.60	4.70*	-6.07***	84
	Affective ToM	-.40 (.74)	.40 (.73)	-.80	.16	-1.12, -.48	.26	-5.03***	84
PREJUDICE	Prejudice	9.84 (7.09)	10.49 (6.15)	-.65	1.43	-3.50, 2.19	0.54	-0.46	84
	Counter-bias	6.98 (4.93)	8.53 (5.88)	-1.56	1.17	-3.89, .077	2.27	-1.33	84

2.3.2 Individual differences in executive function and theory of mind and its relation with prejudice

Firstly, we carried out one-tailed partial correlations controlled by composite IQ (see Table 2.4) with the whole sample, in order to analyze the relationship between individual differences in the cognitive skills of interest (that is, EF and ToM) and prejudice. Moreover we included participants' age (in months) for further testing the role of age in EF, ToM and prejudice. The composite IQ was added as a control variable given that age group differences in IQ were observed. Literature has consistently reported a link between EF and IQ (e.g., Arffa, 2007). Moreover, when studying the contribution of EF to ToM, researchers (e.g., Carlson et al., 2015; Lecce and Bianco, 2018) usually make use of verbal ability tasks given the overlap between verbal intelligence and ToM. Accordingly, we controlled by IQ in order to ensure that the relationships between cognitive skills and prejudice are due to individual differences in such cognitive skills and not due to age group differences in IQ. As noted in the Method, EF scores were reversed, with higher scores indicating better EF skills. Results showed expected significant associations of age with EF and ToM, and pointed towards the expected relationship between age and prejudice. Age was positively correlated with simple conflict resolution, cognitive flexibility and WM. Post-hoc statistical analyses revealed an achieved power of 1 for correlations of age with simple conflict resolution and WM, and of .58 for the correlation between age and cognitive flexibility. There was a strong relationship between age and both cognitive and affective ToM (achieved power = 1 for both). Concerning prejudice, a marginal positive relationship between age and counter-bias was found (achieved power =

.48). As expected, results showed a significant relationship between EF and ToM. None of the correlations between mixed conflict resolution and the other variables were significant. In contrast, simple conflict resolution positively correlated with both cognitive and affective ToM. Cognitive flexibility positively correlated with affective ToM and tended to be positively correlated with cognitive ToM (p = .07). Moreover, WM was positively associated with both cognitive and affective ToM. Results also confirmed our prediction regarding the link between EF and prejudice. Indeed, there was a significant negative relationship between EF and prejudice. Correlations showed that the less cognitive flexibility the more prejudice, and in the same line, a positive relation between cognitive flexibility and the measure of counter-bias. Moreover, WM was positively associated with counter-bias. The post hoc statistical analysis revealed an achieved post-hoc power of .84 for the correlation between cognitive flexibility and prejudice, and an achieved power of .62 for the correlation between WM and counter-bias. Finally, only affective ToM was positively associated with counter-bias (achieved power = .62).

Next, in light of the significant correlations found, we performed stepwise regression analyses. We included IQ (and age if necessary) in the first step, EF in the second step and ToM in the third step. First we used the composite IQ and cognitive flexibility scores as predictors of prejudice. The model was significant (ΔR^2 = .08, p < .05; F = 7.04, p = .01), and cognitive flexibility was the only significant predictor (β = -.28, p = .01). Secondly, in order to predict the counter-bias score, we used the age in moths, composite IQ, cognitive flexibility, WM and affective ToM as predictors. The model was significant (ΔR^2 = .07, p < .05; F = 6.05, p

< .05). Cognitive flexibility was the only significant predictor included in the model (β = .26, $p < .05$).

Table 2.4.

One-tailed correlations controlled by total IQ. p < .05; p < .01**; p < .001***; p > .05#. Cognitive ToM = Cognitive Theory of mind; Affective ToM = Affective Theory of Mind*

	1	2	3	4	5	6	7	8
1. Age (months)	-							
2. Simple	.51***	-						
3. Mixed	.06	.07	-					
4. Cognitive	.19*	.15#	.12	-				
5. Working	.60***	.33***	.11	.26**	-			
6. Cognitive	.55***	.21*	.13	.17#	.42***	-		
7. Affective	.49***	.19*	-.04	.29**	.42***	.57***	-	
8. Prejudice	.03	-.03	-.02	-.28**	-.09	.10	-.13	-
9. Counter-bias	.16#	.14	.01	.26**	.21*	.03	.21*	-.92***

2.3.3 Exploratory analyses on age-related distinctive contributions of cognitive skills to prejudice

As noted in the goals of the study, we were interested in exploring possible distinctive age-related contributions of EF and ToM to prejudice. Consequently, we performed one-tailed correlations for the two age groups (see Table 2.5). For preschoolers the expected relationship between EF and ToM was just marginally significant between simple conflict resolution and cognitive ToM (p = .08; achieved power = .43). Interestingly, a significant relationship between EF and prejudice emerged. Both cognitive flexibility and WM negatively correlated with prejudice (achieved power = .69 for both relationships) and positively with counter-bias (achieved power = .49 for cognitive flexibility and .69 for WM). Finally, a marginal relationship in the expected direction between affective ToM and prejudice was found (p = .08; achieved power = .43). Concerning third-graders, the analyses showed significant associations between EF and ToM, and importantly, between EF and prejudice. Specifically, cognitive flexibility was positively associated with affective ToM (achieved power = .52). Moreover, both simple conflict resolution and cognitive flexibility were negatively associated with prejudice and positively associated with counter-bias. For the simple conflict resolution, achieved power was .57 for the association with prejudice and .68 for the association with counter-bias. Achieved powers of .63 and .58 were respectively found for the relation between cognitive flexibility and prejudice and between cognitive flexibility and counter-bias. Finally, we performed stepwise regression analyses for each age group. Following the same analytic strategy used for the previous analysis for the whole sample, only variables that had significantly correlated were considered. We introduced IQ in the first step, EF in the second step, and ToM in the third one. For preschoolers, regression analysis to predict prejudice included IQ, cognitive flexibility, WM, and affective ToM. The model was significant ($\Delta R^2 = .10$, $p < .05$; $F = 4.55$, $p < .05$). Cognitive flexibility was the only significant predictor included in the model ($\beta = -.32$, $p < .05$). The model for predicting counter-bias included IQ, cognitive flexibility and WM. In this case, none of the predictors reached significance. For third-graders, a first regression analysis with prejudice as dependent variable and IQ, simple conflict resolution and cognitive flexibility as predictors was not significant for any of the variables. In contrast, the regression analysis predicting counter-bias from IQ, simple conflict resolution and cognitive flexibility resulted in a significant model ($\Delta R^2 = .11$, $p < .05$; $F = 4.56$, $p < .05$), being simple conflict resolution the significant predictor ($\beta = .32$, $p < .05$).

Table 2.5.
Correlations split by age group. One-tailed correlations controlled by total IQ. p < .05; p < .001***; p > .05#. Cognitive ToM = Cognitive Theory of mind; Affective ToM = Affective Theory of Mind*

	Age	1	2	3	4	5	6	7
1. Simple conflict resolution	5-6	-						
	8-9	-						
2. Mixed conflict resolution	5-6	-.01	-					
	8-9	.20						
3.Cognitive flexibility	5-6	.09	.16	-				
	8-9	.31*	.04					
4.Working Memory	5-6	.04	.05	.31*	-			
	8-9	.06	.21#	.14				
5. Cognitive ToM	5-6	.23#	.13	.06	.18	-		
	8-9	-.19	.16	.14	-.05			
6. Affective ToM	5-6	.09	-.09	.20	.15	.33*	-	
	8-9	-.01	.06	.26#	.15	.51***		
7. Prejudice	5-6	.08	.04	-.32*	-.32*	.13	-.22#	-
	8-9	-.29*	-.16	-.30*	-.04	.02	-.16	
8. Counter-bias	5-6	.12	.08	.24#	.32*	-.13	.17	-.92***
	8-9	.31*	.15	.28*	.05	-.01	.20	-.98***

2.4. Discussion

The first goal of the present research was to analyze age-related changes in EF, ToM and prejudice in children aged from 4 to 9. Secondly, we examined whether individual differences in EF and ToM are associated with prejudice. Finally, we explored age-related differences in the contribution of cognitive skills to the expression of prejudice. As noted above, previous research mainly using adult samples has shown a link between EF and prejudice (e.g., Bartholow et al., 2006), as well as between empathy and prejudice (e.g., Pettigrew and Tropp, 2008). The present research aimed at gaining a better understanding of the role of cognitive skills in the expression of prejudice in children.

Firstly, results showed an overall age-related improvement in the Dots task. Importantly, the manipulations had the expected effect. Indeed, participants responded faster to congruent than incongruent trials, as was expected according to the spatial incompatibility effect (Craft and Simon, 1970). Interestingly, a three-way interaction between Congruency, Block and Age group was found. In the mixed block, whereas third-grade children still showed the spatial incompatibility effect (though it was low), preschoolers found congruent and incongruent trials equally difficult. Arguably, this result suggests that older children are better able to maintain the task set and adjust responses accordingly. Conversely, younger's children executive resources seem to be exhausted by maintaining and switching between rules, thus congruent and incongruent trials become equally difficult. This is reflected in larger overall RT in the mixed block and in the lack of congruency effect observed only in this block and only for young children. The so-called global context effect (Davidson et al., 2006) claims that performance is affected not only by the nature of a single trial, but also by the context in which the trial is presented. In the mixed block, the changing rule overloads the requirement of executive control, which affect the adjustment of responses in both congruent and incongruent trials. As expected, the switching context of the mixed block influenced children's performance.

2.4.1 Developmental changes

With respect to results on developmental changes, a global age-related improvement on performance was found. Concerning EF, both inhibitory control and WM significantly improve between early and middle childhood. This result is consistent with previous research that accounts for inhibitory control improvements beyond early childhood (e.g., Brocki and Bohlin, 2004; Steinberg et al., 2008) and with research suggesting a protracted WM development (Gathercole et al., 2004; Luciana and Nelson, 1998). For cognitive flexibility, only marginally significant age-related gains were found. We argue that there is a chance that the allowed response time (2500 ms) has affected the task's sensitivity to capture slight but significant developmental changes. In a previous research using the Dots task (Davidson et al, 2006), the allowed response time was 2500 ms for children between 4 and 6 years old and 1250 ms for participants aged 7 and older, as well as for a sub-group of 6-year-olds. It is likely that our Dots task posed less cognitive demands than the Dots task used by Davidson et al. (2006), that is, older children in our study might have taken advantage of the 2500 ms allowed response time and accordingly the difficulty of the task diminished as children had more time to respond. In fact, in our study, 8-to-9-year-old children had a mean reaction time in the mixed block of around 200 ms larger than in Davidson et al. (2006) study. Consequently, the task may not have precisely detected older children's individual differences in cognitive flexibility skills. With regard to ToM, our results expand previous findings (Miller, 2013) by showing that the development of cognitive and affective ToM goes beyond the early school years and continue along middle childhood. Finally, contrary to what we expected, results showed no age-related changes in prejudice. In relation to it, we found neither a significant age-related prejudice decrease nor a significant counter-bias increase. Previous studies mostly based on research in traditional multi-ethnic Western countries have documented a decrease in explicit racial prejudice (Raabe and Beelmann, 2011), as well as a counter-bias increase (Doyle and Aboud, 1995) in late childhood, from age 8 on. In the Spanish context, studies on the development of prejudice along childhood, though still scarce, have provided valuable evidence about singularities of Spanish children's development of prejudice. For instance, whereas children from traditional multi-ethnic societies categorize people on the basis of race at 3-4 years old (Holmes, 1995), Enesco et al. (1999) found that Spanish children were not consistently able to use skin color as a classification criterion until 7 years old. However, more recently it has been suggested that Spanish children categorize people according to skin color earlier in the development, at around age 6 (Enesco et al., 2008). Enesco et al. (2005) found that children's agreement with stereotypes held by society towards Romany people decrease between second and sixth grades (7-11 years old). Then, it could be possible that the age range considered in our study is not wide enough to capture significant developmental changes linked to prejudice regulation.

2.4.2 EF and ToM in relation with prejudice: individual differences and age-related distinctive contributions

Finally, we were interested on studying the relationships between individual differences in EF, ToM and prejudice. We also explored possible age-related differences in the contribution made by EF and ToM to prejudice. As expected, and according to previous literature (e.g., Carlson and Moses, 2001; Perner et al., 2002; Devine et al., 2016), results showed a significant relationship between EF and ToM. This relationship was marginally significant for third-graders in the exploratory correlational analyses split by age group. This result supports the EF-ToM relationship beyond the preschool years, and presumably captures the proposed role of EF in enabling the necessary cognitive processes for performing ToM tasks (e.g., Apperly, 2012).

Results also provided global support for our predictions concerning relationships between cognitive skills and prejudice. First, correlational analyses about individual differences (that is, with the whole sample) showed that both cognitive flexibility and WM were significantly associated with prejudice and counter-bias scores. Interestingly, inhibitory control did not show any significant association with prejudice. Further analyses confirmed that cognitive flexibility was a significant predictor of both prejudice and counter-bias after controlling by composite IQ (and by age when predicting counter-bias). Secondly, correlational analyses for each age group revealed slightly different relationships between cognitive skills and prejudice. For both age groups, significant relationships between EF and ToM emerged; however, only younger children showed a marginal relationship between affective ToM and prejudice. Importantly, regression analyses suggested that different

EF processes may underlie prejudice regulation in each age group. In our view, these results shed light on the cognitive factors responsible for prejudice regulation in childhood. Studies on adults' prejudice regulation mainly highlight the role played by inhibitory control skills. In the present study, inhibitory control processes that are presumably responsible for inhibiting unwanted and non-socially desirable answers seem to be the mechanism underlying prejudice regulation in older children. Conversely, our results provide support for the role of cognitive flexibility on enabling preschool children to engage in a reflective processing of social information, as it had been suggested by Enesco et al (2009). Whereas inhibitory control seems to operate by facilitating the suppression of automatic stereotypical tendencies in favor of socially accepted, egalitarian behaviors, we presume that cognitive flexibility may facilitate children's tendency to call stereotypes into question. Moreover, cognitive flexibility skills may underlie a flexible assessment of people according to a variety of dimensions beyond the salient features usually used to categorize people (e.g., skin color). One point of inquiry is that cognitive flexibility's predictive power seems to be higher in younger children. This could be attributed to the likely limitation of our Dots task when it comes to capture older children's individual differences in cognitive flexibility skills. Moreover, our results suggest that individual differences in older children's inhibitory control skills are accounting for children's ability to suppress their prejudiced attitudes. In other words, since a global decrease of prejudice in middle-aged children was not observed, it is possible that, by middle childhood, individual differences in the ability to regulate explicit prejudice play a key role in inhibiting prejudiced attitudes. However, since analyses on age-related distinctive relationships between EF, ToM and prejudice are exploratory, further studies are needed for a better understanding of the EF role in prejudice. Accordingly, forthcoming research should address whether EF acts more as a regulatory mechanism that prevents children from expressing unwanted prejudiced behaviors or more as a facilitator of a deeper cognitive processing of social categories leading to a reduction in prejudice.

Finally, only the affective ToM component was significantly related to the counter-bias score when analyzing individual differences (and only marginally significant in preschoolers). This result is in accordance with that of Fitzroy and Rutland (2010). In fact, they found that performance on a false-belief task focused on feelings predicted regulation of prejudice. Accordingly, it seems pertinent to disentangle cognitive and affective ToM components, as they distinctively contribute to prejudice. However, affective ToM did not play a predictive role of counter-bias. It could be possible that our second-order false belief task did not fully account for the emotional empathy aspect of affective ToM. Arguably, the task used by Fitzroy and Rutland (2010) involved a character victim of a social transgression, which may trigger more empathic feelings for participants. Consequently, in order to test whether affective ToM predicts prejudice, affective ToM tasks should likely assess reasoning about feelings and trigger empathic concern at the same time. Possibly, an effective affective ToM task would test participants' ability to reason about others' feelings in interpersonal situations where the negative feelings experienced by a victim are due to the damage caused by a perpetrator's intentional behavior.

2.5 Limitations and future research

This study analyzed developmental changes between early and middle childhood. Given protracted children's cognitive development, we expect age-related changes in the late childhood that is out of our scope. Widening the age range of the sample could presumably result in significant developmental changes in prejudice. We explored possible age-related differences in relationships between EF, ToM and prejudice. Since these results are exploratory, more evidence about whether the relationship between cognitive skills and prejudice changes along the development is needed. Another key aspect to consider is the measure of prejudice. Possibly the MRA is an explicit measure that mainly focuses on stereotyping of Romany people. Accordingly, future studies should consider including implicit measures that allow the assessment of automatic biases. Moreover, given the involvement of motivational factors in resistance to express prejudice (e.g., Devine, 1989, Dunton and Fazio, 1997; Payne, 2005) future studies should include the assessment of motivation to control prejudice as a factor that can independently or jointly with EF make a contribution to avoid the expression of prejudice. Finally, future research should address the possibility that the improvement of cognitive skills could impact on the expression of prejudice. Previous research has shown that cognitive skills can be enhanced through interventions (e.g., Bianco et al., 2016; Rueda et al., 2005). Consequently, it is expected that interventions to improve EF and ToM would potentially impact on prejudice expression.

Chapter 3.

Does executive function and theory of mind predict prejudice along childhood? A study about age-related changes and individual differences

3.1 Introduction

A 13.01% (about 6 million people) of Spanish population are migrants (United Nations Organization (UNO), 2019). Within the multicultural Spanish context, Romany population represents an important minority consisting of between 800,000 and 970,000 members. Approximately 40 percent of the Romany population of the country lives in the Spanish region where the present study was carried out (Foessa Survey, 2007/2008 and 2009/2010). The Romany population is present in Spain since the fifteen century, and has suffered from pervasive discrimination, despite inclusion programs have recursively been implemented in the last 40 years (2020 National strategy for the social inclusion of Romany population).

In the extent to which roots of prejudice can be found in childhood (e.g., Nesdale, 1999, 2007), the eradication of prejudice requires early prevention and intervention strategies that target at factors underlying origin and increase of prejudice. Though developmental models of prejudice point to the involvement of cognitive skills in the rise and age-related changes of prejudice, scant research has been devoted to understand the role that individual differences in cognitive skills play in the regulation of prejudice. The present research's main goal is to disentangle the contribution of individual differences in executive function (EF) and theory of mind (ToM) to prejudice. We also explored the contribution of motivation to control prejudice to the regulation of prejudice.

3.1.1 Prejudice

Prejudice is defined as a negative attitude, emotion or behavior that manifests directly or indirectly toward a group or toward a person because of his/her group membership (Brown, 2010). It manifests overtly but also in subtle ways (e.g., Kovel, 1970; Wolfe & Spencer, 1996; Pearson et al., 2009). Prejudice entails both positive and negative stereotypes that aim at keeping and fostering intergroup inequalities by placing the in-group in a superior status (Dovidio et al., 2009; Brown, 2010).

Prejudice has a potential influence on social behavior, as long as it is partly guided by category-based evaluations of other people. A deep understanding of the effects of prejudice in social interactions is needed for two reasons. First, there is an increased likelihood of interracial interactions due to growing in multi-ethnic societies. Second, legislations of democratic countries encourage equal opportunities and non-discriminatory behavior. Thus, while prejudice is pervasive and exerts overt and/or subtle influence on people’s behavior, prejudicial attitudes are socially discouraged. Thus, people often must resolve the conflict between their implicit attitudes and their goal of unfolding socially approved behavior (Amodio, 2014).

In early childhood, the emergence of category-based processing of people supports the formation of attitudes towards the in-group and the out-group (e.g., Aboud, 2008). Developmental changes in prejudice throughout childhood show a peak generally observed by preschool age, followed by a slight decrease in middle childhood (Raabe & Beelman, 2011).

3.1.2 Prejudice, executive function and motivation to control prejudice

EFs are a set of cognitive skills underpinning self-regulation (Rueda et al., 2011) and that include cognitive flexibility, working memory and inhibitory control ((Miyake & Friedman, 2012; Friedman & Miyake, 2017). Developmental research has scarcely examined the role of EF skills on the regulation of prejudice. To our knowledge, two studies have examined this issue thus far. In one of them, Bigler and Liben (1993) analyzed the relation between cognitive flexibility and prejudice in early and middle childhood. They found that children who expressed less racial bias and were better at flexibly sorting cards according to diverse dimensions were also better at remembering information from stories about interracial interactions that included stereotype-inconsistent information. Lapan and Boseovski (2015) studied the contribution of inhibitory control and ToM skills to prejudice regulation in preschoolers. ToM but not EF played a significant role in prejudice.

Conversely, a significant amount of research has been devoted to analyze the relation between EF and prejudice in adults. Evidence poses the role of conflict monitoring skills in adults' prejudice regulation (e.g.,; Amodio et al., 2008; Beer et al., 2008; Payne, 2005). Adults engage their conflict monitoring system when they perform a task that elicits their implicit stereotypes toward out-groups. Presumably, conflict monitoring skills allow the detection of conflict between the automatic prejudiced response and the controlled or socially-desired, non-prejudiced one. Once the conflict is detected, regulatory processes to prevent people from showing their implicit attitudes are activated. Another strand of evidence for the EF-prejudice relation is found in cognitive control depletion studies that manipulate self-regulation demands during intergroup interactions (e.g., Richeson et al., 2005; Bartholow et al., 2006). For instance, Richeson et al. (2005) posed that interracial interactions demand cognitive resources to control the expression of bias and thus impair performance of subsequent EF tasks. As hypothesized, they found that impaired control of interference occurred after an interracial interaction but not after a same-race interaction.

People vary in their motivations to devote cognitive resources for prejudice regulation. For instance, people may make an active effort to internalize values and beliefs against prejudice because they do not want to be prejudiced (Allport, 1954; Devine; 1989; Dutton, 1976; Sherman & Gorkin, 1980). Other people, instead, may be concerned about not looking like prejudiced, and then orientate their efforts to regulate their prejudice in accordance with egalitarian social standards that they do not personally endorse. Evidence suggests that motivation exerts influence on expression of explicit and implicit prejudice. For instance, Fazio et al. (1995) found that people who score high in implicit prejudice will also score high in explicit prejudice if they present low motivation to control prejudice. In contrast, motivation does not modulate the expression of explicit prejudice in people with low implicit prejudice. More recently, Devine et al. (2002) informed that people that were mainly internally motivated displayed less racial bias than people that were mainly externally motivated or whose motivation was led by a combination of internal and external motives.

3.1.3 Prejudice, theory of mind and theory-of-mind-related skills

The cognitive mechanism that let us infer what other people may be thinking and feeling is known as ToM (Premack & Woodruff, 1978). A relatively recent strand of evidence suggests that the ability to understand others' mental states plays a role in prejudice. For instance, better false-belief understanding has been related to preschoolers' preference for peers that do not endorse gender prejudices (Mulvey et al., 2016). Children in middle childhood who score higher when inferring emotions in a second-order false-belief task depicting a social transgression show less explicit prejudice (Fitzroy & Rutland, 2010). Moreover, Lapan and Boseovski (2015) found that preschool-age children with higher ToM skills hold more positive or neutral attitudes to peers from stigmatized out-groups and expect the out-group to behave prosocially in greater extent than children with low ToM skills.

Apart from the above-cited literature, research has mainly focused on the relation between ToM-related concepts and prejudice. One of these concepts refers to children's ability to regulate the impression they cause on other people (known as the self-presentation ToM). Self-presentation ToM is associated with more favorable out-group assessment (Aboud, 2013; Nesdale, 2013; Rutland, 2013). Research on adults has widely focused on empathy. For instance, Vescio et al. (2003) reported a link between perspective-taking, empathy and more positive out-group attitudes. Besides, empathy mediates the relation between intergroup contact and decrease of prejudice (Pettigrew & Tropp, 2008). Similarly, empathy appears to play a role in children's prejudiced attitudes. For instance, Nesdale et al. (2005) found that emotional empathy is linked to children's more positive out-group attitudes.

3.1.4 Developmental changes in executive function, theory of mind and prejudice

Literature informs that inhibitory control, working memory and cognitive flexibility present differentiated developmental trajectories (Best & Miller, 2010). For the purposes of this study, here we focus on inhibitory control and cognitive flexibility. A significant amount of inhibitory control development takes place in early childhood, as children improve their ability to overcome prepotent motor responses and learned tendencies in sorting cards (Best & Miller, 2010; Carlson, 2005; Hughes, 1998; Zelazo et al., 2003). Further inhibitory control fostering is observed beyond early childhood in computerized tasks (e.g., Brocki & Bohlin, 2004; Davidson et al., 2006; Johnstone et al., 2007). Concerning cognitive flexibility, simple measures that require to switch between two answering rules (Hughes, 1998) or present reduced inhibitory control demands (Rennie et al., 2004) show age-related improvements in preschoolers. Luciana & Nelson (1998) accounted for a protracted development of shifting skills from early childhood to young adulthood by making use of a set-shifting task characterized by several stages of increasing difficulty. Similarly, Huizinga et al. (2006) found an age-related, linear developmental tendency to reduce the rule-switching cost between 7 and 11 years of age. Furthermore, adult-like shifting level is achieved by age 15. Davidson et al. (2006) found that, from about 10 years of age on, a pattern characterized by decreased speed in order to preserve the accuracy under rule-switching demands emerges and develops until adulthood.

Regarding ToM development, between 3 and 5 years of age children experiment a growth in their capacities to understand desires, beliefs, false beliefs and hidden emotions (Wellman & Liu, 2004). During middle childhood, children improve their ability to flexibly use ToM skills (Devine et al., 2016) and to perform complex cognitive and affective ToM (Devine and Hughes, 2013; Lecce et al., 2017; Miller, 201; Perner and Wimmer, 1985; Pons et al., 2004). Beyond childhood, further improvements in ToM are documented in developmental research that uses advanced ToM tasks based on recursive thinking (Valle et al., 2015), in brain image studies on neural basis of cognitive and affective ToM (Sebastian et al., 2012), and in perspective-taking tasks that require online use of ToM (Dumontheil et al., 2010).

The developmental trajectory of explicit prejudice is characterized by a peak in early childhood (between 5 and 7 years of age), followed by a slight decrease in middle childhood, between 8 and 10 years of age. Implicit prejudice emerges at around the same developmental stage, but decline is not evident until adolescence (Raabe & Beelmann, 2011). The Sociocognitive theory (Aboud, 1988), the Social identity theory (Nesdale & Flesser, 2001), and the Developmental intergroup theory (Bigler & Liben, 2007) are theoretical approaches that have tried to explain sociocognitive factors underlying age-related changes in prejudice. Mainly, children’s increased ability to use multiple classification skills and to feel empathy toward others and adopt their perspective are the factors that presumably underlie developmental decline of prejudice. Empirical evidence points a slightly different developmental path of prejudice in Spanish children. For instance, in a study that focused on children in second, four and sixth grades, Enesco et al. (2005) reported knowledge about and endorsement of stereotypes toward different ethnic groups on the part of Spanish and Latin American children living in Spain. Concerning stereotype endorsement (i.e., children's informed level of agreement with stereotypes held by society), they found a significant age-related decrease in the agreement with negative stereotypes attributed to Romany people between second and sixth grades. In a study about development of implicit attitudes, Callejas et al. (2011) informed that ethnicity did not influence participants' attributions of intentionality in rule violation. By studying implicit automatic associations about Arab people, Chas et al. (2018) found no decrease in prejudice between 10 and 13 years of age. Altogether, results suggest that the rise and decline of prejudice in Spanish children is somehow delayed in comparison with the developmental trajectory shown by children from traditional multi-ethnic countries.

3.1.4 The current study

As previously noted, still few studies have examined the contribution of EF and ToM to prejudice in children. It also remains unknown the role played by children's motivations to control their prejudiced attitudes.

By examining individual differences in three age groups, the present research aims to shed light on the role of individual differences in the relationship between cognitive skills and prejudice. Preschool-age children, third-graders and sixth-graders took part in the present study. We administered measures of EF, ToM, prejudice and motivation. We also assessed intelligence to be included as a control variable. Prejudice was assessed toward the Romany group, as this ethnic group is a salient minority in Spain (Enesco et al., 2005) that is frequently target of negative stereotypes (Gamella & Sánchez Muros, 1998).

We first examined participants' patterns of trust movements in a novel implicit, trust-based measure of prejudice. We expected that age and ethnicity would modulate participants' patterns of trust. Then we explored developmental changes in EF, ToM and prejudice, and analyzed relationships between cognitive skills and prejudice. In light of previous findings (e.g., Best & Miller, 2010; Carlson & Moses, 2001; Devine & Hughes, 2013; Enesco et al., 1999, 2005; Raabe & Beelmann, 2011; Vetter et al., 2013), we expected to find significant age-related improvements in EF and ToM along childhood. Concerning the developmental trajectory of prejudice, data obtained from Spanish children somehow suggest that children's explicit negative out-group attitudes arise and decline slightly later than in the case of children from countries traditionally inhabited by population of diverse ethnic origins (e.g., Enesco et al., 2005). Then, we regarded the possibility that explicit prejudice decline would not be evident until late childhood. Conceivably, implicit prejudice accounted by participants' trust patterns might also present a delayed developmental path. We expected age-related increases in EF and ToM, and an age-related decrease in explicit prejudice being evident by late childhood. We also expected to find significant associations of EF and ToM with prejudice. We predicted a negative relationship between EF and prejudice, as well as between ToM and prejudice.

3.2 Method

3.2.1 Participants

A total of 193 children divided in groups of preschoolers (n = 60, 31 girls; Mean age = 69.88 months, SD = 2.99 months), third-graders (n = 93, 43 girls; Mean age = 103.57 months, SD = 3.56 months) and sixth-graders (n = 40, 18 girls; Mean age = 140.85 months, SD = 3.27 months) participated in the study. Participants were recruited in schools located in urban and suburban areas of middle- and middle-low socioeconomic status. All participants' ethnicity was non-Romany. Participants did not present neurodevelopmental or psychological disorders.

3.2.2 Procedure

The study received approval of the University's Ethic Committee (Reference: 465/CEIH/2018). We also obtained informed parental consent. The assessment was carried out in two sessions. Children of the third-grade group participated in subsequent experimental sessions of a larger study not reported here. All participants performed all tasks in a quiet room of the school, with the exception that third-graders performed motivation and EF tasks in the lab. In the first session, intelligence and ToM were assessed. In the second session we measured motivation to control prejudice, prejudice and EF.

3.2.3 Measures

3.2.3.1 Intelligence

The Spanish adaptation of the Kaufman Brief Intelligence Test (K-BIT; Cordero & Calonge, 2009) was administered to obtain a composite IQ score on fluid and crystallized intelligence. Previous research shows that intelligence is related to both EF and ToM (e.g., Arffa, 2007; Lecce & Bianco, 2018). Therefore, IQ was used as a control variable.

3.2.3.2 Prejudice

3.2.3.2.1 Identification scale and control questions

We assessed the level of participants' identification with the Romany and non-Romany group. We also interviewed participants about their contact with Romany children.

Participants were presented with drawings depicting Romany and non-Romany individuals in counterbalanced order. A scale of faces was utilized to measure identification. The scale represented a thermometer containing faces with gradually changing emotional expressions. The drawings, the scale, and a detailed description of it can be found in Appendix, S.1.3. Participants were instructed to point to the face that best describes how much he/she looks like the child in the drawing. Children were made to understand that, the happier the chosen face, the higher the identification with the child in the drawing. Romany and non-Romany similarity scores ranged from very low (0) to very high (8). Afterwards, contact with out-group members was assessed by asking children if they had Romany friends and/or Romany classmates.

3.2.3.2.2 The Multirresponse Racial Attitude

The Multirresponse Racial Attitude (MRA; Doyle & Aboud, 1995) is a trait-attribution task that measures children's explicit favorable and unfavorable Romany and non-Romany evaluations. Participants were shown two gender-matched drawings of in-group Non-Romany and Romany children (see Appendix, S.1.3). Participant's task was to assign a total of 10 positive, 10 negative and 4 neutral attributes by pointing toward one or both of the drawings. In order to minimize forced-choice behavior, children were also allowed to respond "none of them". To reduce the influence of social desirability concerns, children were informed that there were neither correct/incorrect nor good/bad answers. To calculate the scores, we first aggregated positive attributes and negative attributes separately. Scores on attitude towards each group were calculated by subtracting negative from positive aggregated scores. Out-group attitude score was subtracted from the in-group attitude score in order to calculate composite prejudice. The resulting score could range from -20 to 20, with higher scores informing of greater prejudice. We also calculated a counter-bias score by summing positive out-group and negative in-group traits. This score ranged from 0 to 20, with higher scores indicating less prejudiced attitudes.

3.2.3.2.3 Computer-based Trust game

Based on the premise that attitudes toward the in-group and the out-group are likely to influence children's trusting decisions (Fiske & Taylor, 1991; Hilton & von Hippel, 1996; Brewer, 1999), we developed an implicit prejudice measure consisting in a computer-based version of the Berg et al. (1995)'s "investment game". For a detailed description of the procedure and an example of the decision scheme presented to children, see Appendix, S.1.4.

We programmed and presented the computer-based Trust game with the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). Participants were made to believe that they were playing with a child from another school. Each participant played with both a fictitious player from the in-group (Non-Romany) and a fictitious player from the out-group (Romany). The order of in-group and out-group conditions was counterbalanced across participants. In both in-group and out-group conditions, the participant had the role of trustor and the fictitious player had the role of trustee.

The game was presented as a token game where the child would get rewards in exchange of tokens. The experimenter provided children with instructions to play with the help of a decision scheme (see Appendix, S.1.4). In each turn, children would receive 10 tokens and they had to choose to either share them or not with the other player (i.e., the trustee). The “not sharing” decision entailed the child to keep only half of the initial amount of tokens (i.e., 5). If the child decided to share the tokens, then the trustee had 20 tokens that could equally or unequally share with the trustor (i.e., the participant). Thus, the trustee could choose between cooperating (i.e., equal distribution of tokens) or deceiving (i.e., unequal distribution that undermines trustor’s gains). The game comprised 3 blocks with six trials each. Along the game, the fictitious player’s behavior was manipulated so that it could be cooperative or deceptive. In the first block, the fictitious player’s behavior was always cooperative. In the second block, cooperation and deception were intermixed, resulting in the following trial order: deception-cooperation-deception-deception-cooperation-deception. In the third block the fictitious player was always cooperative.

The game measures the participant’s patterns of trust and distrust movements. Several indices were calculated for both the in-group and the out-group conditions. Initial distrust index (IDI) was the percentage of distrust movements in Block 1. The index of punishment (IPun) informs the proportion of times the participant decides not to trust after the trustee shows a deceptive behavior. IPun was calculated by summing the participant’s distrust movements in trials 2, 4 and 5 of block 2 and in trial

1 of block 3, and by dividing the amount of distrust movements between the number of deceptive experiences. The index of forgiveness (IFor) accounts for the recovery of trust in Block 3. IFor was calculated by summing the number of trust movements in the last five trials of the third block. All indices were expressed as percentage scores.

We subtracted in-group and out-group indices to calculate the index of initial prejudice (IIP), the punishment-based prejudice index (IPrejPun), and the forgiveness-based prejudice index (IPrejFor). IIP was calculated by subtracting in-group IDI from out-group IDI. Greater IIP informs of greater out-group relative to in-group distrust. IPrejPun is out-group IPun minus in-group IPun. Greater IPrejPun entails more out-group than in-group punishment. IPrejFor was computed as in-group IFor minus out-group IFor, so more IPrejFor indicates more in-group than out-group forgiveness. For a smoother presentation of results, we report here results concerning IDI and IIP indices. Results with the other indices can be found in Appendix, S.1.5.

3.2.3.3 Executive function

We assessed EF with the Dots spatial conflict task (Davidson et al., 2006). We programmed and presented the task with the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). We utilized a slightly modified version of the Dots task used in a previous study (Hoyo et al., 2019).

In each trial, a fixation point of duration between 1000 and 1500 ms was displayed. Then, a white dot was presented in congruent trials and a stripped dot was presented in incongruent trials. The dot, displayed during 500 ms, was followed by a blank screen for 900 ms. Thus, the allowed response time for each trial was 1400 ms. Response keys were identified by stickers. For preschoolers and third-graders, response keys were “d” and “l” in the computer keyboard. As third-graders performed this task in the lab, response keys were “1” and “5” in a serial response box (Psychology Software Tools, Pittsburgh, PA). Children’s task was to press as accurately and quickly as possible the correct response key. In congruent trials, children had to press the key in the same side where the dot appeared (i.e., “d” or “1” if the dot appeared in the left, and “l” or “5” if the dot appeared in the right). In incongruent trials, correct answer was to press the key in the opposite side of the dot (i.e., “l” or “5” if the dot appeared in the left, and “d” or “1” if the dot appeared in the right). In the current study, congruent and incongruent blocks are simple blocks that have 48 trials each. The mixed block has 96 trials (half congruent and half incongruent), with a break in the middle. Before each simple block an eight-trial practice block was included, and a sixteen-trial practice block preceded the mixed block.

We utilized percentage of errors and reaction time to calculate conflict resolution and cognitive flexibility scores. Conflict resolution compares performance in simple congruent and simple incongruent trials, and accounts for the spatial incompatibility effect (Craft & Simon, 1970). The formula is:

Simple conflict resolution = Incongruent Block Median RT/% Errors - Congruent Block Median RT/% Errors

Cognitive flexibility accounts for the difficulty of flexibly switching between two answering rules in comparison with the difficulty of a response based on a single rule. Thus, the score compares performance under contextual shifting demands with performance in a context with no shifting demands. The formula to calculate this score is:

Cognitive flexibility = Mixed Block Median RT/% Correct responses – Mean (Incongruent Block Median RT/% Correct responses + Congruent Block Median RT/% Correct responses)

Children presenting a pattern of inattentive/impulsive performance (i.e., who had more than 2 *SD* above the mean in errors in the Congruent condition or who had more than 2 *SD* above the mean in anticipatory responses through the task (that is, responses made in less than 200 milliseconds) were not included in analyses involving EF scores. Following this criteria, we removed 3 preschool-age children (n = 1 for errors in Congruent condition and n = 2 for errors in anticipatory responses), 3 third-grade children (n = 1 for errors in Congruent condition and n = 2 for errors in anticipatory responses) and four sixth-grade children (n = 1 for errors in Congruent condition and n = 3 for errors in anticipatory responses). Concerning reaction time, anticipatory responses (rt < 200 ms), as well as reaction times that were more than 2 *SD* above the mean reaction time for each condition in each age group were removed. Thus, the percentage of correct trials that was removed in the congruent condition was 16% for preschoolers, 4% for third-graders, and 11% in sixth-graders. In the incongruent condition, we removed 17% of trials for preschoolers, 5% of trials for third-graders, and 12% of trials for sixth-graders. Finally, in the mixed condition, 14% of trials in preschoolers, 4% of trials in third-graders, and 12% of trials in sixth-graders were removed.

3.2.3.4 Theory of mind

3.2.3.4.1 Affective second-order false-belief task

It is possible to disentangle cognitive and affective aspects of ToM (Shamay-Tsoory et al., 2010). In the present study we focus on affective ToM, as previous research highlights the contribution of affective aspects of ToM to prejudice (e.g., Fitzroy & Rutland, 2010). We measured affective ToM with second-order false belief stories (Miller, 2013; see the affective stories in Appendix, S.1.1) that required children to identify and explain false beliefs about emotions. One point was given if only identification was correct. Two points were awarded when both identification and explanation were correct. Incorrect answers to both questions received zero points.

3.2.3.4.2 Test of Emotion Comprehension

We also used the Test of Emotion Comprehension (TEC; Pons, Harris & de Rosnay, 2004) to assess the affective components of ToM. The TEC is a picture-based, story-telling task where children answer by pointing to faces depicting emotional expressions. We administered gender-matched versions of the TEC. The TEC assesses the understanding of nine components of emotion: emotion recognition, external causes of emotions, emotions based on desires, emotions based on beliefs, role of reminders in emotions, emotional regulation, hidden emotions, mixed emotions, and moral emotions. One point was awarded for each correctly answered component, so the final score could range between 0 and 9.

3.2.3.4.3 Strange Stories task

We utilized the White et al. (2009) version of the Strange Stories task by Happé (1994). In order to understand the stories, children must make adequate contextual interpretations of the mental states underlying non-literal statements in the story. Six stories represented social situations involving the following mental states: double-bluff, persuasion, misunderstanding, lie and white lie. In each story, the characters' behavior is influenced by their underlying mental states (for instance, in the misunderstanding story, children wrongly believe that a policeman wants to scold them because he has seen the children playing a joke on an old man, but the policeman just intends to warn children not to jaywalk). Children had to explain a character's behavior on the basis of the understanding of the mental states of all involved characters. The scoring procedure was similar to that of White et al. (2009). Two points were awarded to explanations based on correct mental-state attributions. One point was given if the answer made reference to the behavior but not to the underlying mental state.

3.2.3.5 Motivation

We designed a series of items to measure internal and external motivation to control prejudice. The wording of items was based on the Dunton and Fazio (1997) scale for adults, from where we selected and adapted 5 items. Two items tap internal motivation (e.g., "I get angry with myself when I have negative thoughts about Romany people") and three items tap external motivation (e.g., "It is important to hide from people what I think about Romany people"). Stacks of five tokens each depicted the response options of a five-point scale. From left to right, the number of colored tokens progressively incremented, from zero colored tokens to five colored tokens. Children were first read aloud the item and then informed about the response options. Children were made to understand that, the more colored tokens in the stack they chose, the more agreement with the item. Internal motivation scores went from 0 to 10, and external motivation scores went from 0 to 15.

3.3 Results

We first checked the effects of experimental manipulations and age group in performance on the Dots task. These results are presented in Appendix, S.1.6.

3.3.1 Identification and experience of contact with the Romany out-group

Detailed information concerning frequency of scores for identification with Non-Romany and for identification with Romany is available in Appendix, S.1.7. Overall children identified themselves more with the Non-Romany than with the Romany drawing. Concerning contact, 49.2 percent informed contact with Romany children, whereas 50.8 percent informed no contact with Romany children.

3.3.2 Trust game

In order to test the effects of the experimental manipulations in the Trust game, we performed an ANOVA with Block (1, 2 and 3) and Ethnicity (Non-Romany and Romany) as within-subject factors and Age group (preschoolers, third-graders and sixth-graders) and Game order (Ingroup-Outgroup and Outgroup-Ingroup) as between-subject factors. Table 3.1 represents means and standard deviations split by age group. Significant differences between age groups were found in the composite IQ score ($F(2, 190) = 7.59$, $p < .01$, $\eta_p^2 = .07$), so it was introduced as a covariate. A main effect of Age group was found, $F(2, 184) = 13.15$, $p < .001$, $\eta_p^2 = .13$. Sixth-graders trusted significantly more than preschoolers ($p < .001$) and third-graders ($p < .001$). No significant difference was observed between preschoolers and third-graders ($p = .14$). No other main effects were observed. A significant interaction between Ethnicity and Game order was found, $F(1, 184) = 17.45$, $p < .001$, $\eta_p^2 = .09$. Greater trust was placed the second time the game was played, irrespectively of whether that second time it was played with the in-group ($p < .01$) or with the out-group ($p < .05$). A significant interaction between Block and Age group was found, $F(2, 184) = 29.64$, $p < .001$, $\eta_p^2 = .24$. In Block 1, there is increased trust with age, with significant differences between the three age groups (preschoolers and third-graders $p < .05$; preschoolers and sixth-graders $p < .001$; third-graders and sixth-graders $p < .001$). In Block 2, no significant differences between age groups were found (all *p*s > .1). In Block 3, there is increased trust with age, with significant differences between the three age groups (preschoolers and third-graders $p < .05$; preschoolers and sixth-graders $p < .001$; third-graders and sixth-graders $p < .01$). Figure 3.1 shows differences between Blocks within each age group. No differences between blocks were observed for preschoolers. For both third-graders and sixth-graders a significant decrease in trust was observed between Block 1 and 2 (third-graders $p < .001$; sixth-graders $p < .001$), as well as a significant increase in trust between Block 2 and 3 (third-graders $p < .001$; sixth-graders $p < .001$). Moreover, only sixth-graders presented greater trust in Block 1 than in Block 3 ($p < .01$).

Table 3.1.
Descriptive statistics of mean (M) and standard deviation (SD) of percentages of trust split by age group.

Condition	Block	Preschoolers 1In2Out *M*(*SD*)	Preschoolers 1Out2In *M*(*SD*)	Third-graders 1In2Out *M*(*SD*)	Third-graders 1Out2In *M*(*SD*)	Sixth-graders 1In2Out *M*(*SD*)	Sixth-graders 1Out2In *M*(*SD*)
In-group	1	49.45 (26.07)	52.78 (31.59)	61.63 (28.99)	62.93 (38.08)	81.07 (21.39)	93.52 (12.96)
	2	47.78 (28.94)	46.11 (27.92)	48.45 (28.36)	46.60 (32.09)	47.73 (22.00)	64.81 (23.49)
	3	48.33 (33.15)	49.44 (29.84)	64.34 (36.84)	62.92 (37.77)	75.00 (28.98)	85.19 (27.94)
Out-group	1	52.78 (33.07)	44.44 (26.38)	67.45 (34.11)	56.81 (31.35)	90.91 (17.61)	91.67 (13.10)
	2	46.67 (31.98)	40.00 (26.84)	47.67 (28.07)	41.84 (26.60)	61.36 (22.65)	54.63 (19.64)
	3	47.22 (35.31)	45.56 (29.01)	61.63 (39.60)	55.78 (35.77)	81.06 (31.41)	83.33 (28.58)

Notes. 1In2Out: first game with the in-group, second game with the out-group; 1Out2In: first game with the out-group, second game with the in-group

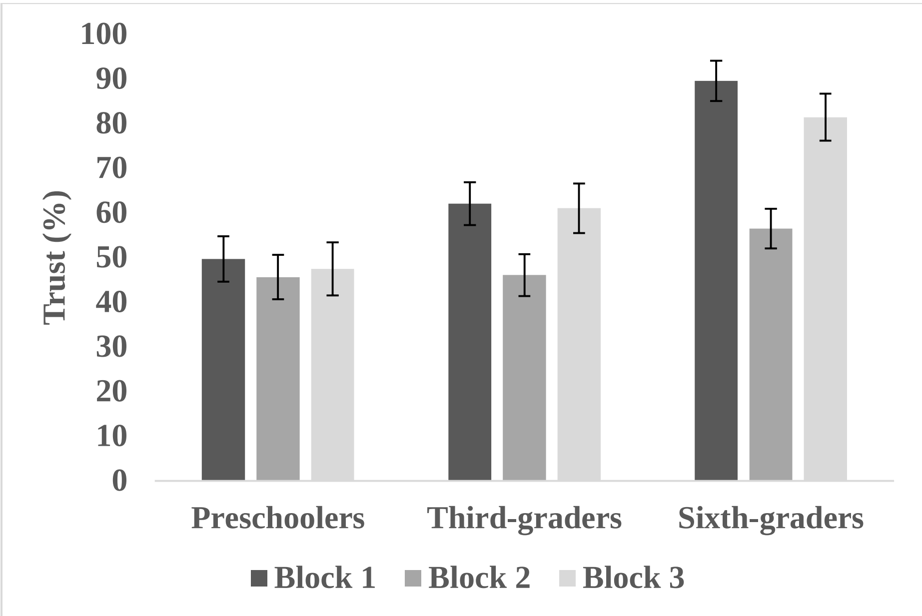


Figure 3.1. *Graph for the Block by Age group interaction*.

A series of ANOVAs on the initial distrust index (IDI), the index of punishment (IPun), and the index of forgiveness (IFor) were performed. Table 3.2 represents means and standard deviations for each index split by age group. In each ANOVA, Ethnicity was included as within-subject factor. Age group and Game order were included as between-subject factors. Intelligence was included as a covariate. For the IDI index, a main effect of Age group was found, $F(2, 186) = 23.19$, $p < .001$, $\eta_p^2 = .20$. There is an age-related significant decrease in the IDI, with significant differences between all age groups (preschoolers and third-graders $p < .05$; preschoolers and sixth-graders $p < .001$; third-graders and sixth-graders $p < .001$). A significant interaction between Ethnicity and Game order was also showed, $F(1, 186) = 13.84$, $p < .001$, $\eta_p^2 = .07$. In line with the previously reported effect in the first series of

ANOVAs performed, greater distrust was placed the first time the game was played, irrespectively of whether that first time it was played with the in-group ($p < .01$) or with the out-group ($p < .05$).

For the IPun index, a marginally significant effect of Ethnicity was found, $F(1, 186) = 2.88$, $p = .09$, $\eta_p^2 = .02$. Though there was greater punishment toward the out-group than the in-group, the difference was not significant ($p = .45$). A significant Ethnicity x Age group x Game order interaction was found, $F(2, 186) = 3.93$, $p < .05$, $\eta_p^2 = .04$. Pairwise comparisons showed that third-graders punished significantly more the out-group than the in-group when they played the game first with the out-group ($p < .01$; see Figure 3.2). No significant differences were found for the other age groups.

Table 3.2.
Descriptive statistics of mean (M) and standard deviation (SD) of percentages of trust split by age group.

		Preschoolers		Third-graders		Sixth-graders	
Index	Condition	1In2Out *M*(*SD*)	1Out2In *M*(*SD*)	1In2Out *M*(*SD*)	1Out2In *M*(*SD*)	1In2Out *M*(*SD*)	1Out2In *M*(*SD*)
IDI	In-group	50.56 (26.07)	47.22 (31.59)	38.37 (28.99)	36.67 (37.80)	18.97 (21.39)	6.50 (12.97)
	Out-group	47.22 (33.07)	55.56 (26.38)	32.56 (34.11)	43.00 (31.06)	9.09 (17.61)	9.26 (13.06)
IPun	In-group	48.33 (46.80)	60.00 (44.76)	63.95 (38.48)	49.50 (40.84)	73.49 (35.898)	50.93 (33.56)
	Out-group	56.39 (47.23)	55.00 (48.18)	59.69 (39.63)	69.17 (41.45)	59.09 (32.82)	60.65 (32.82)
IFor	In-group	51.33 (32.67)	50.00 (30.96)	64.65 (36.47)	64.40 (37.97)	78.18 (29.54)	85.56 (28.12)
	Out-group	48.67 (35.89)	46.00 (30.24)	61.86 (40.19)	58.80 (37.12)	80.91 (32.35)	84.44 (27.91)

Notes. IDI: Initial Distrust Index; IPun: Index of Punishment; IFor: Index of Forgiveness; 1In2Out: first game with the in-group, second game with the out-group; 1Out2In: first game with the out-group, second game with the in-group

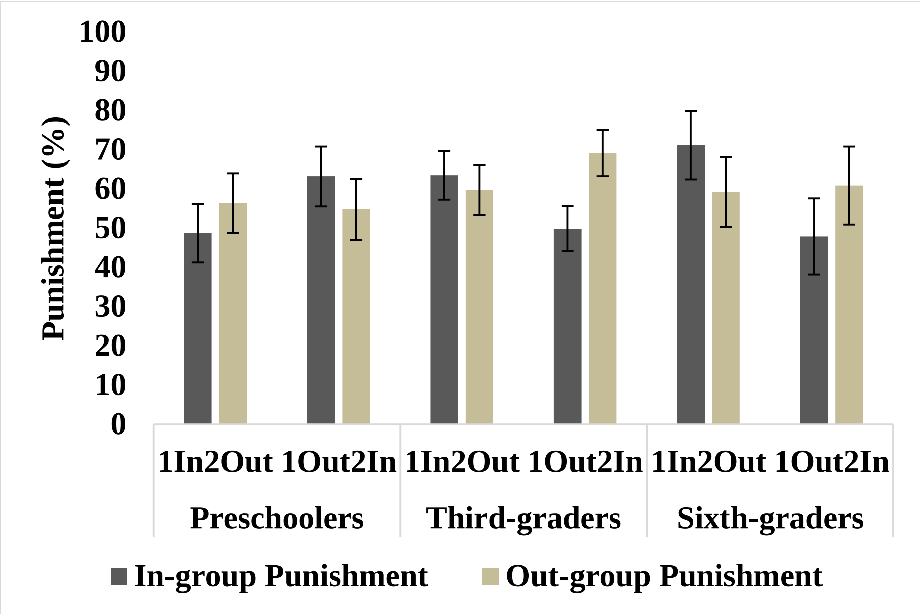


Figure 3.2. *Graph for the Ethnicity by Age group by Game order interaction.*

Finally, for the IFor index, a marginally significant effect of Ethnicity was found, $F(1, 186) = 3.87$, $p = .051$, $\eta_p^2 = .02$. Though participants tended to forgive more the in-group than the out-group, the difference was not significant ($p = .33$). A main effect of Age group was found, $F(2, 186) = 12.22$, $p < .001$, $\eta_p^2 = .12$. There is an age-related significant increase in the IFor, with significant differences between all age groups (preschoolers and third-graders $p < .05$; preschoolers and sixth-graders $p < .001$; third-graders and sixth-graders $p < .01$). No significant interaction effects were found.

3.3.3 Developmental changes in executive function, theory of mind and prejudice

Shapiro – Wilk normality tests showed that several scores did not follow a normal distribution; accordingly, a series of non-parametric, Kruskal-Wallis tests for independent samples were conducted to analyze differences between age groups (see Table 3.3). As expected, age-related EF improvements were observed. Importantly, the improvement only occurred for accuracy. Pairwise comparisons showed statistically significant differences between preschoolers and third-graders (p = .001 for conflict resolution errors and p < .01 for cognitive flexibility errors) and between preschoolers and sixth-graders (p < .01 for conflict resolution errors and p < .05 for cognitive flexibility errors), but not between third-graders and sixth-graders (p = 1 for both conflict resolution errors and cognitive flexibility errors). As hypothesized, a significant age-related increase in ToM was found. For the TEC score, pairwise comparisons showed statistically significant differences between preschoolers and third-graders (p < .001) and between preschoolers and sixth-graders (p < .001), but not between third-graders and sixth-graders (p = .42). Pairwise comparisons for the Affective ToM score showed no statistically significant differences between preschoolers and third-graders (p = .74), but significant differences between preschoolers and sixth-graders (p < .001), and between third-graders and sixth-graders (p < .001). Significant differences between preschoolers and third-graders (p < .001) and between preschoolers and sixth-graders (p < .001) but not between third-graders and sixth-graders (p = .20) were found for the Strange Stories score. Concerning prejudice, analyses confirmed the predicted developmental trajectory, as the decrease of prejudice was observed by late childhood. For the prejudice score, no significant differences were found between preschoolers and third-graders ($p = 1$), but significant differences were found between preschoolers and sixth-graders ($p < .05$), and between third-graders and sixth-graders ($p = .001$). For the counter-bias score, no significant differences were found between preschoolers and third-graders ($p = 1$), but significant differences were found between preschoolers and sixth-graders ($p < .001$), and between third-graders and sixth-graders ($p < .001$).

Table 3.3.
Kruskal-Wallis test for age-related differences in EF, ToM and explicit prejudice

		Preschoolers		Third-graders		Sixth-graders			
		n	Mean rank	n	Mean rank	n	Mean rank	χ^2	η^2_H
Executive function	Conflict resolution reaction time	57	102.52	90	86.46	36	89.21	3.33	.01
	Conflict resolution errors	57	115.18	90	83.04	36	77.71	16.33***	.08
	Cognitive flexibility reaction time	57	85.29	90	94.39	36	96.65	1.38	.00
	Cognitive flexibility errors	57	111.34	90	84.51	36	80.11	11.23**	.05
Theory of mind	Test of Emotion Comprehension	60	52.10	93	112.68	40	127.89	61.32***	.31
	Affective theory of mind	60	80.79	93	91.19	40	134.81	25.72***	.12
	Strange Stories	60	47.15	93	113.67	40	133.03	73.51***	.38
Prejudice	Composite prejudice	60	99.80	93	107.39	40	68.65	13.72***	.06
	Counter-bias	60	82.75	93	88.08	40	139.11	29.14***	.14

Notes. $^{**}p < .01$, $^{***}p. < .001$

3.3.4 Relations between executive function, theory of mind, prejudice and motivation

Given that several scores did not follow a normal distribution, one-tailed partial Spearman correlations controlling for IQ were carried out. EF scores were inverted, so higher EF scores inform better EF skills. To ease the interpretation of results, inverted EF scores for conflict resolution errors and cognitive flexibility errors are now called conflict resolution accuracy and cognitive flexibility accuracy, and inverted EF scores for conflict resolution reaction time and cognitive flexibility reaction time are now called conflict resolution efficiency and cognitive flexibility efficiency. Together with the traditional *p* values, we calculated the post-hoc, achieved power with G*Power version 3.1.9.4, and adjusted *p* values for multiple comparisons (*q* values; Storey, 2002).

Table 3.4 shows correlations of EF and ToM with explicit and implicit prejudice. Here we present analyses with the whole sample, and about indices related to distrust toward the out-group in the first block of the Trust game (see analyses with punishment and forgiveness indices in Appendix, S.1.5. See exploratory analyses on correlations split by age group in Appendix, S.1.8). No significant associations between EF and explicit prejudice were found. Concerning correlations between EF and trust-based prejudice indices, significant negative associations were found between conflict resolution efficiency and Outgroup IDI, and between conflict resolution accuracy and Outgroup IDI.

With regard to the relation between ToM and prejudice, analyses revealed that better ToM skills were associated with less prejudice.

Importantly, ToM correlated with both explicit and implicit prejudice (see Table 3.4).

Table 3.4.
One-tailed Spearman correlations between EF, ToM and prejudice. Control variable: IQ.

		Prejudice	Counter-bias	Out-group IDI	IIP
		Rho(*q*,power)	Rho(*q*,power)	Rho(*q*,power)	Rho(*q*,power)
Executive function	Conflict resolution efficiency	-.04	.04	-.17*(*,.76)	-.00
	Cognitive flexibility efficiency	-.00	-.01	.06	.10#(*ns*,.38)
	Conflict resolution accuracy	-.06	.07	-.20**(*,.86)	-.06
	Cognitive flexibility accuracy	.02	-.00	-.09	-.12#(*ns*,.38)
Theory of mind	Test of emotion comprehension	-.03	.13*(#,.63)	-.24***(***,.96)	-.03
	Affective theory of mind	-.19**(*,.88)	.25***(***,.96)	-.18**(*,.78)	-.06
	Strange Stories	-.19**(*,.88)	.31***(***,1.00)	-.35***(***,1.00)	-.20**(*,.88)

Notes. Out-group IDI: out-group initial distrust index; IIP: index of initial prejudice
#05 < p < 1.00, *p < .05, **p < .01, ***p. < .001. q = adjusted p value for multiple comparisons. Power = achieved power.

As stated in the goals of the present study, the relation between motivation to control prejudice and prejudice was also explored. Internal and external motivation scores were correlated with MRA and trust-based prejudice scores. As shown in Table 3.5, internal motivation was associated with less explicit and implicit prejudice.

Table 3.5.
One-tailed Spearman correlations between motivation and prejudice. Control variable: IQ.

	Prejudice	Counter-bias	Out-group IDI	IIP
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Internal motivation	-.21** (*,.88)	.18** (*,.78)	-.17* (*,.78)	-.11# (*ns*,.40)
External motivation	-.01	-.03	.04	-.11# (*ns*,.40)

Notes. Out-group IDI: out-group initial distrust index; IIP: index of initial prejudice
#.05 < p < 1.00, *p < .05, **p < .01, ***p. < .001. q = adjusted p value for multiple comparisons. Power = achieved power.

3.3.5 Regression analyses on the predictive role of executive function, theory of mind and motivation

As a function of the significant correlations found, a series of stepwise analyses were carried out. In line with correlation analyses, EF scores were inverted to facilitate interpretation. For each analysis, IQ and motivation were introduced in step 1 and 2, respectively. In step 3, we included the EF score(s) or the ToM score(s) that significantly correlated with the dependent variable. If both EF and ToM were significantly correlated with the dependent variable, we included EF in step 3 and ToM in step 4.

First we carried out regression analyses to predict prejudice scores from the MRA. IQ, Internal motivation, Affective ToM and Strange Stories scores were included to predict prejudice score. The first model resulted significant, F (1, 191) = 5.08, p < .05, R^2= .03. Internal motivation was the only significant predictor (β = -.16, t = -2.25, p < .05).

Regression analysis to predict counter-bias included IQ, Internal motivation, and Strange Stories (see Table 3.6). Both Models 1 and 2 were significant, Model 1, F (1, 191) = 6.08, p < .05, and Model 2, F (2, 190) = 9.80, p < .001. Whereas Internal motivation was a significant predictor in Model 1, it fell out of significance when Strange Stories was added to Model 2.

Table 3.6.
Stepwise regression analyses. DV: Counter-bias

	ΔR^2	Predictors	β	t
Step 1	.03*	Internal motivation	.18	2.47*
Step 2	.06***	Internal motivation	.11	1.49
		Strange Stories	.26	3.62***

Notes. **p* < .05, ****p*. < .001.

Secondly, regression analyses on the index of initial distrust toward the out-group were performed. In order to predict Outgroup IDI, IQ, Internal motivation, Conflict resolution accuracy, Conflict resolution efficiency and Strange Stories scores were analyzed as predictors (see Table 3.7). Model 1 was marginally significant, F (1, 181) = 3.91, p = .05. All the other Models were significant, Model 2, F (2, 180) = 7.57, p < .01, Model 3, F (3, 179) = 6.73, p < .001, and Model 4, F (4, 178) = 7.27, p < .001. In Model 2, Conflict resolution accuracy was a significant predictor. In Model 3, both Conflict resolution accuracy and Conflict resolution efficiency were significant predictors. Finally, in Model 4, together with conflict resolution scores, Strange Stories score was also a significant predictor.

Table 3.7.
Stepwise regression analyses. DV: Out-group IDI

	ΔR^2	Predictors	β	t
Step 1	.03*	Internal motivation	.18	2.47*
Step 2	.06***	Internal motivation	.11	1.49
		Conflict resolution accuracy	-.26	3.62***
Step 3	.02*	Internal motivation	-.08	-1.06
		Conflict resolution accuracy	-.25	-3.43**
		Conflict resolution efficiency	-.16	-2.18*
Step 4	.04**	Internal motivation	-.03	-.44
		Conflict resolution accuracy	-.20	-2.79**
		Conflict resolution efficiency	-.14	-2.04*
		Strange Stories	-.21	-2.84**

Notes. **p* < .05, ***p* < .01, ****p*. < .001.

3.4 Discussion

As noted in the Introduction, developmental research has not profusely investigated the role played by individual differences in the relationship between cognitive skills and prejudice. The present research's main goal was to deepen in the understanding of the contribution of individual differences in EF, ToM and motivation to individual differences in prejudice. We also examined developmental changes in EF, ToM and prejudice, and analyzed trust movements as indicators of indirect prejudice in a computer-based Trust game.

3.4.1 The computer-based Trust game as a prejudice measure

We first tested the effects of the experimental manipulations included in the trust-based prejudice measure. We expected that trustee's ethnicity would influence participants' trust decisions through the task. This hypothesized effect of fictitious player's ethnicity on trust decisions was found only for the IPun index. Importantly, this effect was only significant for third-graders, who punished more the out-group than the in-group when they first played with the out-group and then with the in-group. This suggests that the experimental manipulation allowed to detect third-graders' patterns of punishment-based distrust, and accordingly their implicit prejudice toward the out-group. However, the experimental manipulation did to detect this type of implicit prejudice in preschoolers and sixth-graders. It does not necessarily imply that the other age groups do not present implicit prejudice. According to previous studies, implicit prejudice emerges at about 2-4 years of age, increases until 5-7 years of age, and does not decrease until late adolescence (Raabe & Beelman, 2011). Noteworthy, the results of this revision are based on a limited number of studies (37) that made use of a child-friendly version of the Implicit Association Task (IAT; e.g., Baron & Banaji, 2006), a widely used measure to assess implicit prejudice in adults. Whereas the IAT accounts for automatic positive and negative stereotypic associations, the Trust game accounts for the influence of automatic and implicit attitudes on overt behavior, presumably without children's awareness about that influence. The difference between the Trust game and the IAT in the way to measure indirect prejudice might explain the discrepancy between our results and that of the previous literature. Another point of inquiry is that trustee's ethnicity may have not been sufficiently salient for trust decisions in our Trust game. Previous literature informs that discrimination toward out-groups increases in situations of economic scarcity (Krosch & Amodio, 2014; 2017). This result suggests that ethnicity is a factor that people consider when deciding about the distribution of limited resources. In our Trust game, trust decisions do not pose a big threat to resources. Then, it is likely that trustee's ethnicity does not become a salient factor for trust decisions.

Apart from the expected effect of ethnicity on trust, an age-related increase in global trust through the task was found. This increase in trust was not modulated by the fictitious player's ethnicity. Critically, the experimental manipulations of our Trust game have likely promoted children's trust decisions. Whatever the participant's trust decision in each turn, a minimum gain of 5 tokens is guaranteed. Thus, trusting in the fictitious player entails to get, at least, as many tokens as not trusting. Older children, supposedly endowed with greater ability to estimate the probability of gains, may have made trust decisions on the basis of this distribution of tokens. As previously argued, trust at least partly draws on the pondering of the likelihood of gains and losses (e.g., Evans et al., 2013). However, it is also possible that children trust because of concern about trustee's benefit, as proposed by the encapsulated interest approach (Mújdriczca, 2019). Older children's increased ability to take others' perspective may also probably foster trust by underpinning expectancies of reciprocity on the part of the trustee (Evans et al., 2013). Future studies should elucidate the relative contribution of self-interest and perspective-taking skills to children's trust decisions. Moreover, in our results, the age-related increase in trust interacts with our manipulation of the fictitious player's behaviour, as it was found that participants from third grade and sixth grade modulated their trust in accordance with the trustee's patterns of cooperative and deceptive behavior. In contrast, preschoolers present a pattern of general distrust, whatever the trustee's behavior. With age, trust increases likely due to older children's greater reciprocity expectancies (Evans et al., 2013). Furthermore, given older children's better perspective-taking skills (Evans et al., 2013), third-graders and sixth-graders may be more sensitive to the trustee's violation of reciprocity, and accordingly they withdraw their confidence after trustee's deceptive behavior. We also observed that, after trustee's deceptive behavior, sixth-graders do not recover their trust at their initial level (i.e., their trust in Block 1). As a possibility, sixth-graders may re-evaluate the fictitious player's trustworthy after Block 2 and as a result they do not completely recover their trust.

Our results also show that fictitious player's ethnicity interacts with game order. The interaction informs that greater trust is placed the second time the game is played, irrespectively of the fictitious player's ethnicity. This interaction effect suggests that learning processes underpin participants' trust movements. Accordingly, children learn that trusting behavior increases the likelihood of getting tokens. Indeed, theorists of trust pose that learning experiences modulate trust (e.g., the System Theory; Mujdrizca, 2019). Then, the learning experience that participants obtain in the first game makes them more prone to trust in the second game.

3.4.2 Developmental changes in executive function, theory of mind and prejudice

We were interested in analyzing age-related changes in EF, ToM and prejudice. For EF, we found improvements in accuracy, but not efficiency, in conflict resolution (that informs about the inhibitory control component of EF) and cognitive flexibility. Our results also informed about no accuracy improvements beyond middle childhood. A previous study that used another version of the Dots task reported here (Davidson et al., 2006) found that inhibitory control improves in efficiency and accuracy along childhood and up to late childhood (i.e., 11 years of age). Concerning cognitive flexibility, improvements in efficiency and accuracy were not evident until late childhood, and even adolescents at age 13 did not reach an adult-like performance. In our Dots task the allowed response time was 1400 ms, and in Davidson et al. (2006) participants were provided with 1250 ms to respond. This difference, though small, makes it difficult to establish straightforward comparisons between our results and that of Davidson et al. (2006). A possible explanation for the absence of age-related efficiency improvements is that children from all age groups may have taken advantage of the allowed response time in order to preserve accuracy through the task, being the benefit for accuracy evident by comparing early with middle and late childhood. Thus, participants' individual differences in their ability to use the allowed response time to preserve accuracy may have attenuated the task sensitivity to detect age-related differences in response efficiency.

Concerning ToM, our results inform that between early and middle childhood children significantly improve their understanding of emotions, as well as their understanding of mental states involved in complex social interactions. In contrast, comprehension of affective second-order mental states presents a more protracted development. Our results are in accordance with previous evidence showing that ToM significantly develops along middle childhood (e.g., Apperly et al., 2011; Devine & Hughes, 2013; Devine et al., 2016) and that children present a sophisticated emotion understanding by the end of middle childhood (Pons et al., 2004). Concerning second-order mental states, significant improvements were observed by late childhood. By using the same second-order task, Miller (2013) found that first-grade children outperformed preschoolers when identifying a character's belief about another character's belief or emotion. However, first-grade children were not better than preschoolers in justification of second-order beliefs. Unlike Miller (2013), we did not separately analyze identification and justification scores. Thus, what our results suggest is that it is by late childhood when children show improved ability to identify and explain second-order false beliefs about emotions. Altogether, results support and extend previous findings, and show that ToM development is protracted and diverse.

Results on children's developmental trajectory of explicit prejudice confirmed our prediction. As hypothesized, the decrease in prejudice and the increase in counter-bias were not evident until late childhood. This result evinces that the developmental path of explicit prejudice in Spanish children is delayed with respect to that of children from traditional multi-ethnic societies, were a decrease in explicit prejudice is observed by the end of middle childhood, at about 8 to 10 years of age (Raabe & Beelmann, 2011) Previous studies in the Spanish context suggested the delayed developmental trajectory of prejudice in

Spanish children. For instance, Enesco et al. (2005) informed about Spanish and Latin American children's knowledge of and agreement with stereotypes about Romany people, among other groups. Second grade children manifested agreement with negative stereotypes toward Romany people in greater extent than sixth-grade children did. The present study aimed at shed light on the developmental course of Spanish children's explicit prejudice by administering the MRA, a widely used trait attribution measure. What our results show is that Spanish children persist in prejudicial, stereotype-based evaluations of out-groups up to middle childhood. The decrease in prejudice by late childhood may reflect that sixth-graders know social norms against discriminatory behavior and are concerned about not showing a non-socially desirable behavior. We presume that not only social desirability accounts for developmental decrease in prejudice. Instead, the growing socio-cognitive skills that enable a flexible and regulated behavior and a better understanding of others' mental states are likely to be involved as well (e.g., Aboud, 2008) . The role of cognitive skills in prejudice will be discussed later, in sections concerning correlation and regression analyses.

3.4.3 Relations between executive function, theory of mind, prejudice and motivation

An important goal of the present study was to test the relation between individual differences in cognitive skills and prejudice. First, no significant relation was found between EF and explicit prejudice. In a previous research with preschoolers and third-graders (Hoyo et al., 2019), a significant relationship between efficiency in cognitive flexibility and prejudice was found. Methodological differences between the afore-mentioned and the present study may explain the difference in results. In the present study we reduced the allowed response time to 1400 ms., and filtered out response times that were more than 2 *SD* above the mean. It is possible that children who are less efficient (i.e., that take more time) when required to flexibly switch between answering rules also find more difficult to regulate the explicit expression of prejudice. Thus, if the slower children are also the more prejudiced, it is possible that the relationship between EF and explicit prejudice could be captured by analyzing the longest response times. Future studies should explore this possibility. Nevertheless, significant relationships were observed between EF and implicit prejudice. More efficiency and more accuracy in conflict resolution are related with less initial distrust toward the out-group (out-group IDI). Conflict resolution accuracy and efficiency also correlated significantly with forgiveness toward the out-group, as well as more efficiency in cognitive flexibility associated with less punishment toward the out-group (see Appendix, S.1.5). These results are in line with findings from research on adults. As Amodio (2014) argues, adults' prejudice regulation relies upon abilities to resolve the conflict between the implicit automatic bias and the controlled non-prejudiced response (in line with predictions from the conflict monitoring theory; Botvinick et al., 2001). The result in our study then points toward the same role for conflict monitoring in children's regulation of implicit prejudice. An aspect that deserves attention is that we measured conflict resolution and cognitive flexibility skills in a task that did not simultaneously presented stimuli to measure prejudice. In this sense, our procedure is different to that of studies with adults.

Concerning the relation between ToM and prejudice, the role of ToM was evident for both implicit and explicit prejudice. ToM scores negatively correlated with prejudice and positively with counter-bias. These results extend findings from previous literature which has mostly focused on linking empathy, which is a ToM-related skill, to explicit prejudice (e.g., Nesdale et al., 2005). In particular, our results suggest that less prejudiced children have a deeper understanding of affective and complex mental states. Likely, children make use of their knowledge about mental states when attributing traits and behaviors to in-group and out-group members. A possibility is that advanced mentalizing skills are associated with a decreased tendency to draw on stereotypes when judging others' traits and behaviors. In other words, children high in ToM do not draw on categorization processes. This, in turn, could enable children to perceive more similarities between in-group and out-group members. For the ToM-trust relation, we found that ToM was related to less initial distrust towards the out-group in absolute terms (out-group IDI) and in relation with distrust toward the in-group (IIP), what means that, as ToM increases, the difference between out-group and in-group distrust decreases. Similar results were found for the index of forgiveness toward the out-group (see Appendix, S.1.5). What our results suggest is that those children with higher ToM skills do not rely on fictitious player's ethnicity when judging his/her trustworthiness. It is then likely that their trusting decisions are not biased by a negative attitude toward the out-group. Instead, children with better ToM skills may elaborate a theory of the trustee's mind (as Castelfranchi et al. (2000) argue) in order to estimate the likelihood of success of the trusting decision. Better ToM skills enable children to decide whether to trust or not (Koenig & Harris, 2005) and to appraise of the other's mental states with the aim to infer his/her intentions during economic games (Frith & Singer, 2008). In the same line, data from neuroimaging research hint at ToM involvement in trusting decisions. For instance, in participants showing a cooperative behaviour in the Trust game, greater activation of brain areas for ToM is observed when participants are made to believe that they are playing with a person rather than when they believe to play with a computer (McCabe et al., 2001).

We finally analyzed the relation between motivation and prejudice. Analyses for both explicit and implicit prejudice showed that only internal motivation was significantly associated with less prejudice. According to Plant and Devine (2009), internally motivated people consider that prejudice is unacceptable and dedicate efforts to eradicate their prejudiced attitudes. Externally motivated people, in contrast, direct their efforts to prejudice concealment from public audiences. There is a chance that children are not sufficiently acquainted with normative behavior against prejudice, and so external motivation has much less potential influence on children’s explicit prejudice regulation. Research on adults informs that motivation modulates the mechanisms that underlie implicit prejudice regulation. For instance, Amodio et al. (2006) found that internally motivated people control their implicit bias through the activation of conflict monitoring processes, and regulation was not influenced by their sensitivity to non-prejudiced norms or by the modality of bias assessment (public vs. private). In contrast, for externally motivated people, mechanisms of error perception predicted prejudice regulation only if people showed high sensitivity to non-prejudiced norms and bias was assessed in public context. Amodio et al. (2008) found that low prejudice people internally motivated showed better control of bias during a stereotype-inhibition task than participants with mixed internal and external motivations. Future studies with children population should aim at the design of studies that enable to analyze whether the same mechanisms by which motivation influences regulation of prejudice also operate in children.

3.4.4 Regression analyses on the relations between executive function, theory of mind, prejudice and motivation

Stepwise regression analyses to test whether EF, ToM and motivation can predict prejudice were carried out. For the prejudice score, the predictive role of internal motivation and ToM was tested. Results showed that internal motivation was the only significant predictor. Internal motivation presumably involves children's active efforts to reduce their prejudiced attitudes and so the implementation of cognitive control (e.g., Amodio et al., 2008). For the counter-bias score, the predictive power of internal motivation fell out of significance when ToM was included as a predictor. Previous developmental research suggests that as children get older they tend to increase their counter-to-stereotype answers (e.g., Bigler & Liben, 1993). The increase in counter-bias presumably takes place in association with developmental changes in ToM skills relevant to prejudice. Interestingly, internal motivation was not able to predict counter-bias when ToM was introduced. There is a possibility that ToM mediates or moderates the relationship between internal motivation and prejudice regulation. As this goal was not part of the present's study scope, further research should clarify this possibility.

Concerning implicit prejudice, EF and ToM were proved as significant predictors. For out-group IDI, accuracy and efficiency in conflict resolution, as well as performance in Strange Stories were significant predictors. Similar results were obtained for the index of forgiveness toward the out-group (see Appendix, S.1.5).

As already argued, our results are in line with research on adult population pointing toward conflict monitoring skills as a regulatory mechanism of implicit racial bias (Amodio, 2014). Importantly, our results also support that ToM skills predict implicit prejudice. The influence of EF and ToM on implicit prejudice occurred over and above the influence of internal motivation. This result suggests that, for children, internal motivation is not as important as cognitive skills when predicting implicit prejudice. A possibility is that mechanisms through which internal motivation may impact on regulation of implicit prejudice are complex and then not fully developed yet in children.

3.5 Conclusions and future directions

In short, our study shows that children's cognitive skills have an impact on their regulation of both implicit and explicit prejudice. Future research should replicate and extend the findings of the present study. Concerning the role of EF, more studies making use of a fine-grained approach to assess accuracy and efficiency in EF processes in relation to prejudice are needed. Moreover, future studies should aim at the design and validation of child-friendly experimental tasks that account for how children apply their EFs for *online* regulation of implicit bias. Furthermore, it would be interesting the use of child-friendly procedures to gather information about brain activity underlying the regulation of prejudice.

Future research should also address the mechanisms underlying the link between ToM and prejudice. Likely, categorization and individuation processes underlying out-group perception may play a role in the contribution of ToM to prejudice. Finally, research designs should include experimental manipulation of variables like the prejudice's public accountability and should assess not only children's motivation but also their knowledge about societal norms promoting egalitarian and non-discriminatory behavior.

Chapter 4.

Section 1: Modulations of N2 and P3 components in middle childhood underlie performance in a spatial conflict task: implications for top-down control and performance

4.1 Introduction

4.1.1 Cognitive control and executive functions

Humans' cognitive control skills allow accomplishing effortful goals and coping with challenging environmental demands. The ability to implement top-down cognitive control for behavioral regulation has important implications for diverse aspects in life, including health, wealth, socio-emotional and professional development and social adjustment (Moffitt et al., 2011).

The model proposed by Dosenbach et al. (2008) establishes that top-down cognitive control draws on two differentiated brain networks subserving maintenance and adjustment of behavior. On one hand, the cingulo-opercular network contributes to goal achievement by maintaining the task set and monitoring goal-related performance. On the other hand, the fronto-parietal network is involved in situations demanding for recurrent adjustments of task set. Presumably, cognitive control networks are involved in the cognitive operations of response inhibition / interference suppression and response selection / flexibility encompassed by the concept of executive function (EF; Friedman & Miyake, 2017; Miyake & Friedman, 2012).

4.1.2 Measures of cognitive control

Usually devised cognitive control tasks have targeted a single cognitive function, either inhibition or flexibility. For instance, the Flanker task (Eriksen & Eriksen, 1974), the Simon task (Hommel, 2011), the Go – NoGo task (Verbruggen & Logan, 2008), and the Stop – Signal task (Verbruggen & Logan, 2008) are measures of individuals' ability to inhibit prepotent but incorrect response tendencies and to control the interference produced by task-irrelevant information. Examples of measures that require a flexible selection of the response rules are the card sorting tasks, such as the Wisconsin Card Sorting task for adults (Milner, 1964; Stuss et al., 2000), and the Dimensional Change Card Sort test for children (Zelazo et al., 1996, 2003). Moreover, computerized switching tasks that present two-dimension stimuli with different possible rules that change and request individuals to select the relevant response on a trial-by-trial basis have been devised (e.g., Allport et al., 1994; Hillman et al., 2006; Scisco et al., 2008).

Research employing cognitive control tasks that combine demands on diverse EF components is scarce. An exception is the study carried out by Davidson et al. (2006), where tasks combining diverse demands of EFs were administered to trace the dynamic interrelations between EFs along the development. Davidson et al. (2006) utilized a Simon-like, spatial conflict task denoted as the Dots task to account for age-related changes in behavioral performance from young childhood to young adulthood. This task presents spatial compatible (i.e., congruent) and spatial incompatible (i.e., incongruent) trials in single-task and rule-switching blocks. Whereas comparison of performance in simple congruent and incongruent blocks accounts for inhibition and resolution of the conflict elicited by the effect of spatial incompatibility of stimulus and response locations (also called the Simon effect; Craft & Simon, 1970), comparison of performance in single-task blocks with rule-switching blocks allows to index the task-set switching cost. The comparison between incongruent and congruent trials in the mixed block indexes the inhibition cost of prepotent response tendencies within the rule-switching context (i.e., the modulation of the Simon effect in the mixed block; Vu & Proctor, 2004). Moreover, the task allows examination of the effect of the global context (i.e., single-rule or rule-switching context) in performance in single trials, by which performance in non-switch congruent trials within the mixed block becomes harder than performance in non-switch congruent trials in the simple, single-rule block. Accordingly, the Dots task allows the study of inhibition and flexibility components and the interrelation among them. Performance in the Dots task presumably draws on top-down cognitive control functions of task set maintenance and adjustment.

4.1.3 Cognitive control in middle childhood

Empirical evidence on EF development along childhood suggests the usefulness of fine-grained computerized tasks to study complex inhibition and response selection processes in middle childhood (Best & Miller, 2010). Several strands of evidence suggest that middle childhood is an appropriate stage to study the dynamic of cognitive functions linked to inhibition and cognitive flexibility. In middle childhood, the structure of EF becomes more complex, as diverse EF components can account for performance in EF tasks (e.g., Lehto et al., 2003; Huizinga et al., 2006; Welsh et al., 1991). Furthermore, increasingly localized brain activity in cognitive control areas during complex response inhibition tasks suggests enhanced efficiency in inhibition (Bell et al., 2007). Research on electrophysiological indices linked to inhibition informs of increased efficiency in middle childhood of conflict monitoring, a mechanism that signals the need to inhibit a prepotent response that conflicts with the task-relevant response (Jonkman, 2006). Middle childhood is also a period where improvements in complex response selection tasks are observed. For instance, Huizinga et al. (2006) showed that the cost of switching between response sets in reaction time performance progressively decreases from middle to late childhood. By using the Dots task, Davidson et al. (2006) informed that by 10 years of age children increase accuracy when switching back and forth between task sets in a block that combines spatial compatible (i.e., congruent) and spatial incompatible (i.e., incongruent) trials.

4.1.4 Electrophysiological correlates of cognitive control: the N2 and P3 components

Brain electrical activity in even-related potential (ERPs) protocols can be examined in relation to conflict tasks performance. The amplitude of N2 and P3 ERPs components is modulated by the manipulation of processes related to cognitive control, like conflict monitoring, inhibitory control and cognitive flexibility. The N2 and P3 ERPs are already present in childhood.

The N2 is a negative polarity component located at medial-frontal sites that arises approximately 200 - 400 milliseconds post-stimulus (Abundis et al., 2014; Lamm et al., 2006). The N2 has been related to conflict monitoring and interference suppression skills linked to task set maintenance (e.g., Donkers & Van Boxtel, 2004; Espinet et al., 2012; Jonkman et al., 2007b). Enhanced N2 amplitude is observed in response to interference, as in the case of spatial incongruent trials where target and response key locations are contralateral (Lo, 2018). Research on brain image and source localization informs that the anterior cingulate cortex (ACC), an important node in the cingulo-opercular network, and the orbitofrontal cortex are the regions that generate the conflict-related

N2 modulation (e.g., Bokura et al., 2001; Botvinick et al., 2004; Jonkman et al., 2007a; Lamm et al., 2006; van Veen et al., 2001). Concerning the link between N2 and performance in tasks targeting conflict monitoring and response inhibition, some research informs about better performance in both adults (Jodo & Kayama, 1992) and children (Brydges et al., 2014; Cragg et al., 2009) who display larger/more negative N2 amplitudes. In fact, greater activity in the ACC region (i.e., a generator of the N2 component) also links to the recruitment of cognitive resources for behavioral adjustment (Kerns et al. 2004). Despite the evidence suggesting that greater N2 amplitudes indicate better ability to inhibit and resolve the cognitive conflict, some studies report smaller N2 amplitudes associated with better cognitive flexibility in preschool-age children (Espinet et al., 2012) and with better inhibition and flexibility from middle childhood to late adolescence (Lamm et al., 2006). Yet, some research has not found significant correlation between N2 and behavioral performance (Jonkman et al., 2003; Larson & Clayson, 2011). The decrease of N2 amplitude to the conflicting condition along childhood and up to adolescence (Lo, 2018) indexes increased age-related efficiency in response preparation and cognitive resources recruitment. Then, increased N2 amplitudes in children likely inform the relative immaturity of the inhibition-related conflict monitoring mechanism (Casey et al., 1997; Durston et al., 2006), but also the extent to which children detect the conflict and recruit cognitive resources.

The P3 component is a positive deflection arising between 300 and 500 ms post-stimulus (Bruin & Wijers, 2002; Pfefferbaum et al., 1985). The amplitude and latency of P3 component index the allocation of attentional resources and processing efficiency, respectively (Polich, 2007; Scisco et al., 2008). Evidence suggests that P3 is involved in response inhibition (Bruin et al., 2001; Brydges et al., 2014; Gajewski & Falkenstein, 2013; Jonkman et al., 2007b; Wessel, 2018), in task-set switching (Brydges et al., 2014; Duan & Shi, 2014; Gajewski & Falkenstein, 2011; Gajewski et al., 2008; 2010; Hsieh, 2006; Hsieh & Yu, 2003; Hung et al., 2016; Kieffaber & Hetrick, 2005), and in updating and behavioral adjustment (Dai et al., 2013; Donchin & Coles, 1988), in both children and adults. Thus, P3 is elicited by tasks involving response withdrawal, like Go – NoGo tasks (e.g., Pires et al., 2014), but also by switching tasks requiring task-set-related selection of appropriate response on a trial-by-trial basis (e.g., Duan & Shi, 2014). In adults, activity in P3a and P3b subcomponents has been linked to frontal and parietal areas (e.g., Bledowski et al., 2004; Volpe et al., 2007). Research suggests that in middle childhood P3 amplitude is most prominent in central and parietal areas (Jonkman et al., 2003). Given the involvement of P3 in multiple mental operations, this component arguably engages brain networks involved in both maintenance and adjustment of behavior. Increased P3 amplitudes link to enhanced cognitive processing and better performance due to task-relevant allocation of cognitive resources (Brydges et al., 2014; van Dinteren et al., 2014).

4.1.5 Aims of the present study

Thus far, little research has examined dynamics of conflict monitoring and cognitive flexibility processes if both cognitive functions are simultaneously demanded by a task. Further evidence on electrophysiological activity underlying performance in tasks that combine demands on diverse cognitive control functions is needed specially in middle childhood, given the increasing complexity of cognitive functions of inhibition and flexibility in this developmental stage. The present study intended to provide further evidence on this by investigating electrophysiological brain activity underlying task-set maintenance and adjustment demands in middle childhood in association with children performance. For this purpose, we measured electroencephalographic (EEG) activity and examined N2 and P3 ERPs as indices of the involvement of inhibition and flexibility during performance of a version of the Dots task in a group of 8-to-9-year-old children. In accordance with the conflict monitoring, response inhibition and cognitive flexibility demands, we expected to find poorer performance (i.e., decreased accuracy and increased reaction time) and increased N2 (i.e., more negative) and P3 (i.e., more positive) amplitudes when comparing: a) incongruent and congruent trials, b) mixed and simple blocks, and c) switch and repeat trials within the mixed block. As stated in the Introduction, the global context where single trials are presented influences performance (Davidson et al., 2006). In line with this, as the global context of the mixed block poses inhibition and flexibility demands, participants are expected to show undermined performance and increased N2 and P3 amplitudes even in less conflicting (i.e., congruent) trials. In addition to this, and in line with findings of Vu and Proctor (2004) concerning the elimination of the Simon effect in a block that intermixes spatial compatible and spatial incompatible trials, we hypothesized that the inhibition-related congruency effect at both behavioral (i.e., the greater difficulty to perform incongruent / spatial-incompatible than congruent / spatial-compatible trials) and electrophysiological levels (i.e., the greater N2 and P3 amplitudes to spatial-incompatible than to spatial-compatible trials) would be attenuated within the mixed block. Finally, we explored the association between behavioral indices of conflict resolution and cognitive flexibility and mean amplitudes in N2 and P3 locked to correct targets. As already exposed, there is mixed evidence concerning N2. Here, we argue that N2 amplitude in childhood indexes the extent to which children monitor performance and detect the need of implementing cognitive control for behavioral adjustment (Best & Miller, 2010). Moreover, greater (i.e., more negative) N2 amplitudes in childhood do not necessarily address impaired performance but rather the relative immaturity of conflict monitoring mechanism in middle childhood (Casey et al., 1997; Durston et al., 2006). Then, we expected that more negative N2 amplitudes would associate with better accuracy performance. Concerning P3, in line with the literature pointing that more positive P3 amplitudes link to better processing and allocation of task-relevant cognitive resources in childhood (e.g., Brydges et al., 2014), more positive P3 amplitudes were expected to associate with greater accuracy. The link of N2 and P3 with reaction time was explored.

4.2 Method

4.2.1 Participants

Upon obtaining parental consent for voluntary participantion, the sample consisted in a total of 93 children aged between 8 and 9 years (mean age = 103.57 months, *SD* age = 3.56 months; 43 girls) from elementary schools in the region of Granada (Spain). Children participating in our study were Caucasian, belonged to middle to upper-middle socioeconomic status environments, and had no history of psychological disorders or learning disabilities. A gift card and a t-shirt with the logo of the lab were awarded to children in appreciation for their participation.

4.2.2 Procedure

The assessment was carried out at the University's lab. The task reported here is part of a wider investigation where other cognitive tasks were administered. The complete assessment session took approximately 90 minutes for completion. Children performed the Dots task always at the end of the session and took approximately 20 minutes to complete it. Before starting the test session, the experimenter familiarized children with the assessment procedure and made sure they felt comfortably to wear the sensor net. We asked children to seat in front of the display monitor (20-inch screen) at approximately 60 cms of distance. Experimenter remained in an adjacent room monitoring EEG acquisition. We programmed a version of the Dots task of Davidson et al. (2006) with the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA).

4.2.2.1 The Dots task

In our version of the task, we presented two single-task blocks (simple blocks) of 48 trials each, and one dual-task block (mixed block) with 96 trials. The first block contained spatial compatible (i.e., congruent) trials where stimulus and response locations were ipsilateral, and the second block contained spatial incompatible (i.e., incongruent) trials where stimulus and response locations were contralateral. The third block randomly presented congruent and incongruent trials. Children were initially instructed to respond as accurately and quickly as possible through the task. Before each block, we provided specific instructions on the answering rules, as well as an eight-trial practice block preceding each simple block and a sixteen-trial practice block before the mixed block. Practice was repeated if considered necessary by the experimenter.

Breaks after each block and in the middle of the mixed block were administered.

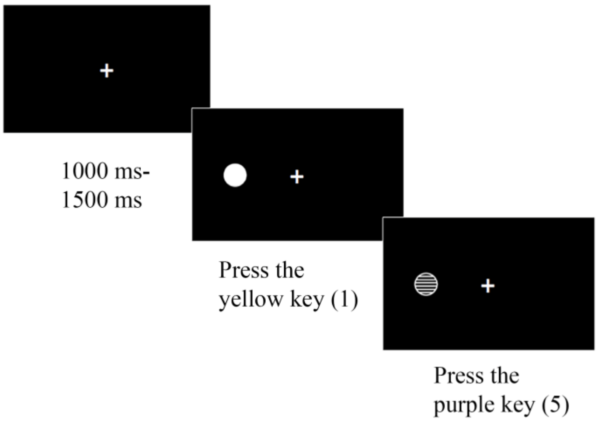


Figure 4.1. *Dots task*

Each trial (see Figure 4.1) started with a fixation cross of random duration (1000 ms – 1500 ms) in the center of the screen. Afterwards, a dot (2.5 cm x 2.5 cm) could appear during 500 ms on the left or on the right side over a black screen. A 900 ms blank screen followed the dot. Thus, children counted on 1400 ms to respond. Children responded by pressing either key “1” or “5” of a serial response box (Psychology Software Tools, Pittsburgh, PA), covered by a yellow and a purple sticker respectively. In congruent trials, white dots were displayed. Children were instructed to press the yellow key if the dot appeared on the left, and to press the purple key if the dot appeared on the right. In incongruent trials, striped dots were presented, and children were instructed to press the yellow key if the dot appeared on the right, and to press the purple key if the dot appeared on the left. A tone of 1500 ms duration was used to provide feedback for correct and incorrect responses in the practice trials. In experimental trials, feedback was only provided for incorrect responses.

We calculated inhibition / conflict resolution and cognitive flexibility behavioral scores on reaction time and percentage of errors. Only correct trials were considered in reaction time scores. Moreover, the first trial of the mixed block was not considered in cognitive flexibility scores. Behavioral scores were calculated as follows (see Table 4.1):

Table 4.1.
Behavioral scores in the Dots task

Score	Formula
Spatial conflict interference (inhibition of prepotent response)	Incongruent Block Median RT/% Errors - Congruent Block Median RT/% Errors
Global switching (effect of global context: switching rules vs. no switching rules)	Mixed Block Median RT/% Errors – Mean (Incongruent Block Median RT/% Errors + Congruent Block Median RT/% Errors)
Local switching (within a global switching context)	Mixed Block Switch Trials Median RT/% Errors – Mixed Block Repeat Trials Median RT/% Errors

4.2.2.2 EEG recording

We used a 128-channel high-density geodesic net and the software Net Station 4.3 (EGI Geodesic Sensor Net, Eugene, OR) to register electroencephalographic (EEG) activity. The signal was registered with a band filter of 0.1 – 100 Hz and a 250 Hz sampling rate, and was online referenced to Cz. Electrical artifacts during signal acquisition were filtered out with a 50-Hz notch filter. Impedances were kept under 70 kΩ. Children's responses were recorded with a serial response box (Psycholgoy Software Tools, Pittsburgh, PA). EEGlab and ERPlab toolboxes were utilized for EEG signal processing (Delorme & Makeig, 2004; Lopez-Calderon & Luck, 2014).

4.2.2.3 Processing of the EEG signal

We filtered continuous data with a 0.2 to 30 Hz bandpass finite impulse response (FIR) filter, and offline re-referenced them to the average signal. Bad channels were visually inspected and spherically interpolated, with a maximum of 13 interpolated channels per participant. Signal was segmented in target-locked epochs of 1000 ms long and with a pre-stimulus baseline of 200 ms. Performance in simple and mixed blocks was accounted for by segmenting EEG data in the following conditions: congruent simple block (CSB), incongruent simple block (ISB), congruent mixed block (CMB), and incongruent mixed block (IMB). For analyses within the mixed block, data were segmented in repeat trial and switch trial conditions.

We visually inspected segmented data for removing epochs containing movement and/or muscular artifacts. Blinks and eye movement artifacts were identified and removed by using Independent Component Analysis (ICA). Then we computed target-locked event-related potentials (ERPs). We only considered correctly answered targets in analyses. Like in the calculation of behavioral scores, the first trial of the mixed block was not considered when testing switching effects. A total of 64 children presented sufficient (i.e., a minimum of 12) valid epochs per condition for analyses on block and congruency effects: congruent simple block (*M* = 31.41; *SD* = 7.84), incongruent simple block (*M* = 26.86; *SD* = 8.76), congruent mixed block (*M* = 20.11; *SD* = 6.44), and incongruent mixed block (*M* = 22.17; *SD* = 7.90). Concerning analyses on switching effects within the mixed block, 60 children fulfilled the criterion of 12 free-artifact valid epochs per condition: repeat (*M* = 22.68; *SD* = 8.12), and switch (*M* = 19.98; *SD* = 6.60).

4.2.2.4 Selection of time windows and electrodes for block and congruency analyses

Channels to be included and time windows to compute N2 and P3 mean amplitudes were selected according to previous literature (e.g., Abundis-Gutiérrez et al., 2014; Gajewski & Falkenstein, 2011) and on the basis of visual inspection of topological maps of the ERPs and its grand average. We calculated mean amplitudes given their greater robustness and noise reduction as compared with peak amplitudes, especially in childhood (Clayson et al., 2013).

N2 mean amplitude was calculated in the time window of 300 – 500 ms. N2 included averaged activity of channels Fz, 5 and 12. P3 mean amplitude was calculated in a time window of 450 – 850 ms by averaging the activity of channels Pz, 61 and 62.

4.2.2.5 Selection of time windows and electrodes for switching analyses

Analyses on switching analyses were carried out in medial and lateralized locations in frontal and parietal areas. For the N2 mean amplitude, a 350 – 600 ms. time window was used. Left (F3: channels 24 and 25), medial (Fz), and right (F4: channels 3 and 124) locations were considered. For mean amplitude in P3, we chose a time window of 300 – 550 ms. Channels 60 (P3), Pz and 86 (P4) were analyzed for left, medial and right locations respectively.

4.2.2.6 Analysis procedure

We first computed means and standard deviations of electrophysiological and behavioral indices in congruent simple block, incongruent simple block, congruent mixed block and incongruent mixed block conditions (see Table 4.2), and in repeat and switch conditions within the mixed block (see Table 4.3). Then we carried out a series of repeated measures analyses of variance (ANOVAs) on behavioral scores and on mean amplitudes in N2 and P3. In order to test the effects of block and congruency, Block (Simple vs. Mixed) and Congruency (Congruent vs. Incongruent) were included as within-subject factors. Switching effects within the mixed block were analyzed by including Condition (Switch vs. Repeat) and, in the case of N2 and P3, Location (Left, Central and Right) as within-subject factors. Pairwise comparisons were Bonferroni-corrected. Corrected *p* and Greenhouse – Geisser epsilon (ε) values were reported in case of sphericity assumption violation.

Next, we carried out correlational analyses between electrophysiological and behavioral indices. Electrophysiological indices of conflict resolution (spatial conflict interference scores) were calculated by subtracting N2 and P3 mean amplitudes in simple congruent block from that of simple incongruent block conditions. In order to calculate cognitive flexibility (global switching scores), we averaged congruent simple block and incongruent simple block conditions on one hand, as well as congruent mixed block and incongruent mixed block conditions on the other hand. Then, we subtracted the averaged simple block from the averaged mixed block. We also calculated local switching scores by subtracting N2-related and P3-related activity in switch and repeat trials to obtain electrophysiological indices of cognitive flexibility within the mixed block. When calculating behavioral scores, reaction times faster than 200 ms and that were 2 *SD* above the mean in each condition were excluded. Neither of the children that were included in the final sample fulfilled the criteria of inattentive/impulsive response pattern (i.e., a percentage of errors in the congruent condition that was 2 *SD* above the mean, and / or a percentage of correct and incorrect anticipatory responses (i.e., faster than 200 ms) through the task that was 2 *SD* above the mean).

Shapiro – Wilk normality tests showed that several scores did not follow a normal distribution: global switching in N2 ($W = .95$, $p < .05$), global switching in P3 ($W = .96$, $p < .05$), local switching in P3 ($W = .95$, $p < .05$), spatial conflict interference percentage of errors ($W = .86$, $p < .001$), and global switching percentage of errors ($W = .93$, $p < .01$). Accordingly, we carried out non-parametric Spearman correlations. We also calculated the post-hoc, achieved power with G*Power version 3.1.9.4, and *p* values for multiple comparisons (*q* values; Storey, 2002) in order to adjust the level of significance.

Table 4.2.
Means (M) and standard deviations (SD) for event-related potentials and behavioral scores in block and congruency

Condition	N2 *M*(*SD*)	P3 *M*(*SD*)	RT *M*(*SD*)	Err *M*(*SD*)
Simple congruent block	-2.03(3.35)	1.86(3.95)	466.27(73.52)	2.15(2.54)
Simple incongruent block	-3.18(3.71)	4.90(4.28)	550.43(79.00)	8.56(7.63)
Mixed congruent block	-2.95(4.39)	7.48(5.15)	635.09(121.26)	21.45(13.64)
Mixed incongruent block	-4.36(4.45)	7.23(5.36)	647.74(102.64)	14.62(12.50)

Notes. RT: reaction time; Err: percentage of errors

Table 4.3.
Means (M) and standard deviations (SD) for event-related potentials and behavioral scores in switch and repeat conditions

Condition	N2 Left	N2 Medial	N2 Right	P3 Left	P3 Medial	P3 Right	RT	Err
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)
Repeat	-3.82 (5.05)	-3.88 (5.25)	-1.59 (3.71)	6.35 (4.30)	10.43 (6.63)	5.87 (5.18)	627.83 (99.66)	13.33 (9.52)
Switch	-4.90 (6.42)	-5.27 (6.44)	-3.37 (4.70)	8.03 (5.87)	10.87 (6.28)	7.62 (5.61)	657.86 (111.47)	23.87 (14.68)

Notes: RT: reaction time; Err: percentage of errors

4.3 Results

4.3.1 Behavioral results

Analyses on block and congruency effects yielded a main effect of block in both percentage of errors (F(1, 63) = 115.92, p < .001, η_p^2 = .65) and reaction time (F(1, 63) = 184.00, p < .001, η_p^2 = .75). Participants had more errors in mixed than in simple blocks (p < .001); moreover, increased reaction time was observed in the mixed as compared with the simple blocks (p < .001). Whereas the main effect of Congruency was not significant for errors (F < 1), it was significant for reaction time, (F(1, 63) = 66.50, p < .001, η_p^2 = .51), with participants showing greater reaction time to incongruent than to congruent trials (p < .001). Analyses revealed a significant Block by Congruency interaction for both errors (F(1, 63) = 77.70, p < .001, η_p^2 = .55) and reaction time (F(1, 63) = 54.51, p < .001, η_p^2 = .46). Whereas participants had more errors in simple incongruent than congruent trials (p < .001), within the mixed block they committed more errors in congruent than incongruent trials (p < .001). Concerning reaction time, participants took more time to respond in simple incongruent than simple congruent trials (p < .001); no differences between incongruent and congruent trials where observed within the mixed block (p = .15).

Analyses on switching effects showed a main effect of Condition in both errors (F(1, 59) = 71.19, p < .001, η_p^2 = .55) and reaction time (F(1, 59) = 27.86, p < .001, η_p^2 = .32). Participants presented more errors and reaction time in switch than repeat trials (errors mean difference = 10.54, p < .001; reaction time mean difference = 30.03, p < .001).

4.3.2 Electrophysiological results

Figure 4.2 shows the ERPs and topographic maps that represent activation in N2 (Fz) and P3 (Pz) in congruent and incongruent trials in simple and mixed blocks. Figure 4.3 represents the ERPs and topographic maps for switch and repeat trials in the mixed block in frontal and parietal locations.

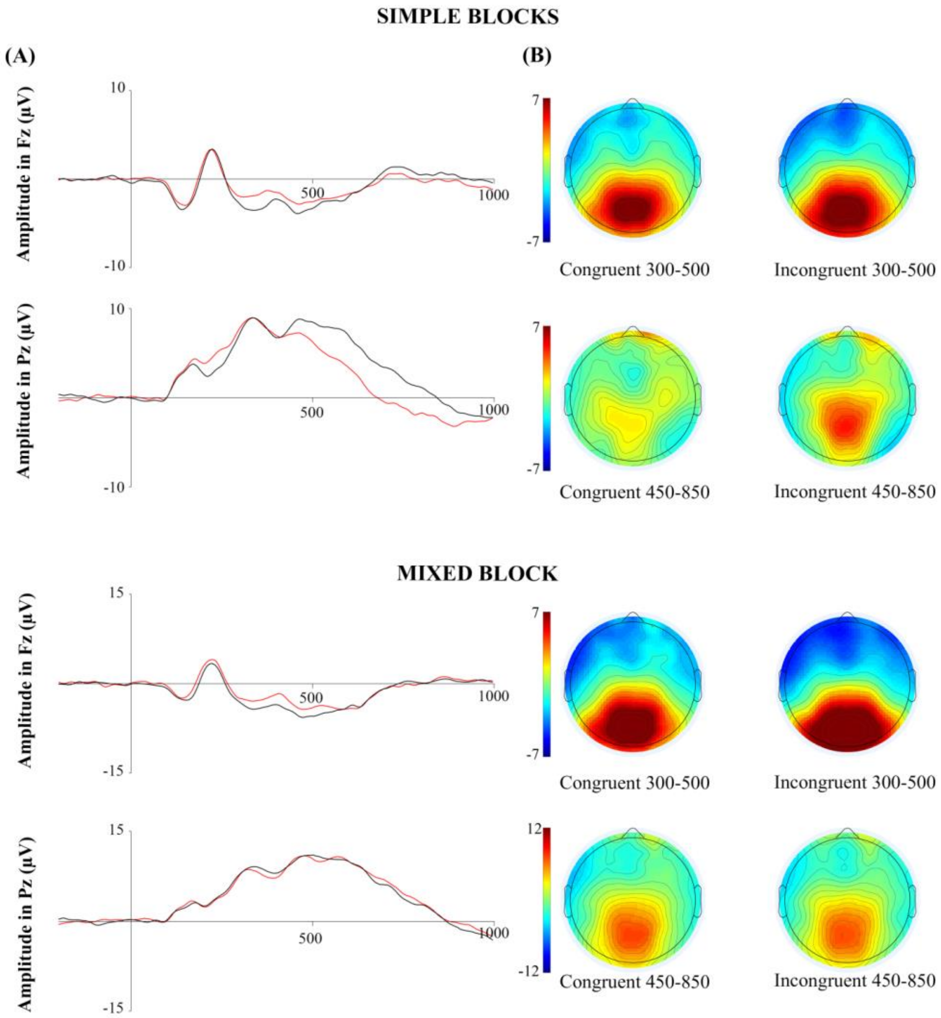


Figure 4.2. *Event-related potentials (A) and topographic maps (B) depicting congruency-related activation in simple and mixed blocks*

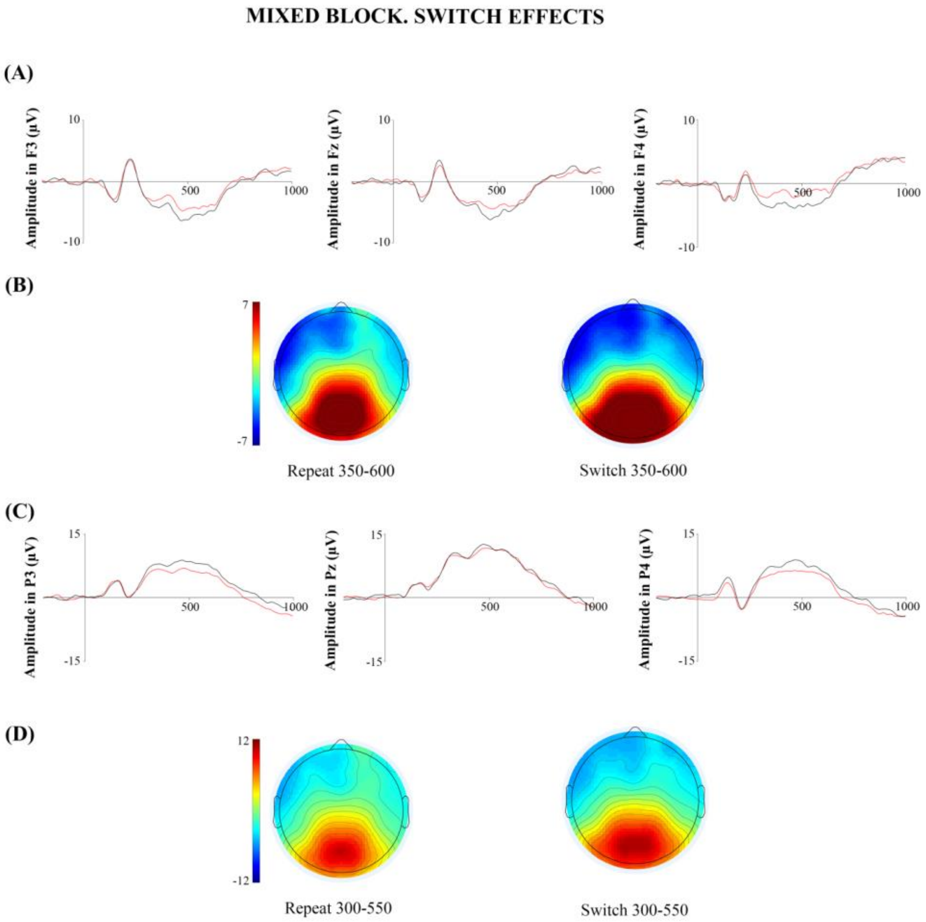


Figure 4.3. *Event-related potentials (A) and topographic maps (B) depicting switching effects in frontal and parietal locations*

Concerning the N2, analyses on block and congruency yielded a main effect of Block, $F(1, 63) = 7.09$, $p < .05$, $\eta_p^2 = .10$. Pairwise comparisons showed that mean amplitude was more negative in mixed than in simple blocks ($p < .05$). Moreover, we found a main effect of Congruency, $F(1, 63) = 20.60$, $p < .001$, $\eta_p^2 = .25$. Mean amplitude of incongruent trials was more negative than that of congruent trials ($p < .001$). The Block by Congruency interaction was not significant ($F < 1$).

Analyses on switching effects in N2 showed significant main effects of Condition, with a more negative amplitude observed for switch than repeat trials ($F(1, 59) = 8.67$, $p < .01$, $\eta_p^2 = .13$), and . Location ($F(2, 59) = 9.35$, corrected $p < .001$, Greenhouse – Geisser ε = .83, $\eta_p^2 = .25$), with greater negative amplitude of N2 component in left and medial sites compared with right (left-right $p < .05$; medial-right $p < .001$) and no difference between left and medial locations ($p = 1$). We found no significant interaction effects.

With respect of P3, analyses showed that both Block ($F(1, 63) = 7.09$, $p < .05$, $\eta_p^2 = .10$) and Congruency ($F(1, 63) = 20.60$, $p < .001$, $\eta_p^2 = .25$) main effects, as well as the Block by Congruency interaction ($F(1, 63) = 29.58$, $p < .001$, $\eta_p^2 = .32$) were significant. More positive P3 amplitude was found in mixed than in simple blocks ($p < .001$) and in incongruent than in congruent trials ($p < .001$). Regarding the interaction effect, we observed enhanced amplitude in incongruent trials than in congruent trials when comparing simple blocks ($p < .001$), but no congruency-related difference in amplitude was found within the mixed block ($p = .61$). Concerning switching effects, there was a main condition effect, ($F(1, 59) = 5.81$, $p < .05$, $\eta_p^2 = .09$), with switch trials presenting higher amplitudes than repeat trials ($p < .05$). A main effect of Location was also found, $F(2, 59) = 21.59$, $p < .001$, $\eta_p^2 = .27$). The medial location was more positive than left ($p < .001$) and right ($p < .001$) locations. No significant difference was observed between left and right locations ($p = 1$). Moreover, analyses informed a Condition by Location significant interaction, $F(2, 59) = 3.19$, $p = .045$, $\eta_p^2 = .05$. We performed ANOVAs for further analysis on amplitude differences between conditions within each location. For left and right locations, the effect of

Condition was significant (left: $F(1, 59) = 8.07$, $p < .01$, $\eta_p^2 = .12$; right: $F(1, 59) = 9.41$, $p < .01$, $\eta_p^2 = .14$). More positive amplitudes were observed in switch than repeat trials in both locations (left $p < .01$; right $p < .01$). The effect of Condition was not significant for the medial location ($F < 1$).

4.3.3 Association between electrophysiological and behavioral indices

As shown in Table 4.4, P3 amplitude in spatial conflict interference positively correlated with spatial conflict interference score in reaction time ($r = .32$, $p < .01$; one-tailed), thus indicating that the greater the P3 amplitude to incongruent than to congruent trials, the more the time children took to resolve the conflict. Concerning cognitive flexibility, correlations showed that more negative N2 amplitude to mixed than simple blocks (i.e., more negative N2 amplitude in global switching) correlated with increased accuracy (i.e., less percentage of errors; $r = .26$, $p < .05$; one-tailed). Moreover, increased P3 amplitude in global switching positively correlated with reaction time ($r = .28$, $p < .05$; one-tailed), again indicating that increased P3 associates with increased response time.

Correlations between local switching scores are shown in Table 4.5. Overall analyses inform that greater N2 and P3 amplitudes associate with better performance in terms of accuracy. Moreover, N2 amplitude negatively correlated with reaction time ($r = -.35$, $p < .01$; one-tailed), thus pointing that greater N2 is linked to children taking more time to switch between response rules.

Table 4.4.
Correlations between electrophysiological and behavioral indices of conflict resolution and cognitive flexibility

	Spatial conflict interference N2	Spatial conflict interference P3
	Rho (*q*,power)	Rho (*q*,power)
Spatial conflict interference % errors	.17# (*ns*,.39)	-.21#(*ns*,.48)
Spatial conflict interference reaction time	.08	.32** (*,.83)
	Global switching N2	Global switching P3
	Rho (*q*,power)	Rho (*q*,power)
Global switching % errors	.26*(*,.69)	-.20#(#,.48)
Global switching reaction time	-.04	.28*(*,.74)

Notes. #.05 < p < 1.00, *p < .05, **p < .01. q = adjusted p value for multiple comparisons. Power = achieved power

Table 4.5.
Correlations between electrophysiological and behavioral indices of cognitive flexibility within the mixed block

	Local switching N2 Left	Local switching N2 Medial	Local switching N2 Right
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Local switching % errors	.23* (#,.54)	.32**(*,.80)	.23*(#,.54)
Local switching reaction time	-.06	-.05	-.35** (**,.87)
	Local switching P3 Left	**Local switching P3 Medial**	**Local switching P3 Right**
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Local switching % errors	-.19#(*ns*,.46)	-.30**(*,.76)	-.22*(#,.54)
Local switching reaction time	.18#(*ns*,.38)	-.08	-.01

Notes. #.05 < p < 1.00, *p < .05, **p < .01. q = adjusted p value for multiple comparisons. Power = achieved power

4.4 Discussion

Our research aimed to extend evidence on dynamics of cognitive control in middle childhood by investigating EEG activity in relation to behavioral indices of performance in the Dots task. Specifically, the Dots task allowed us the study of interactive effects of conflict monitoring and cognitive flexibility demands, as manipulations of this task let examination of conflict monitoring skills alone and in combination with cognitive flexibility demands. We expected that children's performance, together with activity in N2 and P3 ERPs, would be modulated by task manipulations of single- versus dual-task and congruency, informing us about different mechanisms of cognitive control.

As hypothesized, behavioral performance was affected by conflict monitoring, response inhibition and cognitive flexibility demands. The congruency effect was observed in reaction times, with participants being slower in incongruent than congruent trials. This result replicates the spatial compatibility effect (also known as the Simon effect; Craft & Simon, 1970) previously reported in Simon-like tasks (e.g., Simon, 1990). Regarding the effect of conflict monitoring and flexibility demands, children performed differently in simple vs. mixed blocks and repeat vs. switch trials in line with our predictions. Specifically, participants were slower and less accurate in the mixed than in the simple blocks, as well as in switch than repeat trials. Again, these results are consistent with prior studies accounting for the switching cost (e.g., Davidson et al., 2006; Duan & Shi, 2014; Hung et al., 2016). Moreover, our data also corroborated the idea that the global context influences performance in a single trial (Davidson et al., 2006), as we found no differences in reaction time between incongruent and congruent trials within the mixed block. The response to congruent trials may become hindered (more time should be needed) in a context that requires recurrent task-set adjustments (Davidson et al., 2006). Surprisingly, we observed the contrary-to-expected pattern concerning accuracy within the mixed block (i.e., more errors in congruent than incongruent trials). In contrast to Davidson et al. (2006), that found congruency-related differences in reaction time but not in accuracy in the mixed block, our results suggest that performance of a prepotent response (congruent trials) becomes even more difficult than inhibiting a prepotent response (incongruent trials) within a context that poses rule-switching demands. As Davidson et al. (2006) pointed out, both congruent and incongruent trials require of inhibition when intermixed in the same block. Moreover, it has been previously argued that switching to perform the spatial compatible response entails to undo the inhibition of the prepotent response, and this operation is more difficult than switching to inhibit the spatial compatible response (Allport & Wylie, 2000; Allport et al., 1994). Going further and in light of our results, task-set adjustment demands may prepare children to suppress automatic responses to successfully perform spatial incompatible trials (i.e., incongruent trials), but at the same time difficult performance of spatial-compatible trials (i.e., congruent trials), involving a cost.

Changes in electrophysiological brain activity associated to the processing of the stimuli in the different experimental conditions were overall in consonance with behavioral results. As expected, we observed that ERPs were modulated by conflict monitoring, response inhibition and cognitive flexibility demands. Children showed greater mean amplitudes for N2 and P3 in incongruent than congruent trials, in mixed than simple blocks, and in switch than repeat trials in the mixed block.

More negative N2 amplitude in incongruent than congruent trials indicates the detection of the conflict elicited by the spatial incompatibility of the target and the response in line with literature accounting for the role of N2 in conflict monitoring (e.g., Abundis-Gutiérrez et al., 2014; Melara et al., 2008). Concerning the increase in amplitude in P3 for incongruent trials compared with congruent trials, it is likely informing about the greater allocation of cognitive resources needed to inhibit the prepotent response in incongruent trials given the reported role of P3 in response inhibition processes (Bruin et al., 2001; Brydges et al., 2014; Gajewski & Falkenstein, 2013; Jonkman et al., 2007b; Wessel, 2018).

Furthermore, we found enlarged amplitudes of N2 and P3 components in the mixed block (i.e., rule-switching) compared with single-rule blocks, as well as in the switch than in the repeat trials. In the latter case, the effect was prominently found in left and medial locations for N2 and medial sites for the P3 in accordance to previous findings (e.g., Dai et al., 2013; Hung et al., 2016). As stated earlier, increased N2 and P3 amplitudes indicate higher recruitment of cognitive resources for conflict monitoring, inhibition and response selection processes in the mixed block and in switch trials. Conceivably, these results also suggest that the global switching context poses high demands on top-down cingulo-opercular and fronto-parietal control networks, as the task combines task-set maintenance and adjustment demands.

Similarly to behavioral results, analyses of ERPs showed that differences in P3 (but not in N2) amplitude between congruent and incongruent trials disappeared for the mixed block, as the magnitude of the P3 component raises to a similar extent in both conditions in the mixed block. Thus, whereas spatial incompatible trials elicit more conflict than spatial compatible trials irrespectively of the global context where trials are presented (as indexed by the N2), findings on P3 modulation may reflect that task-set-selection requirements within the mixed context difficult response inhibition and selection in both congruent and incongruent trials. These results give further support to the idea that presenting congruent and incongruent trials mixed in a block increments inhibition demands since that generates a demanding context that requires recurrent task-set adjustments (Davidson et al., 2006; Vu & Proctor, 2004). Thereby, within the mixed block, selection of response for congruent trials becomes as hard as for incongruent trials, and this plausibly means that switching demands overload function of the control network involved in task-set adjustment (i.e., the fronto-parietal control network). In fact, behavioral analyses revealed poorer accuracy in congruent than incongruent trials in the mixed block. Taken together electrophysiological and behavioral evidence, our results are likely suggesting that when the conflict monitoring mechanism signals the need of behavioral adjustment within a rule-switching context, performance in terms of accuracy is better for conflicting (i.e., incongruent) than for non-conflicting (i.e., congruent) trials. Thus, top-down conflict monitoring mechanisms seem to be linked to improved subsequent task-set adjustment (Dosenbach et al., 2008; Kerns et al., 2004).

Correlational results were in the expected direction, as increased amplitudes linked to improved performance. A more negative N2 in mixed than simple blocks associated with greater accuracy in cognitive flexibility indexed by the global switching score. This result is in line with previous findings informing that increased amplitudes associate with better performance (e.g., Brydges et al., 2014; Carter & Van Veen, 2007; Dai et al., 2013; Duan & Shi, 2014; Scisco et al., 2008; van Veen & Carter, 2002), and provides further support for the role of N2 in signaling the need of behavioral adjustment. Furthermore, this result may indicate that individual differences in children’s ability to detect the conflict and signal the need of behavioral adjustment are associated with children's ability to implement cognitive control and select the appropriate response on a trial-by-trial basis. Also for global switching effects, N2 and P3 mean amplitudes were positively associated with reaction time, thus informing that children showing more negative N2 and positive P3 amplitudes also take more time to respond. This result sheds light on neural activity underlying the typical speed-accuracy tradeoff observed at the behavioral level (e.g., Davidson et al., 2006). Presumably, increased neural activity associates with a mature response pattern characterized by looking for maximizing accuracy by taking advantage of the allowed response time. Results concerning local switching effects were also in the expected direction. Specifically, more negative N2 and more positive P3 activity in switch versus repeat trials were linked with more accurate response selection.

Altogether, results shed light on electrophysiological and behavioral dynamics underlying cognitive control demands, as well as on the relation between brain activity and response patterns. Conceivably, cognitive control dynamics within the mixed block suggest that the switching context of the mixed block recruits control networks subserving task-set maintenance and adjustment. Moreover, our results suggest that switching demands overload the function of the control network involved in task-set adjustment (i.e., the fronto-parietal control network), as increased reaction time and impairment of accuracy are observed when the context demands recursive rule switching.

One limitation of the present study it that it focused on a single task and on only one age group, so no developmental implications may be drawn. Future research should extend the present findings by including other age groups and targeting at other tasks combining cognitive control demands. Presumably, the dynamic of ERPs, as well as the link between brain activity and behavior, are expected to change through development, indexing age-related maturation in top-down control networks underlying goal-directed behavior.

Chapter 4.

Section 2: Relation of the electrophysiological and behavioral indices of cognitive control with trust-based implicit prejudice

4.5 Introduction

4.5.1 Implicit prejudice: concept and measures in childhood

The expression of prejudices, that is, of negative attitudes toward out-group members, can manifest directly or indirectly (Brown, 2010). It implies that prejudice can be expressed in overt but also in subtle behaviors (e.g., Kovel, 1970; Wolfe & Spencer, 1996; Pearson et al., 2009). According to the motivation and opportunity as determinants model (MODE model; Chaiken & Trope, 1999), implicit prejudice is observed when non-deliberative behavior is driven by automatically activated attitudes. Thus, implicit prejudice corresponds to the subtle expression of attitudes by means of automatic, non-deliberative behavior (Conner et al., 2007).

An implicit prejudice measure that has been widely used in adults is the Implicit Association Test (IAT; Greenwald et al., 1998). The IAT measures the time that participants take to categorize stimuli. It is assumed that the latency in categorization indexes the intensity of the association between targets and attributes. As an instance, it has been found that individuals respond faster to the association of Black targets with unpleasant stimuli than to Black targets associated with pleasant stimuli (Greenwald et al., 1998). Several child-friendly versions of the IAT have been devised. For instance, Baron and Banaji (2006) utilized the IAT to account for children’s implicit attitudes toward Black and White peers. They found that the automatic implicit negative associations for Black targets were already present at age 6 and persisted in middle childhood and in adulthood. Cvencek et al. (2011) developed the Preschool Implicit Association Test (PSIAT) and found that it was useful to assess 4-year-old children’s automatic implicit attitudes toward gender and usually liked objects. Based on the logic that the presentation of an object elicits the activation of the associations held with that object (e.g., Collins & Loftus, 1975; Fazio et al., 1995), priming tasks have been devised to account for implicit attitudes (Fazio et al., 1995). Priming procedures briefly present the object of attitude (e.g., out-group faces) followed by positive and negative adjectives. Presumably, the spontaneous prime-induced activation of category influences the speed of response to adjectives. By combining the administration of IAT and affective priming tasks in children and adolescents, Degner and Wentura (2010) found that, in the affective priming task, responses to stimuli of negative valence were faster if German participants had previously been presented with out-group (Turkish) faces, although this expression of implicit prejudice was only evident by early adolescence. In contrast, the IAT consistently elicited automatic stereotypic associations toward Turkish targets regardless participants' age. Another example of implicit measure adapted to children is the Ambiguous Situation Task (McGlothlin et al., 2005). This task assesses the influence of ethnic categories in children's decision making processes in situations about, for instance, moral transgressions and peer relationships. Concerning peer relationships, McGlothlin et al. (2005) found that fourth-grade children (and more often male than female children in this age group) considered that friendship between a White child and a Black child was less likely when they were presented with a transgression potentially perpetrated by the Black child than when the potential perpetrator of the transgression was the White child.

4.5.2 Trust and prejudice

Several strands of evidence suggest that attitudes toward out-groups are likely to influence trust decisions. Brewer (1999) claims that greater trust is placed in in-group rather than out-group members. Trust decisions may be influenced by category-driven processes, and thus by stereotypes (Fiske & Taylor, 1991). For instance, Sniderman et al. (2014) found that people who are low in generalized social trust also tend to distrust outgroup members. Studies about intergroup contact and prejudice reduction inform that friendship with out-group members can reduce out-group prejudice and increase trust (Paolini et al., 2007), and that trust mediates the relation between contact and more positive attitudes toward out-groups (e.g., Dhont & Van Hiel, 2011; Visintin et al., 2016). Moreover, it has been suggested that perceived trustworthiness is an indirect indicator of prejudice (Freeman et al., 2016). In light of these pieces of evidence, it seems reasonable to expect that trust patterns with in-group and out-group members will indirectly reflect individuals' in-group and out-group attitudes.

4.5.3 Cognitive control of implicit prejudice: evidence in studies with adults and children

Literature informs that people may experiment a conflict between their automatically activated stereotypical associations and their goal to display non-prejudiced behavior (Amodio, 2014). In accordance with Amodio et al. (2008), individuals will engage cognitive control to regulate behavior as long as they detect the conflict between the automatic and the desired controlled response. Conceivably, cognitive control applied to regulation of implicit prejudice entails the initial detection of the conflict between the prepotent prejudiced and the controlled non-prejudiced responses, and the subsequent recruitment of cognitive resources necessary to inhibit the prepotent response and perform the controlled one (Bartholow et al., 2006). This model of cognitive control characterized by conflict monitoring and activation of control processes for behavioral adjustment is similar to the top-down cognitive control model proposed by Dosenbach et al. (2009), where cognitive control is the result of networks involved in monitoring performance and behavioral adjustment.

In research on adult population, evidence regarding the role of cognitive control in regulation of implicit prejudice mainly comes from functional magnetic resonance imaging (fMRI) studies that observe activity in brain regions linked to cognitive control, and from electrophysiological studies that focus on components of brain electrical activity (event-related potentials; ERPs) generated by those brain regions when individuals perform implicit prejudice tasks. Moreover, studies focusing on behavioral indicators of cognitive control (with some of them also accounting for indices on brain activity), have also shed light on the contribution of cognitive control to prejudice regulation in adults.

Concerning fMRI studies with adult samples, investigations suggests that activity in anterior cingulate cortex (ACC) and lateral prefrontal cortex (lPFC) are involved in processing of the conflict elicited by implicit prejudice tasks and implementation of response inhibition and selection processes, respectively (Amodio, 2014). Activity in ACC positively correlates with participants’ ability to detect the appropriate, controlled response in trials that elicit automatic prejudiced associations when performing an IAT (Beer et al., 2008). Moreover, greater activity in ACC is linked to less self-report guilt in low-prejudice individuals and to false feedback informing prejudiced responses during an IAT (Fourie et al., 2014). Accordingly, ACC activity indexes successful inhibition of prejudice due to conflict detection and the indication of the need of implementing cognitive control (Amodio, 2014). Activity in the right inferior frontal gyrus (a region in the lPFC) in response to presentation of Black faces suggests that inhibition of prejudice spontaneously arises due to the activation of racial categories by exposure. Moreover, activity in dorsolateral prefrontal cortex has been related to better control of the influence of stereotypes on behavior (Beer et al., 2008) and suppression of racial stereotypic associations (Knutson et al., 2007).

Electrophysiological research has focused on error related negativity (ERN) and N2 components as indices of conflict-processing-related ACC activity, and on frontal cortical asymmetry and the negative slow wave components as indices of behavioral control and inhibition of prejudice. For instance, the ERN has been linked to individual differences in the ability to control and avoid the expression of automatic stereotypes. By using the Weapons Identification task, Amodio et al. (2004) found that those participants who showed more negative amplitude of the ERN component when commiting errors in stereotype-inconsistent trials (i.e., in those trials were Black faces were followed by pictures of tools and participants wrongly classified the picture of the tool as a picture of a gun) tended to unfold better performance through the task by slowing down after incorrect responses in order to subsequently give accurate responses. By using a stereotype-inhibition task where White and Black faces were followed by words depicting stereotypical traits and trials were preceded by go and no go signals indicating emission and withdrawal of response respectively, Bartholow et al. (2006) found that activity in response-locked N2 component is greater (i.e., more negative) in stereotype-consistent trials that require to withhold the response. This effect in N2 amplitude was not modulated by the induction of cognitive control depletion. Concerning electrophysiological indices of inhibition and control, evidence shows that the P2 ERP, that indexes perceptual attention to faces, mediates the relation between increased left frontal cortical asymmetry in alpha activity (linked to dorsolateral PFC activation, and thus to the implementation of goal-directed, motivational behavior; Harmon-Jones, 2003) and enhanced action control (Amodio, 2010). The negative slow wave (NSW), a frontocentral component that arises around 400 ms. after stimulus onset (e.g., West & Alain, 1999), has been related to enhanced cognitive control of prejudice via the implementation of cognitive control. Specifically, more negative NSW is observed in stereotype-consistent trials, and this increased NSW amplitude is in turn linked to better response inhibition (Bartholow et al., 2006). Altogether, further evidence on ERPs linked to implementation of cognitive control is needed (Amodio, 2014). Conceivably, other ERPs related to response inhibition and selection, like the P3 component, may contribute to regulation of prejudice.

Studies that account for behavioral indicators of cognitive control (together or not with brain image evidence) also support that conflict monitoring skills contribute to prejudice suppression in stereotype-inhibition tasks (e.g., Payne, 2005; Amodio et al., 2008; Beer et al., 2008). Presumably, conflict detection is related to the implementation of subsequent regulatory processes to prevent the expression of implicit attitudes. Other strand of evidence that hints at the role of cognitive control in prejudice regulation comes from cognitive control depletion studies finding that individuals exposed to interracial interaction show subsequent impairment of cognitive control (e.g., Richeson et al., 2005).

In contrast with evidence obtained from adult samples, there is thus far scarce empirical evidence on the role played by cognitive control mechanisms in children's prejudice regulation. Moreover, the study of cognitive control in children's prejudice regulation has been limited to behavioral indices of inhibition and flexibility skills encompassed by the concept of executive function (EF; Friedman & Miyake, 2017; Miyake & Friedman, 2000). Thus, no study has attempted to unravel the contribution to children's prejudice regulation of brain activity related to cognitive control. To our knowledge, two studies have examined behavioral indices of cognitive control of prejudice in children. In one of them, Bigler and Liben (1993) analyzed the relation between cognitive flexibility and prejudice in early and middle childhood. They found that children who expressed less racial bias and were better at flexibly sorting a group of cards according to diverse dimensions were also better at remembering information from stories about interracial interactions that included stereotype-inconsistent information. Lapan and Boseovski (2015) studied the contribution of inhibitory control and theory of mind (i.e., the ability to grasp others' mental states; Premack & Woodruff, 1978) skills to prejudice regulation in preschoolers. According to their results, only theory of mind played a significant role in prejudice.

4.5.4 Aims and hypotheses

As exposed, scant research has explored the role played by cognitive control skills in the regulation of prejudice in childhood. To our knowledge, brain image studies have not yet addressed children's neural activity as an index of the proposed cognitive control mechanisms underlying prejudice regulation in adults. The goal of the present study was to investigate the role played by individual differences in behavioral and electrophysiological indices of cognitive control in relation to implicit prejudice in middle childhood. With this aim, a group of 8-to-9-year-old Caucasian children performed the Dots task (Davidson et al., 2006), which allowed to obtain the behavioral and electrophysiological indices of conflict monitoring, inhibition and response selection/flexibility described in the first section of this chapter. In light of the evidence suggesting that trust may be an indirect index of prejudice (e.g., Freeman et al., 2016), implicit prejudice toward Romany peers was assessed by using a computerized Trust game that accounts for participant's trust patterns when playing with in-group Caucasian and out-group Romany members. We expected that greater accuracy and efficiency in conflict resolution and cognitive flexibility behavioral indices would associate with less implicit prejudice. In accordance with literature suggesting that activity in conflict-processing-related brain regions engages subsequent behavioral adjustment (Amodio et al., 2008; Bartholow et al., 2006), we expected that greater (i.e., more negative) activity in target-locked N2 (an ERP related to conflict processing and generated by the ACC) would associate with better behavioral control, and thus with less implicit prejudice. Although previous studies have not accounted for the role of the P3 component, in the present research we also explored this ERP in light of investigations in both children and adult population reporting that P3 is involved in response inhibition (e.g., Brydges et al., 2014; Gajewski & Falkenstein, 2013), task-set switching (e.g., Brydges et al., 2014; Duan & Shi, 2014; Gajewski & Falkenstein, 2011), and in updating and behavioral adjustment (Dai et al., 2013; Donchin & Coles, 1988). Presumably, more positive P3 amplitude indexes better cognitive control due to task-relevant allocation of cognitive resources (Brydges et al., 2014; van Dinteren et al., 2014). In this line, we predicted that more positive target-locked P3 amplitudes would reflect more engagement of cognitive control and thus would associate with less implicit prejudice.

4.6 Method

4.6.1 Procedure

Data presented here are part of a wider investigation where children participated in assessment sessions in the school and in the lab. The implicit prejudice measure was administered in the school, and the Dots task was administered in the lab in accordance with the already described procedure. As a detailed description of the Dots task was already provided, in this section we focus on characteristics of and scores obtained from the implicit prejudice measure.

4.6.1.1 Computer-based Trust game

By using the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA), we developed a computerized version of the classical investment game of Berg et al. (1995), with the aim to account for the indirect influence of implicit attitudes on children’s trust patterns. A detailed description of the task procedure is available in Appendix, S.1.4.

The game entailed a simulated interaction with a child from another school, represented by a fictitious player from the in-group (Non-Romany) and a fictitious player from the out-group (Romany). In-group and out-group conditions were counterbalanced. Throughout the game, the participant was the trustor and the fictitious player was the trustee.

The goal's game was to get as many tokens as possible, in order to exchange then for rewards. The experimenter utilized a decision scheme (see S.1.4 in Appendix) to inform the participant about how to play. In each turn, the participant received 10 tokens and decided to share them or not with the other player (i.e., the trustee). The participant kept 5 tokens in case of not sharing the 10 tokens. Whenever the participant decided to share (i.e., to trust), the trustee received 20 tokens that could equally or unequally share with the trustor (i.e., the participant). Whereas equally share entailed cooperation and equivalent gains for trustor and trustee, unequal distribution implied deception and decrease in trustor's gains. The game included 3 blocks of six trials each. Trustor's patterns of cooperative and deceptive behavior were manipulated through the game. The trustor was always cooperative in the first and in the third blocks. Trustor cooperated and deceived in intermixed order in the second block, in accordance with this trial order: deception-cooperation-deception-deception-cooperation-deception.

Trustor's behavior manipulation enables to observe modulation of participants' patterns of trust and to calculate several indices that indirectly inform of implicit prejudice. For both the in-group and the out-group conditions, we calculated several indices expressed as percentage scores. The initial distrust index (IDI) indicates the percentage of distrust movements in Block 1. The index of punishment (IPun) accounts for participant's distrust after trustee's deceptive behavior. IPun was calculated by aggregating the participant's distrust movements in trials 2, 4 and 5 of block 2 and in trial 1 of block 3, and by dividing this aggregated score between the number of deceptive experiences. The index of forgiveness (IFor) indicates the recovery of trust in the third block. Participant's trust movements in the last five trials of block 3 were aggregated to calculate IFor.

In order to address composite prejudice, we subtracted in-group and out-group indices to calculate the index of initial prejudice (IIP), the punishment-based prejudice index (IPrejPun), and the forgiveness-based prejudice index (IPrejFor). IIP was obtained by subtracting in-group IDI from out-group IDI. Greater IIP informs of greater out-group relative to in-group distrust. Out-group IPun was subtracted from in-group IPun to obtain IPrejPun. Greater IPrejPun informs more punishment toward the out-group than the in-group. IPrejFor was computed by subtracting in-group IFor and out-group IFor. Greater IPrejFor informs more in-group than out-group forgiveness.

4.7 Results

Mean scores and standard deviations in implicit prejudice indices are informed in Table 4.6. Due to the already mentioned reasons, we performed one-tailed, non-parametric Spearman correlations. Together with the conventional level of significance, *q* values (adjusted *p* values for multiple comparisons; Storey, 2002) are provided. We also calculated the post-hoc, achieved power with G*Power version 3.1.9.4. Two children in analyses comparing simple and mixed blocks, and one child in analyses on switching effects were excluded from correlations on punishment and forgiveness indices because they made distrust movements in the six trials of block 2 and of block 3 in both in-group and out-group conditions, and thus they did not have deception experiences in block 2.

Table 4.6.
Means (M) and standard deviations (SD) for indices of implicit prejudice

Implicit prejudice index	*M*(*SD*)
Out-group IDI	38.02(29.77)
Index of initial prejudice	1.30(22.08)
Out-group IPun	66.80(38.76)
IPrejPun	2.95(44.20)
Out-group IFor	62.26(35.69)
IPrejFor	3.23(29.24)

Notes. Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.

Concerning associations between implicit prejudice and behavioral indices (see Tables 4.7 and 4.8), out-group IDI positively correlated with reaction time scores in spatial conflict interference and global switching. Only the association with spatial conflict interference reaction time was still significant after adjusting the level of significance (see Figure 4.4 for a graphical representation of the association). Then, children who take more time resolving conflict also show more distrust toward the out-group. In contrast, negative correlations were found between out-group IFor and reaction time scores in spatial conflict interference and global switching; however, those relations fell out of significance when adjusting the *p* values. This was also the case for the negative association between IPrejFor and global switching reaction time score.

Table 4.7.
Correlations between implicit prejudice and behavioral indices of conflict resolution and cognitive flexibility

	Spatial conflict interference % errors	Spatial conflict interference reaction time	Global switching % errors	Global switching reaction time
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Out-group IDI	.07	.31**(*,.83)	.04	.25*(*ns*,.63)
Index of initial prejudice	-.03	-.12	.08	.08
Out-group IPun	-.12	.09	-.17#(*ns*,.39)	.15
IPrejPun	.12	.02	-.02	.17#(*ns*,.39)
Out-group IFor	-.12	-.25*(*ns*,.62)	.00	-.23*(*ns*,.55)
IPrejFor	-.07	-.11	-.06	-.23*(*ns*,.55)

Notes. Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.
#.05 < *p* < 1.00, **p* < .05, ***p* < .01. *q* = adjusted *p* value for multiple comparisons. Power = achieved power.

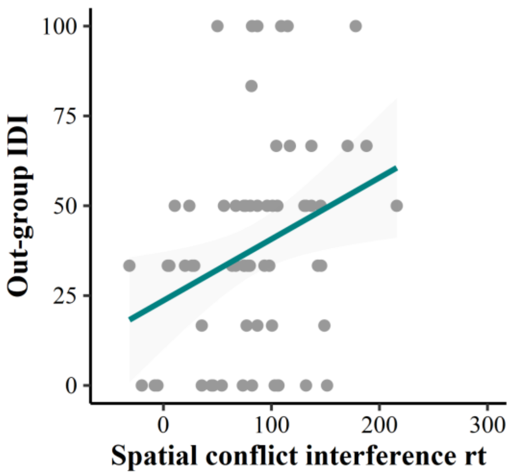


Figure 4.4. *Graph depicting the association between the reaction time behavioral index of conflict resolution (Spatial conflict interference rt) and out-group initial distrust (Out-group IDI).*

Table 4.8.
Correlations between implicit prejudice and behavioral indices of cognitive flexibility (local switching effects)

	Local switching % errors	Local switching reaction time
	Rho (power)	Rho (power)
Out-group IDI	-.04	.07
Index of initial prejudice	-.02	.03
Out-group IPun	-.09	.01
IPrejPun	.06	-.01
Out-group IFor	.04	-.10
IprejFor	-.08	-.11

Notes. Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; out-group IFor: out- group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.

Several significant correlations were found between implicit prejudice and electrophysiological indices (see Tables 4.9, 4.10 and 4.11). Out-group IDI positively correlated with N2 amplitude in global switching score, what means that more negative N2 amplitudes in rule switching associate with less initial distrust toward the out-group. Amplitude of P3 in spatial conflict interference score was positively associated with IIP, indicating greater initial prejudice in children showing more positive P3 amplitudes when resolving the conflict. Out-group IPun positively correlated with N2 amplitude in global switching, thus children with more negative N2 amplitude in rule switching punished the out-group to a less extent. Whereas IPrejPun had a positive correlation with N2 amplitude in global switching, negative correlations were found with amplitude of P3 related to local switching effects in left (P3) and right locations (P4). Accordingly, children with more negative N2 amplitude and more positive P3 amplitude in lateralized locations in rule switching scores showed less punishment-based prejudice. Finally, IPrejFor was negatively associated with N2 amplitude in global switching, informing that the more negative N2 amplitude when switching between response rules, the more forgiveness-based prejudice. This correlation was still significant after adjusting the level of significance (see a graphical representation of it in Figure 4.5).

Table 4.9.
Correlations between implicit prejudice and electrophysiological indices of conflict resolution and cognitive flexibility

	Spatial conflict interference N2	Spatial conflict interference P3	Global switching N2	Global switching P3
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Out-group IDI	-.04	.12	.22*(*ns*,.56)	-.13
Index of initial	-.10	.23*(*ns*,.56)	.14	-.04
Out-group IPun	-.08	.10	.22*(*ns*,.55)	.07
IPrejPun	.15	.03	.24*(*ns*,.62)	.08
Out-group IFor	-.13	.01	-.09	-.02
IPrejFor	.06	.12	-.31**(*,.81)	.11

Notes. Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.
#.05 < p < 1.00, *p < .05, **p < .01. q = adjusted p value for multiple comparisons. Power = achieved power.

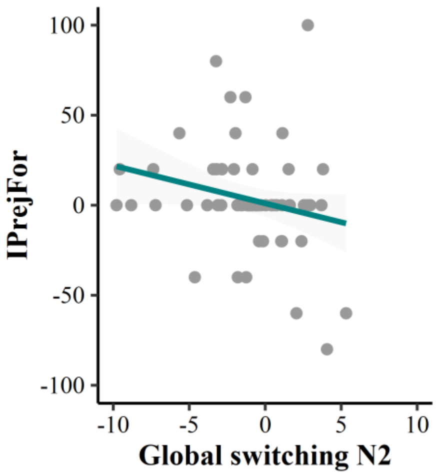


Figure 4.5. *Graph depicting the association between N2 mean amplitude in global switching (Global switching N2) and forgiveness-based prejudice (IPrejFor).*

Table 4.10.
Correlations between implicit prejudice and electrophysiological indices of cognitive flexibility (local switching effects in N2)

	Local switching F3	Local switching Fz	Local switching F4
	Rho (power)	Rho (power)	Rho (power)
Out-group IDI	-.08	-.00	-.03
Index of initial prejudice	-.04	-.01	-.16
Out-group IPun	-.09	-.03	.05
IPrejPun	.06	.02	.03
Out-group IFor	.14	.05	.05
IPrejFor	-.07	.00	-.10

Notes. Local switching F3: local switching in left frontal location; Local switching Fz: local switching in medial frontal location; Local switching F4: local switching in right frontal location; Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.
Power = achieved power.

Table 4.11.
Correlations between implicit prejudice and electrophysiological indices of cognitive flexibility (local switching effects in P3)

	Local switching P3	Local switching Pz	Local switching P4
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Out-group IDI	.04	.06	-.08
Index of initial prejudice	.19#(*ns*,.43)	.04	-.15
Out-group IPun	-.05	-.04	-.08
IPrejPun	-.25*(*ns*,.66)	-.19#(*ns*,.43)	-.22*(*ns*,.53)
Out-group IFor	-.03	-.11	-.04
IPrejFor	.14	.13	-09

Notes. Local switching P3: local switching in left parietal location; Local switching Pz: local switching in medial parietal location; Local switching P4: local switching in right parietal location Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.
#.05 < p < 1.00, *p < .05. q = adjusted p value for multiple comparisons. Power = achieved power.

4.8 Discussion

The aim of this study was to analyze the contribution to implicit prejudice regulation of individual differences in behavioral and electrophysiological indices of cognitive control in middle childhood. The study intended to fill the gap in the literature about the role played in children's regulation of prejudice by cognitive control skills indexed by neural activity and behavioral performance. We accounted for 8-to-9-year-old children's implicit prejudice toward Romany peers on the basis of trust patterns with a fictitious player in a computerized Trust game, and for cognitive control by administering the Dots task (Davidson et al., 2006), which provided behavioral and electrophysiological indices of conflict monitoring, inhibition and response selection/flexibility

First, we expected to find a significant association between behavioral indices of cognitive control and implicit prejudice. Specifically, we predicted that greater accuracy and efficiency in conflict resolution and cognitive flexibility behavioral indices would correlate with less implicit prejudice. Results confirmed the prediction concerning efficiency in both conflict resolution and cognitive flexibility scores, as children taking more time to accurately respond displayed more initial distrust toward the out-group. However, associations occurred in the contrary-to-expected direction between efficiency in both cognitive control indices and forgiveness toward the out-group, and between efficiency in cognitive flexibility and the composite prejudice index of forgiveness (i.e., the IPrejFor). Thus, results suggest a relation between the time that children take to accurately perform and their trust patterns. Our reaction time scores account for the relatively greater amount of time that children dedicate to accurately respond when the task demands conflict resolution and cognitive flexibility skills in comparison with performance under no conflict resolution and cognitive flexibility demands. Conceivably, those children that take advantage of the allowed response time by decreasing speed performance in the most difficult task conditions show a trust pattern characterized by more initial distrust and latter less forgiveness-based prejudice. Then, our results suggest that the relation between cognitive control efficiency and modulation of trust-based implicit prejudice in middle childhood is complex. Arguably, in line with the finding informed in the first section that more positive P3 amplitudes link to slower reaction times in both spatial conflict interference and global switching, it is possible that the higher amount of time that children dedicate to correctly respond under conflict resolution and cognitive flexibility demands indexes the extent to which children with low cognitive control skills engage cognitive resources with the aim to perform correctly. As a possibility, less efficient children require more time and more cognitive effort to successfully adjust behavior, and then they find difficulties in regulation of initial prejudice but latter in the task they are able to regulate their prejudice. It is necessary to point that the correlation between the spatial conflict interference index of conflict resolution and the initial distrust index was the only one that remained significant after adjusting the level of significance, so what our results most clearly show is that children’s ability to deal with the spatial conflict is linked to implicit prejudice indexed by how much trust is initially placed in the out-group. The weaker nature of the other correlations may be suggesting that other factors like individual differences in the motivation to engage cognitive control in both the Dots task and the Trust game are modulating children’s performance.

Concerning electrophysiological indices of cognitive control, we expected that greater amplitude in both N2 and P3 ERPs would associate with less implicit prejudice. This prediction relies on the assumption that greater amplitudes associate with better performance, what is supported by correlational results reported in the first section of this chapter showing that more negative N2 and more positive P3 amplitudes are associated with greater accuracy in cognitive flexibility. Regarding the N2 component, we assumed that more negative N2 amplitude presumably indicates greater involvement of brain regions involved in conflict processing, and signals the need for behavioral adjustment. As expected, we found that more negative N2 amplitude in the rule-switching block than in the single-task blocks correlated with less initial distrust toward the out-group, less out-group punishment and punishment-based prejudice; however, these relations fell out of significance after adjusting the level of significance. In contrast with our predictions, a more negative amplitude in N2 in the same cognitive flexibility index (i.e., rule-switching versus single-task performance) was associated with greater forgiveness-based prejudice, and in this case the relation was still significant after adjusting the *p* values. Results then suggest that conflict monitoring activity signaling the need of behavioral adjustment in the rule-switching context of the mixed block is linked to better regulation of implicit prejudice in terms of initial distrust and modulation of children's trust patterns when trustee's behavior intermixed cooperation and deception. Taken this preliminary evidence with caution, our results offer initial support for the premise that, similarly to adults, in children the N2 component plays a role of in conflict processing and subsequent engagement of cognitive control for behavioral adjustment (Amodio et al., 2008; Bartholow et al., 2006).

Specifically, results hint at the role of N2 in promoting behavioral control when the task demands recursive switching between response rules, and thus cognitive flexibility engagement. Intriguinly, the association was in the opposite-to-the-expected direction with the forgiveness-based prejudice. Arguably, together with cognitive control, other factors like the trustee's manipulated behavior may be influencing children's expression of implicit attitudes throughout the Trust game. On the other hand, it is possible that indices of initial distrust in block 1 might best account for children's implicit attitudes than punishment and forgiveness indices, in which case other factors like the estimation of likelihood of gains and perspective-taking skills (e.g., Evans et al., 2013) may underpin (together with cognitive control of implicit attitudes) children's trust patterns.

Results concerning P3 amplitude were mixed. Whereas more positive P3 in conflict resolution correlated with more initial prejudice, P3 activity accounting for switching effects negatively correlated with punishment-based prejudice. These relations were not significant after adjusting the *p* values; therefore, these results should be cautiously interpreted. There is the possibility that P3 amplitude is informing about different cognitive operations under conflict resolution and cognitive flexibility demands. More positive P3 in conflict resolution may indicate the comparatively greater difficulty to perform the incongruent condition than the congruent condition, and thus the difficulty to inhibit the prepotent response and select the correct one (Groom & Cragg, 2015). Then, more positive P3 amplitude in the context of conflict resolution might be informing about a greater inhibition cost that would associate with a higher initial prejudice index. This interpretation would be in line with results reported in the previous section concerning the association between reaction time and P3 amplitude in the resolution of the spatial conflict interference, in the extent to which a more positive P3 correlates with slower reaction times (what presumably indexes a greater cost to resolve the spatial conflict). In contrast, P3 amplitude in the switching context of the mixed block may account for relevant allocation of cognitive resources (Scisco et al., 2008) and task-set updating processes (Kieffaber & Hetrick, 2005) that are associated with enhanced behavioral adjustment. By putting this in relation with correlational results reported in the previous section, a more positive P3 in local switching correlates with better performance in terms of accuracy. Then, more positive P3 amplitudes in switch versus repeat trials would indicate the updating of the task set and the engagement of cognitive control in order to adjust behavior according to the current task set. This enhanced ability to flexibly switch between task sets would, in turn, associate with less initial prejudice and less punishment-based prejudice.

4.9 Conclusions, limitations and future directions

Altogether, findings of the present study provide with preliminary evidence on the hypothesized contribution of cognitive control to regulation of implicit prejudice in children. All in all, correlational analyses suggest that individual differences in conflict resolution and cognitive flexibility associate with characteristic trust patterns that indirectly inform about children's implicit attitudes toward Romany peers.

Two limitations may be posed to this study. First, our data concerning the relation between cognitive control and implicit prejudice are merely correlational, so no conclusions about causal mechanisms may be drawn. Moreover, we target a single age group, which limits the possibility to interpret results in terms of developmental processes.

Apart from the afore-mentioned limitations, the prejudice measure that we utilized is different to the ones used by studies focusing on adult samples. Unlike studies with adults, our measure did not address automatically elicited stereotypical associations. It is possible that measures of automatic stereotypes usually used in adults involve the need to implement cognitive control for regulation to a greater extent than the measure reported here. Consequently, individual differences in cognitive control may play a less relevant role in the modulation of children's trust decisions.

Future studies should extend evidence on age-related differences in the relation between cognitive control and prejudice by targeting at other age groups. Moreover, future research including experimental manipulation of cognitive control in a similar way to cognitive control depletion studies in adults (e.g., Richeson & Trawalter, 2005) would provide further support for the role of cognitive control in regulation of prejudice in childhood.

Chapter 5.

Improving executive function and theory of mind with cognitive training in middle childhood: near and far transfer effects

5.1 Introduction

Cognitive skills encompassed under the concepts of executive function (EF) and theory of mind (ToM) have shown to be relevant for children's success in diverse life domains like academic achievement and socio-emotional adjustment (e.g., Best et al., 2011; Blair & Razza, 2007). In light of the relevance of EF and ToM for children's adaptive behavior, interventions have been designed with the goal of improving those skills and examining whether improvements transfer to other cognitive domains and other aspects of children's life.

5.1.1 Executive function: concept, relevance for social behavior and motivational implications

EFs are a set of cognitive skills underpinning self-regulation (Rueda et al., 2011). Traditionally, working memory, cognitive flexibility/shifting and inhibitory control have been the core EF skills (Miyake et al., 2000, but see Friedman & Miyake, 2017, for a recent reconceptualization of the model). Working memory allows to hold and manipulate information in mind; cognitive flexibility involves the flexible allocation of attention and shifting between mental representations, and inhibitory control is responsible for overriding automatic and inappropriate responses.

Individual differences in EFs have an impact on the socio-emotional domain (Riggs et al., 2006). In this line, preschoolers with poorer EFs experience more difficulties regulating disruptive behavior (Cole et al., 1993) and emotions (Speltz et al., 1999), as well as delaying gratification and understanding false beliefs (e.g., Carlson & Moses, 2001). Longitudinal studies with elementary school children have found that earlier inhibitory control predicts latter social competence and behavior problems (Nigg et al., 1999; Riggs et al., 2003). Presumably, EF may play a role in regulating behaviors based on cognitions and evaluations about out-groups. Research with adults shows that individual differences in inhibitory-control and conflict monitoring are associated with the ability to successfully regulate implicit prejudice (e.g., Amodio et al., 2004). However, so far, little research has examined the role of EFs in children's attitudes expressed toward out-groups. Bigler and Liben (1993) found that cognitive flexibility (concretely, the ability to use multiple dimensions to categorize people) associates with better recall for stereotype-inconsistent information. In contrast, other researchers found no relation between inhibitory control and the regulation of prejudice (Lapan and Boseovski; 2015).

Children's motivations to use cognitive control skills to regulate prejudice also deserve attention. Despite of it, the link between motivation and prejudice in children remains mainly unexplored. In the case of adults, the empirical evidence shows (Dunton & Fazio, 1997; Plant & Devine, 1998) that they are motivated to invest cognitive resources to regulate prejudice because they regard prejudice as unacceptable (i.e., they are internally motivated) and/or because they want to conceal their prejudiced attitudes (i.e., they are externally motivated). Overall, research in adults indicates that internally motivated people are more effective in regulating implicit bias (Devine et al., 2002). Therefore, research addressing the possible role that motivation plays on the relation between cognitive skills and prejudice in children is needed.

5.1.2 Theory of mind: concept and relevance for social behavior

The cognitive mechanism that let us infer what other people may be thinking and feeling is known as ToM (Premack & Woodruff, 1978). This mechanism has been claimed to be based on children's own personal experiences (e.g., Hobson, 1991) or on implicit theories regarding how others think and feel (e.g., Gopnick & Wellman, 1992). Mind-reading skills entail different levels of complexity, from emotion recognition in faces to inference of context-appropriate complex mental states (Tirapu-Ustárroz et al., 2007).

Similar to EFs, ToM also plays a role in children's socio-emotional competence. It has been shown that ToM contributes to better navigate in the social domain in preschoolers (e.g., Capage & Watson, 2001) and in elementary school children (e.g., Devine et al., 2016; Liddle & Nettle, 2006). A meta-analytical revision informed about a moderate association between ToM and prosocial tendencies (i.e., cooperation, helping, consoling) along childhood (Imuta et al., 2016). Recent research suggests a link between ToM and prejudice, with children higher in ToM showing more positive out-group attitudes (Fitzroy & Rutland, 2010; Lapan & Boseovski, 2015) and greater preference for peers who do not endorse stereotypes (Mulvey et al., 2016).

5.1.3 The relation between executive function and theory of mind

Literature posits that EF and ToM show a protracted relation along the development. However, there are two different points of view regarding their association. The *emergence* framework (e.g., Russell, 1996) poses that EF is involved in the origin and development of ToM. In contrast, the *expression* framework (e.g., Perner et al., 2002b) claims that EF enables ToM skills to be implemented, thus limiting the EF role to the supply of the necessary cognitive resources for mind-reading.

Empirical evidence offers certain support for both theoretical frameworks. Data showing that earlier EF predicts later ToM in longitudinal studies (e.g., Devine & Hughes, 2014; Lecce et al., 2017) and that individual differences in working memory moderate the impact of ToM training in middle-aged children (Lecce & Bianco, 2018) favor the emergence account. Moreover, the finding that the degree of the association between EF and ToM depends on the type of false belief task used to assess ToM (Devine & Hughes, 2014) arguably provides support for the expression framework. In preschool-age children, Kloo and Perner (2003) reported benefits from ToM training to EF and the other way around, and thus provided with mixed evidence favoring both frameworks. As argued by Devine and Hughes (2014), data do not let to favor one framework above the other.

5.1.4 Cognitive training

According to the literature, structured programs requiring the use and practice of cognitive skills appear to foster the cognitive functioning. It is assumed that training improves brain functioning by repeatedly recruiting the brain networks underlying the trained cognitive functions (e.g., Hsu et al., 2014; Olesen et al., 2004).

Literature reported two types of transfer effects of cognitive training. Near transfer refers to improvement of non-trained tasks that target the same cognitive skills underlying the task used for training. Far transfer refers to improvement in tasks that substantially differ in content to the trained tasks (Simons et al., 2016). This far transfer takes place because the same cognitive processes and/or neural circuits underlie the non-trained task (Dahlin, 2013; Morrison & Chein, 2011). Research shows near transfer effects to a greater extent than far transfer effects of training (Simons et al., 2016).

5.1.4.1 Attention and executive function training in childhood: near and far transfer effects

Some training programs have targeted EF single components. Programs aiming to enhance WM, like the Cogmed Working Memory Training program (CWMT; Klinberg, 2010) and the n-back training (Jaeggi et al., 2011) have reported near transfer to WM and, to some extent, transfer to non-trained domains, like fluid intelligence, reasoning and academic achievement (e.g., Bergman-Nutley et al., 2011; Bergman-Nutley & Klingberg, 2014; Jaeggi et al., 2011). Task-switching training programs administered to children and adolescents report near transfer to cognitive flexibility and far transfer to processing speed and WM (Zinke et al., 2012), as well as to inhibitory control (Dörrembächer et al., 2014). Other programs aim at enhancing diverse aspects of attention and EF. Training of attention and EFs in preschool-age children fosters fluid intelligence (Pozuelos et al., 2019; Rueda et al., 2005; 2012) and produces changes in event-related potentials linked to the executive control of attention (Rueda et al., 2012) and to conflict resolution (Pozuelos et al., 2019). Blakey and Carroll (2015) showed that WM and inhibitory control training improved preschoolers' WM and mathematical reasoning. Tools of the Mind is an example of a program integrated in the school curriculum that enhances EFs in preschool children by making use of teacher scaffolding and interaction with peers in cooperative activities. Blair and Raver (2014) extensively applied

Tools of the Mind to 759 preschoolers, finding near transfer to EFs and reasoning, as well as far transfer effects to academic achievement by the end of the preschool period and in first grade.

5.1.4.2 Theory of mind training. Near and far transfer effects

Hofmann et al. (2016) meta-analyzed results from ToM training programs implemented at different ages, from early childhood to late adolescence, and also with children with typical development and with Autism Spectrum Disorder (ASD). They report that the training was effective to improve children's trained ToM skills at all ages and in both children with ASD and typically developing children.

Most training programs concerning typical developing children have focused on preschool population. Several training procedures have resulted in preschoolers' enhanced ToM measured by performance in first-order false belief tasks involving unexpected content or transfer. Examples of those procedures include the metacognitive training (Carbonero Martín et al., 2013), the sentential complement training (Hale & Tager-Flusberg, 2003), the use of videos about mental state concepts (Nash, 2002), and sociodramatic play (Qu et al., 2015). Evidence of far transfer of ToM training in preschoolers is still limited. Exceptions are the research by Kloo and Perner (2003) who provided evidence that preschool age children trained in false belief understanding improve their shifting skills in a card sorting task. Furthermore, Ding et al. (2015) reported that ToM-trained children at age 3 increase their social competence manifested in lying behavior. In contrast, Tompkins (2015) did not find transfer from a storybook-based intervention to children's social competence. Moreover, whereas language training fosters ToM, no transfer from ToM training to language has been observed (Hale & Tager-Flusberg, 2003).

Concerning ToM training in school-age children, evidence consistently shows that training improves middle-age children’s ability to make context-appropriate mental state inferences (e.g., Bianco & Lecce, 2016; Bianco et al., 2016; Lecce et al., 2014) and to other non-trained ToM areas (Bianco et al., 2016). However, far transfer effects of ToM have not been examined yet.

5.1.5 Goals of the present study

The present study aims to extend previous findings on near and far transfer effects of EF and ToM training. As already argued, evidence widely supports near transfer effects of EF training, especially in young children. Thus, more research on near and also far transfer of EF training in school-age children is needed. Moreover, whereas near transfer effect of ToM training has been shown along childhood, far transfer effects to socio-emotional competence have barely been explored. Accordingly, we trained 8-to-9-year-old children in EF and ToM skills and analyzed the near transfer effects of both skills, the far transfer effects of EF to ToM and of ToM to EF, and the far transfer effect from both EF and ToM trainings to prejudice. We expected EF and ToM training to transfer to the trained skills (i.e., near transfer). Based on previous findings (e.g., Blair & Raver, 2014; Blakey & Carroll, 2015; Pozuelos et al., 2019), we expected transfer from EF training to fluid intelligence. Furthermore, in the extent that ToM improves after EF training (Kloo & Perner, 2003), and that individual differences in EF predict how much children benefit from a ToM training (Benson et al., 2013), we also expected EF training transference to ToM. Also in line with results from Kloo and Perner

(2003), we examined whether ToM training transfers to EF. We did not expect that ToM training transfer to intelligence, as there is no previous evidence in this regard. Based on evidence pointing that cognitive skills are involved in the regulation of prejudice, the present research poses that the enhancement of children's cognitive skills may not only transfer to the trained cognitive functions (near transfer), but also to children's ability to regulate their prejudiced attitudes (far transfer processes). In this research we focus of racial prejudice toward Romany population, as this ethnic group is pervasively discriminated in Spanish society (Enesco et al., 2005). Another aim of the current research was to explore the role of motivation in the relation between enhanced cognitive skills and better regulation of prejudice. We explored the possibility that motivation to control prejudice moderates the degree of transfer from both training modalities to prejudice. Based on the differentiation between internal and external motivation in studies with adults (e.g., Devine et al., 2002), we separately explored the role of both types of motivation in the relation between cognitive skills fostering and enhanced prejudice regulation.

5.2 Method

5.2.1 Participants

The total sample consisted in 93 third-grade Caucasian children. Participants were randomly assigned to the following conditions: EF training condition (*n* = 25, 12 girls. Mean age = 102.04 months, *SD* = 3.56 months); EF control condition (*n* = 24, 11 girls. Mean age = 103.79 months, *SD* = 3.64 months); ToM training condition (*n* = 22, 11 girls. Mean age = 103.82 months, *SD* = 3.25 months); and ToM control condition (*n* = 22, 11 girls. Mean age = 104.82 months, *SD* = 3.38 months). Groups were equivalent at pre-test in the mean composite IQ score, F (3, 89) = .21, p = .89. Participants were recruited in six schools located in urban and suburban areas of middle- and low-middle socioeconomic status.

5.2.2 Procedure

Approval of the University's Ethic Committee was obtained before the start of the study (Code: 208/CEIH/2016). Informed parental consent was obtained. The study involved two pre-intervention and two post-intervention assessment sessions. The first pre and post assessment sessions were carried out individually in a quiet room of the school. Assessment at the school took approximately 1 hour. The second pre and post assessment sessions were carried out in the lab. Assessment in the lab took approximately 2 hours. Intervention was carried out at school in the morning and consisted in 10 sessions of 45 minutes each. Intervention was group-based, with between 4 and 6 children per training/control group. Electroencephalographic activity was recorded during pre and post assessment of EF, but analyses about the effect of training at the neural level exceed the aims of the current research. In the pre and post assessment sessions in the lab, we also administered the subtest of numerical aptitude from the EFAI 1 (Santamaría et al., 2005). However, results from this test will not be considered in the present research.

5.2.2.1 Training procedure

We structured the intervention so that it was equivalent in number and length of sessions across conditions. Training and control groups received a total number of ten sessions of approximately 45 minutes each. As specified in the procedure of each training modality, differences between experimental and control conditions are based in the content of the training tasks.

5.2.2.1.1 Executive function training

The EF training was based on the computer-based training program developed by Bajo and Rueda (see Maraver et al., 2016) at the University of Granada. The PEC-UGR (http://pec-ugr.es/portal/) is a computer-based training program of shifting, working memory and inhibitory control. The training procedure consisted in seven child-friendly exercises of increasing difficulty (see Appendix, S.1.9 for a detailed description of the training tasks). Shifting, working memory and inhibitory control skills were trained using Stroop – like, Go – NoGo, n – back, visual search, memory and sorting games. Each training session lasted about 45 minutes, and involved children playing with each task for five minutes. We administered the same number of sessions (i.e., ten) to the EF training and the EF control group. The EF control group played versions of the training tasks where the difficulty of games did not increase as children got experience with them.

5.2.2.1.2 Theory of mind training

We implemented an adapted version of the conversation-based ToM training program developed by Lecce and collaborators (Lecce et al., 2014). In each session children's ToM is fostered by engaging them in conversations about two stories that deal with one particular ToM concept. In this version of the program, we administered ten sessions of approximately 40 minutes each and trained children in comprehension of misunderstanding, double bluff, faux pas, sarcasm, emotional regulation, bivalent emotions, moral emotions, lie, white lie and persuasion. Thus, by including the stories on emotions we addressed the training of advanced aspects of affective mental state understanding that conform the reflective component of emotion comprehension (Pons et al., 2004). Each session in both training and control conditions included the same number of stories and questions as the original version of the training program (see the Appendix, S.1.10 for a sample session). In the present study, the second story of each training session explicitly described the main character's ethnicity as Romany. This modification of the original training program was introduced to indirectly make children reflect on mental states involved in intrarracial and interracial interactions. In the control condition we also described the main character in the second story as Romany so that training and control conditions were also equivalent in this feature.

5.2.2.2 Pre and post assessment measures at school

Intelligence. We utilized the Spanish adaptation of the Kaufman Brief Intelligence Test (K-BIT; Cordero & Calonge, 2009), to obtain fluid, verbal and composite intelligence (IQ) scores.

Theory of mind. Children's emotion understanding in the pre- and post-intervention assessment sessions was measured with the Test of Emotion Comprehension (TEC; Pons et al., 2004). The TEC uses gender-matched stimuli, and involves narratives accompanied by vignettes. Children respond by pointing to faces displaying emotional expressions. The TEC assesses children's comprehension of nine components of emotion: emotion recognition, external causes of emotions, emotions based on desires, emotions based on beliefs, role of reminders in emotions, emotional regulation, hidden emotions, mixed emotions, and moral emotions. Every time that participants correctly identified a component of these emotions received one point. Children's scores ranged between 0 and 9, with higher scores informing better emotion understanding.

We assessed affective ToM by using second-order false belief stories from Miller (2013). In the post-intervention assessment session, we administered parallel versions of the stories used in the pre-assessment. Children's comprehension of a character's false belief about another character's feelings was assessed with two vignette-based stories. Once the experimenter finished reading aloud each story, children's understanding of the story was checked with two comprehension questions. Next, two ToM questions were asked. The first ToM question concerned one character's false belief about the other character's emotion, and the second ToM question required children to justify the character's false belief. Incorrect answers for both ToM questions received 0 points. Children that only correctly answered the first ToM question were given 1 point. Children were given 2 points in case responses to both ToM questions were correct, entailing that children are able to both identify and justify the false belief.

We assessed advanced ToM with the White et al. (2009) version of the Strange Stories task (Happé, 1994). Parallel versions of the pre-assessment stories were administered in the post-assessment session. The Strange stories task accounts for children's ability to grasp characters' mental states on the basis of non-literal utterances. Similarly to Bianco et al. (2016), we used six stories concerning the following mental states: double-bluff, persuasion, misunderstanding, lie and white lie. In each story, participants were asked about the reason for certain character's behavior. Thus, the task accounts for participants' ability to infer the mental states that underlie and explain the characters' behaviors. We used the scoring procedure of White et al. (2009). We awarded two points when the participant correctly explained the character's behavior on the basis of his/her mental states. Explanations that were only about the character's behavior and its result received one point. Thus, scores ranged from 0 to 12.

Prejudice. We first used an identification measure with the in-group (non-Romany) and the out-group (Romany). Drawings that depicted in-group and out-group members were shown to participants. We counterbalanced the order in which in-group and out-group drawings were presented. Participant's identification with the in-group and the out-group was assessed with a scale of faces (see Appendix, S.1.3 for a detailed description of the scale and the scoring procedure). For both the in-group and the out-group, participants had to judge their identification with the child depicted in the drawing by pointing toward a face of the scale. Children were informed that, the happier the chosen face, the higher their identification. Scores in this measure ranged from very low (0) to very high (8). An in-group and out-group identification scores were obtained.

We also collected information about participants' contact with out-group members by asking children if they had Romany friends and/or Romany classmates. Data about identification and contact were used to check that intervention and control groups were equivalent in both identification and contact opportunities.

Afterwards we administered the Multirresponse Racial Attitude Measure (MRA; Doyle & Aboud, 1995). It is a trait-attribution task that informs about children's positive and negative explicit attitudes toward the in-group and the out-group. In the task, gender-matched drawings for in-group (White) and out-group (Romany) children were presented. Children had to assign 10 positive, 10 negative and 4 neutral attributes by pointing toward one or both of the drawings. Children were also given the possibility of saying “none of them”, with the aim of minimizing forced-choice behavior. Moreover, children were informed that there were neither correct/incorrect nor good/bad answers. This procedure aims at lowering the potential influence of social desirability on children’s attitudes. For both the in-group and the out-group, positive and negative attitudes scores were obtained by respectively summing positive and negative attributes. Then, positive and negative scores were subtracted to calculate scores about in-group and out-group attitudes. The difference between in-group and out-group attitude scores was calculated to get a composite prejudice score, which ranged from -20 to 20. Higher composite prejudice scores indicated greater prejudice. Counter-bias attributions were informed by a counter-bias index. To calculate it, positive out-group and negative in-group attributions were summed. Counter-bias index ranged from 0 to 20. Higher scores informed about less prejudice.

Computer-based Trust game task. Based on the premise that people may consider social categories when making trust decisions (e.g., Brewer, 1999; Fiske & Taylor, 1991; Hilton & Von Hippel, 1996), we developed a measure of implicit prejudice based on patterns of trust toward the in-group and the out-group during a computer-based, economic Trust game. The Trust game used is a modified version of the investment game of Berg et al. (1995). See a detailed description of the task in Appendix, S.1.4.

Our Trust game was programmed and presented with the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). The game was presented to children as a computer-based interaction with a trustee depicted by a gender-matched drawing. The interaction was simulated, as participants were made to believe that the trustee was a real child that was in a different school. The participant had the role of trustor throughout the game. Each participant played the game twice, one with a trustee from the in-group and the other with a trustee from the out-group. The order of in-group and out-group conditions was counterbalanced.

The game started by informing participants that the aim was to get as many tokens as they could, in order to exchange them for gifts. Then, the experimenter explained the dynamic of the game with instructions on the computer screen (see Appendix, S.1.4). The game comprised 3 blocks with six trials each. In each trial, the participant (i.e., the trustor) was given 10 tokens and he or she could decide to share or not them with the game partner (i.e., the trustee). The participant would keep 5 tokens in case of deciding not to share. If he or she decided to share the 10 tokens, then the trustee would have 20 tokens and could equally or unequally distribute them with the trustor (i.e., the participant). Hence, the trustee could cooperate (i.e., equal division of tokens) or deceive (i.e., unequal division that reduces trustor's gains). We manipulated trustee's patterns of cooperative and deceptive behavior along the game. In block 1, the trustee always cooperated. The trustee showed the following pattern along the six trials of block 2: deception-cooperation-deception-deception-cooperation-deception. In block 3, the trustee cooperated along the six trials.

The experimental manipulation of trustee's behavior enabled us to obtain data on participants' patterns of trust and distrust and to calculate several indices for both the in-group and the out-group conditions. All indices were expressed as percentage scores. Initial distrust index (IDI) was the percentage of distrust movements in Block 1. Indices of punishment and recovery of trust were calculated on the basis of fictitious player's manipulated behavior. The index of punishment (IPun) accounts for the proportion of times the participant distrusts after the fictitious player's deceptive behavior. In order to calculate IPun we aggregated participant's distrust movements in trials 2, 4 and 5 of block 2 and in trial 1 of block 3, and divided the aggregated distrust between the number of deceptive experiences. The index of forgiveness (IFor) informs about trust recovery in block 3. IFor was obtained by aggregating the number of trust movements in the last five trials of block 3.

The difference between in-group and out-group indices was calculated to obtain the index of initial prejudice (IIP), the punishment-based prejudice index (IPrejPun), and the forgiveness-based prejudice index (IPrejFor). IIP was calculated by subtracting in-group IDI from out-group IDI, with greater IIP indicating greater distrust toward the out-group than toward the in-group. IPrejPun resulted from the difference between out-group IPun and in-group IPun. Greater IPrejPun informs more out-group than in-group punishment. IPrejFor was computed by subtracting out-group IFor from in-group IFor. Then, more IPrejFor accounts for greater forgiveness toward the in-group than toward the out-group.

5.2.2.3 Pre and post assessment measures in the lab

Reading comprehension. We administered the text comprehension subtest from the revised battery for the assessment of reading processes (PROLEC-R; Cuetos et al., 2007). Children were presented with four stories. The experimenter first read aloud each story, and then covered the story and posed four questions about it. Correct answers required participants to make appropriate inferences from information provided in the text. The score could range between 0 and 16. We used this score as a control variable when analyzing the effect of ToM training.

Motivation. We adapted a measure of internal and external motivation from scales of the same constructs used for adults (Dunton & Fazio, 1997; Plant & Devine, 1998). Two items assesses internal motivation (e.g., "I get angry with myself when I have negative thoughts about Romany people"). Three items account for external motivation (e.g., "It is important to hide from people what I think about Romany people"). Each item was answered with a five-point scale. Response options were depicted with six stacks containing five tokens each. The number of colored tokens in each stack progressively incremented from left to right, so the first stack had zero colored tokens and the sixth stack had five colored tokens. The experimenter explained children that the number of colored tokens represented their level of agreement with the item, so the more colored tokens, the more agreement. Participants answered by pointing to the stack of tokens that best described the level of agreement with the item. The experimenter first read aloud each item, and then showed the response options. Participants' internal motivation score ranged from 0 to 10. Scores for external motivation ranged from 0 to 15. The higher the score, the higher the specific motivation. Correlation between internal and external motivation scores was low (r = .11, p = .30, two-tailed), what informs about the independence between the two types of motivation (Plant & Devine, 1998).

Dots task. We used the Dots spatial conflict task (Davidson et al., 2006) to measure conflict resolution and cognitive flexibility. The task was programmed and presented with the software E-Prime 2.0 (Psychology Software Tools, Pittsburgh, PA). Like in a previous version of the task (see Hoyo et al., 2019), the current version presented, in fixed order, a congruent, an incongruent and a mixed block, and all participants received the same stimulus-response mapping. Congruent and incongruent blocks contained congruent and incongruent trials respectively. The mixed block combined intermixed congruent and incongruent trials. A practice block was included before each experimental block. In the current study, practice blocks administered before each simple block contained 8 trials. Simple congruent and incongruent blocks contained 48 trials each. The practice block preceding the mixed block had 16 trials. Double number of trials (96) was included in the mixed block, and a break was administered after the first 48 trials.

In each trial, a central cross was used as fixation point of random duration (1000 ms - 1500 ms). The cross continued to be present while the dot was displayed. Stimuli used were white dots in congruent trials and stripped dots in incongruent trials. The dot (25% tall x 25% wide) appeared during 500 ms, and then a 900 ms blank screen was presented. As response was allowed during the dot and during the blank screen, children counted with a total of 1400 ms to respond. Children answered by pressing “1” and “5” keys in a serial response box (Psychology

Software Tools, Pittsburgh, PA). A yellow sticker identified “1” and a purple sticker identified “5”. The task began by providing children with the task instructions on the screen. Children were informed that they would see circles on the screen, and that they should respond to the circles according to some rules. Children were encouraged to accurately and quickly respond. Instructions to perform the congruent block indicated children that they had to press the key coinciding with the side where the dot appeared (i.e., “1” when the dot appeared in the left, and “5” when the dot appeared in the right). Instructions for the incongruent block informed that the correct answer entailed to press the opposite key to the dot location in the screen (i.e., “5” when the dot appeared in the left, and “1” when the dot appeared in the right). Conflict resolution and cognitive flexibility scores were calculated on the basis of percentage of errors and reaction time. The score for conflict resolution represents the relative greater difficulty of performing the incongruent block as compared with the congruent block. This difficulty arises from the incompatibility between the location of the dot and that of the response key in the incongruent block (the spatial incompatibility effect; Craft & Simon, 1970). Conflict resolution was calculated as follows:

Conflict resolution = Incongruent Block Median RT/% Errors - Congruent Block Median RT/% Errors

Scores on cognitive flexibility compare performance in the mixed block with that of the simple blocks. Cognitive flexibility scores are based on the assumption that it is more difficult to switch between rules to answer than to give single-rule based responses. Cognitive flexibility was calculated with the following formula:

Cognitive flexibility = Mixed Block Median RT/% Errors – Mean (Incongruent Block Median RT/% Errors + Congruent Block Median RT/% Errors)

5.3 Results

5.3.1 Descriptive statistics of identification and contact

We first examined children's reports in the pre-intervention session about identification and contact with Romany and Non-Romany children Concerning identification (see Appendix, S.1.11 for detailed information), no differences between EF training and control groups were found in identification with neither the Non-Romany character ($t(47) = -.23$, $p = .82$) nor with the Romany character ($t(47) = .13$, $p = .90$). Similarly, level of identification was not different between ToM training and control groups for neither Non-Romany character ($t(42) = -.57$, $p = .57$) nor Romany character ($t(42) = -1.31$, $p = .20$). We also analyzed children's reports on contact with Romany children or children from other ethnic groups (see Appendix, S.1.12 for detailed information). No differences between groups were found in reported contact with Romany children, neither when comparing EF training and control groups (χ^2 (2, $N = 49$) = .51, $p = .77$), nor when comparing ToM training and control groups (χ^2 (2, $N = 44$) = 2.19, $p = .33$).

5.3.2 Effects of training

In order to test the effects of EF and ToM training, a series of repeated measures ANCOVAs were carried out. For each type of training, session (pre vs. post) was taken as the within-participants factor and condition (training vs. control) as the between-participants factor. Reading comprehension was included as a covariate when the effect of training on ToM was analyzed. ANOVAs including internal and external motivation to control prejudice as covariates were performed when we analyzed the effect of training on prejudice. In all analyses, pairwise comparisons were Bonferroni-corrected. In all cases that a significant effect of training on performance was found, homogeneity of variance tests showed no violation of homogeneity and sphericity assumptions (all *p*s > .05).

We considered several criteria to determine whether children were included in analyses. In the Trust game, due to technical problems, one participant's in-group post-assessment measure of ToM training group was not recorded. Then, due to this data missing this participant was not included in analyses about the composite scores. Also, we excluded from analyses on punishment and forgiveness indices those children who showed a distrust pattern throughout the block 2, as those children did not have deception experiences that would make feasible to analyze their trust patterns based on punishment and forgiveness. In accordance with this criterion, 2 participants of the EF training group and 1 participant from the ToM control group were not further considered in analyses on punishment and forgiveness indices.

Data from the Dots task were filtered according to errors and anticipatory responses, that is, responses made in less than 200ms. These filters were applied to exclude from analyses those children showing an inattentive/impulsive response pattern. Children fulfilling one or both of the exclusion criteria were only removed from analyses concerning the effect of training on EF scores. Children whose percentage of errors in the Congruent condition was 2 *SD* above the mean were excluded. Moreover, we removed from analyses children that through the task and for both correct and incorrect responses had a percentage of anticipatory responses that was 2 *SD* above the mean. From the pre scores, 3 children were not considered (1 child from the EF training group was not included due to errors in Congruent condition. 1 child from the ToM training group and another from the EF control group were discarded for anticipatory responses). From the post scores, 1 child from the ToM training group fulfilled both exclusion criteria. Other 3 children were excluded due to errors in Congruent condition (2 children from control ToM group and 1 from the EF training group).

5.3.2.1 Effects of the executive function training

Pre and post means and standard deviations in measures for EF training and control groups are shown in Tables 5.1 and 5.2.

Table 5.1.
Means (M) and standard deviations (SD) of intelligence (IQ), executive function and theory of mind (ToM) measures for EF training (T) and control (C) groups.

Measure	Measure	Group	Pre *M*(*SD*)	Post *M*(*SD*)
Intelligence	Fluid IQ	EF T	102.8(13.7)	110.4(13.7)
		EF C	104.0(13.5)	109.1(14.4)
	Verbal IQ	EF T	114.0(14.9)	116.0(13.0)
		EF C	110.2(12.2)	112.4(12.3)
	Composite IQ	EF T	107.3(14.1)	113.0(13.2)
		EF C	106.0(12.5)	110.0(13.3)
Dots task	Conflict resolution rt	EF T	93(48)	91(50)
		EF C	99(59)	84(42)
	Cognitive flexibility rt	EF T	134(84)	91(50)
		EF C	149(85)	148(54)
	Conflict resolution err	EF T	6.8(6.8)	4.4(6.0)
		EF C	5.3(6.5)	3.4(5.0)
	Cognitive flexibility err	EF T	12.7(8.8)	10.5(10.3)
		EF C	11.0(10.7)	7.8(8.7)
ToM	TEC	EF T	77.3(14.6)	80.4(13.0)
		EF C	80.1(11.8)	83.3(10.3)
	Affective ToM	EF T	35.0(39.0)	68.0(28.5)
		EF C	38.5(30.5)	62.5(30.5)
	Strange Stories	EF T	57.0(26.1)	69.0(20.3)
		EF C	65.7(18.6)	67.3(24.9)

Notes. Conflict resolution rt: conflict resolution reaction time; Cognitive flexibility rt: cognitive flexibility reaction time; Conflict resolution err: conflict resolution errors; Cognitive flexibility err: cognitive flexibility errors; TEC: Test of Emotion Comprehension; Affective ToM: affective theory of mind.

Table 5.2.
Means (M) and standard deviations (SD) in explicit and implicit prejudice measures for EF training (T) and control (C) groups.

Measure	Score	Group	Pre *M*(*SD*)	Post *M*(*SD*)
MRA	Prejudice	EF T	8.6(6.3)	7.5(6.5)
		EF C	8.5(7.7)	8.7(6.7)
	Counter-bias	EF T	7.8(4.0)	8.8(4.7)
		EF C	7.9(5.3)	8.0(5.5)
Trust game	Out-group IDI	EF T	40.7(32.7)	24.7(32.0)
		EF C	41.0(38.4)	18.8(27.9)
	IIP	EF T	.0(18.6)	-3.3(24.5)
		EF C	-2.8(24.4)	7.6(19.0)
	Out-group IPun	EF T	64.3(42.9)	53.6(38.3)
		EF C	71.2(39.6)	71.9(30.7)
	IPrejPun	EF T	21.2(36.9)	-3.3(45.1)
		EF C	14.2(42.5)	5.2(26.0)
	Out-group IFor	EF T	55.2(40.5)	75.7(31.3)
		EF C	51.7(41.7)	86.7(28.7)
	IPrejFor	EF T	4.2(11.8)	7.5(28.8)
		EF C	13.3(24.8)	-5.8(30.4)

Notes. Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; Out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.

5.3.2.1.1 Near transfer effects of the executive function training

For the Dots task, analyses on percentage of errors in conflict resolution revealed a main effect of Session, $F(1, 44) = 5.58$, $p < .05$, $\eta_p^2 = .11$. Children in both EF training and control groups committed more errors in the pre than in the post session (mean difference = 1.95, $p < .05$). No other effects were significant. For percentage of errors in cognitive flexibility, analyses revealed a marginally significant effect of Session, $F(1, 44) = 3.58$, $p = .07$, $\eta_p^2 = .08$. Children in both EF training and control groups committed more errors in the pre than in the post session (mean difference = 2.54, p = .07). No other effects were significant. For conflict resolution reaction time and for cognitive flexibility reaction time, neither main nor interaction effects were significant.

5.3.2.1.2 Far transfer effects of the executive function training

Intelligence. ANOVAs revealed an effect of Session on the vocabulary measure, $F(1, 47) = 5.83$, $p < .05$, $\eta_p^2 = .11$. Pairwise comparisons showed greater vocabulary score in the post compared to the pre session (mean difference = 2.17, $p < .05$). No other effects were significant. For the matrices score, a main effect of Session was found, $F(1, 47) = 26.99$, $p < .001$, $\eta_p^2 = .37$. Pairwise comparisons showed that children in both EF training and control groups showed higher means in the post compared to the pre session (mean difference = 6.36, $p < .001$). There was not the expected significant Session by Condition interaction ($F(1, 47) = 1.09$, $p = .30$, $\eta_p^2 = .02$). The ANOVA on the composite IQ score revealed a main effect of Session, $F(1, 47) = 36.54$, $p < .001$, $\eta_p^2 =$ .44. Pairwise comparisons showed that children in both EF training and control groups showed higher scores in the post compared to the pre session (mean difference = 4.78, $p < .001$).

Theory of mind. As afore-stated, the effect of EF training on ToM was analyzed by including reading comprehension as covariate. For the Strange Stories score, we found a significant effect of Reading comprehension, $F(1, 46) = 16.32$, $p < .001$, $\eta_p^2 = .26$. Furthermore, a marginally significant Session by Condition interaction was found, $F(1, 46) = 2.99$, $p = .09$, $\eta_p^2 = .06$. Pairwise comparisons showed that only the

EF training group had greater scores in Strange Stories in the post than in the pre session (mean difference = 1.47, $p < .01$; see Figure 5.1.). For the TEC score, analyses revealed neither significant main nor interaction effects. For the affective ToM score, analyses revealed a significant effect of Reading comprehension, $F(1, 46) = 8.39$, $p < .01$, $\eta_p^2 = .15$. Moreover, a significant effect of Session was found, $F(1, 46) = 4.80$, $p < .05$, $\eta_p^2 = .10$. Pairwise comparisons showed that scores in the post session were significantly greater than in the pre session for children from both EF training and control groups (mean difference = 1.14, $p < .001$).

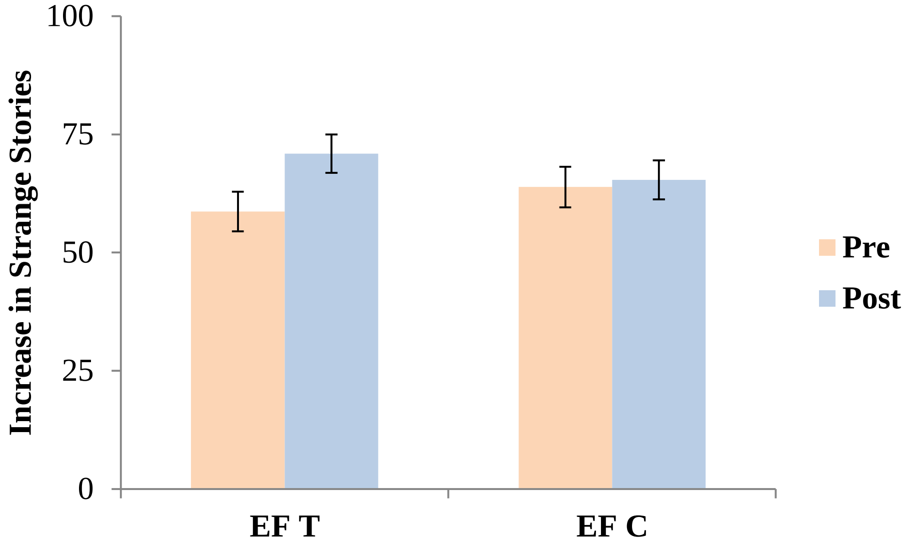


Figure 5.1. *Pre and post percentage scores in Strange Stories. Notes: EF T: EF training group; EF C: EF control group; Strange Stories (%): mean percentage score in Strange Stories.*

Explicit prejudice. For the composite prejudice measure, a marginally significant effect of Condition was found, $F(1, 43) = 3.38$, $p = .07$, $\eta_p^2 = .07$. A marginally significant Condition by Internal motivation interaction was also found, $F(1, 43) = 3.41$, $p = .07$, $\eta_p^2 = .07$. As expected, an interaction between Session and Condition was observed, $F(1, 43) = 3.41$, $p = .07$, $\eta_p^2 = .07$. Moreover analyses revealed a marginally significant interaction between Session, Condition and Internal motivation, $F(1, 43) = 3.00$, $p = .09$, $\eta_p^2 = .07$. For the Session by Condition interaction, pairwise comparisons showed that the measure of prejudice was lower in the post-assessment compared to the pre-assessment only for the EF training group, though the reduction was not significant (mean difference = 1.11, $p = .28$). On the contrary, a non-significant increase in prejudice in the post-assessment was observed for the EF control group (mean difference = .22, p = .84). For the three-way interaction between Session, Condition and Internal motivation, regression analyses were performed for each condition separately (see Figure 5.2). In each analysis, internal motivation was the predictor of the reduction of the prejudice measure between the pre and the post session. For the EF training group, regression analyses showed that internal motivation was a marginally significant negative predictor (R^2 = .14, F(1, 23) = 3.60, p = .07) of the reduction of prejudice in the post-assessment. The regression coefficient was -.37, so the greater the internal motivation, the less tendency to reduce the score in composite prejudice. For the EF control group, internal motivation was not a significant predictor of reduction in composite prejudice (R^2 = .01, F(1, 22) = .31, p = .59). The regression coefficient was -.12.

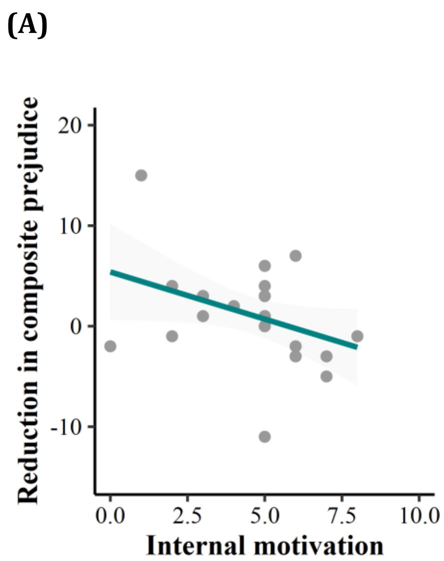


Figure 5.2. *Prejudice reduction as a function of Internal Motivation for the EF training (A) and the EF control groups (B).*

For the counter-bias score, analyses revealed a marginally significant effect of Condition, $F(1, 43) = 3.83$, $p = .06$, $\eta_p^2 = .08$. Moreover, a significant Condition by Internal motivation was found, $F(1, 43) = 4.39$, $p < .05$, $\eta_p^2 = .09$. As it was expected, a significant interaction between Session and Condition was found, $F(1, 43) = 4.70$, $p < .05$, $\eta_p^2 = .10$. Pairwise comparisons showed that although the gain in counter bias between the pre and the post assessment was higher for the EF training group (mean difference = 1.05) than for the EF control group (mean difference = .11), none of the differences was significant ($p = .14$ for EF training group and $p = .88$ for EF control group). A marginally significant interaction between Session, Condition and Internal motivation was also found, $F(1, 43) = 3.92$, $p = .05$, $\eta_p^2 = .08$. Regression analyses were performed for further testing of this interaction (see Figure

5.3). For the EF training group, internal motivation was a significant predictor of gains in counter-bias (R^2 = .16, $F(1, 23) = 4.53$, $p < .05$). The regression coefficient was -.41, informing that the greater the internal motivation, the less the gain in counter-bias. For the EF control group, internal motivation was not a significant predictor of gains in counter-bias (R^2 = .02, $F(1, 22) = .39$, $p = .54$). The regression coefficient was .13.

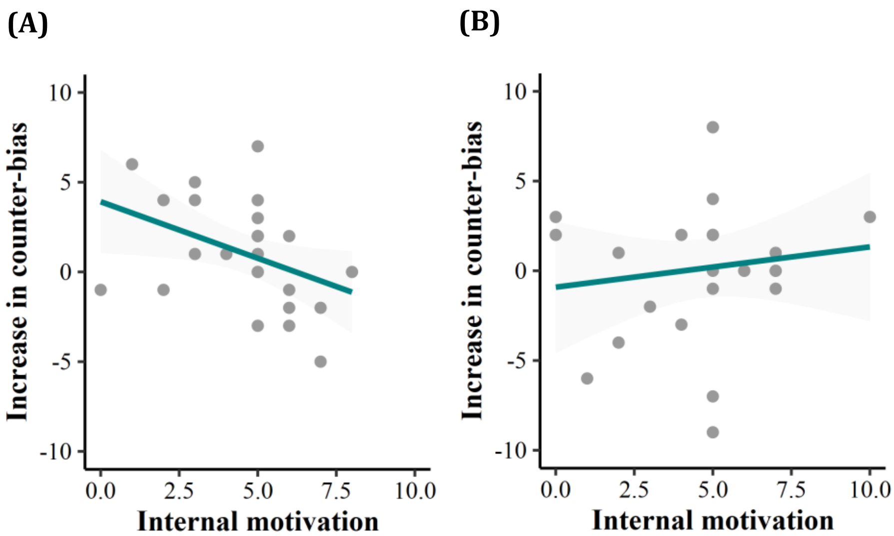


Figure 5.3. *Counter-bias increase as a function of Internal Motivation for the EF training (A) and the EF control groups (B)*

Implicit prejudice. Concerning the effect of training on implicit prejudice, for the out-group IDI, analyses revealed a marginally significant effect of Session, $F(1, 43) = 4.16$, $p = .05$, $\eta_p^2 = .09$. Pairwise comparisons showed that a significant decrease in out-group IDI between the pre and post session took place, both for training and control groups (mean difference = 18.86, p < .01). No other effects were significant. Neither internal nor external motivation significantly interacted with the other variables. For the IIP, only a marginally significant interaction between Session and Internal motivation was found, $F(1, 43) = 2.85$, p = .10, $\eta_p^2 = .06$. No other effects were significant. For the out-group IPun, a significant interaction between Condition and External motivation was found, $F(1, 41) = 8.65$, $p < .01$, $\eta_p^2 = .17$, as well as a marginally significant interaction between Condition and Internal motivation was found, $F(1, 41) = 3.99$, $p = .05$, $\eta_p^2 = .09$. For the IPrejPun, out-group IFor and IPrejFor indeces, none of the effects was significant (all *p*s > .10).

5.3.2.2 Effects of the theory of mind training

Pre and post means and standard deviations in measures for ToM training and control groups are shown in Tables 5.3 and 5.4.

Table 5.3.
Means (M) and standard deviations (SD) in intelligence (IQ), executive function and theory of mind (ToM) measures for ToM training (T) and control (C) groups.

Measure	Score	Group	Pre *M*(*SD*)	Post *M*(*SD*)
Intelligence	Fluid IQ	ToM T	104.1(11.8)	108.8(9.9)
		ToM C	102.3(10.1)	110.6(14.7)
	Verbal IQ	ToM T	108.5(10.0)	112.1(8.5)
		ToM C	110.2(14.1)	113.7(10.9)
	Composite IQ	ToM T	104.9(9.9)	109.7(8.9)
		ToM C	104.9(10.7)	111.6(11.1)
Dots task	Conflict resolution rt	ToM T	88.7(53.2)	80.6(44.0)
		ToM C	80.1(58.8)	80.5(47.5)
	Cognitive flexibility rt	ToM T	148.3(64.7)	138.4(69.9)
		ToM C	126.6(78.8)	132.9(49.6)
	Conflict resolution err	ToM T	7.5(7.7)	3.8(4.5)
		ToM C	4.3(5.0)	3.0(3.9)
	Cognitive flexibility err	ToM T	11.0(8.2)	8.9(7.7)
		ToM C	11.6(8.4)	8.1(8.8)
ToM	TEC	ToM T	77.2(12.1)	87.9(11.9)
		ToM C	79.3(15.4)	81.8(12.1)
	Affective ToM	ToM T	36.3(32.5)	72.8(27.8)
		ToM C	39.8(35.0)	72.8(27.8)
	Strange Stories	ToM T	56.4(20.6)	79.9(16.4)
		ToM C	65.5(19.3)	65.2(17.0)

Notes. Conflict resolution rt: conflict resolution reaction time; Cognitive flexibility rt: cognitive flexibility reaction time; Conflict resolution err: conflict resolution errors; Cognitive flexibility err: cognitive flexibility errors; TEC: Test of Emotion Comprehension; Affective ToM: affective theory of mind.

Table 5.4.
Means (M) and standard deviations (SD) in explicit and implicit prejudice measures for ToM training (T) and control (C) groups.

Measure	Score	Group	Pre *M*(*SD*)	Post *M*(*SD*)
MRA	Prejudice	ToM T	8.7(6.0)	8.1(6.7)
		ToM C	7.8(5.8)	7.0(8.0)
	Counter-bias	ToM T	7.8(4.4)	8.7(4.7)
		ToM C	8.6(4.5)	8.8(4.9)
Trust game	Out-group IDI	ToM T	31.1(24.8)	22.7(27.0)
		ToM C	38.6(34.3)	33.3(37.1)
	IIP	ToM T	4.6(23.7)	2.3(16.5)
		ToM C	-.0(19.3)	7.6(28.0)
	Out-group IPun	ToM T	72.0(34.2)	62.5(40.2)
		ToM C	51.1(44.4)	55.2(43.1)
	IPrejPun	ToM T	6.4(51.8)	8.0(41.1)
		ToM C	-6.4(49.2)	3.4(53.8)
	Out-group IFor	ToM T	69.1(31.3)	82.7(29.8)
		ToM C	66.4(38.2)	79.1(28.6)
	IPrejFor	ToM T	3.6(35.3)	-7.6(27.9)
		ToM C	-3.8(33.8)	-3.8(24.2)

Notes. Out-group IDI: out-group initial distrust index; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; Out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness.

5.3.2.2.1 Near transfer effects of the theory of mind training

Concerning effects of training on ToM, analyses on scores on Strange Stories task showed a main effect of Reading comprehension, $F(1, 41) = 9.50$, $p < .01$, $\eta_p^2 = .19$. As hypothesized, a significant Session by Condition interaction was found, $F(1, 41) = 16.17$, $p < .001$, $\eta_p^2 = .28$ (see Figure 5.4). Pairwise comparisons showed that the Strange Stories measure for the post compared to the pre session was higher for the ToM training group (mean difference = 2.83, $p < .001$) but not the ToM control group (mean difference = .06, $p = .91$). Analyses on the TEC measure showed a marginally significant effect of Session, $F(1, 41) = 3.04$, $p = .09$, $\eta_p^2 = .07$. Pairwise comparisons showed that participants in both age groups had higher post than pre assessment means (mean difference = .59, $p < .01$). As it was expected, we found a significant Session by Condition interaction, $F(1, 41) = 4.89$, $p < .05$, $\eta_p^2 = .11$. Pairwise comparisons (see Figure 5.5) showed higher scores in the post compared to the pre assessment for the ToM training group (mean difference = .94, $p < .001$), but not for the ToM control group (mean difference = .24, $p = .30$). For the affective ToM score, neither main nor interaction significant effects were found.

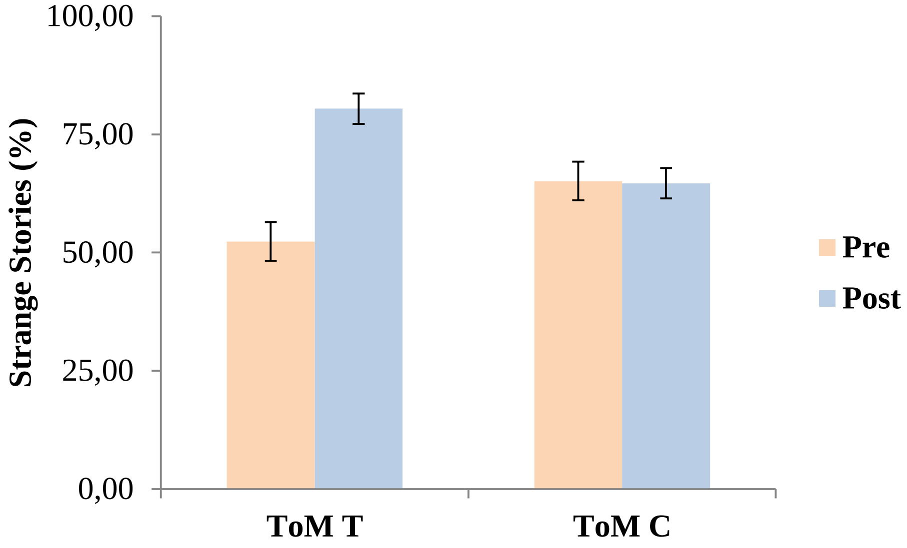


Figure 5.4. *Pre and post percentage of correct answers in Strange Stories for ToM training group (ToM T) and ToM control group (ToM C)*

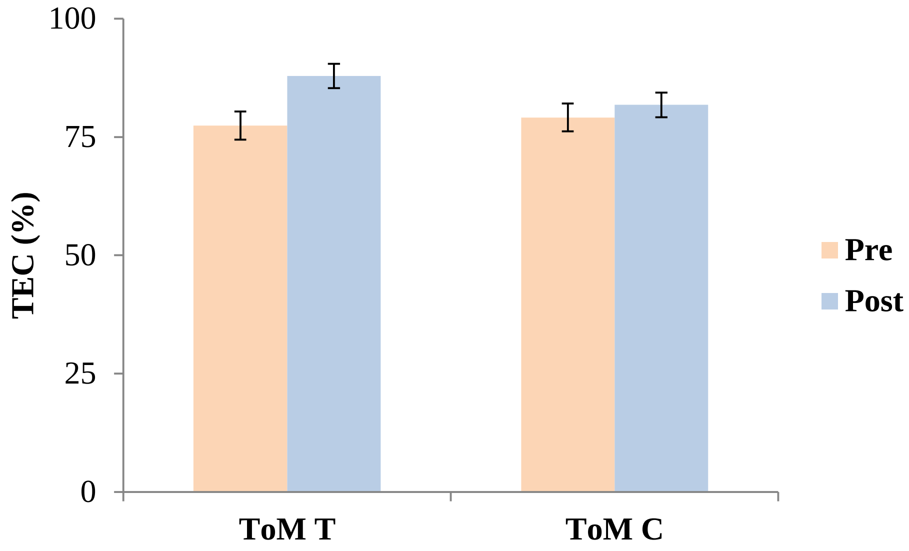


Figure 5.5. *Pre and post percentage of correct answers in the Test of Emotion Comprehension for ToM training group (ToM T) and ToM control group (ToM C)*

5.3.2.2.2 Far transfer effects of the theory of mind training

Intelligence. ANOVAs revealed an effect of Session for the three measures taken: vocabulary (F(1, 42) = 9.22, p < .01, η_p^2 = .18); matrices (F(1, 42) = 14.44, p < .001, η_p^2 = .26); and composite IQ (F(1, 42) = 21.06, p < .001, η_p^2 = .33). Pairwise comparisons showed higher scores in the post compared to the pre session measures (vocabulary mean difference = 3.57, p < .01; matrices mean difference = 6.52, p < .001; composite IQ mean difference = 5.73, p < .001). As hypothesized, the Session by Condition interaction was not significant in any case: vocabulary (F(1, 42) = .00, p = .95, η_p^2 = .00); matrices (F(1, 42) = 1.15, p = .29, η_p^2 = .03); and composite IQ (F(1, 42) = .59, p = .45, η_p^2 = .01).

Executive function. Regarding the measure of the Dots task, analyses on percentage of errors in conflict resolution revealed a marginally significant effect of Condition, $F(1, 38) = 3.36$, $p = .08$, $\eta_p^2 = .08$. Though the Session by Condition interaction was not significant ($F < 1$), pairwise comparisons showed that the ToM training group showed marginally significant less conflict resolution error scores in the post- compared to the pre-assessment (mean difference = 2.71, $p = .09$). The difference was not significant for the ToM control group (mean difference = .52, $p = .74$). For percentage of errors in cognitive flexibility, analyses revealed a marginally significant effect of Session, $F(1, 38) = 3.36$, $p = .08$, $\eta_p^2 = .08$. Both training and control groups showed less errors after the intervention (mean difference = 2.08, $p = .08$). For conflict resolution and cognitive flexibility reaction time measures, analyses did not reveal significant effects.

Explicit prejudice. For the composite prejudice measure, a marginally significant effect of Session was found, $F(1, 38) = 3.30$, $p = .08$, $\eta_p^2 = .08$. Pairwise comparisons showed lower level of prejudice in the post compared to the pre session, but this difference was not significant (mean difference = .93, $p = .23$). A significant interaction between Session, Condition and External motivation was found, $F(1, 38) = 4.50$, $p < .05$, $\eta_p^2 = .11$. Regression analyses were carried out to further analyze this three-way interaction (see Figure 5.6). For the ToM training group, the regression was marginally significant, $R^2 = .15$, $F(1, 20) = 3.45$, $p = .08$. The regression coefficient was -.38, indicating that the higher the level of external motivation, the lower the reduction of prejudice. For the ToM control group, the regression was not significant, $R^2 = .05$, $F(1, 20) = 1.07$, $p = .31$. In this case, the regression coefficient was positive (.23). For the counter-bias score, no significant main or interaction effects were found.

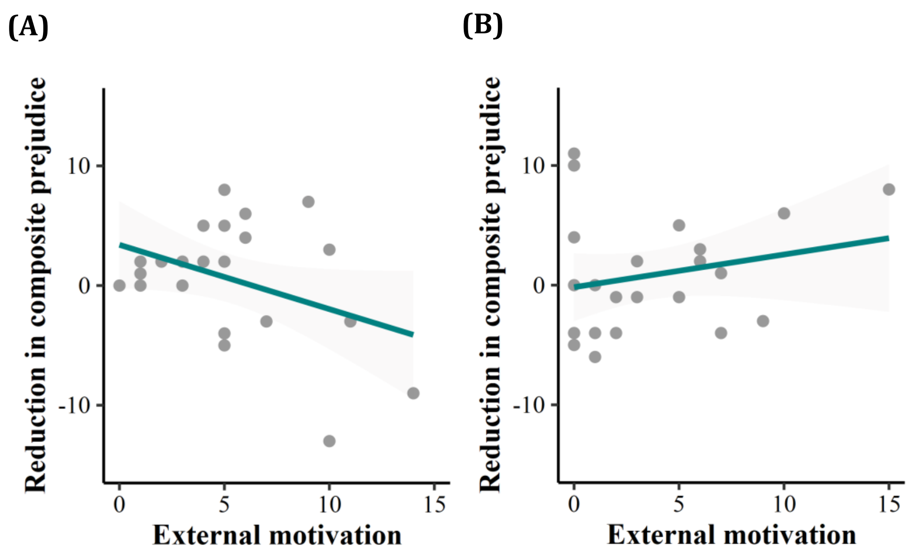


Figure 5.6. *Composite prejudice reduction as a function of External Motivation for the ToM training (A) and the ToM control groups (B)*

Implicit prejudice. For the out-group IDI, a marginally significant Condition by External motivation interaction was found, $F(1, 38) = 3.20$, $p = .08$, $\eta_p^2 = .08$. For the IIP, a significant Condition by Internal motivation interaction was found, $F(1, 37) = 8.40$, $p < .01$, $\eta_p^2 = .19$. For the out-group IPun, a significant effect of Internal motivation was observed, $F(1, 37) = 5.50$, $p < .05$, $\eta_p^2 = .13$. Moreover, a marginally significant Session by External motivation interaction was found, $F(1, 37) = 3.13$, $p = .09$, $\eta_p^2 = .08$. For the IPrejPun, only a significant effect of Internal motivation was found, $F(1, 36) = 7.85$, $p < .01$, $\eta_p^2 = .18$. For the out-group IFor, a marginally significant effect of External motivation was shown, $F(1, 37) = 3.77$, $p = .06$, $\eta_p^2 = .09$. Moreover, we found a

Session by Internal motivation significant interaction, $F(1, 37) = 4.94$, $p < .05$, $\eta_p^2 = .12$. As expected, analyses revealed a Session by Condition interaction, $F(1, 37) = 3.74$, $p = .06$, $\eta_p^2 = .09$. However, pairwise comparisons (see Figure 5.7) showed that both, ToM training and ToM control groups presented greater out-group IFor in the post compared to the pre session (mean difference for training group = 15.22, $p < .05$; mean difference for control group = 16.34, $p < .05$;). This two-way interaction was qualified by a significant Session by Condition by External motivation interaction, $F(1, 37) = 8.14$, $p < .01$, $\eta_p^2 = .18$. Regression analyses were performed for each condition (see Figure 5.8). For the ToM training group, the regression was not significant, $R^2 = .12$, $F(1, 20) = 2.76$, $p = .11$. The regression coefficient was -.35. For the ToM control group, the regression was significant, $R^2 = .22$, $F(1, 19) = 5.50$, $p < .05$. The regression coefficient was .47, informing that children who were greater in external motivation increased more their forgiveness toward the out-group in the post compared to the pre session assessments. For the IPrejFor, a main effect of External motivation was found, $F(1, 35) = 4.36$, $p < .05$, $\eta_p^2 = .11$. No other effects were significant.

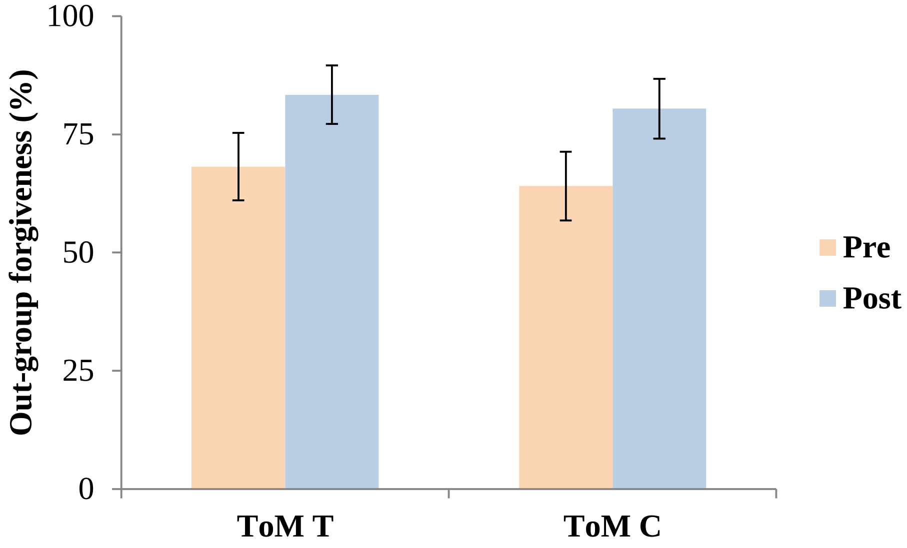


Figure 5.7. *Pre and post percentage of forgiveness toward the out-group for ToM training group (ToM T) and ToM control group (ToM C)*

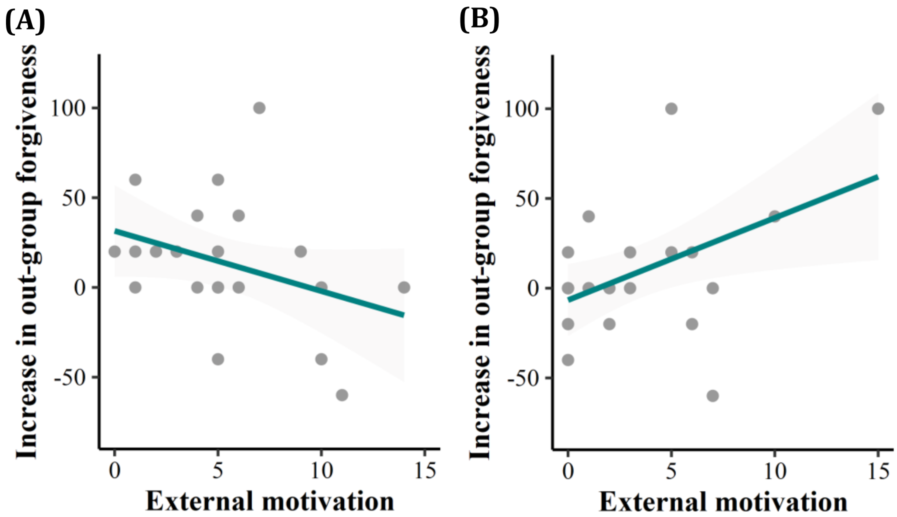


Figure 5.8. *Increase in out-group forgiveness e as a function of External Motivation for the ToM training (A) and the ToM control groups (B)*

5.4 Discussion

The present study aimed to contribute to the existing evidence about near and far transfer effects of cognitive skills training administered to school-age children. With this goal, we administered EF and ToM training modalities, and measured near transfer effects, as well as far transfer to intelligence and prejudice. Next we discuss hypotheses and results concerning each training modality.

5.4.1 Executive function training: near and far transfer effects

In accordance with data from previous studies, we expected a transfer of EF training to inhibitory control and cognitive flexibility measures. However, we did not find evidence for near transfer from our EF training program to performance in the Dots task. The absence of training effect on EF could be attributed to the fact that the practice with the initial levels of the training exercises is enough to foster EF performance, and so the active control group also gets benefit. In consonance with this, and in line with Diamond and Ling (2019), it is arguably more difficult to find differences in performance between a trained and an active control group. On the other hand, it could also be possible that the intervention (i.e., the number of sessions and the time spent) is not large enough to produce changes that are observable at the behavioral level. It is often the case that the training produces effects that are captured at the neural but not at the behavioral level (e.g., see Pozuelos et al., 2019). Also, it might be the case that training exercises did not involve sufficient increases in cognitive load despite being adaptive to the performance of the child given that the child had to perform a number of runs of each difficulty level before going on to the next one. Moreover, this null finding could be due to the difference between the training and the assessment tasks used. For instance, whereas the training included Go – NoGo and Stroop – like tasks, a spatial conflict task (i.e., the Dots task) was used for assessment. Finally, previous research informs that EFs especially improve when the intervention includes metacognitive scaffolding in order to make children reflect on their own cognitive skills and performance (e.g., Espinet et al., 2013; Kray et al., 2008). In this regard, our intervention might have been less effective given the lack of a metacognitive component.

Concerning far transfer, we expected fluid intelligence to be improved after EF training. Again, we did not find such transfer. It has been suggested that WM training shows limited capacity to transfer to fluid intelligence (Diamond & Ling, 2019). Moreover, although some studies find transfer to fluid intelligence in middle childhood (Jaeggi et al., 2011;) and also in older children and adults (Karbach & Kray, 2009), most of studies which report transfer from EF training to fluid intelligence have focused on preschool-age participants (e.g., Bergman-Nutley et al., 2011; Neville et al., 2013; Peng et al., 2017; Pozuelos et al., 2019; Rueda et al., 2005). In this line, Wass et al. (2012) informed that the more widespread effects of training are observed the younger the participants. This could be explained because EF presents a great development in early years (e.g., Carlson & Moses, 2001; Zelazo et al., 2003). On the other hand, the inclusion of the metacognitive component has also proved to boost the effect of EF training on fluid intelligence (e.g., Pozuelos et al., 2019).

On the other hand, results yielded the expected transfer from EF training to ToM performance. Arguably, this result may indicate that EF enables unfold of ToM knowledge, and / or that the EF improvement fosters ToM development. It is possible that the EF training enables children to show ToM skills that they *already* had before the training, or that the training has genuinely fostered ToM. In any case, this result points that the EF training produces changes in EF that indirectly impact on ToM performance. Although our results do not let draw conclusions on whether it is the emergence or the expression framework the one that could best explain this transfer effect, in the extent to which the improvement was observed in the Strange Stories task, that seemingly pose less inhibition and working memory demands than, for instance, the second-order false belief task, it is likely that EF contributes to the acquisition of ToM and not only to its expression.

On the basis of the role played by cognitive skills and motivation in prejudice regulation, we explored the transfer to prejudice and the possibility that motivation modulates such transfer. Concerning explicit prejudice, our results suggest that children with less internal motivation to control prejudice are the ones that tend to show training-related improvement in prejudice regulation. Research on adults reports a significant relation between low prejudice and high internal motivation to control it (e.g., Devine et al., 1991, 2002; Plant & Devine, 1998, 2009), as well as between better implicit prejudice regulation (addressed by greater conflict-monitoring brain activity and greater stereotype inhibition) and greater internal motivation (Amodio et al., 2008). It is possible that the EF training is less effective in highly internally-motivated children because they are already low-prejudiced children and good prejudice regulators. Instead, low internally-motivated children may present certain levels of prejudice, and therefore, training may help them to regulate explicit prejudice. On the contrary, EF training did not have a significant impact on implicit prejudice. As a possibility, our experimental task may not have elicited children's need for conflict detection and monitoring. Whereas implicit tasks typically used in adults directly elicit the activation of automatic stereotypic associations, we assessed implicit bias with a task about trust decisions. Conceivably, children might have involved other cognitive processes, like their mentalizing and perspective-taking skills (Evans et al., 2013), distinct to cognitive control mechanisms when making trust decisions throughout the task.

5.4.2 Theory of mind training: near and far transfer effects

As established in our hypothesis on near transfer effects, we found that training improved ToM. Interestingly, training enhanced the performance in the ToM tasks more connected to the training and did not impact on second-order affective ToM. As argued, near transfer of cognitive training is mainly observed to fairly similar tasks to the practiced ones (Simons et al., 2016). Our results provide further support to the already-shown ToM training efficacy (Hofmann et al., 2016).

With regard to far transfer, as expected, non-attributable-to-training improvement in intelligence was found. We examined whether ToM training impacts on EF. In this regard, a marginal improvement in conflict resolution accuracy was found. It is possible that ToM training enhances in certain extent inhibitory control skills as participants are prompted to inhibit their own knowledge in order to adopt the characters' perspectives and reflect on a character's false belief about another character's belief. Thus, our results offer support for the EF transfer to ToM, and also suggest that EFs can be fostered by practicing tasks that do not directly address EFs but draw on them.

Far transfer to prejudice from ToM training was also predicted. We found that external motivation modulated the effect of training, as reduction of explicit prejudice was greater for children with less external motivation to control prejudice. Evidence suggests that high-ToM children are less concerned about showing themselves as prejudiced to others and they showed low explicit prejudice irrespectively of it is made public or kept private (Fitzroy & Rutland, 2010). It is possible then that the impact of ToM training on prejudice is more evident for those children that usually engage less effort to conceal prejudice and tend to overtly express their attitudes. Then, the reduced explicit prejudice would result from the combination of higher ToM skills and low concern about public accountability. With regard to implicit prejudice, whereas both trained and control groups increased the forgiveness toward the out-group in the post-assessment session, in the case of the control group this effect was modulated by participants' external motivation. This result indicates that, whereas gains in the ToM training group are likely attributable to the training effect, the increased in forgiveness in the ToM control group is linked to participants' motivation to conceal their prejudiced attitudes. Then, though ToM training does not impact on participants' initial distrust, certain evidence on implicit prejudice reduction is found in children's recovery of trust after trust transgression. The recovery of trust informs reduction of prejudice in adults (e.g., Hewstone et al., 2006), and it may also inform about children's greater empathic concern about the trustee's outcomes.

5.4.3 Conclusions and future directions

As Kloo and Perner (2008) argued, EF and ToM training studies that account for transfer effects to domains like social competence are needed. This study aimed to address near and far transfer effects of EF and ToM training. Our results extend previous findings on near and far transfer effects, and provide preliminary support for the impact of cognitive skills training in prejudice regulation. Given the tentative role of motivation, future studies should include experimental manipulations (like, for instance, the accountability of prejudice) that let account for differential impact of training for children presenting different levels of motivation to control prejudice. Altogether, our results provide support for the role of cognitive skills training in fostering children's cognitive and social outcomes.

Chapter 6.

General discussion

In the present work we aimed to account for the relation between cognitive skills and explicit and implicit forms of prejudice along childhood. We mainly studied the relation between cognitive skills and prejudice at the level of individual differences, and explored possible developmental-related peculiarities. Another objective of the present work was to implement two modalities of cognitive training in order to check their near and far transfer effects.

Together with the above-exposed aims, we also intended to shed light on other issues, like the developmental trajectories of EF, ToM and prejudice, the relation between EF and ToM, and the neural activity linked to cognitive control and prejudice regulation. In the next sections of this chapter, we address the general discussion of our findings in connection with the research questions posed in the present dissertation.

6.1 Do individual differences in executive function, theory of mind and motivation relate to prejudice?

We predicted that individual differences in EF and ToM would associate with explicit and implicit prejudice, and thus there would be a negative relation between EF and prejudice, as well as between ToM and prejudice. Concerning motivation, we expected to find a negative relation between motivation and prejudice. We aimed to shed light on these issues by conducting two cross-sectional studies where preschool children, third-grade children and sixth-grade children participated. Overall results confirmed our predictions concerning the association between EF and prejudice, but results were mixed: EF had a significant association with explicit prejudice in the first study, but only with implicit prejudice in the second study. Affective ToM in the first cross-sectional study, together with advanced mentalizing and emotion understanding skills in the second cross-sectional study were the variables that significantly correlated with both explicit and implicit prejudice. Thus, our results in the second study showed that both EF and ToM significantly correlated with implicit prejudice. With respect to the role of motivation, we found significant associations of internal motivation with explicit and implicit prejudice. Analyses to shed light on significant predictors of prejudice showed a mixed pattern of results for EF, as whereas cognitive flexibility was the significant predictor of explicit prejudice in the first study, in the second study conflict resolution was the significant predictor of implicit prejudice. Concerning ToM, regression analyses in the second study showed that advanced ToM addressed by performance in the Strange Stories task was the significant predictor of explicit and implicit prejudice. Internal motivation significantly predicted the explicit prejudice score of composite prejudice; in contrast, for the other scores of explicit and implicit prejudice, the predictive power of internal motivation fell out of significance when EF and ToM were included in the equation.

With the aim to explore possible developmental peculiarities, we also carried out separated by age group analyses. In the first study, only preschoolers showed a significant relation between affective ToM and prejudice; moreover, whereas cognitive flexibility was the significant predictor of explicit prejudice in preschoolers, inhibitory control significantly predicted third-grade children’s explicit prejudice. In the second study, exploratory correlational analyses showed that preschoolers presenting better EF scores also showed less explicit and implicit prejudice; for third-grade and sixth-grade children, the relation between EF and prejudice was weak and contrary-to-expected in some case. The association between ToM and prejudice was evident in third-grade and sixth-grade children; specifically, higher scores in Strange Stories associated with third-grade children's less explicit and implicit prejudice, and with sixth-grade children's less implicit prejudice. However, third-grade children scoring higher in emotion comprehension punished the out-group in greater extent.

Overall, our results supported the predicted association between EF and prejudice, and informed that individual differences along childhood in both inhibitory control and cognitive flexibility contribute to regulation of prejudice. In this regard, our cross-sectional research extends findings from previous studies (Bigler & Liben, 1993; Lapan & Boseovski, 2015) and contributes to fill the gap in the literature about the link between individual differences in EF and prejudice along childhood. Results on the association between EF and implicit prejudice support that, similarly to adults, children apply cognitive control to regulate implicit prejudice. Given that children's ability to resolve the conflict predicted implicit prejudice regulation, our findings suggest that conflict monitoring skills play a similar role for both children and adults in regulation of implicit prejudice. Unlike tasks typically used in adults, our implicit prejudice task did not tap children's ability to inhibit automatically activated implicit bias, and thus we did not account for EF and implicit prejudice in the same task. Then, our results suggest that the general EF ability measured by a neutral task is able to predict the regulation of prejudice measured by a different task. Concerning the link between individual differences in EF and explicit prejudice, it was only significant in the first cross-sectional study. This could be explained, as argued in the Discussion section of the second cross-sectional study, by the methodological differences between both studies. In the second study, we reduced the allowed response time and removed reaction times

2 standard deviations above the mean; it is possible that failure to control explicit prejudice is higher among children that take more time to give accurate responses, and accordingly, in the second study we did not capture the variability of individual differences that mostly relate to explicit prejudice (i.e., children's variability in the longest response times).

Exploratory analyses separated by age group suggested that EF seems to contribute to prejudice regulation in middle and early childhood in greater extent than in late childhood. Data from the first study suggest that whereas cognitive flexibility mainly underpins preschoolers' prejudice regulation, inhibitory control predicts better prejudice regulation on the part of third-grade children. Results from the second study provide further preliminary evidence on the association between EF and prejudice in preschool-age children. Conceivably, for preschool-age children it is important to have the ability to carry out a flexible processing of social information; in contrast, by middle childhood, prejudice regulation presumably underlies in children's ability to inhibit the expression of prejudiced responses. All in all, our findings in this regard are exploratory and constitute a first approximation to the peculiarities of the link between EF and prejudice in different developmental stages.

Our results (specially those from the second cross-sectional study) supported the predicted role of ToM in prejudice. Our findings extend previous research focused on ToM-related concepts like emotional empathy (Nesdale et al., 2005), and provide further support for the role of affective aspects of ToM in children's prejudice regulation (Fitzroy & Rutland, 2010). Importantly, our findings suggest that affective ToM significantly contribute to prejudice regulation, but also that advanced ToM skills that underpin children's understanding of mental states underlying complex social situations contribute to predict prejudice expression over and above the understanding of emotions and of beliefs about emotions. Presumably, advanced ToM skills addressed by the Strange Stories task involve the contextualized understanding of emotional mental states (e. g., the white lie story accounts for children's understanding that a character's behavior has the intention of not hurting another character's feelings). Furthermore, it could be possible that the content of the stories arises children's empathic concern about the characters involved, and accordingly the task may also capture the aspect of emotional empathy that contributes to ToM in accordance with the model of Shamay-Tsoory et al. (2009, 2010). Separated by age group analyses in the second cross-sectional study provided further support for the role of advanced mentalizing skills in relation with both explicit and implicit prejudice especially in middle and late childhood. A peculiarity was that third-grade children with higher emotion understanding punished more the out-group. In the extent to which some research suggests that higher affective ToM associates with higher emotional reactivity (Kalbe et al., 2007), we could speculate that third-grade children who are better at emotion comprehension are also more emotionally reactive. Conceivably, results may be suggesting that implicit prejudice based on patterns of punishment toward the out-group after trust transgression is particularly high in third-grade children that present better emotional understanding and that consequently are more "emotionally reactive" to out-group behavior. This increased emotional reactivity could make children more prone to perceive the out-group behavior as threatening, and could pose difficulties when regulating prejudice after trustee's deceptive behavior. Altogether, this preliminary evidence suggests that the relation between mentalizing skills and implicit prejudice in middle childhood is complex.

With respect to the link between motivation and prejudice, results showed that internal motivation was associated with both explicit and implicit prejudice, and contributed to regulation of prejudice. Whereas internal motivation predicted the regulation of explicit prejudice, it fell out of significance when EF and ToM variables were included to predict implicit prejudice. This could be suggesting that, similarly to adults (Amodio et al., 2008), cognitive control may mediate the association between internal motivation and implicit prejudice. This possibility should be addressed in future studies that, similarly to studies with adult population, account for the *online* cognitive control applied during performance of implicit prejudice tasks and analyze the role of motivation in engaging that *online* cognitive control (Payne, 2005). Moreover, future research should explore the possibility that mentalizing skills mediate the link between internal motivation and implicit prejudice. On the other hand, our findings resemble to that of studies with adults that suggest better prejudice regulation when individuals are primarily internally motivated (Amodio et al., 2008; Devine et al., 2002). Regarding external motivation, it is likely that the mechanisms by which this kind of motivation can influence the expression of prejudice are not sufficiently developed in children. In other words, children may not have interiorized societal norms against prejudice expression, and accordingly external motivation has much less potential influence on their behavior. In this regard, Amodio et al. (2006) found that adults who are externally motivated to regulate prejudice exert control over prejudiced responses as long as they are sensitive to anti-prejudice norms and their prejudice was assessed in public. By extrapolating this finding to children, it is then likely that children's acknowledgment of anti-prejudice societal norms and public accountability of prejudiced responses are needed for externally motivated children to engage cognitive control for prejudice regulation.

6.2 Is there a significant relation between executive function and theory of mind in early and middle childhood?

Results from correlational analyses on individual differences in the first cross-sectional study replicated the link between EF and ToM. Exploratory separated by age group analyses showed that the relation between EF and ToM was weaker in both age groups. Thus, our results suggest that the link between individual differences in EF and ToM is observable in childhood. The cross-sectional and correlational nature of our study does not let draw conclusions on which theoretical framework (i.e., whether the emergence or the expression account) could best explain the data. Conceivably, this issue would be best addressed by longitudinal studies (e.g., Lecce et al., 2017).

6.3 Do cognitive skills and prejudice present developmental changes from early to late childhood?

In accordance with our results from the two cross-sectional studies, EF, ToM and prejudice present age-related changes. Regarding EF, findings from the first cross-sectional study showed that EFs improve from early to middle childhood; specifically, between early and middle childhood children became more efficient in inhibitory control (i.e., they take less time to accurately respond and resolve the conflict elicited by spatial incompatibility) and increased their working memory span. The second cross-sectional study showed accuracy improvements in inhibitory control and cognitive flexibility between early and middle childhood, but no further improvement in late childhood. All in all, results are in line with previous research reporting that EF development is protracted and continues beyond early childhood (e.g., see Best & Miller for a revision of EF development). However, and in contrast with previous research using a version of the Dots task (Davidson et al., 2006), we did not find EF fostering in late childhood for neither accuracy nor efficiency. As argued in the Discussion sections of both studies, methodological differences, like the allowed response time, may have influenced the task sensitivity to capture individual differences especially in efficiency in middle and late childhood. Moreover, and as argued by Davidson et al. (2006), it is possible that as children grow they tend to show an adult-like response pattern characterized by an accuracy-speed tradeoff that entails to slow down in order to preserve accuracy. Conceivably, this behavioral pattern may have diminished age-related differences in accuracy and response speed between middle and late childhood.

Results concerning ToM showed that emotion understanding and performance in Strange Stories improve between early and middle childhood, and that second-order affective ToM continues to develop until late childhood. Whereas our results on development of emotion understanding are in line with evidence showing that by the end of middle childhood children reach advanced understanding of emotions (Pons et al., 2004), we could expect that, in line with results of Devine and Hughes (2013), performance in the Strange Stories task would improve between middle and late childhood. What our results indicated is that third-graders and sixth-graders have quite a similar performance in the Strange Stories task, and that both age groups are still far from ceiling performance (specifically, third-graders and sixth-graders had mean scores of 61.11 and 69.17 percent of correct answers respectively). Similarly, results regarding affective ToM showed that sixth-graders performed significantly better than the other age groups, but were still far from ceiling performance (concretely, sixth-graders had a mean score of 66.25 percent of accuracy). These findings suggest that further improvement of individuals' ability to comprehend complex mental states should be expected beyond childhood, as it is shown, for instance, in studies addressing the development of advanced aspects of affective ToM across adolescence and beyond (e.g., Sebastian et al., 2012; Vetter et al., 2013).

With regard to age-related changes in prejudice, our results show the presumed delayed developmental trajectory. In the first cross-sectional study, no age-related decline in explicit prejudice was found between early and middle childhood. Results from the second cross-sectional study provided evidence that explicit prejudice decline is not observed until late childhood, and thus it takes place slightly later than reported in the meta-analytical revision of Raabe and Beelmann (2011). Our results are also in consonance with that of Enesco et al. (2005), who reported that by sixth grade children reduce the level of agreement with stereotypes held by society about the Romany out-group. Analyses on developmental changes in implicit prejudice consisted in checking whether the player's ethnicity influenced in different ways the trust movements made by each age group along the Trust game. Results revealed that third-grade children showed punishment-based prejudice (i.e., they significantly punished more the out-group than the in-group when they played first with the out-group and then with the in-group).

This punishment pattern based on ethnicity was not observed in the other age groups, and no other ethnicity-related effects were modulated by age. Thus far, we count on limited evidence about developmental changes in implicit prejudice suggesting that it emerges at about 2-4 years of age, increases until 5-7 years of age, and does not decrease until late adolescence (Raabe & Beelman, 2011). This developmental trajectory is documented on the basis of findings from studies that account for implicit automatic associations instead of the possible influence of implicit attitudes on overt behavior, like our measure intends to. Altogether, our data do not let draw conclusions about the developmental trajectory of implicit prejudice, as overall participants from all age groups modulated trust in greater extent in accordance to other factors than player's ethnicity. Even although third-grade children's implicit prejudice likely underpins their punishment behavior, other factors distinct to the player's ethnicity (like their mentalizing skills; Evans et al., 2013) have modulated their initial (dis)trust and forgiveness behaviors.

6.4 Are electrophysiological brain activity and behavioral performance modulated by the combination of executive function demands?

In order to address this question, we investigated electrophysiological brain activity underlying task-set maintenance and adjustment demands in a version of the Dots task (Davidson et al., 2006) administered to third-grade children. We specifically measured activity in N2 and P3 ERPs as indices of the involvement of inhibition and flexibility skills, and also accounted for behavioral performance.

Furthermore, we analyzed the associations between electrophysiological and behavioral indices of cognitive control.

As we predicted, we found that the combined cognitive control demands on diverse EF components underpinned modulation of brain activity and behavioral performance. Concerning behavioral performance, we replicated the spatial compatibility effect or Simon effect (Craft & Simon, 1970) for reaction time, as participants were slower in incongruent (i.e., spatial incompatible) than congruent (i.e., spatial compatible) trials. We also replicated the switching effect for accuracy and reaction time previously reported in literature (e.g., Davidson et al., 2006; Duan & Shi, 2014; Hung et al., 2016), that entails impaired performance in mixed versus simple blocks (i.e., the global switching cost), and in switch versus repeat trials (i.e., the local switching cost). As expected, the global context of the mixed block that combined conflict monitoring / inhibitory control and cognitive flexibility demands influenced performance. Specifically, the Simon effect disappeared within the mixed block for reaction time (i.e., participants were not slower in incongruent than congruent trials), what means that the global context of the mixed block posed difficulty even in the spatial compatible, congruent trials, and more time was needed to accurately perform (Davidson et al., 2006). Contrary to expected, and opposite to results of Davidson et al. (2006), the Simon effect for accuracy was reversed (i.e., participants committed more errors in congruent than incongruent trials) within the mixed block. Plausibly, the recurrent task-set adjustment demands of the mixed block imply that inhibition is required to perform both congruent and incongruent trials. Moreover, switching from congruent to incongruent trial is arguably less difficult than switching from incongruent to congruent trial, as whereas the former just requires to inhibit the prepotent response, the later demands to undo the inhibition of the prepotent response (Allport & Wylie, 2000; Allport et al., 1994). Furthermore, it is also possible that in the global context of the mixed block, task-set adjustment demands simultaneously prepare children to inhibit automatic responses in spatial incompatible trials and involve a cost in performance of spatial-compatible trials.

Electrophysiological activity was modulated by tasks demands as well. Greater N2 and P3 mean amplitudes (i.e., more negative N2 and more positive P3) were found in incongruent than congruent trials, in mixed than simple blocks, and in switch than repeat trials in the mixed block. In regard of the congruency effect (i.e., the spatial compatibility effect or Simon effect), whereas N2 amplitude indexes its conflict monitoring role in the detection of the conflict elicited by the spatial incompatibility of the target and the response (e.g., Abundis-Gutiérrez et al., 2014; Melara et al., 2008), P3 amplitude inform allocation of cognitive resources for response inhibition (Bruin et al., 2001; Brydges et al., 2014; Gajewski & Falkenstein, 2013; Jonkman et al., 2007b; Wessel, 2018). Concerning switching effects (i.e., more negative N2 and more positive P3 amplitudes in mixed versus simple blocks and in switch versus repeat trials), enlarged amplitudes presumably index the recruitment of cognitive resources to successfully accomplish the varied EF demands posed by the mixed block and switch trials on conflict monitoring, inhibitory control and response selection. The effect of the global context of the mixed block also implied that whereas the congruency effect was still observed for N2 amplitude (i.e., incongruent trials elicited more negative N2 amplitudes than congruent trials), there was no congruency-related effect in P3 amplitude, as P3 amplitude in congruent trials was similar to that of incongruent trials. These findings suggest that the degree of conflict elicited by a single trial does not depend on the global context, and thus incongruent trials elicit greater conflict than congruent trials irrespectively of whether trials are embedded in a single-rule or in a rule-switching context. Conceivably, whereas a global switching context does not undermine cognitive control function of conflict monitoring and detection indexed by N2 activity, the recurrent switching demands seemingly overload response inhibition and selection processes indexed by P3 activity. In terms of the cognitive control networks subserving behavioral regulation proposed by Dosenbach et al. (2008), and by gathering electrophysiological and behavioral evidence, it is likely that the greater activity in the network linked to conflict monitoring and detection (i.e., the cingulo-opercular network) in incongruent than congruent trials within the mixed block would facilitate participants' better performance in incongruent than congruent trials. In other words, activity in the network linked to conflict monitoring and detection mechanisms would entail the subsequent engagement of the fronto-parietal network, responsible for task-set adjustment.

Concerning the link between brain activity and behavioral performance, results confirmed our prediction, as increased (i.e., more negative N2 and more positive P3) amplitudes correlated with better performance in terms of accuracy. Moreover, results suggested that increased amplitudes were associated to an adult-like response pattern previously reported (e.g., Davidson et al., 2006) characterized by maximizing accuracy by taking advantage of the allowed response time.

6.5 Is there a relation between indices of electrophysiological brain activity and behavioral performance linked to cognitive control and implicit prejudice regulation?

In order to answer this question we correlated third-graders' performance at neural and behavioral levels in the Dots task (Davidson et al., 2006) with trust patterns in the implicit prejudice measure based on the Trust game. Concerning behavioral performance, analyses presumably yielded that cognitive control associated with characteristic trust patterns. Specifically, those children that took more time to accurately respond in the most difficult task conditions (i.e., in the simple incongruent block and in the mixed block) showed a trust pattern characterized by more initial distrust and posterior less forgiveness-based prejudice. Arguably, this trust pattern might inform about individual differences in children's cognitive control and their effort to engage cognitive control in both the Dots task and the Trust game. As a possibility, less efficient children require more time and more cognitive effort to successfully adjust behavior. By adjusting the level of significance in correlational analyses, what the results most clearly showed was that children's ability to deal with the spatial conflict links to implicit prejudice indexed by how much trust is initially placed in the out-group.

Results on electrophysiological indices were mixed and suggested that the relation between trust-based implicit prejudice and cognitive control is complex. As expected, a more negative N2 amplitude linked to cognitive flexibility was associated with less implicit prejudice addressed by initial distrust and punishment-based trust patterns; however, the link was in the opposite to expected direction for the index of prejudice based on forgiveness. The expected findings suggest that implicit prejudice regulation lies in children's ability to process conflicting information and to engage subsequent behavioral adjustment, in line with evidence from previous research (Amodio et al., 2008; Bartholow et al., 2006). In regard of our unexpected results, we argue that it is likely that the initial distrust index is the one that best account for children's implicit prejudice, as other factors distinct to the player's ethnicity (like, for instance, the estimation of likelihood of gains and perspective-taking skills) are probably influencing participants' punishment and forgiveness patterns. We also obtained mixed findings concerning P3 amplitude, as whereas more positive P3 amplitude in conflict resolution associated with higher initial prejudice, more positive P3 amplitude in switching was negatively correlated with punishment-based prejudice. Suggestively, there is the possibility that P3 amplitude is a marker of distinct cognitive operations. For instance, when it is required to resolve a congruency-related conflict, greater P3 may be informing about the increased difficulty to inhibit the prepotent response in incongruent trials (Groom & Cragg, 2015). In contrast, greater P3 amplitude in a rule-switching context may signal updating and allocation of resources that results in better performance (Kieffaber & Hetrick, 2005; Scisco et al., 2008). Altogether, our results provide preliminary evidence on the role of cognitive control in children's prejudice regulation and suggest that individual differences in neural activity linked to cognitive control skills may play a role in control of implicit prejudice.

6.6 Can prejudiced attitudes be reduced by fostering children's cognitive skills underpinning prejudice's regulation?

We addressed this question by administering EF and ToM training to third-grade children and by analyzing their effects on children's explicit and implicit attitudes toward Romany peers. Moreover we investigated whether the effect of training was modulated by children's motivations to control prejudice.

Results revealed that children trained in EFs and that presented less internal motivation to control prejudice were the ones that showed post-training decline in explicit prejudice. Conceivably, the EF training may have been less effective among highly internally motivated children because they already present low prejudice and / or they already unfolded prejudice regulation before the training, as previous studies inform that internally motivated adults are better at prejudice regulation (Amodio et al., 2008; Devine et al., 1991, 2002; Plant & Devine, 1998, 2009). Accordingly, it is likely that the training is more effective among children that present less motivation and certain level of explicit prejudice. We found a non-significant effect of training on implicit prejudice that could be due to the nature of our implicit prejudice task. Concretely, our Trust game did not address children's stereotypic associations, and accordingly it is possible that children may have not detected the need to engage cognitive control mechanisms to regulate prejudice. In other words, there is the possibility that our procedure did not elicit automatic biases to the extent that implicit association tasks do, and then it is more improbable that training-related EF gains can account for decline in implicit prejudice measured by trust patterns.

With respect to ToM training, results yielded that the decline of explicit prejudice was evident in children presenting less external motivation to control prejudice. In accordance with previous evidence about how the concern about appearing as prejudiced to other people modulates the link between ToM and explicit prejudice (Fitzroy & Rutland, 2010), it is possible that the impact of ToM training is more evident among those children that express low concern about the impression they cause on others and that tend to overtly express their attitudes irrespectively of whether other people would be informed about them or not. Finally, analyses showed that children in both ToM training and control groups forgave the out-group member in greater extent after the intervention, although in the case of the control group this effect was modulated by motivation. Thus, whereas children trained in ToM skills increased out-group forgiveness independently of their motivations, children in the control group showed that increase in the extent to which they were concerned about appearing as prejudiced and thus tended to conceal their attitudes. Investigation in adults reports that the recovery of trust informs prejudice decline (e.g., Hewstone et al., 2006). Arguably, in the extent to which empathy contributes to ToM (Shamay-Tsoory et al., 2009, 2010), it is possible that trained children also increase the tendency to experiment empathic concern. Consequently, increased forgiveness might also result from greater empathic concern about the trustee's gains.

6.7 Does cognitive training present near and far transfer effects to cognitive skills?

In order to answer this research question we measured training effects on EF, ToM and intelligence. Results concerning EF training did not confirm our hypotheses on near transfer to EF and far transfer to fluid intelligence, but showed transfer to ToM. Arguably, the lack of near transfer may be explained by the distance between the training and the assessment tasks (Simons et al., 2016). In our study, whereas we used

Stroop-like and Go – NoGo tasks during the training, EF fostering was assessed with a Simon-like, spatial conflict task. Thus, the distance between task modalities may difficult to find transfer even though the targeted EF processes are the same. Other factor that may have attenuated the effect of training is that we used an active control group that practiced less difficult versions of the training games; accordingly, children in the control group may have obtained some benefit as well (in line with Diamond and Ling, 2019). Also, the intervention may have not been large enough to produce observable changes at the behavioral level (e.g., see Pozuelos et al., 2019).

Contrary to our prediction, EF training did not foster children's fluid intelligence. Several factors may explain this null finding. In their revision, Diamond and Ling (2019) informed, for instance, about limited transfer to fluid intelligence from working memory training. Although some evidence shows transfer to fluid intelligence in middle childhood (Jaeggi et al., 2011;) and in older children and adults as well (Karbach & Kray, 2009), most of studies reporting transfer from EF training to fluid intelligence have focused on the preschool-age period (e.g., Bergman-Nutley et al., 2011; Neville et al., 2013; Peng et al., 2017; Pozuelos et al., 2019; Rueda et al., 2005). In this line, Wass et al. (2012) informed that the more widespread effects of training are observed the younger the participants. Moreover, our training lacked the metacognitive component that previous research reports is able to boost the effect of EF training on fluid intelligence (e.g., Pozuelos et al., 2019).

On the other hand, results yielded the expected transfer from EF training to ToM performance. Arguably, this result may be informing that EF enables ToM performance, and / or that the EF improvement contributes to the development of ToM skills. Although our results do not let draw conclusions on whether it is the emergence or the expression framework the one that could best explain this transfer effect, in the extent to which improvement occurred in the Strange Stories task that require to infer contextually-appropriated mental states, and not in the second-order false belief task were evident demands of inhibition and working memory are placed, it is likely that EF contributes to the acquisition of ToM and not only to its expression.

In regard of near and far transfer effects of ToM training, we observed the predicted transfer to ToM; however, in line with the claim of Simons et al. (2016) posing that transfer is restricted by the degree of similarity between tasks, the improvement was observed in the ToM skills directly addressed by the training (i.e., emotion understanding and the ability to make contextualized mental state inferences) and not in the ability to make second-order mental states inferences. In sum, our findings replicated the already-documented effectiveness of ToM training at improving ToM (Hoffman et al., 2016). Concerning far transfer, results confirmed that ToM training had no impact on intelligence. Furthermore, results suggested that trained children tended to improve accuracy in conflict resolution skills. Presumably, the training fosters in certain extent children’s inhibitory control skills, as children are encouraged to inhibit their knowledge when understanding false beliefs and to take the characters’ perspectives. Thus, it is likely that the training of skills that draw on EFs may also improve them.

6.8 Conclusions and future directions

All in all, results from the studies carried out in the present dissertation demonstrated that individual differences along childhood in cognitive skills predict children's explicit and implicit attitudes. Moreover, preliminary evidence hinted that the relative contribution of different cognitive skills to prejudice may change along the development. We also provided evidence on development of explicit attitudes along childhood; concretely, results showed that explicit prejudice decline is not observed until late childhood. Our investigation also informed about brain and behavioral cognitive control dynamics indexing performance under varied EF demands in middle childhood. The present work also provided with preliminary evidence suggesting that in middle childhood there is a link between children's individual differences in cognitive control measured at brain and behavioral levels and their ability to regulate implicit prejudice. Finally, findings from the training study provided initial empirical support to the idea that it is possible to improve children's attitudes and / or the ability to regulate their attitudes by fostering their cognitive skills. Moreover, results showed that the effect of training was in general modulated by children's internal and external sources of motivation to control prejudice.

Arguably, our research findings are mainly based on correlational analyses on individual differences. With the aim to extend our findings, future research should test the link between cognitive skills and prejudice by including experimental manipulations that are more similar to that implemented in studies with adult populations. One instance would be to assess the impact of cognitive resources depletion on children's ability to regulate prejudice, in a similar vein to studies conducted by Richeson et al. (2005) and Trawalter and Richeson (2005). Another interesting line of research would entail the design of procedures to replicate findings from research with adults that assess the *online* use of cognitive control of implicit bias and accounts for the factors that influence the success to implement such *online* regulation (e.g., Amodio et al., 2002, 2004, 2008; Devine et al., 2002; Payne, 2005). On the other hand, our results are based on cross-sectional research. Arguably, longitudinal studies would contribute to shed light on the within-individual stability or change of prejudiced attitudes along childhood, as well as on whether earlier cognitive skills can predict children's attitudes in posterior developmental stages.

Finally, we observed a prejudice decline after the intervention, but our design does not let elucidate the extent to which that decline is due to children's better ability to conceal their prejudiced attitudes or to a *real* change in children's attitudes. The question is: Does training help children to learn to control the expression of prejudice, or does it improve children's attitudes by, for instance, fostering their ability to engage in flexible and counter-stereotypical social categorization processes? In order to address this fundamental question, future intervention designs should include the necessary manipulations to check whether training results in an change in prejudiced attitudes and / or in a better regulation ability that extrapolates to the control of prejudice expression.

Chapter 7.

Resumen en español

El objetivo principal de la presente tesis doctoral fue el de analizar la relación entre las diferencias individuales en una serie de habilidades cognitivas y el prejuicio manifestado tanto a nivel explícito como implícito a lo largo de la infancia. En concreto, nos centramos en las etapas evolutivas de infancia temprana (entre 5 y 6 años), media (entre 8 y 9 años) y tardía (entre 11 y 12 años). Además, exploramos si la relación entre habilidades cognitivas y el prejuicio varía en función al estadio evolutivo en que se encuentra el/la niño/a. También se pretendió aunar evidencia para dar respuesta a las siguientes preguntas de investigación:

¿Existe una relación significativa entre la función ejecutiva y la teoría de la mente en las infancias temprana y media?

¿Ocurren cambios evolutivos a lo largo de la infancia en las habilidades cognitivas y el prejuicio?

¿El desempeño conductual y la actividad electroencefalográfica están modulados por la combinación de demandas en diversos procesos de función ejecutiva?

¿Existe relación entre los índices de actividad cerebral electrofisiológica y de desempeño conductual ligados al control cognitivo y la regulación del prejuicio implícito?

¿La mejora de las habilidades cognitivas que se relacionan con la regulación del prejuicio reduce las actitudes prejuiciosas de los/as niños/as?

¿El entrenamiento cognitivo mejora las habilidades entrenadas y las no entrenadas pero relacionadas?

Brown (2010) definió el prejuicio como una actitud negativa que la gente mantiene hacia miembros de un exogrupo. Las actitudes negativas se pueden expresar de forma explícita o de forma sutil o implícita (p. ej., Conner et al., 2007). En el presente trabajo, las habilidades cognitivas que se estudiaron en relación al prejuicio son las funciones ejecutivas y la teoría de la mente. Además, se exploró el rol de la motivación para controlar el prejuicio.

El concepto de funciones ejecutivas alude a un conjunto de habilidades cognitivas que fundamentan la autorregulación de los individuos (Rueda et al., 2011). Se abordó el estudio de las habilidades de control inhibitorio, flexibilidad cognitiva y memoria de trabajo tradicionalmente englobadas bajo el concepto de función ejecutiva (Miyake et al., 2000; véase Friedman & Miyake, 2017, y Miyake & Friedman, 2012, para una reciente reconceptualización del modelo). El control inhibitorio ayuda a la supresión de respuestas automáticas pero inapropiadas; la flexibilidad cognitiva facilita el ajuste del comportamiento a las demandas cambiantes del ambiente; y la memoria de trabajo permite el mantenimiento, manipulación y actualización de los contenidos en memoria. El desempeño en funciones ejecutivas puede ser entendido no sólo analizando la ejecución comportamental, sino también observando la actividad eléctrica del cerebro mientras se llevan a cabo tareas que requieren, por ejemplo, inhibir respuestas automáticas y elegir flexiblemente la regla de respuesta adecuada. Con este fin, se ha recurrido al análisis de componentes de actividad eléctrica llamados potenciales evocados (Luck, 2014), tales como los componentes N2 y P3. El componente N2 es una deflagración negativa que aparece aproximadamente entre los 200 y los 400 milisegundos tras un estímulo (Abundis et al., 2014; Lamm et al., 2006) y que está ligada a las habilidades de monitorización del conflicto y supresión / control de la interferencia (p.ej., Donkers & Van Boxtel, 2004; Espinet et al., 2012; Jonkman et al., 2007b). El componente P3 implica una activación de polaridad positiva que aparece aproximadamente a los 300 – 500 milisegundos tras un estímulo (Bruin & Wijers, 2002; Pfefferbaum et al., 1985). La amplitud del componente P3 ha sido relacionada con la inhibición de respuesta (p. ej., Bruin et al., 2001; Brydges et al., 2014; Wessel, 2018), la flexibilidad en el cambio de set de tarea (p. ej., Duan & Shi, 2014; Hung et al., 2016) y la actualización y ajuste comportamental (Dai et al., 2013; Donchin & Coles, 1988). La actividad en N2 y P3 constituye un índice de la implicación de redes cerebrales involucradas en la monitorización y detección del conflicto, así como en el mantenimiento y en el reajuste del set de tarea (redes cíngulo-opercular y fronto-parietal; Dosenbach et al., 2008).

Por otro lado, la teoría de la mente consiste en la habilidad para comprender los pensamientos y sentimientos propios y ajenos, y por tanto para atribuir estados mentales (Premack & Woodruff, 1978). La investigación empírica ha mostrado la necesidad de diferenciar entre estados mentales de tipo cognitivo y de tipo afectivo (p. ej., Miller, 2013; Sebastian et al., 2012). De acuerdo con el modelo propuesto por Shamay-Tsoory et al. (2010), los estados mentales pueden versar sobre emociones (teoría de la mente afectiva) o sobre creencias (teoría de la mente cognitiva). Además, para realizar inferencias sobre estados mentales de tipo afectivo es necesario entender primero que las emociones se basan en creencias (Miller, 2013; Shamay-Tsoory et al., 2010).

La evidencia científica informa que es posible mejorar las habilidades de función ejecutiva y de teoría de la mente a través de la práctica estructurada, intensa y repetitiva (p.ej., Olesen et al., 2004). De acuerdo con Simons et al. (2016), además de impactar directamente sobre las funciones cognitivas entrenadas (transferencia cercana), el entrenamiento puede producir mejoras en otras habilidades relacionadas y / o en la ejecución en tareas que se basan en los mismos procesos cognitivos (Morrison & Chein, 2011; Dahlin, 2013). Con respecto al entrenamiento en funciones ejecutivas, la literatura informa de transferencias cercana y lejana a funciones ejecutivas no entrenadas y a dominios relacionados como la inteligencia fluida, el razonamiento y el logro académico (p. ej., Blair & Raver, 2014; Blakey & Carroll, 2015; Pozuelos et al., 2019). En cuanto al entrenamiento en teoría de la mente, se ha demostrado su eficacia para mejorar las habilidades de mentalización a lo largo de la infancia (Hofmann et al., 2016). Hasta el momento, existe cierta evidencia sobre la transferencia a habilidades de teoría de la mente no entrenadas (Bianco et al., 2016) y a la competencia social (Ding et al., 2015). Además, en etapa preescolar se ha encontrado transferencia recíproca entre función ejecutiva y teoría de la mente, de manera que la mejora de la función ejecutiva impacta sobre la teoría de la mente y viceversa (Kloo & Perner, 2003).

En relación a la motivación para controlar el prejuicio, las investigaciones realizadas en adultos sugieren que mientras que alguna gente no quiere ser prejuiciosa dado que lo considera como indeseable y realiza un esfuerzo activo para internalizar los valores y creencias en contra del prejuicio, otras personas orientan sus esfuerzos a esconder sus actitudes y ofrecer una impresión acorde con los valores y normas que propugnan la igualdad y no discriminación (p. ej., Devine; 1989). La evidencia muestra que la motivación influye sobre la expresión del prejuicio explícito e implícito. Por ejemplo, Fazio et al. (1995)

encontraron una correlación positiva entre las expresiones explícita e implícita del prejuicio en aquellas personas que muestran una baja motivación para controlar el prejuicio, pero que, en cambio, la motivación no modula el prejuicio en el caso de las personas que expresan poco prejuicio implícito. Más recientemente, Devine et al. (2002) informaron que la expresión del prejuicio es menor en las personas internamente motivadas que en aquellas personas externamente motivadas o que presentan simultáneamente fuentes de motivación internas y externas.

Para dar respuesta a las preguntas de investigación planteadas, y partiendo desde el marco conceptual presentado, se llevaron a cabo una serie de estudios. El primero consistió en un estudio transversal donde participaron niños y niñas de 5 a 6 (n = 43) y de 8 a 9 (n = 43) años. Examinamos la relación entre diferencias individuales en prejuicio explícito hacia el grupo étnico gitano, función ejecutiva y teoría de la mente cognitiva y afectiva. Otros objetivos fueron: comprobar los efectos experimentales de la tarea Dots (Davidson et al., 2006); examinar la relación entre función ejecutiva y teoría de la mente; analizar los cambios evolutivos en función ejecutiva, teoría de la mente y prejuicio; y explorar si la relación entre habilidades cognitivas y el prejuicio explícito está condicionada por el estadio evolutivo. En el segundo estudio, también de tipo transversal, participaron 193 niños y niñas. Para ampliar los resultados del primer estudio, incluimos un grupo de niños y niñas de entre 11 y 12 años, y medimos tanto el prejuicio explícito como implícito, así como las fuentes de motivación interna y externa para controlar el prejuicio. Junto con los objetivos del primer estudio, examinamos los patrones de confianza expresados por los/as participantes en un juego de la confianza diseñado para medir el prejuicio implícito, así como el rol de la motivación en la regulación del prejuicio. Llevamos a cabo un tercer estudio con el objetivo de examinar si, en la infancia media, la actividad electrofisiológica del cerebro está modulada por las demandas planteadas sobre varios procesos cognitivos. Para ello, analizamos la actividad electrofisiológica cerebral en los componentes N2 y P3 en relación a las demandas de monitorización y resolución del conflicto (ligadas al control inhibitorio) y de ajuste del set de tarea (ligadas a la flexibilidad cognitiva) planteadas por una tarea de conflicto espacial (tarea Dots; Davidson et al., 2006). Además de la modulación de la actividad eléctrica cerebral, examinamos la ejecución (es decir, precisión y tiempo de reacción), y las relaciones entre los índices electrofisiológicos y comportamentales. En un cuarto estudio, tuvimos el objetivo de ampliar la evidencia existente sobre el rol que los mecanismos de control cognitivo desempeñan en la regulación del prejuicio infantil. Para cumplir tal objetivo se estudió la muestra reportada en el tercer estudio. Estábamos interesadas en proporcionar evidencia preliminar sobre la relación entre la actividad cerebral ligada al control cognitivo y la regulación del prejuicio implícito. Finalmente, llevamos a cabo un quinto estudio donde implementamos una doble intervención con el objeto de examinar sus efectos sobre las habilidades entrenadas (transferencia cercana) y sobre habilidades no entrenadas pero relacionadas (transferencia lejana) de niños y niñas de entre 8 y 9 años. Un total de 93 participantes fueron distribuidos entre dos modalidades de intervención y dos modalidades de control activo: entrenamiento en funciones ejecutivas (n = 25); control en funciones ejecutivas (n = 24); entrenamiento en teoría de la mente (n = 22); y control en teoría de la mente (n = 22). Analizamos los efectos de transferencia cercana del entrenamiento de funciones ejecutivas y del entrenamiento en teoría de la mente, de transferencia entre función ejecutiva y teoría de la mente, y de transferencia lejana a inteligencia fluida y a la regulación del prejuicio.

En conexión con las preguntas de investigación planteadas, los resultados obtenidos a lo largo de los cinco estudios mostraron lo siguiente:

1- Las habilidades cognitivas de función ejecutiva y teoría de la mente, así como la motivación interna, juegan un papel evidente en la regulación del prejuicio tanto de tipo explícito como implícito y a nivel de diferencias individuales a lo largo de la infancia. Sin embargo, los resultados no apoyan claramente que unas habilidades cognitivas u otras tengan más importancia en la regulación del prejuicio dependiendo del estadio evolutivo en el que se encuentre el/la niño/a.

2- Existe una correlación significativa entre función ejecutiva y teoría de la mente en las infancias temprana y media.

3- La mejora en el desempeño en tareas de función ejecutiva y de teoría de la mente se observa especialmente entre las infancias temprana y media, aunque la comprensión de estados mentales de tipo afectivo continúa desarrollándose hasta la infancia tardía. Mientras que el descenso evolutivo del prejuicio explícito no es evidente hasta la infancia tardía, no hay una trayectoria evolutiva clara en el caso del prejuicio implícito.

4- Tanto el desempeño comportamental como la actividad en los componentes N2 y P3 están modulados por las demandas de control inhibitorio y flexibilidad cognitiva planteadas por una tarea de conflicto espacial. Los datos sugieren que en la condición más demandante de la tarea (es decir, en la que requiere simultáneamente de los procesos de inhibición y selección de respuesta) hay una mayor necesidad de contar con recursos cognitivos y el sistema de inhibición y selección de respuesta encargado de ajustar el set de tarea se sobrecarga (es decir, se ve afectada la función de la red fronto-parietal del modelo de Dosenbach et al., 2008, tal como indica la amplitud media en P3). Además, cuando el mecanismo de monitorización del conflicto (informado por la amplitud media del N2) señala la necesidad de ajuste comportamental, el desempeño es mejor en ensayos de conflicto espacial (incongruentes) que en ensayos de no conflicto (congruentes). Los resultados confirmaron la predicción de que amplitudes medias incrementadas se relacionarían con un mejor desempeño y sugieren que una mayor amplitud media en los componentes N2 y P3 se asocia a un patrón de respuesta caracterizado por un ajuste entre el tiempo de respuesta y la precisión.

5- Nuestros hallazgos sugieren una relación entre la ejecución en la tarea Dots y los patrones de confianza en la medida de prejuicio implícito. En concreto, se encontró que los niños que decrecen la velocidad de respuesta para ejecutar correctamente la tarea presentan un patrón caracterizado por una mayor desconfianza inicial y un menor prejuicio posterior (en base al perdón al exogrupo). En cuanto a los componentes N2 y P3, los resultados muestran que la monitorización del desempeño y de la necesidad de ajuste comportamental se relaciona con un menor prejuicio basado en la desconfianza inicial y en el castigo al exogrupo, pero con mayor prejuicio basado en el perdón al exogrupo. Por último, los datos sugieren que una mayor amplitud media del P3 podría estar informando de una mayor dificultad para inhibir el prejuicio inicial y de una mayor flexibilidad en la regulación del prejuicio basado en el castigo.

6- Con respecto a la transferencia observada al prejuicio desde el entrenamiento de las funciones ejecutivas, los resultados mostraron que los/as participantes con una menor motivación interna para controlar el prejuicio eran los que mejoraban en el control del prejuicio explícito. No se observó transferencia al prejuicio implícito. En cuanto al entrenamiento en teoría de la mente, se encontró que la reducción del prejuicio explícito fue mayor para aquellos/as participantes que presentaban una menor motivación externa para controlar el prejuicio. Además, aunque observamos que tanto el grupo entrenado como el grupo control incrementaban su perdón al exogrupo tras el entrenamiento, este efecto estuvo modulado en el caso del grupo control por la motivación externa, de manera que el incremento en perdón era mayor cuanto más externamente motivados/as para controlar el prejuicio estaban los/as participantes del grupo control.

7- Al examinar los efectos del entrenamiento en funciones ejecutivas, encontramos que no hubo la esperada transferencia cercana del entrenamiento al control inhibitorio ni a la flexibilidad cognitiva, así como tampoco hubo transferencia lejana a la inteligencia fluida. En cambio, sí hubo transferencia a la teoría de la mente. El entrenamiento en teoría de la mente mejoró el desempeño en aquellas tareas de evaluación más directamente relacionadas con las usadas en el entrenamiento. Además, se encontró un efecto marginalmente significativo de mejora en control inhibitorio.

References

References

Aboud, F. E. (1988). *Children and prejudice* (1st ed.) New York: Blackwell.

Aboud, F. E. (2008). A social-cognitive developmental theory of prejudice. In S. M. Quintana & C. McKown (Eds.), *Handbook of race, racism, and the developing child* (pp. 55–71). doi: 10.1002/9781118269930.ch4

Aboud, F. E. (2013). What are they thinking? The mystery of young children's thoughts on race. In M. R. Banaji & S. A. Gelman (Eds.), *Navigating the social world: what infants, children and other species can teach us* (pp. 332–335). New York: Oxford University Press.

Abrams, D., Rutland, A., Pelletier, J., & Ferrell, J. M. (2009). Children's group nous: Understanding and applying peer exclusion within and between groups. *Child Development, 80*, 224–243. doi: 10.1111/j.1467-8624.2008.01256.x

Abundis-Gutiérrez, A., Checa, P., Castellanos, C., & Rosario Rueda, M. (2014). Electrophysiological correlates of attention networks in childhood and early adulthood. *Neuropsychologia*, *57*(1), 78–92. doi: 10.1016/j.neuropsychologia.2014.02.013

Al-Issa, I. (1997). The psychology of prejudice and discrimination. In I. Al-Issa & M. Tousignant (Eds.), *Ethnicity, immigration, and psychopathology*. New York: Plenum Press.

Allport, A., Styles, E., & Hsieh, S. (1994). Shifting intentional set: Exploring the dynamic control of tasks. In C. Umilta & M. Moscovitch (Eds.), *Attention and performance XV* (pp. 421–452). Cambridge: MIT Press.

Allport, A., & Wylie, G. (2000). Task switching, stimulus-response bindings, and negative priming. *Attention and performance, 18*, 33–70. doi: 10.7551/mitpress/1481.003.0008

Allport, G. W. (1954). *The nature of prejudice*. Reading, MA: Addison-Wesley.

Amodio, D. M. (2010). Coordinated roles of motivation and perception in the regulation of intergroup responses: Frontal cortical asymmetry effects on the P2 event-related potential and behavior. *Journal of Cognitive Neuroscience*, *22*(11), 2609–2617. doi: 10.1162/jocn.2009.21395

Amodio, D. M. (2014). The neuroscience of prejudice and stereotyping. *Nature Reviews Neuroscience, 15*(10), 670–682. doi: 10.1038/nrn3800

Amodio, D. M., Devine, P. G., & Harmon-Jones, E. (2008). Individual differences in the regulation of intergroup bias: The role of conflict monitoring and neural signals for control. *Journal of Personality and Social Psychology*, *94*, 60–74. doi: 10.1037/0022-3514.94.1.60

Amodio, D. M., Harmon-Jones, E., Devine, P. G., Curtin, J. J., Hartley, S. L., & Covert, A. E. (2004). Neural signals for the detection of unintentional race bias. *Psychological Science*, *15*(2), 88–93. doi: 10.1111/j.0963-7214.2004.01502003.x

Amodio, D. M., Kubota, J. T., Harmon-Jones, E., & Devine, P. G. (2006). Alternative mechanisms for regulating racial responses according to internal vs external cues. *Social Cognitive and Affective Neuroscience*, *1*(1), 26–36. doi: 10.1093/scan/nsl002

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child Neuropsychology*, *8*(2), 71–82. doi: 10.1076/chin.8.2.71.8724

Apperly, I. (2011). *Mindreaders: The Cognitive Basis of "theory of mind"*. London: Psychology Press

Apperly, I. A. (2012). What is "theory of mind"? Concepts, cognitive processes and individual differences. *Quarterly Journal of Experimental Psychology*, *65*(5), 825–839. doi: 10.1080/17470218.2012.676055

Apperly, I. A., Warren, F., Andrews, B. J., Grant, J., & Todd, S. (2011). Developmental continuity in theory of mind: Speed and accuracy of belief-desire reasoning in children and adults. *Child Development*, *82*(5), 1691–1703. doi: 10.1111/j.1467-8624.2011.01635.x

Arffa, S. (2007). The relationship of intelligence to executive function and non-executive function measures in a sample of average, above average, and gifted youth. *Archives of Clinical Neuropsychology*, *22*, 969–978. doi: 10.1016/j.acn.2007.08.001

Banaji, M. R., Baron, A. S., Dunham, Y., & Olson, K. (2008). The development of intergroup social cognition: Early emergence, implicit nature, and sensitivity to group status. In S. R. Levy & M. Killen (Eds.), *Intergroup attitudes and relations in childhood through adulthood* (pp. 197–238). doi: 10.4324/9781315805634

Baron, A. S., & Banaji, M. R. (2006). The development of implicit attitudes: Evidence of race evaluations from ages 6 and 10 and adulthood. *Psychological Science*, *17*(1), 53–58. doi: 10.1111/j.1467-9280.2005.01664.x

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a “theory of mind”? *Cognition*, *21*, 37–46. doi: 10.1016/0010-0277(85)90022-8

Baron-Cohen, S., O’Riordan, M., Stone, V., Jones, R., & Plaisted, K. (1999). Recognition of faux pas by normally developing children and children with asperger syndrome or high-functioning autism. *Journal of Autism and Developmental Disorders*, *29*(5), 407–418. doi: 10.1023/A:1023035012436

Baron-Cohen, S., Wheelwright, S., Spong, A., Scahill, V., & Lawson, J. (2001). Are intuitive physics and intuitive psychology independent? A test with children with Asperger Syndrome. *Learning*, *5*, 47–78. doi: 10.1111/j.1469-7610.2004.00232.x

Bartholow, B. D., Dickter, C. L., & Sestir, M. A. (2006). Stereotype activation and control of race bias: Cognitive control of inhibition and its impairment by alcohol. *Journal of Personality and Social Psychology*, *90*(2), 272–287. doi: 10.1037/0022-3514.90.2.272

Beaudoin, C., Leblanc, É., Gagner, C., & Beauchamp, M. H. (2020). Systematic Review and Inventory of Theory of Mind Measures for Young Children. *Frontiers in Psychology*, *10*, Article number 2905. doi: 10.3389/fpsyg.2019.02905

Beer, J. S., Stallen, M., Lombardo, M. V., Gonsalkorale, K., Cunningham, W. A., & Sherman, J. W. (2008). The Quadruple process model approach to examining the neural underpinnings of prejudice. *NeuroImage*, *43*, 775–783. doi: 10.1016/j.neuroimage.2008.08.033

Bell, M. A., Wolfe, C. D., & Adkins, D. R. (2007). Frontal lobe development during infancy and childhood. In D. J. Coch, K. W. Fischer, & G. Dawson (Eds.), *Human behavior, learning, and the develoing brain: Typical development* (pp. 247–276). New York: Guilford.Bell

Benson, J. E., Sabbagh, M. A., Carlson, S. M., & Zelazo, P. D. (2013). Individual differences in executive functioning predict preschoolers' improvement from theory-of-mind training. *Developmental Psychology*, *49*(9), 1615–1627. doi: 10.1037/a0031056

Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and Economic Behavior*, *10*, 122–142. doi: 10.1006/game.1995.1027

Bergman-Nutley, S., & Klingberg, T. (2014). Effect of working memory training on working memory, arithmetic and following instructions. Psychological Research, 78(6), 869–877. https://doi.org/10.1007/s00426-014-0614-0

Bergman Nutley, S., Söderqvist, S., Bryde, S., Thorell, L. B., Humphreys, K., & Klingberg, T. (2011). Gains in fluid intelligence after training non-verbal reasoning in 4-year-old children: A controlled, randomized study. *Developmental Science*, *14*(3), 591–601. https://doi.org/10.1111/j.1467-7687.2010.01022.x

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development*, *81*(6), 1641–1660. doi: 10.1111/j.1467-8624.2010.01499.x

Best, J. R., Miller, P. H., & Naglieri, J. A. (2011). Relations between executive function and academic achievement from ages 5 to 17 in a large, representative national sample. *Learning and Individual Differences*, *21*(4), 327–336. doi: 10.1016/j.lindif.2011.01.007

Bianco, F., & Lecce, S. (2016). Translating child development research into practice: Can teachers foster children's theory of mind in primary school? *British Journal of Educational Psychology*, *86*(4), 592–605. doi: 10.1111/bjep.12125

Bianco, F., Lecce, S., & Banerjee, R. (2016). Conversations about mental states and theory of mind development during middle childhood: A training study. *Journal of Experimental Child Psychology*, *149*, 41–61. doi: 10.1016/j.jecp.2015.11.006

Bigler, R. S., & Liben, L. S. (1993). A cognitive-developmental approach to racial stereotyping and reconstructive memory in Euro-American children. *Child Development*, *64*, 1507–1518. doi: 10.1111/j.1467-8624.1993.tb02967.x

Bigler, R. S., & Liben, L. S. (2007). Developmental intergroup theory: Explaining and reducing children's social stereotyping and prejudice. *Current Directions in Psychological Science*, *16*(3), 162–166. doi: 10.1111/j.1467-8721.2007.00496.x

Blair, C. (2016). Developmental science and executive function. *Current Directions in Psychological Science*, *25*(1), 3–7. doi: 10.1177/0963721415622634

Blair, C., & Raver, C. C. (2014). Closing the achievement gap through modification of neurocognitive and neuroendocrine function: Results from a cluster randomized controlled trial of an innovative approach to the education of children in kindergarten. *PLoS ONE*, *9*(11), e112393. doi: 10.1371/journal.pone.0112393

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*(2), 647–663. doi: 10.1111/j.1467-8624.2007.01019.x

Blakey, E., & Carroll, D. J. (2015). A short executive function training program improves preschoolers' working memory. *Frontiers in Psychology*, *6*, 1827. doi: 10.3389/fpsyg.2015.01827

Bledowski, C., Prvulovic, D., Hoechstetter, K., Scherg, M., Wibral, M., Goebel, R., & Linden, D. E. J. (2004). Localizing P300 generators in visual target and distractor processing: A combined event-related potential and functional magnetic resonance imaging study. *Journal of Neuroscience, 24*(42), 9353–9360. doi: 10.1523/JNEUROSCI.1897-04.2004

Bokura, H., Yamaguchi, S., & Kobayashi, S. (2001). Electrophysiological correlates for response inhibition in a Go/NoGo task. *Clinical Neurophysiology*, *112*(12), 2224–2232. doi: 10.1016/S1388-2457(01)00691-5

Botvinick, M. M., Carter, C. S., Braver, T. S., Barch, D. M., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review*, *108*(3), 624–652. doi: 10.1037/0033-295X.108.3.624

Botvinick, M. M., Cohen, J. D., & Carter, C. S. (2004). Conflict monitoring and anterior cingulate cortex: An update. *Trends in Cognitive Sciences*, *8*(12), 539–546. doi: 10.1016/j.tics.2004.10.003

Brewer, M. B. (1999). The psychology of prejudice: Ingroup love or outgroup hate? *Journal of Social Issues*, *55*(3), 429–444. doi: 10.1111/0022-4537.00126

Brocki, K. C., & Bohlin, G. (2004). Executive functions in children aged 6 to 13: A dimensional and developmental study. *Developmental Neuropsychology*, *26*(2), 571–593. doi: 10.1207/s15326942dn2602_3

Brown, R. (2010). *Prejudice: Its social psychology* (2nd ed.). Oxford: Wiley Blackwell.

Bruin, K. J., & Wijers, A. A. (2002). Inhibition, response mode, and stimulus probability: A comparative event-related potential study. *Clinical Neurophysiology*, *113*(7), 1172–1182. doi: 10.1016/S1388-2457(02)00141-4

Bruin, K. J., Wijers, A. A., & Van Staveren, A. S. J. (2001). Response priming in a go/nogo task: Do we have to explain the go/nogo N2 effect in terms of response activation instead of inhibition? *Clinical Neurophysiology*, *112*(9), 1660–1671. doi:10.1016/S1388-2457(01)00601-0

Brydges, C. R., Fox, A. M., Reid, C. L., & Anderson, M. (2014). Predictive validity of the N2 and P3 ERP components to executive functioning in children: A latent-variable analysis. *Frontiers in Human Neuroscience*, *8*(1), 80. doi: 10.3389/fnhum.2014.00080

Bull, R., Espy, K. A., & Senn, T. E. (2004). A comparison of performance on the towers of London and Hanoi in young children. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *45*(4), 743–754. doi: 10.1111/j.1469-7610.2004.00268.x

Buss, K. A., Dennis, T. A., Brooker, R. J., & Sippel, L. M. (2011). An ERP study of conflict monitoring in 4-8-year old children: Associations with temperament. *Developmental Cognitive Neuroscience*, *1*(2), 131–140. doi: 10.1016/j.dcn.2010.12.003

Buttelmann, F., & Karbach, J. (2017). Development and plasticity of cognitive flexibility in early and middle childhood. *Frontiers in Psychology*, *8*(JUN), 1040. doi: 10.3389/fpsyg.2017.01040

Callejas, C., Solbes, I., Dopico, C., & Escudero, A. (2011). Estudio de las actitudes interétnicas en la infancia a través de una medida implícita. *Anales de Psicologia*, *27*(3), 655–661.ISSN: 02129728

Capage, L., & Watson, A. C. (2001). Individual differences in theory of mind, aggressive behavior, and social skills in young children. *Early Education and Development*, *12*(4), 613–628. https://doi.org/10.1207/s15566935eed1204_7

Carbonero Martín, M. Á., Manzanares, M. C. S., & Sánchez, J. M. R. (2013). Efecto de un programa de entrenamiento metacognitivo en habilidades mentalistas. *Psicothema*, *25*(1), 31–37. doi: 10.7334/psicothema2011.192

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, *28*(2), 595–616. doi: 10.1207/s15326942dn2802_3

Carlson, S. M., Claxton, L. J., & Moses, L. J. (2015). The relation between executive function and theory of mind is more than skin deep. *Journal of Cognition and Development*, *16*(1), 186–197. doi: 10.1080/15248372.2013.824883

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, *72*(4), 1032–1053. doi: 10.1111/1467-8624.00333

Carter, C. S., & Van Veen, V. (2007). Anterior cingulate cortex and conflict detection: An update of theory and data. *Cognitive, Affective and Behavioral Neuroscience*, *7*(4), 367–379. doi: 10.3758/CABN.7.4.367

Carver, C. S., & Scheier, M. F. (2000). Autonomy and self-regulation. *Psychological Inquiry*, *11*(4), 284–291.

Casey, B. J., Trainor, R. J., Orendi, J. L., Schubert, A. B., Nystrom, L. E., Giedd, J. N., … Rapoport, J. L. (1997). A developmental functional MRI study of prefrontal activation during performance of a go-no-go task. *Journal of Cognitive Neuroscience*, *9*(6), 835–847. doi: 10.1162/jocn.1997.9.6.835

Castelfranchi, C., & Falcone, R. (2000). Trust is much more than subjective probability: Mental components and sources of trust. *Proceedings of the Hawaii International Conference on System Sciences*, p. 132. doi: 10.1109/hicss.2000.926815

Cepeda, N. J., Kramer, A. F., & Gonzalez de Sather, J. C. (2001). Changes in executive control across the life span: Examination of task-switching performance. *Developmental Psychology*, *37*(5), 715–730. doi: 10.1037/0012-1649.37.5.715

Chaiken, S., & Trope, Y. (1999). *Dual-process Theories in Social Psychology* (S. Chaiken & Y. Trope, eds.). New York London: The Guilford Press.

Chas, A., Betancor, V., Delgado, N., & Rodríguez-Pérez, A. (2018). Children consider their own group to be more human than other social groups: Evidence from indirect and direct Measures. *Social Psychology*, *49*(3), 125–134. doi: 10.1027/1864-9335/a000329

Clark, K.B., Clark, M. P. (1947). Racial identification and preference in Negro children. In T. M. Newcomb & E. L. Hartley (Eds.), *Readings in social Psychology* (pp. 169–178). New York: Holt, Rinehart & Winston.

Clayson, P. E., Baldwin, S. A., & Larson, M. J. (2013). How does noise affect amplitude and latency measurement of event-related potentials (ERPs)? A methodological critique and simulation study. *Psychophysiology, 50*(2), 174–186. doi: 10.1111/psyp.12001

Cole, P. M., Usher, B. A., & Cargo, A. P. (1993). Cognitive risk and its association with risk for disruptive behavior disorder in preschoolers. *Journal of Clinical Child Psychology*, *22*(2), 154–164. doi: 10.1207/s15374424jccp2202_3

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review*, *82*(6), 407–428. doi: 10.1037/0033-295X.82.6.407

Conner, M. T., Perugini, M., O'Gorman, R., Ayres, K., & Prestwich, A. (2007). Relations between implicit and explicit measures of attitudes and measures of behavior: Evidence of moderation by individual difference variables. *Personality and Social Psychology Bulletin*, *33*(12), 1727–1740. doi: 10.1177/0146167207309194

Cordero, A., & Calonge, I. (2009). *Spanish adaptation of the Kaufman brief intelligence test* (3rd Ed). Madrid: TEA Ediciones, S.A.

Corral, S., Arribas, D., Santamaría, P., Sueiro, M. J., & Pereña, J. (2005). *Spanish adaptation of the Wechsler intelligence scale for children* (4º ed.). Madrid: TEA Ediciones.

Craft, J. L., & Simon, J. R. (1970). Processing symbolic information from a visual display: Interference from an irrelevant directional cue. *Journal of Experimental Psychology*, *83*(3, Pt. 1), 415–420. doi: 10.1037/h0028843

Cragg, L., Fox, A., Nation, K., Reid, C., & Anderson, M. (2009). Neural correlates of successful and partial inhibitions in children: An ERP study. *Developmental Psychobiology*, *51*(7), 533–543. doi: 10.1002/dev.20391

Cuetos, F., Rodríguez, B., Ruano, E., & Arribas, D. (2007). *PROLEC-R, Batería de evaluación de los procesos lectores, Revisada*. Madrid: TEA.

Cvencek, D., Greenwald, A. G., & Meltzoff, A. N. (2011). Measuring implicit attitudes of 4-year-olds: The preschool implicit association test. *Journal of Experimental Child Psychology*, *109*(2), 187–200. https://doi.org/10.1016/j.jecp.2010.11.002

Dahlin, K. I. E. (2013). Working memory training and the effect on mathematical achievement in children with attention deficits and special needs. *Journal of Education and Learning*, *2*(1). doi: 10.5539/jel.v2n1p118

Dai, C. T., Chang, Y. K., Huang, C. J., & Hung, T. M. (2013). Exercise mode and executive function in older adults: An ERP study of task-switching. *Brain and Cognition*, *83*(2), 153–162. doi: 10.1016/j.bandc.2013.07.007

Dapretto, M., Davies, M. S., Pfeifer, J. H., Scott, A. A., Sigman, M., Bookheimer, S. Y., & Iacoboni, M. (2006). Understanding emotions in others: Mirror neuron dysfunction in children with autism spectrum disorders. *Nature Neuroscience*, *9*(1), 28–30. doi: 10.1038/nn1611

Davey, A. (1983). *Learning to be prejudiced*. London: Edward Arnold.

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*, 2037–2078. doi: 10.1016/j.neuropsychologia.2006.02.006

Degner, J., & Wentura, D. (2010). Automatic prejudice in childhood and early adolescence. *Journal of Personality and Social Psychology*, *98*(3), 356–374. doi: 10.1037/a0017993

Delorme, A., & Makeig, S. (2004). EEGLAB: An open source toolbox for analysis of single-trial EEG dynamics including independent component analysis. *Journal of Neuroscience Methods*, *134*(1), 9–21. doi: 10.1016/j.jneumeth.2003.10.009

Devine, P. G. (1989). Stereotypes and prejudice: Their automatic and controlled components. *Journal of Personality and Social Psychology*, *56*, 5–18. doi: 10.1037/0022-3514.56.1.5

Devine, P. G., Monteith, M. J., Zuwerink, J. R., & Elliot, A. J. (1991). Prejudice with and without compunction. *Journal of Personality and Social Psychology*, *60*(6), 817–830. doi: 10.1037/0022-3514.60.6.817

Devine, P. G., Plant, E. A., Amodio, D. M., Harmon-Jones, E., & Vance, S. L. (2002). The regulation of explicit and implicit race bias: The role of motivations to respond without prejudice. *Journal of Personality and Social Psychology*, *82*(5), 835–848. doi: 10.1037/0022-3514.82.5.835

Devine, R. T., & Hughes, C. (2013). Silent films and strange stories: Theory of mind, gender, and social experiences in middle childhood. *Child Development*, *84*(3), 989–1003. doi: 10.1111/cdev.12017

Devine, R. T., & Hughes, C. (2014). Relations between false belief understanding and executive function in early childhood: A meta-analysis. *Child Development*, *85*(5), 1777–1794. doi: 10.1111/cdev.12237

Devine, R. T., White, N., Ensor, R., & Hughes, C. (2016). Theory of mind in middle childhood: Longitudinal associations with executive function and social competence. *Developmental Psychology*, *52*(5), 758–771. doi: 10.1037/dev0000105

Dhont, K., & van Hiel, A. (2011). Direct contact and authoritarianism as moderators between extended contact and reduced prejudice: Lower threat and greater trust as mediators. *Group Processes and Intergroup Relations*, *14*(2), 223–237. doi: 10.1177/1368430210391121

Diamond, A. (1990). Developmental time course in human infants and infant monkeys, and the neural bases of, inhibitory control in reaching. *Annals of the New York Academy of Sciences*, *608*(1), 637–676. doi: 10.1111/j.1749-6632.1990.tb48913.x

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*, 135–168. doi: 10.1146/annurev-psych-113011-143750

Diamond, A., & Ling, D. S. (2019). Review of the evidence on, and fundamental questions about, efforts to improve executive functions, including working memory. In J. M. Novick, M. F. Bunting, M. R. Dougherty, & R. W. Engle (Eds.), *Cognitive and Working Memory Training. Perspectives from Psychology, Neuroscience, and Human Development* (pp. 143–431). Oxford: Oxford University Press. doi: 10.1093/oso/9780199974467.003.0008

Diamond, A., Prevor, M. B., Callender, G., & Druin, D. P. (1997). Prefrontal cortex cognitive deficits in children treated early and continuously for PKU. *Monographs of the Society for Research in Child Development*, *62*(4), 1–208. doi: 10.2307/1166208

Ding, X. P., Wellman, H. M., Wang, Y., Fu, G., & Lee, K. (2015). Theory-of-mind training causes honest young children to lie. *Psychological Science, 26*(11), 1812–1821. https://doi.org/10.1177/0956797615604628

Donchin, E., & Coles, M. G. H. (1988). Is the P300 component a manifestation of context updating? *Behavioral and Brain Sciences*, *11*(3), 357–374. doi: 10.1017/S0140525X00058027

Donkers, F. C. L., & Van Boxtel, G. J. M. (2004). The N2 in go/no-go tasks reflects conflict monitoring not response inhibition. *Brain and Cognition*, *56*(2 SPEC. ISS.), 165–176. doi: 10.1016/j.bandc.2004.04.005

Dörrenbächer, S., Müller, P. M., Tröger, J., & Kray, J. (2014). Dissociable effects of game elements on motivation and cognition in a task-switching training in middle childhood. *Frontiers in Psychology*, *5*, 1275–1296. doi: 10.3389/fpsyg.2014.01275

Dosenbach, N. U. F., Fair, D. A., Cohen, A. L., Schlaggar, B. L., & Petersen, S. E. (2008). A dual-networks architecture of top-down control. *Trends in Cognitive Sciences*, *12*(3), 99–105. doi: 10.1016/j.tics.2008.01.001

Dovidio, J. F., Kawakami, K., Smoak, N., & Gaertner, S. L. (2009). The nature of contemporary racial prejudice: Insight from implicit and explicit measures of attitudes. In R. E. Petty, R. H. Fazio, & P. Briñol (Eds.), *Attitudes: Insights from the New Implicit Measures* (pp. 165–192). doi: 10.4324/9780203809884

Doyle, A.-B., & Aboud, F. E. (1995). A longitudinal study of White children's racial prejudice as a social-cognitive development. *Merrill-Palmer Quarterly*, *41*, 209–228. doi: 10.1016/j.jenvrad.2013.02.007

Doyle, A. B., Beaudet, J., & Aboud, F. (1988). Developmental patterns in the flexibility of children's ethnic attitudes. *Journal of Cross-Cultural Psychology*, *19*(1), 3–18. doi: 10.1177/0022002188019001001

Duan, X., & Shi, J. (2014). Attentional switching in intellectually gifted and average children: Effects on performance and ERP. *Psychological Reports*, *114*(2), 597–607. doi: 10.2466/04.10.PR0.114k21w8

Dumontheil, I., Apperly, I. A., & Blakemore, S. J. (2010). Online usage of theory of mind continues to develop in late adolescence. *Developmental Science*, *13*(2), 331–338. doi: 10.1111/j.1467-7687.2009.00888.x

Dunton, B. C., & Fazio, R. H. (1997). An individual difference measure of motivation to control prejudiced reactions. *Personality and Social Psychology Bulletin*, *23*(3), 316–326. doi: 10.1177/0146167297233009

Durston, S., Davidson, M. C., Tottenham, N., Galvan, A., Spicer, J., Fossella, J. A., & Casey, B. J. (2006). A shift from diffuse to focal cortical activity with development. *Developmental Science*, *9*(1), 1–20. doi: 10.1111/j.1467-7687.2005.00454.x

Dutton, D. G. (1976). Tokenism, reverse discrimination, and egalitarianism in interracial behavior. *Journal of Social Issues*, *32*, 93–107. doi: 10.1111/j.1540-4560.1976.tb02496.x

Enesco, I., Guerrero, S., Callejas, C., & Solbes, I. (2008). Intergroup attitudes and reasoning about social exclusion in majority and minority children in Spain. In S. Levy & M. Killen (Eds.), *Intergroup attitudes and relations in childhood through adulthood* (1st ed., pp. 105–125). Oxford: Oxford University Press.

Enesco, I., Guerrero, S., Lago, M. O., & Rodríguez, P. (2011). How stable is children's affective orientation toward different ethnic groups? A longitudinal study of in-group and out-group attitudes among preschoolers. *Anales de Psicología*, *27*(3), 631–638. ISSN: 0212-9728

Enesco, I., Guerrero, S., Solbes, I., Lago, O., & Rodríguez, P. (2009). El prejuicio étnico-racial. Una revisión de estudios evolutivos en España con niños y preadolescentes españoles y extranjeros. *Cultura y Educacion*, *21*(4), 497–515. doi: 10.1174/113564009790002427

Enesco, I., Navarro, A., Giménez, M., & Del Olmo, C. (1999). Génesis de la conciencia racial: Un estudio sobre identificación y actitudes hacia el color de piel en niños de tres a once años. *Estudios de Psicología*, *20*(63-64), 3-20. doi: 10.1174/021093999960256720

Enesco, I., Navarro, A., Paradela, I., & Guerrero, S. (2005). Stereotypes and beliefs about different ethnic groups in Spain. A study with Spanish and Latin American children living in Madrid. *Journal of Applied Developmental Psychology*. doi: 10.1016/j.appdev.2005.08.009

Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological Review*, *102*(2), 211–245. doi: 10.1037/0033-295x.102.2.211

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics*, *16*(1), 143–149. doi: 10.3758/BF03203267

Espinet, S. D., Anderson, J. E., & Zelazo, P. D. (2012). N2 amplitude as a neural marker of executive function in young children: An ERP study of children who switch versus perseverate on the Dimensional Change Card Sort. *Developmental Cognitive Neuroscience, 2*(SUPPL. 1), 549–558. doi: 10.1016/j.dcn.2011.12.002

Espinet, S. D., Anderson, J. E., & Zelazo, P. D. (2013). Reflection training improves executive function in preschool-age children: behavioral and neural effects. *Developmental Cognitive Neuroscience, 4*, 3–15. doi: 10.1016/j.dcn.2012.11.009

Evans, A. M., Athenstaedt, U., & Krueger, J. I. (2013). The development of trust and altruism during childhood. *Journal of Economic Psychology*, *36*, 82–95. doi: 10.1016/j.joep.2013.02.010

Ewing-Cobbs, L., Prasad, M. R., Landry, S. H., Kramer, L., & DeLeon, R. (2004). Executive functions following traumatic brain injury in young children: A preliminary analysis. *Developmental Neuropsychology*, *26*(1), 487–512. doi: 10.1207/s15326942dn2601_7

Fair, D. A., Dosenbach, N. U. F., Church, J. A., Cohen, A. L., Brahmbhatt, S., Miezin, F. M., … Schlaggar, B. L. (2007). Development of distinct control networks through segregation and integration. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(33), 13507–13512. doi: 10.1073/pnas.0705843104

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology*, *69*, 1013–1027. doi: 10.1037/0022-3514.69.6.1013

Fiske, S. T., & Taylor, S. E. (1991). Social cognition. In *McGrawHill series in social psychology* (2nd ed.). New York: Mcgraw-Hill Book Company.

Fitzroy, S., & Rutland, A. (2010). Learning to control ethnic intergroup bias in childhood. *European Journal of Social Psychology*, *40*, 679–693. doi: 10.1002/ejsp.746

Foessa foundation (2019). VIII report on exclusion and social development in Spain. Retrieved from: https://caritas-web.s3.amazonaws.com/main-files/uploads/sites/16/2019/05/Informe-FOESSA-2019-completo.pdf

Fourie, M. M., Thomas, K. G. F., Amodio, D. M., Warton, C. M. R., & Meintjes, E. M. (2014). Neural correlates of experienced moral emotion: An fMRI investigation of emotion in response to prejudice feedback. *Social Neuroscience*, *9*(2), 203–218. doi: 10.1080/17470919.2013.878750

Freeman, J. B., Pauker, K., & Sanchez, D. T. (2016). A perceptual pathway to bias: Interracial exposure reduces abrupt shifts in real-time race perception that predict mixed-race bias. *Psychological Science*, *27*(4), 502–517. doi: 10.1177/0956797615627418

Friedman, N. P., & Miyake, A. (2017). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex*, *86*, 186–204. doi: 10.1016/j.cortex.2016.04.023

Friedman, D., Nessler, D., Johnson, R., Ritter, W., & Bersick, M. (2008). Age-related changes in executive function: An event-related potential (ERP) investigation of task-switching. *Aging, Neuropsychology, and Cognition*, *15*(1), 95–128. doi: 10.1080/13825580701533769

Frith, U., & Frith, C. D. (2003). Development and neurophysiology of mentalizing. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *358*(1431), 459–473. doi: 10.1098/rstb.2002.1218

Frith, C. D., & Singer, T. (2008). The role of social cognition in decision making. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*(1511), 3875–3886. doi: 10.1098/rstb.2008.0156

Gajewski, P. D., & Falkenstein, M. (2011). Diversity of the P3 in the task-switching paradigm. *Brain Research*, *1411*, 87–97. doi: 10.1016/j.brainres.2011.07.010

Gajewski, P. D., & Falkenstein, M. (2013). Effects of task complexity on ERP components in go/nogo tasks. *International Journal of Psychophysiology*, *87*(3), 273–278. doi: 10.1016/j.ijpsycho.2012.08.007

Gajewski, P. D., Kleinsorge, T., & Falkenstein, M. (2010). Electrophysiological correlates of residual switch costs. *Cortex*, *46*(9), 1138–1148. doi: 10.1016/j.cortex.2009.07.014

Gajewski, P. D., Stoerig, P., & Falkenstein, M. (2008). ERP-correlates of response selection in a response conflict paradigm. *Brain Research*, *1189*(1), 127–134. doi: 10.1016/j.brainres.2007.10.076

Gamella, J., & Sánchez Muros, P. (1998). *La imagen infantil de los gitanos: Estereotipos y prejuicios en escuelas multiétnicas*. Valencia: Fundación Bancaixa.

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: a review using an integrative framework. *Psychological Bulletin*, *134*(1), 31–60. doi: 10.1037/0033-2909.134.1.31

Gathercole, S. E. (1998). The development of memory. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*, 3–27. doi: 10.1017/S0021963097001753

Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental Psychology*, *40*, 177–190. doi: 10.1037/0012-1649.40.2.177

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: performance of children 3 1 2-7 years old on a stroop- like day-night test. *Cognition*, *53*(2), 129–153. doi: 10.1016/0010-0277(94)90068-X

Golan, O., Baron-Cohen, S., & Hill, J. (2006). The Cambridge mindreading (CAM) face-voice battery: Testing complex emotion recognition in adults with and without Asperger Syndrome. *Journal of Autism and Developmental Disorders*, *36*(2), 169–183. doi: 10.1007/s10803-005-0057-y

Gopnik, A., & Wellman, H. M. (1992). Why the child's theory of mind really is a theory. *Mind & Language*, *7*(1–2), 145–171. doi: 10.1111/j.1468-0017.1992.tb00202.x

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*(6), 1464–1480. doi: 10.1037/0022-3514.74.6.1464

Groom, M. J., & Cragg, L. (2015). Differential modulation of the N2 and P3 event-related potentials by response conflict and inhibition. *Brain and Cognition*, *97*, 1–9. doi: 10.1016/j.bandc.2015.04.004

Guerrero, S. (2006). *El desarrollo de la toma de concienca racial. Un estudio evolutivo con niños españoles de 3 a 5 años* (Doctoral dissertation, Universidad Complutense, Madrid, Spain). Retrieved from https://eprints.ucm.es/7495/1/T29614.pdf

Guerrero, S., Enesco, I., & Lam, V. (2011). Racial awareness, affect and sorting abilities: A study with preschool children. *Anales de Psicología/Annals of Psychology*, *27*(3), 639–646. ISSN: 1695-2294

Gupta, R., Kar, B.R., & Srinivasan, N. (2009). Development of task switching and post-error-slowing in children. *Behavioral and Brain Functions*, *5*(38), 1-13. doi: 10.1186/1744-9081-5-38

Hale, C. M., & Tager-Flusberg, H. (2003). The influence of language on theory of mind: A training study. *Developmental Science*, *6*(3), 346–359. doi: 10.1111/1467-7687.00289

Happé, F. G. E. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders*, *24*(2), 129–154. doi: 10.1007/BF02172093

Harmon-Jones, E. (2003). Clarifying the emotive functions of asymmetrical frontal cortical activity. *Psychophysiology*, *40*(6), 838–848. doi: 10.1111/1469-8986.00121

Haslam, N. (2006). Dehumanization: An integrative review. *Personality and Social Psychology Review*, *10*(3), 252–264. doi: 10.1207/s15327957pspr1003_4

Hewstone, M., Cairns, E., Voci, A., Hamberger, J., & Niens, U. (2006). Intergroup contact, forgiveness, and experience of "the troubles" in Northern Ireland. *Journal of Social Issues*, *62*(1), 99–120. doi: 10.1111/j.1540-4560.2006.00441.x

Hillman, C. H., Kramer, A. F., Belopolsky, A. V., & Smith, D. P. (2006). A cross-sectional examination of age and physical activity on performance and event-related brain potentials in a task switching paradigm. *International Journal of Psychophysiology*, *59*(1), 30–39. doi: 10.1016/j.ijpsycho.2005.04.009

Hilton, J. L., & Hippel, W. Von. (1996). Stereotypes. *Annual Review of Psychology*, *47*, 237–271. doi: 10.1146/annurev.psych.47.1.237

Hobson, R. P. (1991). Against the theory of 'theory of mind.' *British Journal of Developmental Psychology*, *9*(1), 33–51. doi: 10.1111/j.2044-835x.1991.tb00860.x

Hofmann, S. G., Doan, S. N., Sprung, M., Wilson, A., Ebesutani, C., Andrews, L. A., Curtiss, J., & Harris, P. L. (2016). Training children's theory-of-mind: A meta-analysis of controlled studies. *Cognition*, *150*, 200–212. doi: 10.1016/j.cognition.2016.01.006

Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, *16*, 174–180. doi: 10.1016/j.tics.2012.01.006

Holmes, R. M. (1995). *How young children perceive race* (1st ed.). Thousand Oaks, CA: Sage Publications.

Hommel, B. (2011). Attention and spatial stimulus coding in the Simon task: A rejoinder to van der Lubbe and Abrahamse (2010). *Acta Psychologica*, *136*(2), 265–268. doi: 10.1016/j.actpsy.2010.10.002

Horowitz, E. L., & Horowitz, R. E. (1938). Development of social attitudes in children. *Sociometry*, *1*(3/4), 301–338. doi: 10.2307/2785586

Hoyo, Á., Rueda, M. R., & Rodríguez-Bailón, R. (2019). Children's individual differences in executive function and theory of mind in relation to prejudice toward social minorities. *Frontiers in Psychology*, *10*, 2293. doi: 10.3389/fpsyg.2019.02293

Hsieh, S. (2006). The lateralized readiness potential and P300 of stimulus-set switching. *International Journal of Psychophysiology*, *60*(3), 284–291. doi: 10.1016/j.ijpsycho.2005.07.011

Hsieh, S., & Yu, Y. T. (2003). Switching between simple response-sets: Inferences from the lateralized readiness potential. *Cognitive Brain Research*, *17*(2), 228–237. doi: 10.1016/S0926-6410(03)00110-1

Hsu, N. S., Novick, J. M., & Jaeggi, S. M. (2014). The development and malleability of executive control abilities. *Frontiers in Behavioral Neuroscience*, *8*(JUNE). doi: 10.3389/fnbeh.2014.00221

Hughes, C. (1998). Executive function in preschoolers: Links with theory of mind and verbal ability. *British Journal of Developmental Psychology*, *16*(2), 233–253. doi: 10.1111/j.2044-835X.1998.tb00921.x

Huizinga, M., Dolan, C. V., & van der Molen, M. W. (2006). Age-related change in executive function: Developmental trends and a latent variable analysis. *Neuropsychologia*, *44*(11), 2017–2036. doi: 10.1016/j.neuropsychologia.2006.01.010

Hung, C. L., Huang, C. J., Tsai, Y. J., Chang, Y. K., & Hung, T. M. (2016). Neuroelectric and behavioral effects of acute exercise on task switching in children with attention-deficit/hyperactivity disorder. *Frontiers in Psychology*, *7*(OCT), 1589. doi: 10.3389/fpsyg.2016.01589

Imuta, K., Henry, J. D., Slaughter, V., Selcuk, B., & Ruffman, T. (2016). Theory of mind and prosocial behavior in childhood: A meta-analytic review. *Developmental Psychology*, *52*(8), 1192–1205. doi: 10.1037/dev0000140

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, *30*(5), 513–541. doi: 10.1016/0749-596X(91)90025-F

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

Jodo, E., & Kayama, Y. (1992). Relation of a negative ERP component to response inhibition in a go/no-go task. *Electroencephalography and Clinical Neurophysiology*, *82*(6), 477–482. doi: 10.1016/0013-4694(92)90054-L

Johnson, M. H. (2005). *Developmental cognitive neuroscience* (2nd ed.). Oxford, England: Blackwell Publishers.

Johnstone, S. J., Dimoska, A., Smith, J. L., Barry, R. J., Pleffer, C. B., Chiswick, D., & Clarke, A. R. (2007). The development of stop-signal and go/nogo response inhibition in children aged 7-12 years: Performance and event-related potential indices. *International*

Journal of Psychophysiology, *63*(1), 25–38. doi: 10.1016/j.ijpsycho.2006.07.001

Johnstone, S. J., Pleffer, C. B., Barry, R. J., Clarke, A. R., & Smith, J. L. (2005). Development of inhibitory processing during the go/nogo task: A behavioral and event-related potential study of children and adults. *Journal of Psychophysiology*, *19*(1), 11–23. doi: 10.1027/0269-8803.19.1.11

Jonkman, L. M. (2006). The development of preparation, conflict monitoring and inhibition from early childhood to young adulthood; a go/nogo ERP study. *Brain Research*, *1097*(1), 181–193. doi: 10.1016/j.brainres.2006.04.064

Jonkman, L. M., Lansbergen, M., & Stauder, J. E. A. (2003). Developmental differences in behavioral and event-related brain responses associated with response preparation and inhibition in a go/nogo task. *Psychophysiology*, *40*(5), 752–761. doi: 10.1111/1469-8986.00075

Jonkman, L. M., Sniedt, F. L. F., & Kemner, C. (2007a). Source localization of the nogo-N2: A developmental study. *Clinical Neurophysiology*, *118*(5), 1069–1077. doi: 10.1016/j.clinph.2007.01.017

Jonkman, L. M., van Melis, J. J. M., Kemner, C., & Markus, C. R. (2007b). Methylphenidate improves deficient error evaluation in children with ADHD: An event-related brain potential study. *Biological Psychology*, *76*(3), 217–229. doi: 10.1016/j.biopsycho.2007.08.004

Kaland, N., Møller-Nielsen, A., Callesen, K., Mortensen, E. L., Gottlieb, D., & Smith, L. (2002). A new "advanced" test of theory of mind: Evidence from children and adolescents with Asperger syndrome. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *43*(4), 517–528. doi: 10.1111/1469-7610.00042

Kalbe, E., Grabenhorst, F., Brand, M., Kessler, J., Hilker, R., & Markowitsch, H. J. (2007). Elevated emotional reactivity in affective but not cognitive components of theory of mind: A psychophysiological study. *Journal of Neuropsychology*, *1*(1), 27–38. doi: 10.1348/174866407X180792

Karbach, J., & Kray, J. (2009). How useful is executive control training? Age differences in near and far transfer of task-switching training. *Developmental Science*, *12*(6), 978–990. doi: 10.1111/j.1467-7687.2009.00846.x

Katz, P. A., Sohn, M., & Zalk, S. R. (1975). Perceptual concomitants of racial attitudes in urban-grade school children. *Developmental Psychology*, *11*(2), 135–144. doi: 10.1037/h0076446

Kerns, J. G., Cohen, J. D., MacDonald, A. W., Cho, R. Y., Stenger, V. A., & Carter, C. S. (2004). Anterior cingulate conflict monitoring and adjustments in control. *Science*, *303*(5660), 1023–1026. doi: 10.1126/science.1089910

Kieffaber, P. D., & Hetrick, W. P. (2005). Event-related potential correlates of task switching and switch costs. *Psychophysiology*, *42*(1), 56–71. doi: 10.1111/j.1469-8986.2005.00262.x

Killen, M., Lee-Kim, J., Mcglothlin, H., Stangor, C., & Helwig, C. C. (2002). How children and adolescents evaluate gender and racial exclusion. *Monographs of the Society for Research in Child Development*, *67*(4), 1–129.

Killen, M., McGlothlin, H., & Henning, A. (2008). Explicit judgments and implicit bias: A developmental perspective. In S. Levy & M. Killen (Eds.), *Intergroup Attitudes and Relations in Childhood Through Adulthood* (pp. 126–145). New York: Oxford University Press.

Killen, M., & Stangor, C. (2001). Children's social reasoning about inclusion and exclusion in gender and race peer group contexts. *Child Development*, *72*(1), 174–186. doi: 10.1111/1467-8624.00272

Kinderman, P., Dunbar, R., & Bentall, R. P. (1998). Theory-of-mind deficits and causal attributions. *British Journal of Psychology*, *89*(2), 191–204. doi: 10.1111/j.2044-8295.1998.tb02680.x

Klingberg, T. (2010). Training and plasticity of working memory. *Trends in Cognitive Sciences*, *14*, 317–324.

Kloo, D., & Perner, J. (2003). Training Transfer between card sorting and false belief understanding: Helping children apply conflicting descriptions. *Child Development*, *74*(6), 1823–1839. doi: 10.1046/j.1467-8624.2003.00640.x

Kloo, D., & Perner, J. (2008). Training theory of mind and executive control: A tool for improving school achievement? *Mind, Brain, and Education*, *2*(3), 122–127. doi: 10.1111/j.1751-228X.2008.00042.x

Knutson, K. M., Mah, L., Manly, C. F., & Grafman, J. (2007). Neural correlates of automatic beliefs about gender and race. *Human Brain Mapping*, *28*(10), 915–930. doi: 10.1002/hbm.20320

Koenig, M. A., & Harris, P. L. (2005). Preschoolers mistrust ignorant and inaccurate speakers. *Child Development*, *76*(6), 1261–1277. doi: 10.1111/j.1467-8624.2005.00849.x

Kovel, J. (1970). *White racism: A psychohistory*. New York: Pantheon Books / Random House.

Kray, J., Eber, J., & Karbach, J. (2008). Verbal self-instructions in task switching: A compensatory tool for action-control deficits in childhood and old age? *Developmental Science*, *11*(2), 223–236. doi: 10.1111/j.1467-7687.2008.00673.x

Krosch, A. R., & Amodio, D. M. (2014). Economic scarcity alters the perception of race. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(25), 9079–9084. doi: 10.1073/pnas.1404448111

Krosch, A. R., Tyler, T. R., & Amodio, D. M. (2017). Race and recession: Effects of economic scarcity on racial discrimination. *Journal of Personality and Social Psychology*, *113*(6), 892–909. doi: 10.1037/pspi0000112

Ladouceur, C. D., Dahl, R. E., & Carter, C. S. (2007). Development of action monitoring through adolescence into adulthood: ERP and source localization. *Developmental Science*, *10*(6), 874–891. doi: 10.1111/j.1467-7687.2007.00639.x

Lamm, C., Zelazo, P. D., & Lewis, M. D. (2006). Neural correlates of cognitive control in childhood and adolescence: Disentangling the contributions of age and executive function. *Neuropsychologia*, *44*(11), 2139–2148. doi: 10.1016/j.neuropsychologia.2005.10.013

Lapan, C., & Boseovski, J. J. (2015). Theory of mind and children's trait attributions about average and typically stigmatized peers. *Infant and Child Development*, *25*(2), 158–178. doi: 10.1002/icd.1923

Larson, M. J., & Clayson, P. E. (2011). The relationship between cognitive performance and electrophysiological indices of performance monitoring. *Cognitive, Affective and Behavioral Neuroscience*, *11*(2), 159–171. doi: 10.3758/s13415-010-0018-6

Lecce, S., & Bianco, F. (2018). Working memory predicts changes in children's theory of mind during middle childhood: A training study. *Cognitive Development*, *47*, 71–81. doi: 10.1016/j.cogdev.2018.04.002

Lecce, S., Bianco, F., Devine, R. T., & Hughes, C. (2017). Relations between theory of mind and executive function in middle childhood: A short-term longitudinal study. *Journal of Experimental Child Psychology*, *163*, 69–86. doi: 10.1016/j.jecp.2017.06.011

Lecce, S., Bianco, F., Devine, R. T., Hughes, C., & Banerjee, R. (2014). Promoting theory of mind during middle childhood: A training program. *Journal of Experimental Child Psychology*, *126*, 52–67. doi: 10.1016/j.jecp.2014.03.002

Lehto, J. E., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology, 21*(1), 59–80. doi: 10.1348/026151003321164627

Lewis, M. D., & Todd, R. M. (2007). The self-regulating brain: Cortical-subcortical feedback and the development of intelligent action. *Cognitive Development*, *22*(4), 406–430. doi: 10.1016/j.cogdev.2007.08.004

Lezak, M. (1983). *Neuropsychological assessment*. New York: Oxford University Press.

Liddle, B., & Nettle, D. (2006). Higher-order theory of mind and social competence in school-age children. *Journal of Cultural and Evolutionary Psychology*, *4*(3), 231–244. doi: 10.1556/jcep.4.2006.3-4.3

Lo, S. L. (2018). A meta-analytic review of the event-related potentials (ERN and N2) in childhood and adolescence: Providing a developmental perspective on the conflict monitoring theory. *Developmental Review, 48,* 82–112. doi: 10.1016/j.dr.2018.03.005

Lopez-Calderon, J., & Luck, S. J. (2014). ERPLAB: An open-source toolbox for the analysis of event-related potentials. *Frontiers in Human Neuroscience*, *8*(1 APR), 213. doi: 10.3389/fnhum.2014.00213

Luciana, M., Conklin, H. M., Hooper, C. J., & Yarger, R. S. (2005). The development of nonverbal working memory and executive control processes in adolescents. *Child Development*, *76*(3), 697–712. doi: 10.1111/j.1467-8624.2005.00872.x

Luciana, M., & Nelson, C. A. (1998). The functional emergence of prefrontally-guided working memory systems in four- to eight-year-old children. *Neuropsychologia*, *36*, 273–293. doi: 10.1016/S0028-3932(97)00109-7

Luciana, M., & Nelson, C. A. (2002). Assessment of neuropsychological function through use of the Cambridge neuropsychological testing automated battery: Performance in 4- to 12-year-old children. *Developmental Neuropsychology*, *22*(3), 595–624. doi: 10.1207/S15326942DN2203_3

Luck, S. J. (2014). *An introduction to the event-related potential technique, second edition*. Cambridge, Massachusetts: The MIT Press. doi: 10.1118/1.4736938

Maraver, M. J., Bajo, M. T., & Gomez-Ariza, C. J. (2016). Training on working memory and inhibitory control in young adults. *Frontiers in Human Neuroscience*, *10*, 588. doi: 10.3389/fnhum.2016.00588

McCabe, K., Houser, D., Ryan, L., Smith, V., & Trouard, T. (2001). A functional imaging study of cooperation in two-person reciprocal exchange. *Proceedings of the National Academy of Sciences of the United States of America*, *98*(20), 11832–11835. doi: 10.1073/pnas.211415698

McGlothlin, H., Killen, M., & Edmonds, C. (2005). European-American children’s intergroup attitudes about peer relationships. *British*

Journal of Developmental Psychology, *23*(2), 227–249. doi: 10.1348/026151005x26101

Melara, R. D., Wang, H., Vu, K. P. L., & Proctor, R. W. (2008). Attentional origins of the Simon effect: Behavioral and electrophysiological evidence. *Brain Research*, *1215*, 147–159. doi: 10.1016/j.brainres.2008.03.026

Miller, S. A. (2009). Children's understanding of second-order mental states. *Psychological Bulletin*, *135*(5), 749–773. doi: 10.1037/a0016854

Miller, S. A. (2013). Children's understanding of second-order false belief: Comparisons of content and method of assessment. *Infant and Child Development*, *22*, 649–658. doi: 10.1002/icd.1810

Milner, B. (1964). Some effects of frontal lobectomy in man. In J. M. Warren & K. Akert (Eds.), *The Frontal Granular Cortex and Behavior* (pp. 313–334). New York: MCGraw-Hill.

Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science*, *21*, 8-14. doi: 10.1177/0963721411429458

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49–100. doi: 10.1006/cogp.1999.0734

Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H. L., … Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(7), 2693–2698. doi: 10.1073/pnas.1010076108

Morrison, A. B., & Chein, J. M. (2011). Does working memory training work? The promise and challenges of enhancing cognition by training working memory. *Psychonomic Bulletin and Review*, *18*(1), 46–60. doi: 10.3758/s13423-010-0034-0

Mújdricza, F. (2019). The roots of trust. *European Journal of Mental Health*, *14*, 109–142. doi: 10.5708/EJMH.14.2019.1.6

Mulvey, K. L., Rizzo, M. T., & Killen, M. (2016). Challenging gender stereotypes: Theory of mind and peer group dynamics. *Developmental Science*, *19*(6), 999–1010. doi: 10.1111/desc.12345

Nash, H. M. (2002). Social skills training, training to task, and theory of mind performance among young children. *Dissertation Abstract International: Section B: The Sciences and Engineering*, *62*(10-B), 4797.

Nesdale, D. (1999). Developmental changes in children's ethnic preferences and social cognitions. *Journal of Applied Developmental Psychology*, *20*, 501–519. doi: 10.1016/S0193-3973(99)00012-X

Nesdale, D. (2010). The development of ethnic prejudice in early childhood: Theories and research. In O. Saracho & B. Spodek

(Eds.), *Contemporary perspectives on socialization and social development in early childhood education* (pp. 213–240). Charlotte: Information Age Publishing.

Nesdale, D. (2013). Social acumen: Its role in constructing group identity and attitudes. In M. R. Banaji & S. A. Gelman (Eds.), *Navigating the social world: What infants, children, and other species can teach us* (pp. 323–326). New York: Oxford University Press.

Nesdale, D., & Flesser, D. (2001). Social identity and the development of children's group attitudes. *Child Development, 72*(2), 506-517. doi: 10.1111/1467-8624.00293

Nesdale, D., Griffith, J., Durkin, K., & Maass, A. (2005). Empathy, group norms and children’s ethnic attitudes. *Journal of Applied Developmental Psychology*, *26*(6), 623–637. doi: 10.1016/j.appdev.2005.08.003

Neville, H. J., Stevens, C., Pakulak, E., Bell, T. A., Fanning, J., Klein, S., & Isbell, E. (2013). Family-based training program improves brain function, cognition, and behavior in lower socioeconomic status preschoolers. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(29), 12138–12143. doi: 10.1073/pnas.1304437110

Nieuwenhuis, S., Yeung, N., Van Den Wildenberg, W., & Ridderinkhof, K. R. (2003). Electrophysiological correlates of anterior cingulate function in a go/no-go task: Effects of response conflict and trial type frequency. *Cognitive, Affective and Behavioral Neuroscience, 3*(1), 17–26. doi: 10.3758/CABN.3.1.17

Nigg, J. T., Quamma, J. P., Greenberg, M. T., & Kusche, C. A. (1999). A two-year longitudinal study of neuropsychological and cognitive performance in relation to behavioral problems and competencies in elementary school children. *Journal of Abnormal Child Psychology*, *27*(1), 51–63. doi: 10.1023/A:1022614407893

Olesen, P. J., Westerberg, H., & Klingberg, T. (2004). Increased prefrontal and parietal activity after training of working memory. *Nature Neuroscience*, *7*(1), 75–79. doi: 10.1038/nn1165

Osterhaus, C., Koerber, S., & Sodian, B. (2016). Scaling of advanced theory-of-mind tasks. *Child Development*, *87*(6), 1971–1991. doi: 10.1111/cdev.12566

Overbye, K., Huster, R. J., Walhovd, K. B., Fjell, A. M., & Tamnes, C. K. (2018). Development of the P300 from childhood to adulthood: A multimodal EEG and MRI study. *Brain Structure and Function*, *223*(9), 4337–4349. doi: 10.1007/s00429-018-1755-5

Paolini, S., Hewstone, M., & Cairns, E. (2007). Direct and indirect intergroup friendship effects: Testing the moderating role of the affective-cognitive bases of prejudice. *Personality and Social Psychology Bulletin*, *33*(10), 1406–1420. doi: 10.1177/0146167207304788

Patterson, M. M., & Bigler, R. S. (2006). Preschool children's attention to environmental messages about groups: Social categorization and the origins of intergroup bias. *Child Development*, *77*, 847–860. doi: 10.1111/j.1467-8624.2006.00906.x

Payne, B. K. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology*, *81*(2), 181–192. doi: 10.1037/0022-3514.81.2.181

Payne, B. K. (2005). Conceptualizing control in social cognition: How executive functioning modulates the expression of automatic stereotyping. *Journal of Personality and Social Psychology*, *89*(4), 488–503. doi: 10.1037/0022-3514.89.4.488

Pearson, A. R., Dovidio, J. F., & Gaertner, S. L. (2009). The nature of contemporary prejudice: Insights from aversive racism. *Social and Personality Psychology Compass*, *3*(3), 314–338. doi: 10.1111/j.1751-9004.2009.00183.x

Peng, J., Mo, L., Huang, P., & Zhou, Y. (2017). The effects of working memory training on improving fluid intelligence of children during early childhood. *Cognitive Development*, *43*, 224–234. https://doi.org/10.1016/j.cogdev.2017.05.006

Perner, J., Kain, W., & Barchfeld, P. (2002b). Executive control and higher-order theory of mind in children at risk of ADHD. *Infant and Child Development*, *11*, 141–158. doi: 10.1002/icd.302

Perner, J., & Lang, B. (1999). Development of theory of mind and executive control. *Trends in Cognitive Sciences*, *3*, 337–344. doi: 10.1016/S1364-6613(99)01362-5

Perner, J., & Lang, B. (2000). Theory of mind and executive function: Is there a developmental relationship? In S. Baron-Cohen, H. Tager-

Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from developmental cognitive neuroscience* (2nd ed., pp. 150–181). New York, US: Oxford University Press.

Perner, J., Lang, B., & Kloo, D. (2002). Theory of mind and self-control: More than a common problem of inhibition. *Child Development*, *73*, 752–767. doi: 10.1111/1467-8624.00436

Perner, J., & Wimmer, H. (1985). “John thinks that Mary thinks that…”: Attribution of second-order beliefs by 5 to 10 year old children. *Journal of Experimental Child Psychology, 39*(3), 437–471. doi: 10.1016/0022-0965(85)90051-7

Petersen, S. E., & Posner, M. I. (2012). The attention system of the human brain: 20 years after. *Annual review of neuroscience, 35*, 73-89. doi: 10.1146/annurev-neuro-062111-150525

Petrides, M., Alivisatos, B., Evans, A. C., & Meyer, E. (1993). Dissociation of human mid-dorsolateral from posterior dorsolateral frontal cortex in memory processing. *Proceedings of the National Academy of Sciences of the United States of America*, *90*(3), 873–877. doi: 10.1073/pnas.90.3.873

Pettigrew, T. F., & Tropp, L. R. (2008). How does intergroup contact reduce prejudice? Meta-analytic tests of three mediatorsy. *European Journal of Social Psychology*, *38*, 922–934. doi: 10.1002/ejsp.504

Pfefferbaum, A., Ford, J. M., Weller, B. J., & Kopell, B. S. (1985). ERPs to response production and inhibition. *Electroencephalography and*

Clinical Neurophysiology, *60*(5), 423–434. doi: 10.1016/0013-4694(85)91017-X

Pires, L., Leitão, J., Guerrini, C., & Simões, M. R. (2014). Event-related brain potentials in the study of inhibition: Cognitive control, source localization and age-related modulations. *Neuropsychology Review*, *24*(4), 461–490. doi: 10.1007/s11065-014-9275-4

Plant, E. A., & Devine, P. G. (1998). Internal and external motivation to respond without prejudice. *Journal of Personality and Social Psychology*, *75*(3), 811–832. doi: 10.1037/0022-3514.75.3.811

Plant, E. A., & Devine, P. G. (2009). The active control of prejudice: Unpacking the intentions guiding control efforts. *Journal of Personality and Social Psychology*, *96*(3), 640–652. doi: 10.1037/a0012960

Polich, J. (2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neurophysiology*, *118*(10), 2128–2148. doi: 10.1016/j.clinph.2007.04.019

Pons, F., Harris, P. L., & de Rosnay, M. (2004). Emotion comprehension between 3 and 11 years: Developmental periods and hierarchical organization. *European Journal of Developmental Psychology*, *1*(2), 127–152. doi: 10.1080/17405620344000022

Pozuelos, J. P., Combita, L. M., Abundis, A., Paz-Alonso, P. M., Conejero, Á., Guerra, S., & Rueda, M. R. (2019). Metacognitive scaffolding boosts cognitive and neural benefits following executive attention training in children. *Developmental Science*, *22*(2), e12756. doi: 10.1111/desc.12756

Premack, D., & Woodruff, G. (1978). Does the Chimpanzee have theory of mind? *Behavioral and Brain Sciences*, *4*, 515–629. doi: 10.1016/j.jpsychires.2009.11.016

Qu, L., Shen, P., Chee, Y. Y., & Chen, L. (2015). Teachers' theory-of-mind coaching and children's executive function predict the training effect of sociodramatic play on children's theory of mind. *Social Development*, *24*(4), 716–733. doi: 10.1111/sode.12116

Raabe, T., & Beelmann, A. (2011). Development of ethnic, racial, and national prejudice in childhood and adolescence: A multinational meta-analysis of age differences. *Child Development*, *82*, 1715–1737. doi: 10.1111/j.1467-8624.2011.01668.x

Rennie, D. A. C., Bull, R., & Diamond, A. (2004). Executive functioning in preschoolers: Reducing the inhibitory demands of the dimensional change card sort task. *Developmental Neuropsychology*, *26*(1), 423–443. doi: 10.1207/s15326942dn2601_4

Richeson, J. A., & Shelton, J. N. (2003). When prejudice does not pay: Effects of interracial contact on executive function. *Psychological Science*, *14*(3), 287–290. doi: 10.1111/1467-9280.03437

Richeson, J. A., & Trawalter, S. (2005). Why do interracial interactions impair executive function? A resource depletion account. *Journal of*

Personality and Social Psychology, *88*(6), 934–947. doi: 10.1037/0022-3514.88.6.934

Richeson, J. A., Trawalter, S., & Shelton, J. N. (2005). African Americans’ implicit racial attitudes and the depletion of executive function after interracial interactions. *Social Cognition*, *23*(4), 336–352. doi: 10.1521/soco.2005.23.4.336

Riggs, N. R., Blair, C. B., & Greenberg, M. T. (2003). Concurrent and 2-year longitudinal relations between executive function and the behavior of 1st and 2nd grade children. *Child Neuropsychology*, *9*(4), 267–276. doi: 10.1076/chin.9.4.267.23513

Riggs, N. R., Jahromi, L. B., Razza, R. P., Dillworth-Bart, J. E., & Mueller, U. (2006). Executive function and the promotion of social-emotional competence. *Journal of Applied Developmental Psychology*, *27*(4), 300–309. doi: 10.1016/j.appdev.2006.04.002

Roberts, A. C., Robbins, T. W., & Everitt, B. J. (1988). The effects of intradimensional and extradimensional shifts on visual discrimination learning in humans and non-human primates. *The Quarterly Journal of Experimental Psychology Section B*, *40B*, 321–341. doi: 10.1080/14640748808402328

Rogers, R. D., & Monsell, S. (1995). Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General*, *124*(2), 207–231. doi: 10.1037/0096-3445.124.2.207

Rueda, M. R., Checa, P., & Cómbita, L. M. (2012). Enhanced efficiency of the executive attention network after training in preschool children: Immediate changes and effects after two months. *Developmental Cognitive Neuroscience, 25,* S192– S204. https://doi.org/10.1016/j.dcn.2011.09.004

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2011). Attentional control and self-regulation. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications (2nd ed.).* (2nd ed., pp. 284–299). New York: The Guilford Press.

Rueda, M. R., Posner, M. I., Rothbart, M. K., & Davis-Stober, C. P. (2004). Development of the time course for processing conflict: An event-related potentials study with 4 year olds and adults. *BMC Neuroscience*, *5*. doi: 10.1186/1471.2202-5-39

Rueda, M. R., Rothbart, M. K., McCandliss, B. D., Saccomanno, L., & Posner, M. I. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(41), 14931–14936. https://doi.org/10.1073/pnas.0506897102

Russell, J. (1996). Agency: Its role in mental development. In *Agency: Its role in mental development.* Oxford, England: Erlbaum (Uk) Taylor & Francis, Publ.

Rutland, A. (2013). How do children learn to actively control their explicit prejudice? In M. R. Banaji & S. A. Gelman (Eds.), *Navigating the social world: what infants, children and other* *species can teach us* (pp. 336–340). doi: 10.1093/acprof:oso/9780199890712.003.0062

Rutland, A., Cameron, L., Milne, A., & McGeorge, P. (2005). Social norms and self-presentation: Children's implicit and explicit intergroup attitudes. *Child Development*, *76*(2), 451–466. doi: 10.1111/j.1467-8624.2005.00856.x

Samson, D., Apperly, I. A., Chiavarino, C., & Humphreys, G. W. (2004). Left temporoparietal junction is necessary for representing someone else's belief. *Nature Neuroscience*, *7*(5), 449–500. doi: 10.1038/nn1223

Santamaría, P., Arribas, D., Pereña, J., & Seisdedos, N. (2005). *EFAI, Evaluación factorial de las aptitudes intelectuales*. Madrid: Departamento I + D. TEA Ediciones.

Schulte-Rüther, M., Markowitsch, H. J., Fink, G. R., & Piefke, M. (2007). Mirror neuron and theory of mind mechanisms involved in face-to-face interactions: A functional magnetic resonance imaging approach to empathy. *Journal of Cognitive Neuroscience*, *19*(8), 1354–1372. doi: 10.1162/jocn.2007.19.8.1354

Scisco, J. L., Leynes, P. A., & Kang, J. (2008). Cardiovascular fitness and executive control during task-switching: An ERP study. *International Journal of Psychophysiology*, *69*(1), 52–60. doi: 10.1016/j.ijpsycho.2008.02.009

Sebastian, C. L., Fontaine, N. M. G., Bird, G., Blakemore, S. J., De Brito, S. A., McCrory, E. J. P., & Viding, E. (2012). Neural processing associated with cognitive and affective theory of mind in adolescents and adults. *Social Cognitive and Affective Neuroscience, 7,* 53-63. doi: 10.1093/scan/nsr023

Senn, T. E., Espy, K. A., & Kaufmann, P. M. (2004). Using path analysis to understand executive function organization in preschool children. *Developmental Neuropsychology*, *26*(1), 445–464. doi: 10.1207/s15326942dn2601_5

Shamay-Tsoory, S. G., & Aharon-Peretz, J. (2007). Dissociable prefrontal networks for cognitive and affective theory of mind: A lesion study. *Neuropsychologia, 45*, 3054-3067. doi: 10.1016/j.neuropsychologia.2007.05.021

Shamay-Tsoory, S. G., Aharon-Peretz, J., & Perry, D. (2009). Two systems for empathy: A double dissociation between emotional and cognitive empathy in inferior frontal gyrus versus ventromedial prefrontal lesions. *Brain*, *132*, 617–627. doi: 10.1093/brain/awn279

Shamay-Tsoory, S. G., Harari, H., Aharon-Peretz, J., & Levkovitz, Y. (2010). The role of the orbitofrontal cortex in affective theory of mind deficits in criminal offenders with psychopathic tendencies. *Cortex*, *46*, 668–677. doi: 10.1016/j.cortex.2009.04.008

Sherman, S. J., & Gorkin, L. (1980). Attitude bolstering when behavior is inconsistent with central attitudes. *Journal of Experimental Social Psychology*, *16*, 388–403. doi: 10.1016/0022-1031(80)90030-X

Simon, J. R. (1990). The effects of an irrelevant directional cue on human information processing. *Advances in Psychology*, *65*(C), 31–86. doi: 10.1016/S0166-4115(08)61218-2

Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., & Stine-Morrow, E. A. L. (2016). Do “brain-training” programs work? *Psychological Science in the Public Interest, Supplement*, *17*(3), 103–186. doi: 10.1177/1529100616661983

Sinclair, S., Dunn, E., & Lowery, B. (2005). The relationship between parental racial attitudes and children’s implicit prejudice. *Journal of Experimental Social Psychology*, *41*(3), 283–289. doi: 10.1016/j.jesp.2004.06.003

Sniderman, P. M., Petersen, M. B., Slothuus, R., & Stubager, R. (2014). Paradoxes of liberal democracy: Islam, Western Europe, and the Danish cartoon crisis. In *Paradoxes of liberal democracy: Islam, Western Europe, and the Danish cartoon crisis*. Princeton, NJ: Princeton University Press. doi: 10.1177/0094306116629410jjj

Speltz, M. L., DeKlyen, M., Calderon, R., Greenberg, M. T., & Fisher, P. A. (1999). Neuropsychological characteristics and test behaviors of boys with early onset conduct problems. *Journal of Abnormal Psychology*, *108*(2), 315–325. doi: 10.1037/0021-843X.108.2.315

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. *Developmental Psychology*, *44*, 1764–1778. doi: 10.1037/a0012955

Storey, J. D. (2002). A direct approach to false discovery rates. *Journal of the Royal Statistical Society. Series B: Statistical Methodology*, *64*(3), 479–498. doi: 10.1111/1467-9868.00346

Stuss, D.T., Levine, B., Alexander, M.P., Hong, J., Palumbo, C., Hamer, L., Murphy, K.J., & Izukawa, D. (2000). Wisconsin card sorting test performance in patients with focal frontal and posterior brain damage: Effects of lesion location and test structure on separable cognitive processes. *Neuropsychologia*, *38*, 388–402. doi: 10.1016/S0028-3932(99)00093-7

Tirapu-Ustárroz, J., Pérez-Sayes, G., Erekatxo-Bilbao, M., & Pelegrín-Valero, C. (2007). ¿Qué es la teoría de la mente? *Revista de Neurologia*, *44*(8), 479–489. doi: 10.33588/rn.4408.2006295

Tompkins, V. (2015). Improving low-income preschoolers' theory of mind: A training study. *Cognitive Development*, *36*, 1–19. doi: 10.1016/j.cogdev.2015.07.001

United Nations, Department of Economic and Social Affairs, Population Division (2019). International Migrant Stock 2019 (United Nations database, POP/DB/MIG/Stock/Rev.2019).

Valle, A., Massaro, D., Castelli, I., & Marchetti, A. (2015). Theory of mind development in adolescence and early adulthood: The growing complexity of recursive thinking ability. *Europe's Journal of Psychology*, *11*(1), 112–124. doi: 10.5964/ejop.v11i1.829

Van Dinteren, R., Arns, M., Jongsma, M. L. A., & Kessels, R. P. C. (2014). P300 development across the lifespan: A systematic review and meta-analysis. *PLoS ONE*, *9*(2), 87347. doi: 10.1371/journal.pone.0087347

Van Veen, V., & Carter, C. S. (2002). The tinning of action-monitoring processes in the anterior cingulate cortex. *Journal of Cognitive Neuroscience*, *14*(4), 593–602. doi: 10.1162/08989290260045837

Van Veen, V., Cohen, J. D., Botvinick, M. M., Stenger, V. A., & Carter, C. S. (2001). Anterior cingulate cortex, conflict monitoring, and levels of processing. *NeuroImage*, *14*(6), 1302–1308. doi: 10.1006/nimg.2001.0923

Verbruggen, F., & Logan, G. D. (2008). Response inhibition in the stop-signal paradigm. *Trends in Cognitive Sciences*, Vol. 12, pp. 418–424. doi: 10.1016/j.tics.2008.07.005

Vescio, T. K., Sechrist, G. B., & Paolucci, M. P. (2003). Perspective taking and prejudice reduction: The mediational role of empathy arousal and situational attributions. *European Journal of Social Psychology, 33*, 455-472. doi: 10.1002/ejsp.163

Vetter, N. C., Altgassen, M., Phillips, L., Mahy, C. E. V., & Kliegel, M. (2013). Development of affective theory of mind across adolescence: Disentangling the role of executive functions. *Developmental Neuropsychology*, *38*(2), 114–125. doi: 10.1080/87565641.2012.733786

Visintin, E. P., Brylka, A., Green, E. G. T., Mähönen, T. A., & Jasinskaja-Lahti, I. (2016). The dynamics of interminority extended contact: The role of affective and cognitive mediators. *Cultural Diversity and Ethnic Minority Psychology*, *22*(4), 467–478. doi: 10.1037/cdp0000089

Volpe, U., Mucci, A., Bucci, P., Merlotti, E., Galderisi, S., & Maj, M. (2007). The cortical generators of P3a and P3b: A LORETA study. *Brain Research Bulletin*, *73*(4–6), 220–230. doi: 10.1016/j.brainresbull.2007.03.003

Vu, K. P. L., & Proctor, R. W. (2004). Mixing compatible and incompatible mappings: Elimination, reduction, and enhancement of spatial compatibility effects. *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *57*(3), 539–556. doi: 10.1080/02724980343000387

Wass, S. V., Scerif, G., & Johnson, M. H. (2012). Training attentional control and working memory - Is younger, better? *Developmental Review*, *32*, 360–387. doi: 10.1016/j.dr.2012.07.001

Weimer, A. A., Parault Dowds, S. J., Fabricius, W. V., Schwanenflugel, P. J., & Suh, G. W. (2017). Development of constructivist theory of mind from middle childhood to early adulthood and its relation to social cognition and behavior. *Journal of Experimental Child Psychology*, *154*, 28–45. doi: 10.1016/j.jecp.2016.10.002

Wellman, H. M., & Liu, D. (2004). Scaling of theory-of-mind tasks. *Child Development*, *75*, 523-541. doi: 10.1111/j.1467-8624.2004.00691.x

Welsh, M. C., Pennington, B. F., & Groisser, D. B. (1991). A normative-developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology*, *7*(2), 131–149. doi: 10.1080/87565649109540483

Wessel, J. R. (2018). Prepotent motor activity and inhibitory control demands in different variants of the go/no-go paradigm. *Psychophysiology*, *55*(3), 12871. doi: 10.1111/psyp.12871

West, R., & Alain, C. (1999). Event-related neural activity associated with the stroop task. *Cognitive Brain Research*, *8*(2), 157–164. doi: 10.1016/S0926-6410(99)00017-8

White, S., Hill, E., Happé, F., & Frith, U. (2009). Revisiting the strange stories: Revealing mentalizing impairments in autism. *Child Development*, *80*(4), 1097–1117. doi: 10.1111/j.1467-8624.2009.01319.x

Wiebe, S. A., Espy, K. A., & Charak, D. (2008). Using confirmatory factor analysis to understand executive control in preschool children: I. latent structure. *Developmental Psychology*, *44*(2), 575–587. doi: 10.1037/0012-1649.44.2.575

Williams, A., & Steele, J. R. (2019). Examining children's implicit racial attitudes using exemplar and category-based measures. *Child Development*, *90*(3), e322–e338. doi: 10.1111/cdev.12991

Williams, J. E., Best, D. L., Boswell, D. A., Mattson, L. A., & Graves, D. J. (1975). Preschool racial attitude measure II. *Educational and*

Psychological Measurement, *35*(1), 3–18. doi: 10.1177/001316447503500101

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*, 103-128. doi: 10.1016/0010-0277(83)90004-5

Wolfe, C. T., & Spencer, S. J. (1996). Stereotypes and prejudice: Their overt and subtle influence in the classroom. *American Behavioral Scientist*, *40*(2), 176–185. doi: 10.1177/0002764296040002008

Zelazo, P. D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols*, *1*(1), 297–301. doi: 10.1038/nprot.2006.46

Zelazo, P. D., Frye, D., & Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cognitive Development*, *11*(1), 37–63. doi: 10.1016/S0885-2014(96)90027-1

Zelazo, P. D., Müller, U., Frye, D., Marcovitch, S., Argitis, G., Boseovski, J., Chiang, J., Hongwanishkul, D., Schuster, B., & Sutherland, A. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development*, *68*(3), vii-137. doi: 10.2307/1166202

Zinke, K., Einert, M., Pfennig, L., & Kliegel, M. (2012). Plasticity of executive control through task switching training in adolescents. *Frontiers in Human Neuroscience, 6*, 41. doi: 10.3389/fnhum.2012.00041

Appendix

S.1.1: COGNITIVE AND AFFECTIVE SECOND-ORDER FALSE BELIEF STORIES (MILLER, 2013)

Cognitive theory of mind stories

Soccer

1. Ana and Juan are getting ready to go to soccer practice. They have practice every afternoon after school. They're going to meet at the soccer field with the other players on the team.

2. Ana gets to the soccer field before Juan. When she gets there she sees men working on the field. The coach tells her, "The men are putting in new grass. We can't practice here today. Instead we're going to practice at the park."

3. Ana decides to stop at Juan's house to tell him that practice will be at the park. But before she gets there Juan gets a phone call. It's the coach. The coach tells him, "We can't use the soccer field today – the men are putting in new grass. Soccer practice today will be at the park." Juan says, "OK, see you there."

4. When Ana gets to Juan's house Juan's mom answers the door. She tells Ana, "Juan's not here. He went to soccer practice."

(Turn Picture)

Now Ana did not see that Juan talked to the coach. She did not see that.

Comprehension questions:

Reality Question: Where has Juan gone for soccer practice?

Memory Question: Where was the soccer practice before the men came to work?

Theory of mind questions:

Test Question: Where does Ana think Juan has gone?

Forced Choice: Does Ana think Juan has gone to the soccer field or to the park?

Justification: Why does Ana think Juan is there?

Ice Cream

1. Jorge and Alba are together in the park in the morning. Alba would like to buy ice cream from the man selling it there, but she has left her money at home. “Don’t be sad,” says the ice cream man, “you can fetch your money and buy some ice cream later. I’ll be here in the park in the park in the afternoon too.” “Oh good,” Alba says, “I’ll come back this afternoon then.”

2. After Alba has left, Jorge notices the ice cream man leaving the park. “I’m going to drive my van to the church,” the ice cream man tells Jorge, “There is no one in the park to buy ice cream.”

3. As the ice cream man drives over to the church he passes by Alba’s house. Alba is looking out the window and spots the van. “Hello Alba!” the ice cream man waves, “I’m heading over to the church, hopefully I’ll be able to sell more ice cream there.” Alba says, “It’s a good think I saw you, I’ll meet you there this afternoon.”

4. After lunch Jorge heads over to Alba's house, but she is not home. "She's just left to buy ice cream," Alba's mother says.

(Turn Picture)

Now Jorge did not see that Alba talked to the ice cream man. He did not see that.

Comprehension questions:

Reality Question: Where has Alba gone to buy her ice cream?

Memory Question: Where was the ice cream van in the morning?

Theory of mind questions:

Test Question: Where does Jorge think Alba has gone?

Forced Choice: Does Jorge think Alba has gone to the park or to the church?

Justification: Why does Jorge think Alba is there?

Affective theory of mind stories

<u>Zoo</u>

1. Antonio and María are in the schoolyard before the bell rings and they are very excited. Today their class is taking a trip to the zoo. Antonio likes to go on class trips a lot, but María is extra happy today because she really likes animals.

2. Then Antonio decides to go inside while María plays a game of catch. While Antonio is inside he talks to his teacher. The teacher tells him that the trip to the zoo has been cancelled because the school bus that was going to take them broke down. Antonio goes to find María so he can tell her the bad news.

3. Then, while the teacher is walking around the schoolyard he runs into María. “Are you coming on the zoo trip with us?” María asks. “Haven’t you heard?” says the teacher, “the zoo trip was cancelled because the school bus broke down.” This news makes María very sad because she was looking forward to the trip.

4. Antonio sees María across the schoolyard. He walks over to talk to her.

(Turn Picture)

Now Antonio did not see that María talked to the teacher. He did not see that.

Comprehension questions:

Reality Question: How is María feeling right now?

Memory Question: How was María feeling before she talked to the teacher?

Theory of mind questions:

Test Question: How does Antonio think María is feeling before he finds her?

Forced Choice: Does Antonio think María is feeling happy or sad?

Justification: Why does Antonio think that María is feeling that way?

Vet

1. Andrés goes over to Paula's house because he has some bad news. He is very upset because his dog Toby is very sick. Andrés loves Toby very much so he is very sad. "I'm sorry your dog is sick," says Paula. "I will come over later and visit you to see how you're doing." "I would like that," says Andrés. Then Andrés walks home.

2. Later, Paula starts to head to Andrés's house and on the way she stops into the vet's office to check on Toby. The vet tells Paula that he has good news: Toby is going to be okay! Paula can't wait to get to Andrés's house so she can tell him.

3. Before Paula gets to Andrés's house his phone rings. It's Toby's vet. "Don't worry, Andrés," he says, "Toby's doing much better, he should be well again in no time." This makes Andrés very happy. Toby's going to be okay!

4. Paula hurries over to Andrés's house. She really wants to tell him the news.

(Turn Picture)

Now Paula did not see that Andrés talked to the vet. She did not see that.

Comprehension questions:

Reality Question: How does Andrés feel right now?

Memory Question: How was Andrés feeling when he left Paula's house?

Theory of mind questions:

Test Question: How does Paula think Andrés is feeling as she walks to see him?

Forced Choice: Does Paula think Andrés is feeling sad or happy?

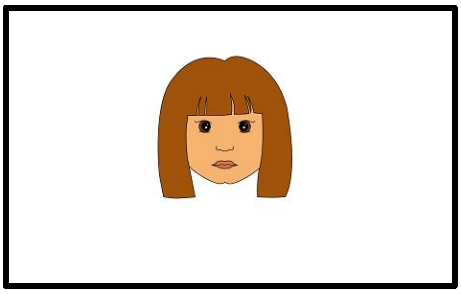
Justification: Why does Paula think Andrés is feeling that way?

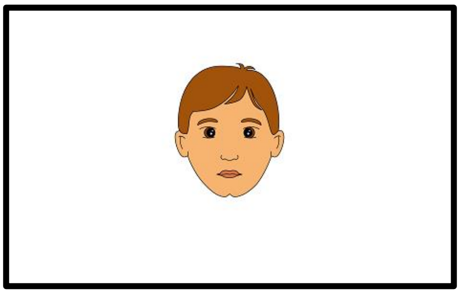
S.1.2: SCALE OF FACES OF THE HIDDEN EMOTION TASK

Scale of faces used in the hidden emotion task. The scale depicted sad (faces 1-3), neutral (face 4) and happy (faces 5-7) emotions. Children received one point if they choose a sad face to describe the character's emotion.

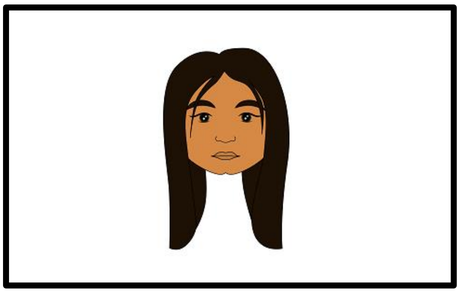
S.1.3: DRAWINGS AND SCALE OF FACES USED IN THE MULTIRRESPONSE RACIAL ATTITUDE TASK (DOYLE & ABOUD, 1995)

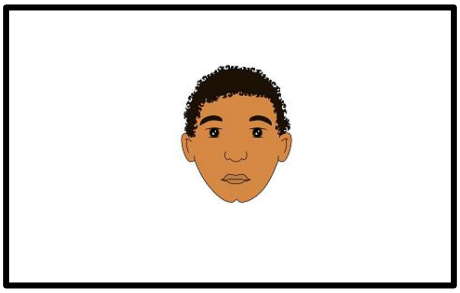
Female and male in-group drawings

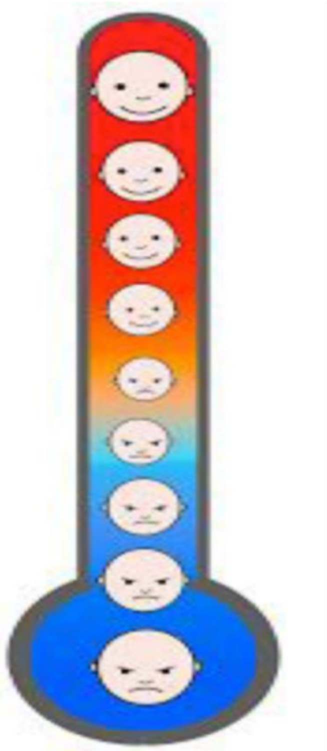




Female and male out-group drawings

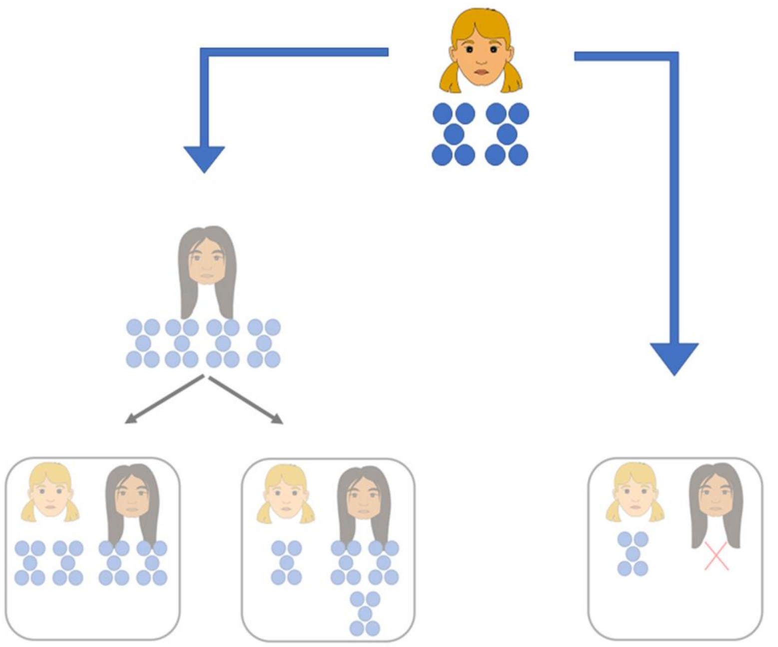






In the inferior half of the thermometer four faces represented, from bottom to top, decreasing anger expressions. The fifth face, located just in the middle of the thermometer, had a neutral expression. The four faces in the superior half included faces with increasing happy expressions.

S.1.4: TRUST GAME: EXAMPLE OF DECISION SCHEME AND DETAILED PROCEDURE



We programmed and presented a computer-based Trust game with the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). Our version of the Trust game is a computer-based simulated interaction in which a non-anonymous trustee is depicted by a gender-matched drawing. Participants were made to believe that they were playing with a child from another school. Children played with a fictitious player from the in-group (Non-Romany) and a fictitious player from the out-group (Romany). The order of in-group and out-group conditions was counterbalanced. In both in-group and out-group conditions, the participant had the role of trustor and the fictitious player had the role of trustee.

The game was presented as a token game where the child could get rewards in exchange of tokens. To foster the child's interest, he/she was shown the rewards and informed that, the more tokens he/she got, the more rewards he/she would obtain. The experimenter informed the child that he/she would play with a child from another school. Then the experimenter told the child: "in order to play, you must choose a character that will depict you and will be shown to the other child. You also have to answer questions about yourself". Afterwards a screen showed two gender-matched characters, one brown-haired and one blonde-haired. Once the child chose a character, the subsequent screen asked about participant's age and ethnicity (Romanian and Non-Romanian). Next, instructions to play were given while displaying a decision scheme were the trustor (i.e., the participant) was depicted by the gender-matched drawing he/she had previously chosen, and the trustee was depicted by a neutral schematic face. The experimenter pointed toward the different game options while providing children with the following verbal instructions: "in this game you will have ten tokens in each turn, and you will have to decide what to do with the ten tokens. You have two options. You can decide not to share your tokens with the other player. In this case, you will get five tokens and the other player will get none. The other option is to share your tokens with the other player; in this case, the other player will have twenty tokens and he/she will decide how to share the tokens. He/she can decide to equally share the tokens (ten for you and ten for him/her), or he/she can decide to share them in this other way: five tokens for you and fifteen for him/her. Do you understand how to play? Have you got any question?" Instructions were repeated if necessary. Next, a screen indicated that information about the other player was available by pressing the spacebar. After a 3-

second interval, a screen displayed the fictitious player's chosen character and age. The game was programmed so that the fictitious player's age matched that of the participant. Whereas in the in-group condition the fictitious player self-identified as a Non-Romay boy/girl, in the out-group condition the fictitious player self-identified as a Romany boy/girl. Now, participants were reminded about the dynamic of the game. Instead of showing the whole decision scheme, the scheme was progressively displayed as explanation of the different options was provided. Moreover, the scheme now displayed participant's and fictitious player's characters. After the explanation, participants were again given the opportunity of asking questions or receiving again the explanation of the game. Next, the game started, and the experimenter indicated the child that it was up to him/her to decide what to do in each trial. In order to minimize the interference of the experimenter in participants' trust decisions, the child played on his/her own while the experimenter was nearby but not paying attention to the child. The game comprised three blocks with six trials each. After the first and second block, a feedback screen informed the tokens the child had got in that block, and the total of tokens the child had got up to then. After the third block, a screen indicated the final amount of tokens and informed the child that he/she could exchange the tokens for gifts.

S.1.5: RESULTS OF ANALYSES WITH PUNISHMENT- AND FORGIVENESS-RELATED INDICES

Table S.1.5.1

One-tailed Spearman correlations between EF, ToM and implicit prejudice. Control variable: IQ.

		Out-group IPun	IPrejPun	Out-group IFor	IPrejFor
		Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Executive function	Conflict resolution efficiency	-.06	-.01	.12# (*ns*,.38)	.06
	Cognitive flexibility efficiency	-.18** (*,.76)	-.10	.02	.04
	Conflict resolution accuracy	.03	-.02	.21** (*,.86)	.01
	Cognitive flexibility accuracy	.12# (*ns*,.38)	-.03	.03	.09
Theory of mind	Test of Emotion Comprehension	.07	.15* (#,.63)	.15* (#,.63)	.02
	Affective theory of mind	.02	.02	.12# (*ns*,.40)	-.02
	Strange Stories	.03	.02	.28*** (**,.99)	-.06

Notes. Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; Out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness

.05 < p < .10, *p < .05, ** p < .01, *** p < .001. q = adjusted p value for multiple comparisons. Power = achieved power.

Table S.1.5.2
One-tailed Spearman correlations between motivation and implicit prejudice. Control variable: IQ.

	Out-group IPun	IPrejPun	Out-group IFor	IPrejFor
	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)	Rho (*q*,power)
Internal motivation	-.08	.00	.06	.06
External motivation	.05	.09	-.08	.07

Notes. q = adjusted p value for multiple comparisons. Power = achieved power

Table **S.1.5.3**
Stepwise regression analyses. DV: Outgroup IFor.

	ΔR^2	Predictors	β	t
Step 1	.07***	Conflict resolution acc	.26	3.56***
Step 2	.03*	Conflict resolution acc	.21	2.84**
		Strange Stories	.18	2.48*

Notes. *$p < .05$; ** $p < .01$; *** $p < .001$

For the dependent variable outgroup index of forgiveness, predictors included were IQ, internal motivation, external motivation, conflict resolution accuracy, TEC, affective ToM and Strange Stories scores. Two Models resulted significant, Model 1, F (1, 181) = 12.67, $p < .001$, and Model 2, F (2, 180) = 9.58, $p < .001$. In Model 1, conflict resolution accuracy was the only significant predictor. In Model 2, both conflict resolution accuracy and Strange Stories scores were significant predictors (see Table S.1.5.3).

S.1.6: ANOVA ON THE DOTS TASK

The effects of age and of the experimental manipulations of block and congruency on performance were tested by performing an ANOVA with Block (Simple vs. Mixed) and Congruency (Congruent vs. Incongruent) as within-subject factors and Age group (preschoolers, third-graders and sixth-graders) as between-subject factor. Composite IQ score was introduced as a covariate. Dependent variables were percentage of errors and median reaction time.

For percentage of errors, a main effect of Composite IQ was found, $F(1, 179) = 7.45$, $p < .01$, $\eta_p^2 = .04$. A main effect of Age group was found, $F(2, 179) = 63.09$, $p < .001$, $\eta_p^2 = .41$. Preschoolers presented overall more errors than third-graders (mean difference = 12.28, $p < .001$) and sixth-graders (mean difference = 13.99, $p < .001$). No significant differences between third-graders and sixth-graders were observed (mean difference = 1.71, $p = .67$). A main effect of Block was also observed, $F(1, 179) = 4.42$, $p < .05$, $\eta_p^2 = .02$. More errors were committed in Mixed block than in Simple blocks (mean difference = 13.20, $p < .001$). We also observed a significant Block by Age group interaction, $F(2, 179) = 6.65$, $p < .01$, $\eta_p^2 = .07$. Within the Simple block, preschoolers had more errors than third-graders (mean difference = 9.47, $p < .001$) and sixth-graders (mean difference = 10.80, $p < .001$). No difference between third-graders and sixth-graders was observed (mean difference = 1.33, $p = .50$). The same pattern was observed within the Mixed block: preschoolers committed more errors than third-graders (mean difference = 15.09, $p < .001$) and sixth-graders (mean difference = 17.18, $p < .001$). Again, third-graders and sixth-graders did not significantly differ in errors (mean difference = 2.09, $p = 1.00$). A significant interaction between Congruency and Age group was also found, $F(2, 179) = 17.94$, $p < .001$, $\eta_p^2 = .17$. Preschoolers had more errors than third-graders and sixth-graders in Congruent (mean difference with third-graders = 9.10, $p < .001$; mean difference with sixth-graders = 8.82, $p < .001$).) and Incongruent trials (mean difference with third-graders = 15.45, $p < .001$; mean difference with sixth-graders = 19.16, $p < .001$). There was not a significant difference between third-graders and sixth-graders neither in Congruent trials (mean difference = .29, $p = 1.00$) nor in Incongruent trials (mean difference = 3.71, $p = .12$). Preschoolers presented more errors in Incongruent than in Congruent trials (mean difference = 6.58, $p < .001$). Third-graders did not significantly differ in errors between Congruent and Incongruent trials (mean difference = .23, $p = .79$). Third-graders had more errors in Congruent than Incongruent trials (mean difference = 3.77, $p < .01$). Finally, a marginally significant effect of Block by Congruency was observed, $F(1, 179) = 3.48$, $p = .06$, $\eta_p^2 = .02$. Participants made more errors in Congruent trials of the Mixed block than in that of the Simple block (mean difference = 19.43, $p < .001$). Similarly, more errors were committed in the Incongruent trials of the Mixed block than in Incongruent trials of the Simple block (mean difference = 6.97, $p < .001$). Within the context of simple block, participants made more errors in Incongruent block than Congruent block (mean difference = 7.25, $p < .001$). However, within the context of the Mixed block, there were more errors in Congruent than in Incongruent trials (mean difference = 5.22, $p < .001$).

Analyses on reaction time revealed a main effect of Age group was found, $F(2, 179) = 47.71$, $p < .001$, $\eta_p^2 = .35$. Preschoolers presented took more time to respond than third-graders (mean difference = 53.46, $p < .001$) and sixth-graders (mean difference = 169.85, $p < .001$). Sixth-graders responded faster than third-graders (mean difference = 116.40, $p < .001$). A main effect of Block was also revealed, $F(1, 179) = 7.87$, $p < .01$, $\eta_p^2 = .04$. Longer reaction times were found in Mixed block than in Simple blocks (mean difference = 139.89, $p < .001$). There was also a main effect of Congruency, $F(1, 179) = 9.32$, $p < .01$, $\eta_p^2 = .05$. Responses to Incongruent trials were slower than to Congruent trials (mean difference = 57.44, $p < .001$). A significant interaction between Congruency and Age group was found, $F(2, 179) = 5.83$, $p < .01$, $\eta_p^2 = .06$. Preschoolers were slower than third-graders and sixth-graders in Congruent (mean difference with third-graders = 42.19, $p < .01$; mean difference with sixth-graders = 156.10, $p < .001$) and Incongruent trials (mean difference with third-graders = 64.72, $p < .001$; mean difference with sixth-graders = 183.61, $p < .001$). Third-graders were slower than sixth-graders in Congruent (mean difference = 113.91, $p < .001$) and Incongruent trials (mean difference = 118.89, $p < .001$. The three age groups were slower in Incongruent than in Congruent trials (mean difference for preschoolers = 74.12, $p < .001$; mean difference for third-graders = 51.59, $p < .001$; mean difference for sixth-graders = 46.61, $p < .001$). Finally, a significant Block by Congruency by Composite IQ was observed, $F(1, 179) = 6.09$, $p < .05$, $\eta_p^2 = .03$. Further regression analyses to split this interaction showed that Composite IQ was a significant predictor of reaction time in Incongruent simple block, $R^2 = .15$, $F(1, 181) = 4.09$, $p = .045$. Greater Composite IQ predicted greater reaction time ($\beta = .15$).

S.1.7: FREQUENCY SCORES ON IDENTIFICATION WITH NON-ROMANY AND ROMANY CHILDREN

Table S.1.7.1
Frequencies of scores for Identification with Non-Romany (N = 193)

Score	*f*	Rel *f*	c*f*	Percentile
8	38	0,20	193	100
7	26	0,13	155	80,31
6	22	0,11	129	66,84
5	29	0,15	107	55,44
4	21	0,11	78	40,41
3	14	0,07	57	29,53
2	13	0,07	43	22,28
1	8	0,04	30	15,54
0	22	0,11	22	11,40

Notes. f = frequency; Rel *f* = relative frequency; c *f* = cumulative frequency.

Table S.1.7.1
Frequencies of scores for Identification with Romany, (N = 193)

Score	*f*	Rel *f*	c*f*	Percentile
8	8	0,04	193	100
7	7	0,04	185	95,85
6	4	0,02	178	92,23
5	17	0,09	174	90,16
4	23	0,12	157	81,35
3	14	0,07	134	69,43
2	16	0,08	120	62,18
1	30	0,16	104	53,89
0	74	0,38	74	38,34

Notes. f = frequency; Rel *f* = relative frequency; c *f* = cumulative frequency.

S.1.8: EXPLORATORY CORRELATIONAL ANALYSES SPLIT BY AGE GROUP

Table S.1.8.1
One-tailed Spearman correlations between EF, ToM and explicit prejudice separated by age group. Control variable: IQ.

			Prejudice	Counter-bias
		Group	Rho (*q*,power)	Rho (*q*,power)
Executive function	Conflict resolution reaction time	5-6	-.24*(*ns*,.58)	.18#(*ns*,.36)
		8-9	.10	-.08
		11-12	-.06	-.09
	Cognitive flexibility reaction time	5-6	-.22*(*ns*,.52)	.16
		8-9	.05	-.08
		11-12	.04	-.10
	Conflict resolution accuracy	5-6	.16	-.13
		8-9	-.11	.06
		11-12	.09	-.02
	Cognitive flexibility accuracy	5-6	.23#(*ns*,.52)	-.21#(*ns*,.44)
		8-9	-.09	.06
		11-12	.11	-.12
Theory of mind	Test of Emotion Comprehension	5-6	-.11	.12
		8-9	.01	.04
		11-12	.21# (*ns*,.35)	-.19
	Affective theory of mind	5-6	-.20# (*ns*,.46)	.13
		8-9	-.10	.16# (*ns*,.51)
		11-12	.22# (*ns*,.40)	-.02
	Strange Stories	5-6	.09	.02
		8-9	-.39*** (***,.99)	.39*** (***,.99)
		11-12	.06	.08

Notes. # .05 < p < .10, *p < .05, *** p < .001. q = adjusted p value for multiple comparisons. Power = achieved power

Table S.1.8.2
One-tailed Spearman correlations between motivation and explicit prejudice separated by age group. Control variable: IQ.

	Group	Prejudice Rho (*q*,power)	Counter-bias Rho (*q*,power)
Internal motivation	5-6	-.16	.07
	8-9	-.01	-.03
	11-12	-.34* (#,.72)	.24# (*ns*,.46)
External motivation	5-6	-.28* (*,.72)	.29* (*,.72)
	8-9	.11	-.14# (*ns*,.39)
	11-12	.01	.14

Notes. # .05 < *p* < .10, **p* < .05. *q* = adjusted *p* value for multiple comparisons.Power = achieved power

Table S.1.8.3

One-tailed Spearman correlations between EF and implicit prejudice separated by age group. Control variable: IQ.

	Group	Out-group IDI Rho (*q*,power)	IIP Rho (*q*,power)	Out-group IPun Rho (*q*,power)	IPrejPun Rho (*q*,power)	Out-group IFor Rho (*q*,power)	IPrejFor Rho (*q*,power)
Conflict resolution reaction time	5-6	-.10	-.10	-.20# (*ns*,.44)	-.13	.03	-.07
	8-9	-.18# (*ns*,.50)	.05	.02	.04	.14	.12
	11-12	-.06	.25# (*ns*,.43)	-.04	-.05	-.19	.23# (*ns*,.37)
Cognitive flexibility reaction time	5-6	.12	.27* (*ns*,.64)	-.27* (*ns*,.64)	-.23# (*ns*,..52)	.18# (*ns*,..36)	-.14
	8-9	-.05	.01	-.13	-.09	.04	.18* (*ns*,.50)
	11-12	-.10	-.12	-.09	.07	-.12	-.03
Conflict resolution accuracy	5-6	-.26* (*ns*,..64)	-.23* (*ns*,..52)	.06	.01	.27* (*ns*,..64)	-.15
	8-9	-.07	.07	.09	.03	.09	.17# (*ns*,.50)
	11-12	.33* (.64)	.14	-.07	-.09	-.22	-.11
Cognitive flexibility accuracy	5-6	.09	-.21# (*ns*,..44)	.16	.07	-.23* (*ns*,..52)	.02
	8-9	-.08	-.11	.14# (*ns*,.38)	-.03	.04	.13
	11-12	-.24# (*ns*,.43)	-.25# (*ns*,.43)	-.13	.20	-.06	-.16

Notes. Out-group IDI: out-group initial distrust index; IIP: index of initial prejudice; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; Out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness
$.05 < p < .10$, *$p < .05$. q = adjusted p value for multiple comparisons. Power = achieved power.

Table S.1.8.4
One-*tailed Spearman correlations between ToM and implicit prejudice separated by age group. Control variable: IQ.*

	Group	Out-group IDI Rho (*q*,power)	IIP Rho (*q*,power)	Out-group IPun Rho (*q*,power)	IPrejPun Rho (*q*,power)	Out-group IFor Rho (*q*,power)	IPrejFor Rho (*q*,power)
Test of Emotion comprehension	5-6	.05	-.06	-.12	-.02	-.20# (*ns*,.46)	.18
	8-9	-.07	.10	.12	.29** (*,.87)	.07	-.01
	11-12	.15	.16	.09	.08	-.20	.15
Affective theory of mind	5-6	-.09	.05	.10	-.02	-.08	.17
	8-9	-.04	-.12	.00	.07	.05	-.03
	11-12	-.14	.05	.06	-.03	-.05	-.04
Strange Stories	5-6	.05	-.10	-.03	-.05	-.12	-.06
	8-9	-.12	-.26** (*,.83)	.09	.01	.10	-.06
	11-12	-.42** (*,.88)	-.14	-.01	.03	.31* (*ns*,.65)	-.06

N*otes.* Out-group IDI: out-group initial distrust index; IIP: index of initial prejudice; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; Out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness
\# .05 < p < .10, *p < .05, ** p < .01. q = adjusted p value for multiple comparisons. Power = achieved power.

Table S.1.8.5

One-tailed Spearman correlations between motivation and implicit prejudice separated by age group. Control variable: IQ.

	Group	Out-group IDI Rho (*q*,power)	IIP Rho (*q*,power)	Out-group IPun Rho (*q*,power)	IPrejPun Rho (*q*,power)	Out-group IFor Rho (*q*,power)	IPrejFor Rho (*q*,power)
Internal motivation	5-6	.01	-.10	-.14	-.27* (*ns*,.66)	-.19# (*ns*,.46)	.11
	8-9	-.06	-.22* (#,.70)	.07	.17# (*ns*,.51)	-.05	.08
	11-12	.34* (#,.72)	.33* (*ns*,.69)	-.29* (*ns*,.56)	.09	-.13	.11
External motivation	5-6	-.05	-.04	.25* (*ns*,.60)	.27* (*ns*,.66)	.16	-.05
	8-9	-.01	-.21* (#,.61)	-.09	-.06	-.15# (.39)	.22* (#,.70)
	11-12	-.19	-.10	.12	.23# (*ns*,.40)	.15	-.10

. *Notes*. Out-group IDI: out-group initial distrust index; IIP: index of initial prejudice; Out-group IPun: out-group index of punishment; IPrejPun: index of prejudice based on punishment; Out-group IFor: out-group index of forgiveness; IPrejFor: index of prejudice based on forgiveness

\# .05 < p < .10, *p < .05. q = adjusted p value for multiple comparisons. Power = achieved power

S.1.9: TRAINING TASKS OF THE EXECUTIVE FUNCTION TRAINING

GAME	TRAINED PROCESS(ES)	DESCRIPTION
PIRATES 	Interference control, inhibitory control and rule-switching	If presented with golden coins, children must choose the bag containing more coins, but if the bag contains silver coins, children must choose the bag with less coins
AQUARIUM 	Interference control, inhibitory control and rule-switching	Select the animal that is identical to some animal of the acuarium, and choose the non-presented animal if none is identical
BOXES 	Working memory	Remember the boxes where the relevant elements are in
WINDOWS 	Working memory	Windows open and close in each trial. You must monitor for repetitions of position or position and color with respect to n-back trials.

GAME	TRAINED PROCESS(ES)	DESCRIPTION
SOUP 	Working memory, visual search	Find the element that is in the soup
ROBOTS 	Interference control, working memory and rule-switching	Robots only take the screws that match their shape. Press or touch the robot when you see a screw that matches the robot's shape. But if the screw is rusted, do not press or touch!
PRAIRIE 	Short-term memory, working memory	Remember 1, 2, 3, 4, 5 or 6 animals. Press the button that exactly matches one of the animals previously displayed. If neither option matches the animal(s), choose the blank button.

S.1.10: EXAMPLE OF THEORY OF MIND TRAINING TASKS

TOM TRAINING - SESSION 5: REGULATION

Trial 1

Story: Raquel's exam

Raquel is in her bedroom, studying for a mathematics exam. She has not paid attention during mathematics lessons and has failed the previous exams. For that reason, the teacher has warned her that she will fail the subject if she continues behaving this way. Now she is studying hard because she does not want to fail again. She has been studying for three days in the afternoon. The following day she does the exam, and believes that she will get a good mark. In the same day the teacher gives the mark: not adequate! The day after Raquel looks very silent and doesn't say 'hello' to her classmate.

Story-Comprehension questions

- How does Raquel feel before knowing the mark and when the teacher gives her the mark?
- In the teacher's opinion, how does Raquel feel after knowing her mark?
- What does her classmate think of Raquel's behavior?
- What could Raquel do in order to feel better? Why by doing this Rachel would feel better?

Vocabulary exercise

- In your opinion, what is the meaning of this line from the story?
" … she <u>believes</u> that she will get a good mark …":
- She knows that she will get a good mark
- She remembers that she will get a good mark
- She **expects** that she will get a good mark
- She understands that she will get a good mark

Feedbacks to the story-comprehension questions:

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), before seeing the mark Raquel feels good because she believes that she will get a good mark. Indeed she has been studying for three days and she thinks she knows everything. Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), when the teacher gives her the mark she feels sad because she realizes that despite she has made a lot of effort this time, she has failed again. She realized that her beliefs about the results of the exam were wrong.

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), the teacher thinks that Raquel is not worried about the result of the exam. The teacher thinks this because she noticed that Raquel did not pay attention during the lessons. Therefore, in the teacher's mind, the result of the exam is not important for Raquel. For these reasons, the teacher thinks that Raquel feels good.

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), the classmate thinks that Raquel is not in a good mood because she does not speak to her. The classmate can imagine that something not pleasant happened to her, and so she is angry or sad.

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), Raquel can do different things to feel better. For example, she can do something she likes. In this way, she will feel a little better as we are happy when we do something we love, as playing with our best friends. To feel better, she could also tell a friend how she feels and why. In this way, the friend can comfort her. In order to feel better, she can also think about pleasant things (for example, she can remember a funny situation of the past, she can think about her pet…). Indeed, if we think about pleasant things we feel good because we start to be focussed on things that we like and distract from the bad situation. For example, Raquel can stop feeling very bad about the mark if she starts to think about pleasant things. Finally, to feel better, Raquel can also reflect in order to understand what has happened. She can ask herself why she has failed again even if she worked hard. In this way, she could detect what she has not understood well of the subject, so she can study it again or ask the teacher for help. If she continues making efforts for the next exam, it is likely that she will pass!

Closing comment on the story:

In this story, Raquel has made a great effort to pass the exam. Sometimes, we made a lot of effort to get something, but at the end we do not get it. As a result, we feel bad and sad. However, as we have discussed, our emotions can change if we do something in order to feel better. We have been speaking about different things one can do in order to feel better. Between them, changing our thoughts, such as thinking about pleasant things is one way to feel better. She can also think about why she has got a bad mark. For example, in this situation Raquel can think that this is the first time that she really makes the effort to understand the subject. Therefore, if she continues paying attention, she will be able to understand it better and better. Moreover when Raquel realises that she has made a great effort, she will also be proud of herself. We have learnt that people can change emotions, even bad and sad emotions and even if the reality remains the same. Emotions depend not only on facts but also on our mind. - Try to remember a situation in which you felt bad. What did you do in order to feel better?

Feedbacks to the Vocabulary exercise:

Of the alternatives, the word that best substitutes "believes" is "expects". "Expecting" means thinking that something will happen. This is what happens to Raquel because she thinks that she will pass the exam after doing it. She expects a good mark.

TOM TRAINING - SESSION 5: REGULATION

Trial 2

Story: Pedro and the cinema

Pedro is a Romani child. It is Friday and Pedro is with his friends at the school break. Jesús, one of the Pedro's friends, tells Pedro that he is going to the cinema this afternoon to see a funny film about animals. Jesús invites Pedro to go with him. Pedro had already heard about the film and he thinks it will be very funny. Pedro comes back home, and asks his parents permission to go to see the film. Pedro's parents tell him that he cannot go to the cinema with his friend today because they have an appointment with the doctor at the same hour that the film is. When Pedro goes to the doctor he doesn't speak.

Story-Comprehension questions

- How does Pedro feel with the idea of going to the cinema? How does Pedro feel when his parents tell him that he cannot go to the cinema?
- In the afternoon, Jesús phones Pedro to tell him the hour to meet for the cinema. Before making the phone call, how does Jesús think that Pedro feels?
- What does the doctor think about Pedro's behaviour?
- Could Pedro do something in order to change his feelings?

Vocabulary exercise

- In your opinion, what is the meaning of this line from the story?

" … he thinks it will be very funny …":

- He knows it will be very funny
- He remembers it will be very funny
- He understands it will be very funny
- He **imagines** it will be very funny

Feedbacks to the story-comprehension questions:

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), Pedro feels happy because he had already heard about the film, and he thought it would be very funny. Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), Pedro feels sad after knowing that he cannot go to the cinema. Pedro feels sad because he really wanted to go to watch the movie and he cannot go anymore.

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), Jesús thinks that Pedro is feeling good. Before making the phone call, Jesús does not know that Pedro cannot go the cinema because of the doctor. So, at that moment Jesús believes that Pedro is happy.

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), the doctor can think different things. We can see that Pedro is not feeling alright and he will think of a reason for this. For example, he can believe that Pedro feels ill. The doctor can think that Pedro does not want to be there. The doctor can think that Pedro does not like to go to the doctor because he is scared of doctors. The doctor can also think that Pedro is shy and doesn't feel confortable with people he doesn't know very well.

- Correct (If the child has given the correct answer) / Wrong (If the child has given the wrong answer), Pedro can do different things to feel better. In order feel better he could do something funny. For example, he can play his favourite game. He can also watch his favourite TV cartoons. Pedro could also feel happier if he visits a friend and play with him. Pedro can also feel better if he thinks about nice things. If he remembers something happy he will feel better. He can remember when he received a gift he really liked. He can remember something funny (e.g., a joke). Indeed, when we think about happy things, we do not pay attention to the things that make us feel bad. If we think about happy things, then we get distracted from the bad things. If we think about happy things, our mind focuses on good and nice things and we do not consider the bad ones. This makes us feel better.

Closing comment on the story:

This story made us reflect on the fact that the things that we do affect our emotions. If we do something that we like we feel happy. Sometimes we cannot do what we want. In addition, sometimes we cannot get what we want. When we do not get what we want we feel angry and sad. For example, in this story, Pedro is in good mood when he thinks that he can go to the cinema. When his parents tell him that he cannot go, he starts to feel bad. He feels angry and sad because he really wanted to go to watch the film but cannot go. Things than happen can make us feel good or bad. Indeed things that happen influence Pedro’s emotions. However, Pedro can also do things to feel better. For example, he can play a funny game. He can also go to play with one friend. We have also learnt that changing our thoughts, such as thinking about pleasant things, is one way to feel better. In this way Pedro can also think about happy things to distract himself. He can remember a funny situation in the past. He can also think about a joke. Controlling our mind and our thoughts is a good way to try to feel better.

Remember a situation in which you felt bad. What happened? Did you do something to try to feel less bad?

Feedbacks to the Vocabulary exercise:

Of the alternatives, the word that best substitutes "thinks" is "imagines". "Imagine" means thinking about the characteristics of something that you do not know yet. This is what Jesús does when he thinks about how the film will be. In doing this, he imagines that the film will be very funny even though he hasn't watched it yet.

S.1.11: FREQUENCY SCORES FOR IDENTIFICATION WITH NON-ROMANY AND ROMANY CHILDREN IN THE WHOLE SAMPLE

Table S.1.11.1
Frequencies of scores for Identification with Non-Romany, (N = 93)

Score	*f*	Rel *f*	c*f*	Percentile
8	14	.15	93	100.00
7	13	.14	79	84.95
6	8	.09	66	70.97
5	18	.19	58	62.37
4	11	.12	40	43.01
3	9	.10	29	31.18
2	10	.11	20	21.51
1	3	.03	10	10.75
0	7	.08	7	7.53

Notes. *f* = frequency; Rel *f* = relative frequency; c *f* = cumulative frequency.

Table S.1.11.2
Frequencies of scores for Identification with Romany, (N = 93)

Score	*f*	Rel *f*	c*f*	Percentile
8	2	.02	93	100.00
7	2	.02	91	97.85
6	1	.01	89	95.70
5	9	.10	88	94.62
4	9	.10	79	84.95
3	9	.10	70	75.27
2	4	.04	61	65.59
1	18	.19	57	61.29
0	39	.42	39	41.94

Notes. f = frequency; Rel *f* = relative frequency; c *f* = cumulative frequency.

S.1.12: PERCENTAGE SCORES FOR CONTACT WITH NON-ROMANY AND ROMANY CHILDREN

Table S.1.12.1
Percentages of reported contact and with Romany, (N = 93)

Group	Contact (%)	
	Yes	No
EF training	52.00	48.00
EF control	54.17	45.83
ToM training	59.09	40.91
ToM control	45.45	54.55

Notes. EF training: executive function training group; EF control: executive function control group; ToM training: theory of mind training group; ToM control: theory of mind control group