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ANXIETY ACROSS DEVELOPMENT:
Temperamental predictors, emotion regulation strategies and attentional mechanisms

-PhD Thesis Abstract-

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Către _____

Vă trimitem rezumatul tezei de doctorat *Anxiety across development: Temperamental predictors, emotion regulation strategies and attentional mechanisms*, autor Ioana Țincaş, teza urmând să fie susținută în vederea obținerii titlului ştiinţific de doctor în psihologie.

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Abstract Contents

Key words: anxiety, development, temperament, effortful control, emotion regulation, attentional networks, perceptual load theory.

Introduction

Anxiety is probably the most common form of emotional problems that can occur during childhood, adolescence and adulthood. Its frequency, as well as its impact upon adaptive functioning, have determined researchers to attempt to find its potential causes, and to better understand its cognitive, behavioral and neurophysiological correlates. Within this context, developmental psychologists have a unique, privileged perspective, since they have the necessary intruments to look at *change*, or, more precisely, to investigate the manner in which factors associated with anxiety interact or modify their importance over the course of development.

The present thesis is an attempt to investigate anxiety from a developmental perspective, by looking – across different developmental samples – at individual differences (in temperament and emotion regulation) that might increase or decrease risk, and by investigating attentional functioning associated with anxiety. The thesis is divided in two parts, corresponding to the two topics investigated. Some of our studies were guided by relatively clear hypotheses, while others had a more exploratory nature. However, all of them have managed to provide some interesting answers to our questions, or at least to generate questions that remain to be tackled in future research.

Chapter 1.
Anxiety in children and adults

Anxiety disorders represent the most prevalent type of psychopathology in children, adolescents and adults. In adults, worldwide 12-month prevalence estimates range between approximately 5.8% (in Europe) and 18.2% (in the USA), while lifetime estimates average 13.6% (in Europe) to 28.8% (in the USA) (Alonso et al., 2004; Demyttenaere et al., 2004; Kessler et al., 2005; see also Miu & Visu-Petra, 2010 for a recent review). In various studies, average prevalence estimates for children and adolescents range between approximately 5% for three-month estimates, 15% for 12-month estimates and 17.2% for lifetime estimates (12-month and lifetime estimates are generated based on adolescent samples; see Bernstein, Borchardt, & Perwien, 1996; Costello, Egger, & Angold, 2004; Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Rapee, Schniering, & Hudson, 2009).

Anxiety refers to a set of behavioral, cognitive and physiological reactions, in response to perceived or expected threats. These reactions are considered excessive from the point of view of the feared stimulus, and they can be disabling to adaptive everyday functioning (Gordon & Hen, 2004; Gross & Hen, 2004). The research literature has taken one of two possible approaches to the conceptualization of anxiety: the clinically-based (categorical) approach or the trait-based approach (see e.g., Miu & Visu-Petra, 2010 for a more extensive discussion of the two

approaches). The clinical approach uses structured, standardized interviews (e.g., *Anxiety Disorders Interview Schedule*: Brown, Di Nardo, & Barlow, 1994; Silverman & Nelles, 1988; Silverman, Saavedra, & Pina, 2001; *Preschool Age Psychiatric Assessment*: Egger et al., 2006) with clear cutoff points to distinguish between the presence or absence of an anxiety disorder in a person (see the current version of the *Diagnostic and Statistical Manual of Mental Disorders*, American Psychiatric Association, 2000 for the main types of anxiety disorders). The second approach conceptualizes anxiety as a *trait* (i.e., a relatively constant predisposition to react or behave in a certain way; see Endler & Kocovski, 2001 for a review). Thus, *trait anxiety* refers to the generalized and enduring predisposition to react with a state of anxiety when encountering even mildly threatening or ambiguous stimuli (Spielberger, 1983). This approach uses questionnaires to assess anxiety symptoms in adults (Endler, Parker, Bagby, & Cox, 1991; Ş. Miclea, Albu, & Ciuca, 2009; Spielberger, 1983) and children (Benga, Ţincaş, & Visu-Petra, 2010; Chorpita, Yim, C. Moffitt, Umemoto, & Francis, 2000; Edwards, Rapee, Kennedy, & Spence, 2010; Spence, 1998; Spence, Rapee, McDonald, & Ingram, 2001).

1.1 Anxiety in children and adults: Development and outcomes

Most anxiety disorders are typically diagnosed starting in middle childhood (see Egger & Angold, 2006a, 2006b; Warren & Sroufe, 2004 for reviews). Therefore, until the 1990s it was typical to consider anxiety as a problem that rarely affected younger children (Rapee et al., 2009). One of the main causes for this reside in the fact that certain types of fears (e.g., of strangers, of animals, storms, imaginary creatures, etc.) constitute a normal part of development during the toddler and preschool years. In addition, some symptoms typical for anxiety in older children and adults might take on a different form in preschoolers (e.g., crying, tantrums, clinging to the caregiver; see Egger & Angold, 2006a), or might not apply at all, while older children, with better verbal abilities, are more capable of describing their symptoms. However, studies have shown that when DSM-based algorithms are used for diagnosis in preschoolers, prevalence and comorbidity of internalizing and externalizing disorders are within the range estimated for older children (Egger & Angold, 2006b; Sterba, Egger, & Angold, 2007).

Whether or not clinically significant, there is currently evidence that continuous variation in anxiety symptoms (i.e., trait anxiety) can be reliably assessed in the general child population (Edwards et al., 2010; Spence et al., 2001), as well as schoolchildren and adolescents (Chorpita, Moffitt, & Gray, 2005; Chorpita et al., 2000; Muris, Merckelbach, Ollendick, King, & Bogie, 2002; Spence, 1997, 1998).

Anxiety disorders are generally more prevalent in women (e.g., American Psychiatric Association, 2000; Hettema, Prescott, Myers, Neale, & Kendler, 2005; Kendler et al., 1995), but data is less clear when it comes to children. In preschoolers, most studies find small or non-significant differences in prevalence or symptom intensity between boys and girls (Costello et al., 2004; Egger & Angold, 2006b; Lavigne et al., 1996; Spence et al., 2001). In older children and adolescents, some studies show higher prevalence or symptom intensity for girls (Chorpita et al., 2000; Costello et al., 2003; Essau et al., 2002; Lewinsohn, Gotlib, Lewinsohn, Seeley, & Allen, 1998; Muris, Meesters, & Knoops, 2005; Spence, 1998), while other studies failed to find significant differences (Canino et al., 2004; Ford, Goodman, & Meltzer, 2003; Nauta et al., 2004).

An early-onset untreated anxiety disorder tends to persist and continue into adolescence and adulthood (Bosquet & Egeland, 2006; Spence, 1998), with negative outcomes for mental

health, as well as social and academic adjustment. Longitudinal studies have found evidence for both homotypic and heterotypic continuity for anxiety, showing that having an anxiety disorder in childhood or adolescence increases the risk for later anxiety disorder, major depression, and substance dependence (Costello et al., 2003; Ferdinand, Dieleman, Ormel, & Verhulst, 2007; Kessler et al., 2005; Rapee et al., 2009; Reef, Diamantopoulou, Van Meurs, Verhulst, & Van Der Ende, 2009; Rutter, Kim-Cohen, & Maughan, 2006; Woodward & Fergusson, 2001). Additionally, some studies have found links between (clinical or trait) anxiety and low academic achievement (e.g., Davis, Ollendick, & Nebel-Schwalm, 2008; Ialongo, Edelsohn, Werthamer-Larsson, Crockett, & Kellam, 1995; Kusche, Cook, & Greenberg, 1993; Owens, Stevenson, Norgate, & Hadwin, 2008). Lastly, in adults anxiety is often accompanied by impairment in quality of life and subjective well-being (e.g., Henning, Turk, Mennin, Fresco, & Heimberg, 2007; Pollack et al., 2008; Rapaport, Fayyad, & Endicott, 2005), as well as cognitive failures and increased risk for accidents in the workplace (see Simpson, Wadsworth, Moss, & Smith, 2005 for a review).

1.2 Conclusion and general characteristics of the thesis

In this chapter, we have introduced the problem of anxiety, by briefly reviewing aspects related to the epidemiology, development, predictors and correlates of anxiety. The rest of the thesis is organized in two parts, focusing on individual difference factors (temperament and emotion regulation strategies) as predictors of anxiety, and on the relationship of anxiety to attention, respectively. Despite its focus on different aspects related to anxiety, there are a few common aspects that run through the whole thesis and should be emphasized here.

First, throughout the thesis we conceptualize anxiety as *trait anxiety*, thus as a dimension that can vary continuously in the general population. However, in reviewing data from different research areas related to anxiety, we will continue to include studies with clinically assessed samples where relevant. For the purpose of conceptual clarity, throughout the thesis we will use the terms "anxiety" or "anxiety symptoms" respectively, when referring to anxiety conceptualized and measured as a trait, and symptoms assessed using a continuous scale. We will reserve terms such as "disorder" or "clinical" for anxiety conceptualized and measured from a clinical perspective. As a consequence of this conceptualization, the assessment of anxiety will be done on a questionnaire basis.

Second, we set out to approach anxiety and variables related to it from a *developmental* perspective. Often, this is understood as research involving children. However, for our approach to be truly developmental, it is not enough to focus on one instance, one "snapshot" from the course of development. Instead, from a methodological point of view, a developmental approach would need to approach the problem either longitudinally (following the same individuals over an extended period of time), or cross-sectionally (assessing, at the same time, different individuals found at different points in their development) (see Robinson, Schmidt, & Teti, 2005 for details on longitudinal and cross-sectional designs). We adopted the second, *cross-sectional approach* in the present thesis. More precisely, we chose to investigate each of our research objectives across three different developmental periods: preschool (3-6/7 years; we only included children aged 4 years or older), middle childhood (6/7-10/11 years) and young adulthood (18-40 years)[1]. Our choice of childhood developmental periods was partly motivated by practical

[1] The only exception to this general design is the last study (Chapter 6), where – due to the difficulty of the task used – we were unable to include preschoolers.

reasons (i.e., anxiety is difficult to asses in children younger than preschoolers, and they would not be able to perform tasks designed to assess some of the attentional mechanisms we were interested in). However, the main reasons for choosing to focus on preschoolers and schoolchildren resided in the fact that they represent stages when essential developments in self-regulatory mechanisms – such as attention, executive functions, control of everyday behavior, self-regulation of emotion – take place (Benga, 2004; Berger, Kofman, Livneh, & Henik, 2007; Crețu, 2006; Davidson, Amso, Anderson, & Diamond, 2006; Eisenberg & Morris, 2002; McCabe, Cunnington, & Brooks-Gunn, 2004; Ruff & Rothbart, 1996; Visu-Petra, 2008). Although our initial intention was to include adolescents as well, we finally decided against it; due to the many complex changes that take place during puberty and adolescence (at the level of brain, cognitive and emotional development; Arnsten & Shansky, 2004; Blakemore & Choudhury, 2006; Casey, Jones, & Hare, 2008), we considered that this age interval might best be tackled in a separate work, which could deal appropriately with all its complexities. As the reader will see, the cross-sectional approach used here does not necessarily involve direct comparisons between the different developmental samples, but rather a focus on how relationships between the variables of interest change from one age period to the next.

Finally, at the level of *statistical methodology*, we attempted to avoid as much as possible the bivariate median-split approach that is frequent in anxiety research, especially when it comes to cognitive correlates of anxiety such as attention. Therefore, our statistical analyses are mostly based on correlation and regression procedures, which preserved the full variability of the data (we only used bivariate median splits in special circumstances – see Chapters 5 and 6 for examples). Our decision was based on several critiques of the bivariate-split approach in the literature, which pointed to the artificial reduction of statistical power, and the risk of generating misleading results (see e.g., Cohen, 1983; Irwin & McClelland, 2003; MacCallum, Zhang, Preacher, & Rucker, 2002).

To summarize, the present thesis investigates potential predictors of anxiety, as well as attentional functioning in anxiety, across three developmental samples: preschool, middle childhood and adulthood. We now turn to the first part of the thesis (Chapters 2 and 3), focusing on temperament and emotion regulation as predictors of anxiety symptoms.

Chapter 2.
Anxiety and individual differences in temperament and emotion regulation

In this chapter, we review temperament and emotion regulation (ER) and their potential links to anxiety, from a developmental perspective emphasizing the period spanning preschool to young adulthood. The purpose of this review is to identify patterns of findings across different developmental periods and to generate hypotheses for research.

2.1 Temperament

While interest in the study of temperament has its roots in Galen's "humoral" theory in modern research, temperament is generally regarded as reflecting biologically based individual differences in behavioral, cognitive, emotional and physiological aspects of reactivity/arousal and self-regulation (Goldsmith et al., 1987; Kagan, 1998; Rothbart, Ahadi, & Evans, 2000).

Most present-day models of temperament converge in their main assumptions (Frick, 2004): (1) temperament is inherited, or at least it has a constitutional (biological) basis; (2) its corresponding behavioral manifestations are observable early in life; and (3) it is relatively stable throughout development. Most research indicates a moderate tendency toward stability in temperamental characteristics (e.g., Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Kagan, Snidman, Kahn, & Towsley, 2007; Pfeifer, Goldsmith, Davidson, & Rickman, 2002).

Currently, there are two theoretical models of temperament that tend to dominate research (see Benga, 2002; Fox, Henderson, Marshall, Nichols, & Ghera, 2005; Pérez-Edgar & Fox, 2005; Rothbart & Bates, 1998 for more extensive reviews that include other models). The first model was initiated by Jerome Kagan and his collaborators (for reviews see Kagan, 2003; Kagan & Snidman, 1991, 1999), and focuses on the concept of *behavioral inhibition to the unfamiliar* (BI) (Kagan, 1998; Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984; Kagan et al., 2007; Reznick et al., 1986). BI is typically assessed in infants and children through laboratory procedures involving observation of the child in different novel contexts or in interactions with unfamiliar adults or peers. In these situations, behaviorally inhibited children tend to display behaviors like motor quieting, long latencies to approach, active avoidance, decreased vocalizations, and increased proximity to caregivers (see also Kagan et al., 1984; Reznick et al., 1986).

The second approach to temperament (the *multidimensional model*), initiated by Mary K. Rothbart (Rothbart et al., 2000; Rothbart & Bates, 1998; Rothbart & Derryberry, 1981), defines temperament in terms of biologically-based individual differences in *reactivity* and *self-regulation*. These two facets of temperament are reflected in individual differences across several lower-order dimensions (or traits), further grouped into higher-order factors (see Table 2.1 for details). This structure of temperament emerged in several factor analysis studies, across different developmental samples, from infants to adults (see Derryberry & Rothbart, 1988; Gartstein & Rothbart, 2003; Putnam, Ellis, & Rothbart, 2001; Putnam, Gartstein, & Rothbart, 2006; Rothbart et al., 2000; Rothbart, Ahadi, Hershey, & Fisher, 2001; Rothbart, 1981). Rothbart's temperament model is more similar to current trait theories of personality (such as the Five-Factor Model – see McCrae & Costa, 1999; McCrae & John, 1992 for details) than Kagan's model. At the highest hierarchical level are the dimensions of *Surgency/Extraversion* (SE; similar to the Extraversion dimension from the Five-Factor Model), *Negative Affect* (NA; according to Rothbart & Bates, 2006 it is somewhat conceptually similar to Neuroticism) and *Effortful Control* (EC; reminiscent of Conscientiousness). The first two dimensions reflect the reactivity aspect of temperament. The third dimension – EC – refers to the ability to inhibit dominant, but inappropriate actions in order to generate a subdominant but more appropriate response, to detect errors and to correct them (Rothbart & Rueda, 2005; Rothbart & Bates, 1998).

Table 2.1

Dimensions and sub-dimensions of the multidimensional model of temperament in preschool, middle childhood and adulthood.

Factor / Scale	Definition	Item examples		
		Preschool (CBQ[a])	**Middle childhood (TMCQ[b])**	**Adulthood (ATQ[c])**
Surgency / Extraversion				
Activity Level	Level of gross motor activity including rate and extent of locomotion.	*Seems always in a big hurry to get from one place to another.*	*Would rather play a sport than watch TV.*	-
Approach / Positive anticipation	Amount of excitement and positive anticipation for expected pleasurable activities.	*Gets so worked up before an exciting event that s(he) has trouble sitting still.*	-	-
High Intensity Pleasure	Amount of pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novelty, and incongruity.	*Likes going down high slides and other adventurous activities.*	*Likes going down high slides or other adventurous activities.*	*When listening to music, I usually like turn up the volume more than other people.*
Positive Affect	Latency, threshold, intensity, duration, and frequency of experiencing pleasure.			*Sometimes minor events cause me to feel intense happiness.*
Shyness*	Slow or inhibited approach in situations involving novelty or uncertainty.	*Often prefers to watch rather than join other children playing.*	*Becomes self conscious when around people.*	-
Sociability	Enjoyment derived from social interaction and being in the presence of others.	-	-	*I would enjoy a job that involves a lot of social interaction.*
Affiliation	The desire for warmth and closeness with others.	-	*Places great importance on friends.*	-
Impulsivity	Speed of response initiation.	*Usually rushes into an activity without thinking about it.*	*Tends to say the first thing that comes to mind, without stopping to think about it.*	

Negative affect				
Fear	Amount of negative affect, including unease, worry or nervousness related to anticipated pain or distress and/or potentially threatening situations.	*Is not afraid of large dogs and/or other animals.***	*Is scared of injections by the doctor.*	*Sometimes, I feel a sense of panic or terror for no apparent reason.*
Anger / Frustration	Amount of negative affect related to interruption of ongoing tasks or goal blocking.	*Has temper tantrums when s(he) doesn't get what s(he) wants.*	*Gets angry when called in from play before s/he is ready to quit.*	*I rarely become annoyed when I have to wait in a slow moving line.*
Sadness	Amount of negative affect and lowered mood and energy related to exposure to suffering, disappointment, and object loss.	*Cries sadly when a favorite toy gets lost or broken.*	*Her/his feelings are easily hurt.*	*Sometimes minor events cause me to feel intense sadness.*
Discomfort	Amount of negative affect related to sensory qualities of stimulation, including intensity, rate or complexity of light, movement, sound, and texture.	*Is not very bothered by pain.***	*Is bothered by light or color that is too bright.*	*Very bright colors sometimes bother me.*
Soothability / Falling Reactivity*	Rate of recovery from peak distress, excitement, or general arousal.	*Has a hard time settling down for a nap.*	*Has a hard time settling down after an exciting activity.*	-

Effortful Control				
Inhibitory Control	The capacity to suppress inappropriate approach behavior.	*Can lower his/her voice when asked to do so.*	*Has an easy time waiting to open a present.*	*It is easy for me to hold back my laughter in a situation when laughter wouldn't be appropriate.*
Attentional Focusing	Tendency to maintain attentional focus upon task-related channels; resistance to distraction.	*When picking up toys or other jobs, usually keeps at the task until it's done.*	*When working on an activity, has a hard time keeping her/his mind on it.***	*When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.*
Attentional Shifting	The ability to transfer attentional shifting from one activity to another.	*Can move easily from one activity to another.*	-	*When interrupted or distracted, I usually can easily shift my attention back to whatever I was doing before.*
Activation control	The ability to perform an action when there is a strong tendency to avoid it.	-	*Can make him/herself do homework, even when s/he wants to play.*	*I can make myself work on a difficult task even when I don't feel like trying.*
Low Intensity Pleasure	Amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty, and incongruity.	*Rarely enjoys just being talked to.*	*Likes the crunching sound of leaves in the fall.*	-
Perceptual Sensitivity	Amount of detection of slight, low intensity stimuli from the external environment.	*Notices the smoothness or roughness of objects s(he) touches.*	*Notices small changes in the environment, like lights getting brighter in a room.*	-

* Sub-dimension with negative loading on its corresponding higher-order dimension.

** Reverse-coded item.

[a] *Children's Behavior Questionnaire* (Rothbart et al., 2001; see also Benga, 2004 for the Romanian version).

[b] *Temperament in Middle Childhood Questionnaire* (Simonds, 2006).

[c] *Adult Temperament Questionnaire* (Derryberry & Rothbart, 1988; Evans & Rothbart, 2007; Rothbart et al., 2000).

2.1.1 Temperament and anxiety

In what follows, we attempt to draw a few tentative conclusions related to the temperament–anxiety link and its specificity. The studies reviewed for this purpose include at least one measure of temperament and one diagnostic measure for anxiety or internalizing symptoms (administered either concurrently, or at a later time point, with respect to the assessment of temperament). We included studies that assess internalizing problems as well as anxiety, because when it comes to children (especially preschoolers) these tend to dominate. The samples involve children, adolescents and young adults.

2.1.1.1 Behavioral inhibition and anxiety

Several studies indicate that being categorized as behaviorally inhibited in infancy significantly increases the risk for an anxiety disorder later in life (in adolescence or adulthood). BI is most clearly linked to social anxiety (Biederman et al., 2001, 1990; Hayward, Killen, Kraemer, & Taylor, 1998; Hirshfeld et al., 1992; Muris & Meesters, 2002; Schwartz, Snidman, & Kagan, 1999). However, other evidence indicates that BI might be a more general predictor, increasing the risk for anxiety disorders *in general* (Biederman et al., 1993; van Brakel, Muris, Bögels, & Thomassen, 2006; Muris, Merckelbach, Wessel, & van de Ven, 1999; Shamir-Essakow, Ungerer, & Rapee, 2005), or even depression (Caspi, Moffitt, Newman, & Silva, 1996; Muris, Merckelbach, Schmidt, Gadet, & Bogie, 2001).

2.1.1.2 NA and EC: The multidimensional model and anxiety

Research investigating temperament–anxiety links from the perspective of the multidimensional model has focused mainly on two of the three dimensions proposed by Rothbart and collaborators: NA and EC.

Negative Affect. Research has consistently found clear links between high NA and high anxiety in studies involving adults (e.g., Clements & Bailey, 2010; Moriya & Tanno, 2008) in children and adolescents from clinical and community samples, with ages ranging from 6 to 18, using both concurrent (Chorpita, 2006; Lonigan, Carey, & Finch, 1994; Lonigan, Hooe, David, & Kistner, 1999; Tully, Zajac, & Venning, 2009) as well as longitudinal measurements (Lonigan, Phillips, & Hooe, 2003). Moreover, improvement after treatment in clinically anxious patients is related to low baseline NA scores (Clark, Watson, & Mineka, 1994).

Effortful Control. Recent years have witnessed an increasing interest in the role of EC in the development of anxiety, suggesting that anxiety vulnerability is associated with high levels of NA and low levels of EC (Nigg, 2006). More precisely, this implies that – due to its self-regulatory aspects – EC might act as a protective factor, diminishing the risk for anxiety even in individuals with relatively high levels of NA. Most current research investigating this possibility tends to conceptualize EC as composed only of attentional control (focusing and shifting) and inhibitory control. Sub-dimensions like perceptual sensitivity or low intensity pleasure (Putnam & Rothbart, 2006; Rothbart et al., 2001) are typically excluded as they do not represent "pure" aspects of self-regulation.

It has been suggested that the contributions of NA and EC might be either *additive* (i.e, high levels of NA and/or low levels of EC independently predict high anxiety) or *interactive* (EC acts as a moderator of the NA-anxiety link; i.e., even if someone has high levels of NA, a

high EC protects them from vulnerability to anxiety) (Lonigan & Phillips, 2001; Muris & Ollendick, 2005).

Research involving adults has offered support for the additive hypothesis, finding negative correlations / regression slopes between EC (or its sub-dimensions) and anxiety (Clements & Bailey, 2010; Derryberry & Reed, 2002; Moriya & Tanno, 2008). However, to our knowledge, there is no research in adults that has actually tested the interactive hypothesis. Similar results – supporting the additive hypothesis – have been obtained in children aged 7 years or older (Meesters, Muris, & Rooijen, 2006; Muris, Mayer, Lint, & Hofman, 2008; Muris, Pennen, Sigmond, & Mayer, 2008; Oldehinkel, Hartman, Ferdinand, Verhulst, & Ormel, 2007). However, research involving children has also found support for the interactive hypothesis (Meesters et al., 2006; Muris, 2006; Oldehinkel et al., 2007). Thus, while it seems that NA and EC are reliable predictors of anxiety/internalizing problems in children and adults, it is not clear at present whether the contributions of the two temperamental traits are additive, interactive or both. In preschoolers, data is rather mixed: while some research shows that children internalizing problems are associated with lower levels of EC (De Pauw, Mervielde, & Van Leeuwen, 2009; Eisenberg et al., 2001, 2005, 2004; Lemery, Essex, & Smider, 2002), there are also studies showing a link between high EC (especially inhibitory control) and high internalization (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Murray & Kochanska, 2002; Thorell, Bohlin, & Rydell, 2004).

2.2 Emotion regulation

The past decade has witnessed an impressive increase in interest for the topic of emotion regulation (ER), in the research focusing on adult functioning (see e.g., Gross, 1998, 2007). However, ER research has a longer history within developmental psychology, dating back at least to the pioneering work of Claire B. Kopp (1989; see also Campos, Campos, & Barrett, 1989). According to one often cited current definition of ER, the construct incorporates a multitude of extrinsic and intrinsic processes, which help modulate the characteristics of emotional responses (in terms of their intensity and timing), with more or less adaptive ends (Thompson, 1994; Thompson et al., 2008). More precisely, through ER, emotional responses can be initiated, prevented or changed, by selecting or modifying the relevant situation, by attending selectively to different aspects of a situation, by changing the interpretation of the situation or by modulating one's behavioral responses to it (Eisenberg et al., 2007; Eisenberg & Morris, 2002; Gross, 1998).

2.2.1 ER and anxiety

The recent interest in ER as related to anxiety was elicited by the potential of ER skills to contribute to the maintenance or extinction of anxiety (Cisler, Olatunji, Feldner, & Forsyth, 2010), as well as the possibility for creating interventions for clinical anxiety by targeting ER (Campbell-Sills & Barlow, 2007; Hannesdottir & Ollendick, 2007; Mennin, 2004; Mennin, Heimberg, Turk, & Fresco, 2002).

Some of the few studies conducted thus far in adults have used a taxonomy of ER strategies proposed by Gross (1998). This research indicates that individuals with clinical anxiety and mood disorders find negative emotions less acceptable (Campbell-Sills, Barlow, Brown, & Hofmann, 2006), are more likely to use suppression to regulate negative affect (Amstadter, 2008; Campbell-Sills et al., 2006), and this is true especially in the case of women

(Campbell-Sills et al., 2006). Working with a different set of ER strategies, other studies found small-to-moderate relationships between ER strategies such as self-blame, rumination and catastrophizing, and high scores of anxiety and/or depression symptoms in adults and adolescents (Garnefski et al., 2001; Garnefski & Kraaij, 2007; Garnefski, Kraaij, & van Etten, 2005; Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002; Kocovski, Endler, Rector, & Flett, 2005; Wong & Moulds, 2009). On the other hand, positive reappraisal and distraction were significantly related to low anxiety and depression scores.

In children and adolescents, most of the earlier coping literature shows that "engagement coping" (such as problem solving, cognitive reappraisal, support seeking, etc.) are related to lower levels of internalizing problems while "disengagement coping" strategies (such as denial or avoidance) are linked to higher internalization (Ebata & Moos, 1991; Herman-Stabl et al., 1995 see also Compas et al., 2001 for a review). Recent ER research tends to confirm these findings. As discussed previously, adolescents with high anxiety or depression tend to report using self-blame, rumination and catastrophizing to a high degree and positive reappraisal to a low degree (Garnefski et al., 2001, 2002, 2005). Additionally, these maladaptive ER strategies mediate the link between NA and anxiety (Tortella-Feliu et al., 2010), perhaps by amplifying and maintaining negative emotionality. Other recent research, conducted with children aged 10-17 and focusing on clinical anxiety, supports these general conclusions (Carthy, Horesh, Apter, Edge, & Gross, 2010; Carthy, Horesh, Apter, & Gross, 2010): anxious children use problem-solving and cognitive reappraisal strategies less frequently (in everyday life or in laboratory situations), they are less effective in using reappraisal to reduce negative affect, and are more likely to use avoidance and help-seeking in everyday life.

In the case of pre-adolescent children, there has been plenty of research linking ER to social competence and adjustment, but research linking ER to anxiety is relatively scarce. There is some evidence to indicate that global deficits in ER (i.e., emotional dysregulation) are linked to internalizing (or mixed) problems in preschool (Calkins, Graziano, & Keane, 2007; Cole et al., 1996; Rubin et al., 1995) and middle childhood (Rydell, Berlin, & Bohlin, 2003). Additionally, a recent study involving 3-4 year-olds (Blair, Denham, Kochanoff, & Whipple, 2004) found that constructive coping (e.g., instrumental coping, cognitive restructuring) significantly predicted reduced internalizing symptoms, while frequent use of emotional venting (crying to release frustration, crying to attract an adult's attention) and aggressive coping (verbal or instrumental aggression) significantly predicted externalizing problems. Blair and collaborators also found that the link between EC and internalizing behavior was moderated by passive coping (denial, distraction, avoidance) in boys and by constructive coping in girls.

Thus, as our short review indicates, research focusing on adolescents and adults has found relatively specific ER strategies linked to anxiety (although in some cases they overlap with depression – see Garnefski's findings). However, in the case of children the data is more scarce and much less clear, especially since many studies have focused on outcomes such as social competence or internalizing problems in general, and have not investigated anxiety in particular.

Chapter 3.
Anxiety and individual differences: Empirical studies

In the present chapter we focused on investigating the roles played by temperamental characteristics (more precisely NA and EC) and ER strategies in predicting the intensity of anxiety symptoms in children and adults. As stated in Chapter 1, we focused on three developmental samples: preschoolers, schoolchildren (middle childhood) and adults.

Our first objective was to investigate the role of temperament in the development of anxiety, from the perspective of the multidimensional model reviewed in Chapter 2. As already discussed, part of the literature focusing on the temperament–anxiety link has generated two different (but not necessarily incompatible) hypotheses regarding the roles of NA and EC in anxiety, namely the "additive" and the "interactive" hypothesis (e.g., Lonigan & Phillips, 2001; Muris & Ollendick, 2005). We were interested in investigating both of these hypotheses in the present chapter. If the additive hypothesis were correct, we would expect both NA and EC to be significant independent predictors of anxiety, and we would expect to find a positive relationship between NA and anxiety, and a negative one between EC and anxiety. If the interactive hypothesis were correct, we would expect the interaction between NA and EC to be a significant predictor of anxiety symptoms. Since previous studies have sometimes used sub-dimensions of EC (most notably attentional control) as predictors, we checked the involvement of these sub-dimensions as well. However, the primary focus was on EC as a global dimension.

Our second objective was to investigate the role of ER strategies in anxiety. Here, we were interested to determine which ER strategies were more likely to be linked to anxiety, but we also wanted to determine whether ER strategies played a more complex role in predicting anxiety symptoms. For this reason, we decided to test whether some ER strategies might act as mediators or moderators of the relationship between temperamental NA and anxiety. The first possibility is justified by the fact that higher levels of NA might elicit more intense regulatory efforts (see e.g., Decker, Turk, Hess, & Murray, 2008 for supporting evidence in adults). To the extent that such efforts are maladaptive they might result in an intensification of NA and thus plausibly an increase in anxiety symptoms. On the other hand, some ER strategies might also act as moderators of the NA–anxiety link, either by reducing, or enhancing the relationship between the two variables.

A third and somewhat secondary objective was to determine whether the patterns of predictors we found for anxiety were specific, or whether they would also apply to depression. This approach would allow us to determine whether it was justified to group the two types of emotional problems into one "internalizing" variable, or whether it was more productive to study them separately. Since a depression measure was not available for preschoolers, specificity was only investigated in schoolchildren and adults.

Since some previous studies showed gender differences in EC and ER, we decided to conduct the analyses both at a whole-sample level, as well as separately for male and female groups.

3.1 Study 1A: Predictors of anxiety in preschoolers

3.1.1 Method

3.1.1.1 Participants and procedure

The children included in this study came from two kindergartens in Cluj-Napoca, and were selected based on informed consent given by parents. The final sample consisted of 119 children (59 girls) aged 4-7 years (M = 66.50 months; SD = 10.82; range = 48-87 months).

3.1.1.2 Measures

Anxiety

The Romanian version of the *Spence Preschool Anxiety Scale* (SPAS; Spence, Rapee, McDonald, & Ingram, 2001; see Benga, Ţincaş, & Visu-Petra, 2010 for the Romanian version) was used as a measure of anxiety symptoms. The SPAS is a caregiver-report instrument composed of 28 items[2], with responses given on a 0-4 scale, where 0 = *not true at all* and 4 = *very often true*. The items assess problems related to five types of anxiety disorders: generalized anxiety (5 items; e.g., "Spends a large part of each day worrying about various things"), social anxiety (6 items; e.g., "Is afraid of talking in front of the class (preschool group)"), obsessive-compulsive disorder (5 items; e.g., "Washes his/her hands over and over many times each day"), physical injury fears (7 items; e.g., "Is afraid of insects and/or spiders"), and separation anxiety (5 items; e.g., "Is reluctant to go to sleep without you or to sleep away from home"). Scale and total scores are computed by summing responses to the relevant items. We only used the total score for the current analysis. The SPAS was shown to have an adequate structure and validity indices on the original sample (see Spence et al., 2001). The Romanian version of the SPAS has a good (or at least acceptable) internal consistency, as indicated by an analysis including 812 children, which found a Cronbach's α coefficient of .87 for the total scale, and α values ranging between .60 and .77 for the sub-scales (Benga et al., 2010). We only used the total score in the present analyses; in the current sample, the α coefficient for the total scale was .85.

Temperament

Parents were administered the Romanian version of the *Children's Behavior Questionnaire* (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001; see Benga, 2004 for the Romanian version), a 195-item caregiver-report instrument designed to measure 15 temperament dimensions reflecting aspects of behavioral/emotional reactivity and self-regulation (see Table 2.1 in Chapter 2 for details and item examples). The questionnaire asks parents to rate their child on a seven-point scale, ranging from 1 (*extremely untrue of your child*) to 7 (*extremely true of your child*). Scale and factor scores are obtained by computing the average score for items belonging to that scale or factor. Adequate internal consistency indices were reported for the original CBQ scales (Rothbart et al., 2001). For the purposes of the present study, we used the NA (Fear = 12 items, Sadness = 12 items, Anger/Frustration = 13 items), and the EC (Attentional control = 15 items, and Inhibitory control = 13 items) factors. As can be seen, we did not use all scales postulated by Rothbart et al. (2001) as belonging to that factor. This decision was made, on the one hand, because in most of the research linking temperament to emotional or behavioral problems these two factors are used in this manner (e.g., Eisenberg et al., 2001), and on the other hand, due to the fact that – computed in this manner – they represent purer measures of NA and EC (for example, the Soothability dimension included in NA represents a measure of self-regulation of negative affect rather than pure negative emotionality).

On an initial Romanian validation study involving 676 4-7-year-old children (Benga, 2004), the CBQ scales used here were reported to have Cronbach's α values ranging between .61 and .86 in 4- to 7-year-old children. In the current sample, internal consistency indices for the sub-scales were as follows: Fearfulness (α = .67); Sadness (α = .60); Anger/Frustration (α = .77), Attentional control (α = .62), and Inhibitory control (α = .80). The higher-order factors of NA and EC had α values of .80 and .82, respectively.

Emotion regulation

[2] The SPAS contains six additional items referring to symptoms of PTSD, which were not included in the present analysis.

In order to assess children's ER strategies, we translated Eisenberg's *Children's Coping Styles Questionnaire* (CCSQ; Eisenberg et al., 1993, 1995). Parents were presented with three hypothetical interpersonal conflict situations, which usually elicit negative emotions in preschool children. For each of these hypothetical scenarios, they were asked to rate, on a seven-point scale, the likelihood that their child would engage in each of ten possible responses: (1) *Cognitive restructuring* (thinking about the situation in a positive way), (2) *Distraction* (doing something else to forget about the problem), (3) *Emotional aggression* (using physical or verbal aggression to release negative feelings), (4) *Venting* (crying to release negative feelings), (5) *Emotional support* (seeking the emotional support of an adult), (6) *Avoidance* (staying away from or leaving the situation), (7) *Emotional intervention* (crying to elicit the intervention of an adult), (8) *Instrumental coping* (taking constructive action to change the situation), (9) *Instrumental aggression* (trying to solve the problem through physical or verbal aggression) and (10) *Doing nothing*. Scores for each ER strategy were computed by averaging parents' responses to that strategy for each of the three situations.

Eisenberg et al. (1993) combined the items into three factors (constructive coping, emotional venting, and passive coping), based on theoretical considerations and item intercorrelations. We decided to generate the different ER factors starting from an empirical basis. We conducted a principal components analysis using Varimax rotation over the ten ER strategies. A number of 114 participants were included in this analysis. The Keiser-Meyer-Olkin measure of sampling adequacy was .68, while Bartlett's test of sphericity resulted in a $\chi^2 = 249.43$, $p < .001$, indicating the adequacy of factor analysis for this data. We obtained four factors accounting for 67.44 % of the total variance. The first factor accounted for 28.34% of the total variance and included the strategies of Cognitive restructuring (loading = .82), Distraction (.76) and Instrumental coping (.71). We therefore named this factor *Active ER*. The second factor (accounted variance = 17.21%) loaded highly on Instrumental aggression (.85) and Emotional aggression (.84), and was therefore termed *Aggressive ER*. The third factor was composed of Emotional intervention (.75), Avoidance (.73) and Venting (.66). We therefore chose to name it *Passive ER*. The last factor (10.00 %) included only Emotional support (.95) and was therefore not involved in the current analysis. "Doing nothing" loaded weakly on both Aggressive regulation (-.34) and Active regulation (.32) and was therefore not used in the analyses included in this study. Thus, the final ER dimensions were as follows: (1) Active ER (Cognitive restructuring, Distraction, Instrumental coping; $\alpha = .79$); (2) Passive ER (Emotional intervention, Avoidance, Venting; $\alpha = .82$); (3) Aggressive ER (Emotional aggression, Instrumental aggression; $\alpha = .85$); and (4) Emotional support ($\alpha = .79$).

3.1.2 Results

3.1.2.1 Temperamental predictors of anxiety

We investigated the additive and interactive contributions of NA and EC through hierarchical regression analyses according to the guidelines put forward by Aiken and West (1991; see also Cohen, Cohen, West, & Aiken, 2003; Sava, 2004). All predictor variables (NA, EC, Inhibitory control, Attentional control) were first centered, and two-way interaction terms were computed as the multiplicative products of these centered variables. Each analysis was conducted both at the level of the entire sample, as well as separately for boys and girls. Gender and age in months were first entered into each equation in order to partial out their effects (only age was entered in the first step for the gender-split analysis). NA was entered in the second step, followed (in the third step) by the potential moderator (EC, Inhibitory control, or Attentional control). The multiplicative term was entered in the fourth step. Effect sizes were computed according to Cohen's f^2 formulas for multiple regression and hierarchical multiple regression, respectively[3] (see Cohen, 1992). For space saving reasons, we will only present the analyses that generated significant results.

The predictor that explained most of the variance was NA: after accounting for the effect of gender and age, it added 21% ($f^2 = 0.32$) in the total sample, 11% ($f^2 = 0.13$) in the

[3] By convention, f^2 values of 0.02, 0.15, and 0.35 are considered small, medium, and large effects respectively (Cohen, 1992).

case of boys, and 27% (f^2 = 0.53) in the case of girls, with relatively steep slopes in all cases. EC was a direct predictor of Anxiety scores in the full sample (β = .18, p < .05), indicating that children with better EC skills were somewhat more anxious. However, this effect was small (f^2 = 0.05), explaining only an additional 3% when added in the third step of the analysis. EC was not a significant moderator of the NA–Anxiety relationship. The interaction term added only 1% (f^2 = 0.02) or less to the amount of explained variance.

Attentional control was neither an independent predictor, nor a moderator of the relationship between NA and Anxiety. However, as an independent predictor Inhibitory control contributed a small but significant amount of explanatory value to the model, and predicted *higher* anxiety scores in the case of the total sample (ΔR^2 = .03; f^2 = 0.05; β = .17, p < .05) and in the case of girls (ΔR^2 = .05; f^2 = 0.11; β = .23, p < .05), but not in the case of boys (ΔR^2 = .01; f^2 = 0.01; β = .06, *ns*). When adding the NA × Inhibitory control term we found a small moderating effect in the girls sub-sample (ΔR^2 = .03; f^2 = 0.07; β = .19, p < .05); this effect was smaller and non-significant in the full sample (ΔR^2 = .01; f^2 = 0.02; β = .10, *ns*) and in the case of boys (ΔR^2 = .00; f^2 = 0; β = .06, *ns*).

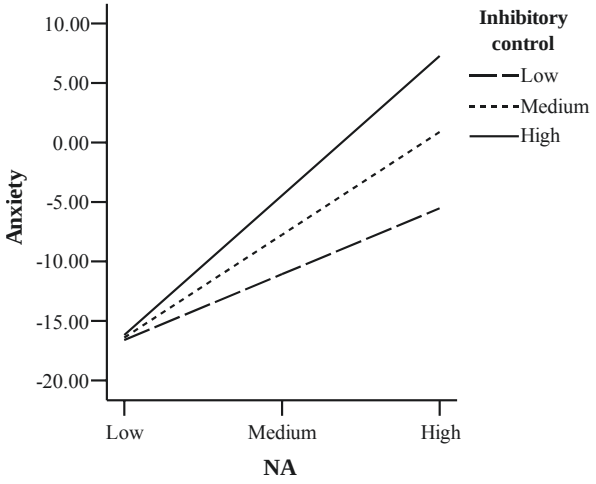

Figure 3.1. Interaction between NA and Inhibitory control in predicting Anxiety in the girls sub-sample.

We probed the NA × Inhibitory control interaction found in the girls' sub-sample by computing slopes for the mean level of Inhibitory control, as well as for values 1 SD above and 1 SD below the mean (see Aiken & West, 1991 or Cohen et al., 2003 for details). Slope statistical tests were carried out using ModGraph (Jose, 2008). The slope of the regression line was statistically significant at medium [t(55) = 2.93, p < .01] and high [t(55) = 5.56, p < .001] levels of Inhibitory control, but not at low values [t(55) = 0.44, *ns*]. As these results and Figure 3.1 indicate, NA significantly predicts anxiety only at medium and high levels of Inhibitory control.

3.1.2.2 ER and Anxiety

Anxiety was related to high Passive ER tendencies at the level of the total sample (r = .26, p < .05) and in the case of boys (r = .32, p < .05) but not girls (r = .22, *ns*). Out of the three Passive ER strategies, Venting was associated with Anxiety in the total sample (r = .22, p < .05) and in girls (r = .29, p < .05), while Emotional intervention was linked to high anxiety in the full sample (r = .24, p < .05) and in boys (r = .30, p < .05). None of the other three types of ER strategies were significantly related to Anxiety.

Mediation analysis. We tested whether Passive ER strategies mediated the link between NA and Anxiety. We carried out the mediation analysis according to the classic steps put forward by Baron and Kenny (1986), which entail (1) showing that NA significantly predicts Anxiety, (2) showing that NA predicts Passive ER and (3) showing that the relationship between NA and Anxiety becomes non-significant (or at least it is significantly reduced) when adding Passive ER to the equation. We tested the statistical significance of the indirect effect using the Sobel test (see MacKinnon, 2008; Preacher & Hayes, 2004 for details, and for arguments for the use of significance tests in mediation analysis). Results of the three steps of the mediation analysis are presented in Table 3.1. As the table shows, adding Passive ER to the regression equation did not cancel the effect of NA (in any of the samples investigated), nor did it significantly reduce it. Additionally, the Sobel test was not statistically significant, indicating that there was no significant reduction of the effect of NA when Passive ER was added. Thus, Passive ER does not mediate the effect of NA upon Anxiety.

Table 3.1

Results for the three steps testing the mediation of the relationship between NA and Anxiety by Passive ER in the preschool sample.

Step	Total sample			Boys			Girls		
	B	SE B	β	B	SE B	β	B	SE B	β
(1) NA → Anx	11.82	1.96	.49***	6.99	2.95	.31*	15.08	2.60	.61***
(2) NA → PER	0.90	0.19	.41***	0.95	0.32	.38**	0.86	0.24	.45**
(3) NA → (PER) → Anx	R^2 = .23; p < .001			R^2 = .11; p = .06			R^2 = .36; p < .001		
NA → Anx	10.69	2.22	.45***	4.59	3.50	.20	14.64	2.85	.62***
PER → Anx	0.53	1.01	.05	1.82	1.39	.19	-0.59	1.43	-.05
Sobel test	0.52; *SE* = 0.92; p = .60			1.20; *SE* = 1.44; p = .23			-0.65; *SE* = 1.25; p = .51		

Note: Anx = Anxiety; PER = Passive ER

**p < .05; **p < .01; ***p < .001*

Moderation analysis. We verified whether Active or Passive ER moderated the relationship between NA and Anxiety, in a manner similar to the one presented above for the interaction between NA and EC. We failed to find any evidence that Active ER moderated the NA–Anxiety relationship (total sample: $\Delta R^2 = .00$, $f^2 = 0$; $\beta = -.06$, *ns*; boys: $\Delta R^2 = .00$, $f^2 = 0$; $\beta = -.06$, *ns*; girls: $\Delta R^2 = .00$, $f^2 = 0$; $\beta = -.07$, *ns*). The almost same pattern emerged for the NA × Passive ER interaction ($\Delta R^2 = .01$, $f^2 = 0.01$; $\beta = .11$, *ns* in the total sample; $\Delta R^2 = .00$, $f^2 = 0$; $\beta = .00$, *ns* in the case of boys), with the exception of the girls sample, where we found a small and marginally significant interaction effect: $\Delta R^2 = .04$, $f^2 = 0.08$; $\beta = .20$, $p = .05$. We probed this effect using ModGraph (Jose, 2008) and found that NA significantly predicted Anxiety at medium [$t(54) = 2.42$, $p < .05$] and high [$t(54) = 4.93$, $p < .001$] levels of Passive ER, but not at low values [$t(54) = 0.73$, *ns*]. (see Figure 3.2).

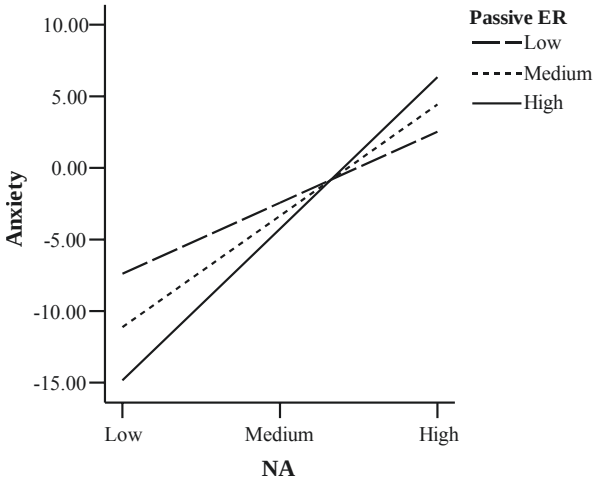

Figure 3.2. Interaction between NA and Passive ER in predicting Anxiety in the girls sub-sample.

3.1.3 Discussion

The present study focused on temperamental characteristics and ER strategies as potential predictors of anxiety symptoms in preschoolers. The results represent an important addition to the literature linking individual differences to anxiety symptoms, since within this literature a very small part of research has focused on preschool children, and most studies have used measures designed to capture internalizing problems in general rather than anxiety *per se*.

With respect to our main analyses, unsurprisingly, NA was a clear moderate-to-strong predictor of anxiety (although its sub-dimensions related differently to anxiety), and this was true for the full sample, as well as the two gender-based sub-samples. Regarding the role of EC, our data does not clearly support either the additive or the interactive hypothesis in this sample. More precisely, instead of decreasing anxiety vulnerability, our data indicates that EC (and especially inhibitory control) *increases* vulnerability (at least after accounting for the contribution of NA), as higher EC/inhibitory control scores predict higher anxiety symptoms (especially in girls). Additionally, we found evidence that inhibitory control moderates the relationship between NA and anxiety in girls, but, contrary to our expectations, it tends to *amplify* the risk in those with higher NA. While these results are contrary to what we would expect, they are however in line with data obtained in a few previous studies (Kochanska et al., 1996; Murray & Kochanska, 2002; Thorell, Bohlin, & Rydell, 2004), which showed that higher EC or inhibitory control were related to higher internalizing/anxiety problems in preschoolers. In line with interpretations put forward in the studies cited above, we can distinguish between a controlled, voluntary form of inhibition, which the Inhibitory control scale attempts to capture (i.e., "The capacity to suppress inappropriate approach behavior"), and an automatic, involuntary form of inhibition. This latter form might be captured by BI as described by Kagan (e.g., Kagan, 1998; Kagan, Reznick, & Snidman, 1987), or more generally, by what Nigg (2000) has termed *motivational* inhibition, or "bottom-up (limbic→cortical) interruption of ongoing behavior or suppression of behavioral response due to fear or anxiety in the presence of immediate novel social situation or cues for punishment" (p. 238)[4]. As one can see, the overt manifestation of these inhibitory mechanisms can be

[4] It is not clear to what degree "motivational inhibition" and temperamental fear overlap. It is possible that they refer to the same construct. However, inhibitory control and fear were unrelated in the present study.

identical (i.e., stopping of an approach behavior), despite potentially different triggers (inhibitory control versus motivational inhibition). It is therefore possible that parents who answered our questionnaires have a hard time distinguishing between the two, and their responses reflect a mix (see also Eisenberg & Morris, 2002). For this reason, children who are motivationally inhibited and therefore more prone to anxiety would have inflated scores on the inhibitory control scale. However, as Kochanska's data shows (Kochanska et al., 1996; Murray & Kochanska, 2002), the same results are obtained when EC is measured via observational measures, thus in situations where parental reports play no role. Thus, automatic inhibitory tendencies, which predispose children to anxiety, might also make them better at solving tasks where controlled inhibition is required.

As already mentioned, the effects of inhibitory control – as an independent predictor or as a moderator – were present mostly in girls. It is not entirely clear why this is the case, since previous studies did not report gender-differentiated patterns of results (see Kochanska et al., 1996; Murray & Kochanska, 2002; Thorell et al., 2004). Additionally, in our sample inhibitory control was the only EC dimension where girls and boys were relatively equal. One possible explanation for these results is that from the point of view of the parents, the two types of inhibition we mentioned above are easier to confound in the case of girls than in boys. However, further studies are necessary to clarify whether this hypothesis is plausible or not.

In the case of ER, while passive ER strategies (venting, avoidance and emotional intervention) were the strongest independent correlate of anxiety (especially in boys), we failed to find any evidence for their mediating role. However, we did find some (marginally significant) indication that passive ER strategies acted as a moderator in girls. More precisely, frequent use of passive ER strategies amplified the impact of NA upon anxiety.

To summarize, this study has investigated the manner in which temperamental NA combines with self-regulatory influences coming from EC or ER strategies, to predict anxiety symptoms in preschool children. Our data shows that while NA is generally the most important predictor, self-regulatory characteristics have a higher impact in the case of girls, where higher inhibitory control and increased use of passive ER strategies amplify the effect of NA upon anxiety. In boys, apart from the impact of NA upon anxiety, we also found a moderately increased tendency to use passive ER strategies.

3.2 Study 1B: Predictors of anxiety in middle childhood

3.2.1 Method

3.2.1.1 Participants and procedure

Children who attended first to fourth grade from two schools in Cluj-Napoca were selected based on informed consents given by parents. The final sample consisted of 221 children (116 girls) aged 6-11 years (M = 108.38 months; SD = 14.35; range = 80-134 months).

Additionally, children from third and fourth grade of one of the schools, whose parents had consented to involve them in the study, were also asked to complete the RCADS and CCSC-R1 questionnaires (described below). This sample consisted of 66 children (32 girls) aged 8-11 years (M = 116.80 months; SD = 8.43; range = 97-134 months).

3.2.1.2 Measures

Anxiety and depression

The *Revised Child Anxiety and Depression Scales* (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to assess anxiety and depression symptoms in the middle childhood sample. The RCADS is composed of 47 items referring to the frequency of occurrence of different anxiety and depression symptoms. The responses are given on a 0-4 scale, where 0 = *never* and 4 = *always*. The items assess problems related to depression (e.g., "Nothing is much fun anymore"), and five types of anxiety disorders: separation anxiety (7 items; e.g., "I feel scared if I have to sleep on my own."), generalized anxiety (6 items; e.g., "I worry that something awful will happen to someone in my family"), panic (9 items; e.g., "I suddenly feel as if I can't breathe when there is no reason for this"), social anxiety (9 items; e.g., "I feel worried when I think someone is angry with me"), obsessive-compulsive disorder (6 items; e.g., "I have to keep checking that I have done things right (like the switch is off, or the door is locked)"). Scale and total scores are computed by summing responses to the relevant items. The RCADS was originally derived from the Spence Children's Anxiety Scale (SCAS; Spence, 1997, 1998) and designed as a self-report measure for children and adolescents.

We translated the items of the original RCADS into Romanian. However, since our study required a parent-report measure especially in the younger children, we derived a parent-report version (RCADS-P), by rephrasing the items in the second person singular[5]. The RCADS was shown to have an adequate structure, and adequate validity and reliability indices on the original sample (see Chorpita, Moffitt, & Gray, 2005; Chorpita et al., 2000). Preliminary analyses on the Romanian parental version suggested a factorial structure similar to the original one. In the current sample, internal consistency indices for the anxiety sub-scales of the RCADS-P ranged between $\alpha = .63$ and $\alpha = .80$, while the full anxiety scale had a Crombach's α of .89. The internal consistency of the Depression scale was $\alpha = .71$.

The child self-report version (RCADS) was administered to the older children in our sample (i.e., third and fourth graders). Internal consistency indices computed over the 66 children who were assessed with this version of the scale ranged between .63 and .83 for anxiety sub-scales. Crombach's α for the entire anxiety scale was .92, while the depression scale had an $\alpha = .71$.

Temperament

Parents were administered the Romanian version of the *Temperament in Middle Childhood Questionnaire* (TMCQ; Simonds, 2006; Simonds & Rothbart, 2006), a 157-item caregiver-report instrument designed to measure 16 temperament dimensions reflecting aspects of behavioral/emotional reactivity and self-regulation. The questionnaire asks parents to rate their child on a five-point scale, ranging from 1 (*almost always untrue of your child*) to 5 (*almost always true of your child*), and offers them an additional response option – "does not apply" – for items which do not apply to that particular child. Scale and factor scores are obtained by computing the average score for items belonging to that scale or factor. We selected the NA sub-scales of Fear (9 items), Sadness (10 items), and Anger/Frustration (7 items) from the total questionnaire as measures of emotional reactivity, and the EC sub-scales of Attentional focusing (7 items; the TMCQ does not have a scale for Attentional shifting), Inhibitory control (8 items) and Activation control (15 items). In the current sample, internal consistency indices were as follows: Fearfulness ($\alpha = .77$), Sadness ($\alpha = .77$), Anger/Frustration ($\alpha = .79$), Attentional focusing ($\alpha = .77$), Inhibitory control ($\alpha = .64$), Activation control ($\alpha = .61$). Internal consistency indices for the higher-order factors of NA and EC were .87 and .83, respectively.

Emotion regulation

We translated the *Children's Coping Strategies Checklist, Revised version* (CCSC-R1; Ayers et al., 1996; Program for Prevention Research, Arizona State University, 1999), a self-report instrument assessing cognitive and behavioral coping strategies in children aged 9-13. The CCSC-R1 is composed of 54 items, with responses given on a 1 (*never*) to 5 (*most of the time*) scale. The items assess 13 coping strategies, grouped into four higher-order factors: Active coping strategies (including Problem-focused coping = 12 items, e.g., "You thought about which things are best to do to handle the problem", and Positive cognitive restructuring = 12 items, e.g., "You told yourself you have taken care of things like this before"), Distraction strategies (9 items; e.g., "You did something like video games or a hobby"), Avoidance strategies (8 items; e.g., "You avoided the people who

[5] Recently, Chorpita and collaborators have also developed a parent-report version of the RCADS (see Ebesutani, Bernstein, Nakamura, Chorpita, & Weisz, 2010), which is fundamentally identical (in item meaning) with the one we obtained.

made you feel bad") and Support seeking strategies (9 items; e.g., "You talked to someone who could help you figure out what to do"). The scores for the lower-order strategies and the higher-order factors are obtained by averaging across items belonging to that strategy/factor. As we were interested in coping strategies present in children since the age of 6 years, we developed a parent-report version (CCSC-R1-P) by rephrasing the translated items in the second person singular, and asking parents to report on their child's behavior. Preliminary data showed a factorial structure that was similar to the one of the original scale. Since it was possible that in some cases parents might not be aware whether their child was using that particular strategy (especially in the case of cognitive strategies), we added the response option "I don't know/Does not apply", which was not scored. For the CCSC-R1-P, internal consistency indices were as follows: α = .91 for Active coping strategies, α = .76 for Distraction, α = .75 for Avoidance and α = .91 for Support seeking.

The CCSC-R1 (self-report version) was administered to third- and fourth-graders. For this version, internal consistency indices were .92 for Active coping, .88 for Distraction, .79 for Avoidance, and .90 for Support seeking.

3.2.2 Results

3.2.2.1 Parent-report data: Temperamental predictors of Anxiety (and depression)

We tested the additive and interactive hypotheses – as in the preschool study – through a hierarchical regression analyses, conducted exactly as described previously.

Anxiety. The full model explains 25% of the variance in anxiety scores (R^2 = .25; f^2 = 0.33) when the entire sample is included in the analysis, 15% in boys (R^2 = .15; f^2 = 0.18), and 39% in girls (R^2 = .39; f^2 = 0.64). NA was a significant moderate-to-strong predictor of anxiety (f^2 = 0.27 in the total sample; f^2 = 0.15 in boys; f^2 = 0.41 in girls). In itself, EC was not a significant independent predictor of Anxiety scores, but in interaction with NA it appeared as a significant negative predictor of Anxiety scores in the full sample (β = -.20, p < .01) and in girls (β = -.34, p < .001). While the interaction term explained a relatively small amount of the variance in the total sample – i.e., 3% (ΔR^2 = .03; f^2 = 0.04), it appeared to have a higher impact in the girls' sub-sample (ΔR^2 = .10; f^2 = 0.16). This effect was absent in boys, where adding the interaction term, practically added nothing to the explained variance.

We probed the interaction for the full sample and for the girls' sub-sample by computing NA–Anxiety slopes for mean, high (+1 SD) and low (-1 SD) levels of EC. Slope statistical tests were carried out using ModGraph (Jose, 2008). The same pattern emerged in both samples: slopes were significant for both medium [t(213) = 3.54, p < .001 for the total sample; t(111) = 2.71, p < .01 for girls], and low values of EC [t(213) = 7.58, p < .001 for the total sample; t(111) = 8.02, p < .001 for girls], but not for high values [t(213) = 0.25, *ns* for the total sample; t(111) = 0.19, *ns* for girls]. As these results and Figures 3.3A and 3.3B indicate, high EC cancels the effect of NA upon Anxiety.

Depression. NA was a significant predictor of Depression symptoms in all samples (f^2 = 0.17 in the total sample; f^2 = 0.10 in boys; f^2 = 0.27 in girls). After accounting for the effects of sex, age and NA, EC was also a significant predictor of lower Depression scores, and it explained a small-to-moderate amount of variance: 6% in the full sample (ΔR^2 = .06; f^2 = 0.08; β = -.28, p < .001), 4% in boys (ΔR^2 = .04; f^2 = 0.05; β = -.22, p < .05) and 7% in girls (ΔR^2 = .07; f^2 = 0.10; β = -.31, p < .01). EC was a significant moderator only in the full sample (β = -.16, p < .05) and in girls (β = -.30, p < .001), where the interactive term was a negative predictor of Depression scores. As can be seen, adding this interaction term added a relatively small percentage of explained variance in the total sample analysis (ΔR^2 = .02; f^2 = 0.03), and when only girls were included (ΔR^2 = .08; f^2 = 0.13).

We probed the interaction for the full sample and the girls sub-sample using the same methodology presented before. The same pattern emerged in both cases: the NA–Depression slope was statistically significant at low levels of EC [full sample $t(213) = 4.94$, $p < .001$; girls $t(111) = 5.00$, $p < .001$], but not at medium [$t(213) = 1.55$, *ns*; $t(111) = 0.42$, *ns*] and high ones [$t(213) = 0.85$, *ns*; $t(111) = 0.60$, *ns*]. As Figures 3.3C and 3.3D indicate, NA significantly predicts Depression scores only when EC is low.

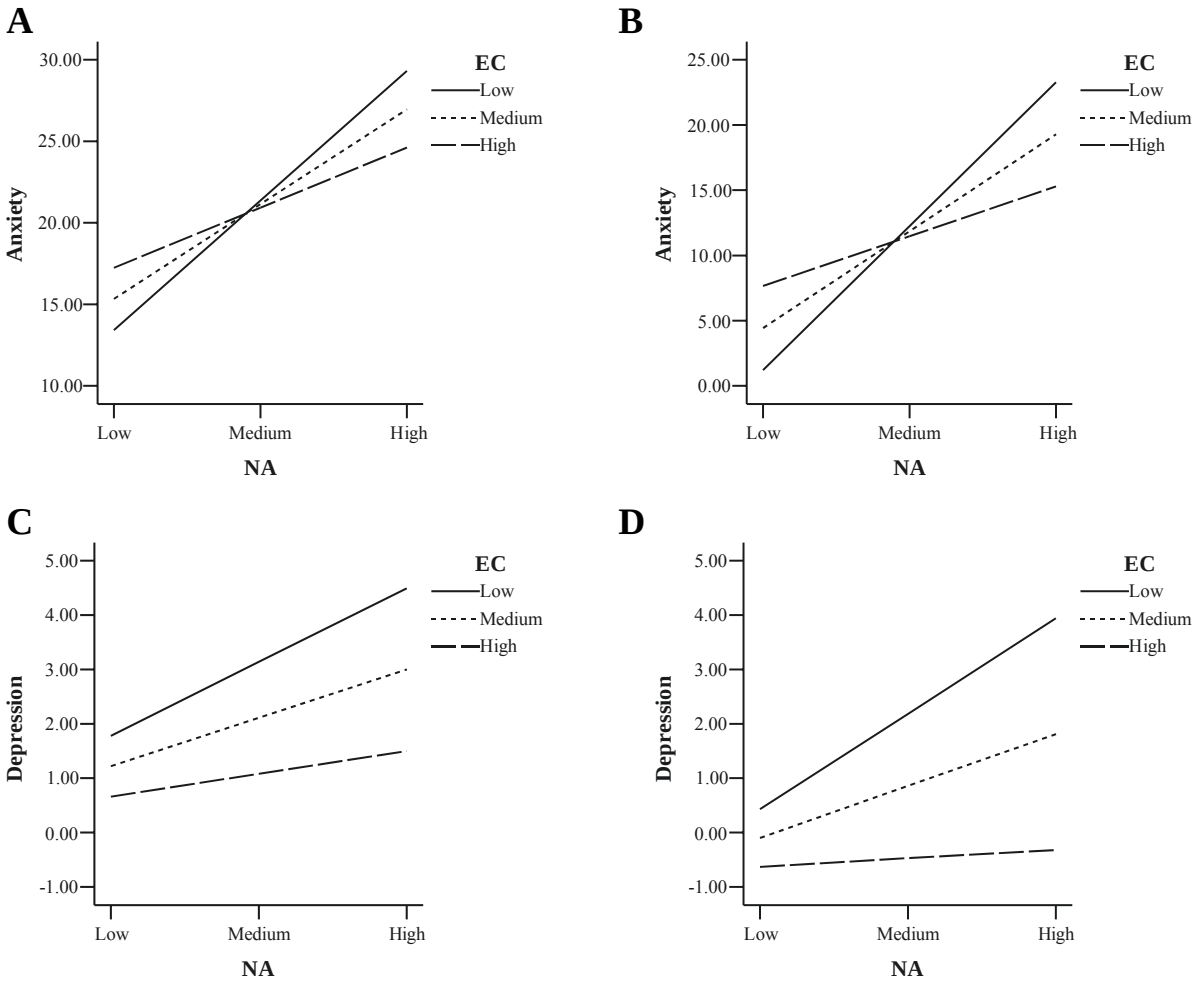

Figure 3.3. Interaction between NA and EC in middle childhood, with Anxiety (A, B) and Depression (C, D) as outcome variables. Anxiety in the total sample (A) and in girls (B); Depression in the total sample (C) and in girls (D).

3.2.2.2 Parent-report data: ER and Anxiety/Depression

In the parent-report data, there was no evidence for any link between ER strategies and Anxiety or Depression (see thesis for details). Thus, there was no evidence that ER strategies might mediate the relationship between NA and Anxiety or Depression.

We tested whether each ER strategy moderated the relationships between NA and Anxiety or Depression, respectively, following the methodology described above. After accounting for the effect of NA, Distraction was a significant negative predictor of Depression

in the case of girls: (ΔR^2 = .04, f^2 = 0.05; β = -.22, p < .05). Support seeking was a significant independent predictor of Anxiety scores in the total sample (ΔR^2 = .02, f^2 = 0.03; β = .14, p < .05) and in girls (ΔR^2 = .03, f^2 = 0.05; β = .18, p < .05). All these effects were small. There was no evidence that any of the five ER strategies moderated the predictive effect of NA on Anxiety or Depression: for each analysis, adding the NA × ER interaction term contributed a small, non-significant amount to the explained variance: ΔR^2 = .00 – .02, f^2 < 0.03; | β | = .01 – .12, *ns*.

3.2.2.3 Child-report data: ER and anxiety/depression

In the full sample, both Anxiety and Depression were associated with higher Avoidance: r = .41, p < .01 and r = .42, p < .01, respectively. This pattern was even stronger in the case of girls: r = .68, p < .001; r = .62, p < .01 for Anxiety and Depression, respectively (boys: r = .22, *ns* for Anxiety; r = .28, *ns* for Depression). No other statistically significant correlations were found in these two samples. In boys, there was a tendency for higher Anxiety scores to be associated with lower use of Distraction strategies (r = -.35, p = .08).

3.2.3 Discussion

The present study had essentially the same objectives and hypotheses as the previous study, with the exception that here – in addition to anxiety – we were also able to asses depression. This allowed us to determine the whether the patterns of predictors we found for anxiety were specific, or whether they were also characteristic of depression. Additionally, due to the older age of children in this sample, we were able to collect self-report data from some of the 8- to 11-year-old children.

Regarding the main objectives of our study, we found – like in the case of preschoolers – that high NA predicted high anxiety scores (with moderate-to-strong effect sizes). The impact of NA was somewhat smaller in the case of depression. However, in this sample EC played a more important role than in the younger children, and its effect was largely in the expected direction, supporting the "interactive hypothesis" when anxiety was the outcome variable. More precisely, while EC was not a significant independent predictor of anxiety symptoms, it did moderate the impact of NA: children with medium or low levels of EC were prone to high anxiety symptoms if they had high NA scores, while children with high EC skills were "protected" from high anxiety even if they had high NA. This pattern was present in the full sample, but was most prominent in girls, and absent in boys. When we used depression as the outcome variable, the pattern of results was generally similar (including the gender-differentiated relationship pattern), with the exception that – along with the moderating effect of EC, there was also evidence to support the "additive hypothesis", as high EC predicted lower depression scores independent of the effect of NA. This indicates that there is a certain degree of specificity in the pattern of factors that predict anxiety, but that EC is potentially more important in reducing the risk for depression.

Previous similar studies have focused mostly on internalizing problems in general (e.g., Meesters, Muris, & Rooijen, 2006; Muris, 2006; Oldehinkel, Hartman, Ferdinand, Verhulst, & Ormel, 2007), and have found evidence for both the additive and interactive hypotheses. Our results for anxiety are partially in line with these previous studies, in that we have found moderating effects of EC in middle childhood and adolescence. However, we failed to identify evidence for an independent effect here. One of the reasons for this discrepancy might reside in

the fact that while these previous studies have used child self-report measures to assess EC, we were constrained – primarily by the younger age of the children in our sample – to use parent-report measures. Another possible explanation for the discrepancy is related to potential cultural differences in EC between our sample and the ones (mostly Dutch) included in previous studies. However, the most likely explanation resides in the fact that while previous studies have combined anxiety and depression into an internalizing score, we chose to treat the two separately. An indication that this is probably the correct explanation comes from the fact that when we used depression as the outcome, we also found evidence for an independent, unique role of EC. Our results therefore emphasize the need to treat anxiety and depression as separate entities in future studies.

Another point of departure between our results and those of previous research is the gender-differentiated pattern of relationships between NA, EC and anxiety/depression. None of the previous studies investigating these relationships reported gender-differentiated analyses, and thus we have no way of knowing whether similar patterns might have emerged in those samples. It is possible that the pattern we have found is largely due to the generally higher EC reported in girls, but more studies are needed to clarify this. However, these results indicate the potential value of gender-separate analyses, especially since anxiety and depression show different intensities/prevalence between men and women in adulthood (American Psychiatric Association, 2000; Hettema, Prescott, Myers, Neale, & Kendler, 2005; Kendler et al., 1995).

When investigating ER strategies related to anxiety and depression, we found no evidence for any links in the parent-report data, and the mediation and moderation analyses returned null results as well. However, when we looked at the child self-report sample, results were generally in line with previous research: children with higher anxiety and depression scores used avoidant ER strategies more frequently (and this was true especially in the case of girls), while boys with higher anxiety had a tendency to use distraction to a lesser degree. Overall, results from the self-report sample are congruent with previous data showing increased use of passive ER strategies such as avoidance in anxious children (Carthy, Horesh, Apter, & Gross, 2010; Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001).

In conclusion, in the present study we investigated the roles of temperamental NA and EC, as well as ER strategies in predicting anxiety symptoms in middle childhood, and we were also interested to determine whether the pattern of predictors for anxiety would be different from the pattern of factors that would predict higher depression scores. While we found limited evidence for the involvement of ER strategies (mostly due to the small sample of children who had self-report data), we did find evidence that high EC acted as a protective factor (especially in girls), limiting the role of NA as a risk factor for anxiety or depression. In the case of depression, EC also contributed as an independent factor, predicting lowed depression scores. Apart from these findings, our results also serve to highlight the importance of treating anxiety and depression as separate outcome entities, and the relevance of gender-differentiated analyses.

3.3 Study 1C: Predictors of anxiety in young adults

3.3.1 Method

3.3.1.1 Participants and procedure

Participants for this study were recruited from among the undergraduate students enrolled in the Psychology program at the Babeş-Bolyai University (BBU) in Cluj-Napoca. The final sample was composed of 175 undergraduate students (152 females), aged 19-39 years (M = 21.77, SD = 4.17). It should be noted that due to the source of our participant pool and the nature of the selection process, the majority of our participants (i.e., N = 153) were below 25 years of age.

3.3.1.2 Measures

Anxiety and depression

Trait anxiety was assessed using the Romanian version of the *State Trait Anxiety Inventory*, form Y[6] (STAI; Spielberger, 1983; see Pitariu & Peleasa, 2007 for the Romanian version; α = .81) and depression was assessed using the *Beck Depression Inventory* (BDI; Beck, Steer, & Carbin, 1988; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; α = .83). BDI was only applied to 90 participants.

Temperament

Participants completed Romanian version of the *Adult Temperament Questionnaire* (ATQ; Derryberry & Rothbart, 1988; Evans & Rothbart, 2007) a 177-item self-report instrument designed to measure 13 temperament dimensions, grouped into four higher-order dimensions reflecting aspects of behavioral/emotional reactivity and self-regulation (see Table 2.1, in Chapter 2, for item examples). The questionnaire asks participants to rate themselves on a seven-point scale where 1 = *extremely untrue of you* to 7 = *extremely true of you*, and offers them an additional response option – "not applicable" – for items which do not apply to them. Scale and factor scores are obtained by computing the average score for items belonging to that scale or factor. From the full questionnaire, we selected the NA (α = .90) sub-scales for Fearfulness (11 items; α = .83), Sadness (14 items; α = .85) and Anger/Frustration (13 items; α = .75), and the EC (α = .90) sub-scales of Attentional control (12 items; α = .86), Inhibitory control (11 items; α = .64) and Activation control (12 items; α = .86).

Emotion regulation

Participants completed the Romanian version of the *Cognitive Emotion Regulation Questionnaire* (CERQ; Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002; Perța et al., in preparation), a 36-item self-report questionnaire assessing nine cognitive ER strategies: Self-blame (α = .75; e.g., "I feel that I am the one who is responsible for what has happened"), Acceptance (α = .66; e.g., "I think that I must learn to live with it"), Rumination (α = .79; e.g., "I want to understand why I feel the way I do about what I have experienced"), Positive Refocusing (α = .90; e.g., "I think of something nice instead of what has happened"), Refocus on Planning (α = .84; e.g., "I think about how to change the situation"), Positive Reappraisal (α = .85; e.g., "I think I can learn something from the situation"), Putting into Perspective (α = .84; e.g., "I think that it all could have been much worse"), Catastrophizing (α = .81; e.g., "I keep thinking about how terrible it is what I have experienced") and Other-blame (α = .80; e.g., "I feel that others are responsible for what has happened"). The CERQ contains 4 items for each ER strategy. Respondents are asked to rate the extent to which they use the different types of cognitive ER strategies on a five-point scale, where 1 means *(almost) never* and 5 means *(almost) always*. The score for each strategy is obtained by summing up the scores of the corresponding items. Garnefski and collaborators have reported good reliability and validity indices for the original (Dutch) version of the scale (see Garnefski & Kraaij, 2007; Garnefski et al., 2002). As can be seen, indices for the Romanian version used here were generally good or very goo, with the exception of the Acceptance scale, which showed only acceptable reliability.

In order to simplify some of the analyses, we were interested to reduce the number of ER strategies. An informal inspection of the strategies indicates that some of them tend to be adaptive / positive strategies, while

[6] D&D Consultants / Testcentral gave us permission to use the Romanian version of *State-Trait Anxiety Inventory*™, *form Y* for research purposes.

others are rather maladaptive / negative strategies (see Tortella-Feliu, Balle, & Sesé, 2010 for a recent, similar approach). However, Acceptance is more difficult to place in one of these two categories, as it might be adaptive in some contexts and non-adaptive in others (see Garnefski, Kraaij, & Spinhoven, 2001). We therefore chose to take an empirical approach, similar to the one taken in the preschool study. We conducted a principal components analysis with Varimax rotation across the nine ER strategies (the Keiser-Meyer-Olkin measure of sampling adequacy was .67, while Bartlett's test of sphericity resulted in a $\chi^2 = 314.74$, $p < .001$, indicating the adequacy of factor analysis for this data). The analysis indicated a three-factor solution, accounting for 61.91% of the total variance. The first factor (27.58%) reunited the strategies of Positive Reappraisal (loading = .84), Putting into Perspective (.73), Refocus on Planning (.70) and Positive Refocusing (.59), indicating the plausibility of an adaptive / positive ER factor. The second (21.72%) and third (12.61%) factors loaded highly on the strategies Other-blame (.86), Catastrophizing (.75) on the one hand, and Self-blame (.84) and Rumination (.73) on the other hand. We decided to group these strategies onto one single factor, reflecting maladaptive / negative ER strategies. As expected, Acceptance included loadings of two factors: the first (positive regulation; .50) and second (the one comprising Other-blame and Catastrophizing; .42). Although the loadings were slightly different, we decided not to include Acceptance in any of the higher-order factors, because its loadings were lower than in the case of the other ER strategies. Thus, we ended up with two ER factors: *Adaptive ER* strategies (α = .89; Positive Reappraisal, Putting into Perspective, Refocus on Planning and Positive Refocusing) and *Maladaptive ER* strategies (α = .82; Other-blame, Catastrophizing, Self-blame and Rumination). The two factors were computed by summing the scores of their underlying dimensions. We used these higher-order factors in the more complex analyses, but we included the individual strategies in the simpler analyses.

3.3.2 Results

Due to the small number of males in our study, the more complex analyses (i.e., moderation and mediation) are presented only for the full and female sample.

3.3.2.1 Temperamental predictors of anxiety (and depression)

Anxiety. The full model explained 22% of the variance in anxiety scores ($R^2 = .22$; $f^2 = 0.28$) when the entire sample is included in the analysis and 16% in the female sample ($R^2 = .16$; $f^2 = 0.19$). NA was a significant predictor of Anxiety, with a moderate effect ($f^2 = 0.15$ in both samples). EC was not a significant independent predictor of Anxiety scores in the full sample ($\Delta R^2 = .01$; $f^2 = 0.01$; $\beta = -.14$, *ns*) or in females ($\Delta R^2 = .01$; $f^2 = 0.01$; $\beta = -.09$, *ns*). There was also no evidence for a moderating role of EC: adding the interaction term to the model did not increase the amount of predicted variance almost at all ($\Delta R^2 = .01$; $f^2 = 0.01$; $\beta = .10$, *ns* for the full sample; $\Delta R^2 = .01$; $f^2 = 0.01$; $\beta = .05$, *ns* for the female sample).

Depression. A hierarchical regression analysis to determine the potential moderating role of EC on the NA–Depression[7] link was carried out in the manner described above for Anxiety. The full model explained 27% of the variance in Depression scores ($R^2 = .27$; $f^2 = 0.37$) when the entire sample is included in the analysis, and 22% in the female sample ($R^2 = .22$; $f^2 = 0.28$). As usually, NA was a significant predictor of Depression symptoms in both samples ($f^2 = 0.27$ in the total sample, $f^2 = 0.25$ in the female sample). However, as in the case of Anxiety, in itself EC failed to significantly predict Depression ($\Delta R^2 = .00$; $f^2 = 0$; $\beta = -.01$, *ns* for the total sample; $\Delta R^2 = .00$; $f^2 = 0$; $\beta = -.03$, *ns* for females). Similarly, there was no evidence that EC moderated the link between NA and Depression ($\Delta R^2 = .00$; $f^2 = 0$; $\beta = -.01$, *ns* for the total sample; $\Delta R^2 = .01$; $f^2 = 0.01$; $\beta = -.10$, *ns* for females).

The pattern of results found here, namely the presence of significant correlations between EC and Anxiety/Depression, and their disappearance in the presence of NA, indicates the possibility that, within this developmental sample, NA might *mediate* the link between EC

[7] Here we used the normalized Depression scores as the criterion variable.

and Anxiety or Depression. We therefore carried out a mediation analysis[8], in a manner identical to the one described for the preschool sample. Results showed that NA was a complete mediator of the relationship between EC and Anxiety (total sample: Sobel statistic = -3.14; *SE* = 0.51; $p < .01$; females: Sobel statistic = -3.07; *SE* = 0.58; $p < .01$), as well as EC and Depression (total sample: Sobel statistic = -3.25; *SE* = 0.14; $p < .01$; female sample: Sobel statistic = -3.19; *SE* = 0.14; $p < .01$). More precisely, the relationship between EC and Anxiety (or Depression) disappears when we add NA to the regression equation (third step), and the Sobel test confirms that the reduction in the effect is significant (see the original thesis for more detailed results).

3.3.2.2 ER and anxiety

Mediation. We only tested Maladaptive ER as a potential mediator of the NA–Anxiety or NA–Depression links. Maladaptive ER did not mediate the relationship between NA and Anxiety (total sample: Sobel statistic = 0.50; *SE* = 0.48; $p = .62$; female sample: Sobel statistic = 0.33; *SE* = 0.53; $p = .54$). However, Maladaptive ER was a partial mediator of the NA–Depression relationship in the full sample: Sobel statistic = 2.12; *SE* = 0.11; $p < .05$ (however, since the slope of the NA–Depression relationship shows no indication of change, this partial mediation effect is probably very small[9]).

As in the case of EC, the pattern of correlations pointed to the possibility that NA mediates the relationship between Maladaptive ER and Anxiety or Depression. With Anxiety as an outcome variable, the mediation analysis showed that the effect of Maladaptive ER upon Anxiety dropped significantly (Sobel statistic = 3.40, *SE* = 0.06, $p < .001$) from $\beta = .25$, $p < .01$ to $\beta = .03$, *ns* when we controlled for the effect of NA (results were almost identical in the female sample). With Depression (normalized) scores as the dependent variable, we only found a partial mediation effect (Sobel statistic = 2.75, *SE* = 0.01, $p < .01$): when controlling for the effect of NA, the effect of Maladaptive ER upon Depression dropped from $\beta = .46$, $p < .001$ to $\beta = .30$, $p < .01$.

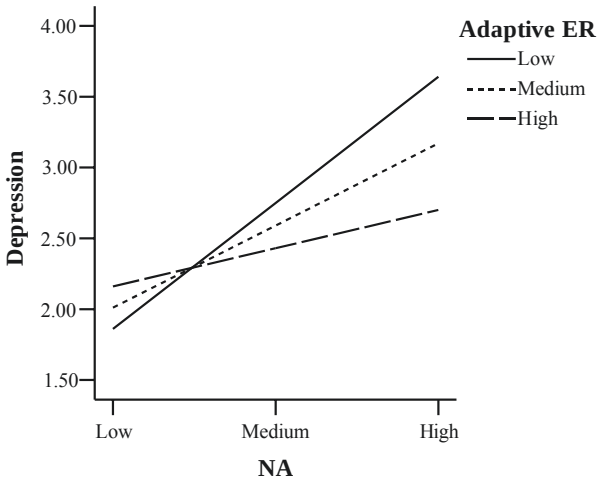

Figure 3.4. Interaction between NA and Adaptive ER in predicting Depression in the adult sample.

Moderation. We carried out hierarchical regression analyses to test both Adaptive ER and Maladaptive ER as potential moderators. Results indicated that the two types of ER strategies did not moderate the NA–Anxiety relationship. However, Adaptive ER was a

[8] Note that this was a *post-hoc* analysis, not one guided by our hypotheses.
[9] We are not aware of any measures of effect size for Sobel tests.

significant moderator for the NA–Depression link (ΔR^2 = .00; f^2 = 0.09; β = -.27, p < .01). Probing this relationship indicated that NA predicted Depression at low [$t(80)$ = 6.27, p < .001], medium [$t(80)$ = 4.08, p < .001], but not high levels [$t(80)$ = 1.90, p = .06] of Adaptive ER (see Figure 3.4 for details).

3.3.3 Discussion

The present study focused on the same general objectives as the previous two studies, but did so in a sample of adults.

With respect to the temperament–anxiety relationships, unsurprisingly, we again found that high NA predicted high anxiety and depression scores, but here NA was a stronger predictor for depression than anxiety. We found some limited correlational evidence that good EC skills were related to low anxiety and depression. This is in line with previous research in adults showing moderate-to-high negative correlations between anxiety and EC in adults and children (e.g., Clements & Bailey, 2010; Derryberry & Reed, 2002; Moriya & Tanno, 2008; Muris, Mayer, Lint, & Hofman, 2008; Muris, Pennen, Sigmond, & Mayer, 2008; Oldehinkel et al., 2007). However, when we accounted for the effect on NA in the hierarchical regression analysis, the impact of EC was cancelled, due to the overlap between the two. There was also no evidence that EC moderated the NA – anxiety / depression relationship. Despite these null results, the presence of a correlation between EC and anxiety / depression, and its disappearance in the presence of NA indicated a potential mediation relationship we had not foreseen in our initial hypotheses. Indeed, the mediation analysis found evidence that in this sample NA mediated both the EC–anxiety and the EC–depression relationship. In other words, it would seem that in adults EC influences anxiety/depression indirectly, by reducing NA. We are not aware of any study reporting similar results in adults. It is thus possible that the patterns of relationships between NA, EC and anxiety / depression change during development from childhood to adulthood. However, taking into account the fact that this mediation relationship was an incidental, post-hoc finding, and that there is no other similar data available in the literature, we are cautious in drawing any firm conclusions based at this point. Future research (perhaps with a longitudinal methodology) should establish whether this is a reliable pattern, or a simple statistical artifact.

Finally, as we would expect, high anxiety / depression scores were linked to frequent use of maladaptive ER strategies and less frequent use of adaptive ER strategies in a manner congruent with previous findings from adults (e.g., Garnefski et al., 2001; Garnefski & Kraaij, 2007; Garnefski, Kraaij, & van Etten, 2005; Garnefski et al., 2002). We failed to find any evidence supporting a mediating or moderating involvement of ER strategies in anxiety symptoms. However, adaptive ER moderated the NA–depression relationship: while NA predicted depression in participants with low or average use of adaptive ER strategies, frequent use of these ER strategies cancelled the risk for high depression even when NA was high. Apart from these results, in the case of anxiety we found a pattern similar to the one found in the case of EC. Namely, maladaptive ER influenced anxiety indirectly, by increasing NA (in other words NA mediated the relationship between maladaptive ER and anxiety). There was only partial evidence that this was also the case for depression (here the mediation model with maladaptive ER as a mediator was also partially supported). However, since this was also an incidental finding, the same precautions discussed for EC apply here, and further studies are necessary to determine whether this pattern of relationships between self-regulatory mechanisms (EC and ER), NA and anxiety are indeed characteristic for adults.

In summary, data in the adult sample failed to support either the additive or the interactive hypothesis concerning the role of NA and EC as predictors of anxiety (despite moderate negative correlations between EC and anxiety). Similarly, while the pattern of ER–anxiety correlations was as expected, ER strategies were neither significant mediators nor moderators of the relationship between NA and anxiety. Incidentally, we found some evidence to support the possibility that EC and maladaptive ER strategies predict anxiety indirectly, by modulating NA. Similar results were found for depression, with the exception that in this case we also found indication that adaptive ER strategies acted as moderators of the NA–depression relationship.

3.4 General discussion

Results of the three studies included in this chapter have clarified some of our starting questions while at the same time raising others. However, the cross-sectional approach has proven valuable in showing that the patterns of relationships between individual characteristics and anxiety are not static throughout development. This was visible especially when investigating NA and EC as predictors of anxiety. NA was a relatively constant predictor of anxiety across all three age groups, with effect sizes ranging from moderate (in boys) to large (in girls). However, its impact was somewhat reduced in adults. These changes (across age samples as well as genders) are partly due to the different contributions of the three NA sub-dimensions (especially anger, which was not always clearly related to anxiety). While we chose to use NA as a global dimension, future studies should determine the relative contributions of the three types of negative emotionality, and the potential explanations behind the gender differences that are apparent in correlation patterns. More interesting developmental changes were found when we investigated the role of EC in predicting anxiety. More precisely, while in preschoolers the EC sub-dimension of inhibitory control was a risk factor for high anxiety (it predicted higher anxiety scores, and amplified the risk for anxiety in children with high NA – especially in girls), the relationship was completely changed in middle childhood, where high EC was a protective factor, limiting the risk for anxiety even in children with high NA (again, this was true especially in girls). This change is probably due to the fact that once children start school and are more and more engaged in tasks that require self-regulation, the difference between automatic and controlled inhibitory influences might become clearer for parents. In adults, incidental findings indicated the possibility that from childhood to adulthood EC gradually starts exerting a regulating influence on temperamental NA, thus modulating anxiety symptoms only indirectly. However, as already discussed, the incidental nature of these findings, and they possibility that they merely represent statistical artifacts, call for caution in interpreting them.

In the case of ER strategies, there was little change from one age sample to the next in the overall pattern of strategies most likely to be related to anxiety. In general, high anxiety was associated with frequent use of passive ER strategies like avoidance (in children) or maladaptive strategies such as catastrophizing (in adults). In preschool girls, an average or highly frequent use of passive ER strategies amplified the NA-anxiety relationship. However, we did not find any evidence that ER mediated the link from NA to anxiety. On the contrary, in the case of adults it seemed rather that maladaptive ER might modulate NA and thus indirectly influence anxiety (but, as in the case of EC, this was an incidental finding to which the same cautionary note applies).

In the middle childhood and adult samples, we were able to assess depression symptoms (in addition to anxiety) and thus determine the degree of specificity of anxiety predictors. While we found many similarities between anxiety and depression predictors, there were enough differences to justify their separate investigation in future studies – especially those focusing on children, which often include the common category of "internalizing problems".

Our results also revealed interesting gender differences in the patterning of anxiety predictors. These differences can be attributed partly to differences in EC between the two genders, but this is likely not the whole story, since patterning differences were also found in the case of ER strategies (where there were no gender differences between the means). Additionally, patterning differences depend not so much on simple mean differences, as on different covariance between variables. In the case of children, it is possible that some of these differences came from gender-based perceptions and expectations parents might have of their children's behavior. While the source of these gender differences is not entirely clear, our results emphasize the need to take participants' gender into account as a potential moderator when investigating internalizing problems.

All of our conclusions must be viewed taking into account certain limitations. First, our interpretations are limited by the cross-sectional (as opposed to longitudinal) nature of our data. It is not clear if similar results would be found if our methodology was applied to the same individuals at different points in time. Second, as some of our data in study 1B showed, the use of parent- as opposed to *self*-report can lead to different results. However, self-report is difficult (if not even impossible) to use reliably in young children, and an alternative measure such as observation would be difficult to use in a large sample of children. Third, despite our efforts, our adult sample was extremely unequal in terms of gender representation, which limits the generalizability of our conclusions to women only.

These limits notwithstanding, the present results make an important contribution to the understanding of individual differences in temperament and ER strategies as factors involved in the development of anxiety in children and adults.

Chapter 4.

Anxiety and attention: From threat processing to general attentional functioning

The present chapter (as well as the rest of the thesis) focuses on the relationship between anxiety and attention. One of the most well-known phenomena is the so-called threat-related attentional bias, namely anxious individuals' tendency to detect and process threat-signaling stimuli faster. However, in the present chapter we attempt to go beyond this phenomenon by turning to fundamental attention research, and trying to determine how much of it has infused anxiety research in children and adults.

4.1 Attention in anxiety

4.1.1 A summary of mainstream empirical facts

One of the most robust cognitive phenomena in anxiety is represented by threat-related attentional biases, more precisely the tendency of anxious individuals to selectively allocate processing resources to threatening material (MacLeod, Andrew Mathews, & Tata, 1986; Mathews & MacLeod, 1994; Williams, Mathews, & MacLeod, 1996). The most frequently used tasks in this research area have been the emotional Stroop (Mathews & MacLeod, 1985), the dot-probe (MacLeod et al., 1986), and the visual search task (see Wolfe, 1998, 2010 for reviews). The tendency of anxious persons to favor threat-related stimuli has been reliably found in adults, both in clinically diagnosed and nonclinical participants, using all three experimental paradigms mentioned above (Becker, Rinck, Margraf, & Roth, 2001; Bradley, Mogg, White, Groom, & De Bono, 1999; Andrew Mathews & Colin MacLeod, 1985; Öhman, Flykt, & Esteves, 2001; Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005; Williams et al., 1996; see Bar-Haim et al., 2007; Cisler & Koster, 2010 for recent reviews). In the case of children the data presents a more mixed picture: some studies have found supporting evidence for selective attention to threat in children and adolescents (e.g., Dalgleish et al., 2003; Heim-Dreger, Kohlmann, Eschenbeck, & Burkhardt, 2006; Vasey, El-Hag, & Daleiden, 1996; Waters & Lipp, 2008; Waters & Valvoi, 2009), while others found the presence of a generalized threat-related attentional bias, unrelated to the child's level of anxiety (e.g., Ehrenreich & Gross, 2002; Kindt, Bierman, & Brosschot, 1997; Susa, Pitica, & Benga, 2008; Waters, Lipp, & Spence, 2004).

Apart from research regarding threat-related biases, there is some evidence (although more limited) that anxiety is also associated with higher distractibility in situations involving non-emotional distractors (Alting & Markham, 1993; Eysenck & Byrne, 1992; Eysenck & Graydon, 1989; Hopko, Ashcraft, Gute, Ruggiero, & Lewis, 1998; Mathews, May, Mogg, & Eysenck, 1990 but see Keogh & French, 1997 for an exception) as well as situations where distractors are threat-related (Byrne & Eysenck, 1995; Calvo, Avero, & Lundqvist, 2006; Gerdes, Alpers, & Pauli, 2008; Keogh & French, 2001; Keogh, Bond, French, Richards, & Davis, 2004; Rinck, Becker, Kellermann, & Roth, 2003; Rinck et al., 2005). There is, to date, little published research relevant for the issue of distractibility in anxious children, and most of it fails to support this hypothesis (see e.g., Hadwin et al., 2003; Waters & Lipp, 2008).

4.1.2 Theoretical perspectives

4.1.2.1 Models of threat-related attentional biases

Most traditional explanations of attentional biases suggest that high anxiety is associated with a tendency to detect threat during an early, "preattentive" (involuntary, automatic) stage of visual processing, and – in some cases – a tendency to avoid the threatening stimulus during later, "attentional" (controlled, voluntary) phases of attentional processing (Mathews & MacLeod, 1994; Mogg & Bradley, 1998; Öhman, 2005; Öhman & Mineka, 2001; Williams et al., 1996).

Various models of threat related attentional biases exist in the literature. For example, Williams et al. (1988; cited in Williams, Watts, MacLeod, & Mathews, 1997) postulate the existence of an *affective decision mechanism* (ADM) that determines the level of threat in the

incoming information, and a *resource allocation mechanism*, which – if trait anxiety is high in that person – assigns a higher priority to the threatening information and distributes attentional resources accordingly. Another model – suggested by Mathews and Mackintosh (1998) – postulates the existence of a *threat evaluation system* (TES) similar to Williams et al.'s ADM. Mogg and Bradley (1998) proposed the so-called *cognitive-motivational model*, which postulates two main processing systems: a *Valence Evaluation System* (which accomplishes the initial, preattentive assessment of environment stimuli) and a *Goal Engagement System* (which is responsible for allocating resources depending on the current goals of the person). Another frequently cited model (Öhman, 2005; Öhman & Mineka, 2001) proposes that the stimulus input is analyzed in a first stage by a *feature detection system* which allows the identification of potentially threatening stimuli based on their simple features (e.g., a sudden movement, the shape of frowned eyebrows, etc.), which can then influence and activate the so-called *fear module* (Öhman & Mineka, 2001).

While all these models assume that the central phenomenon is the tendency of anxious individuals to detect threat *faster*, other empirical findings (Fox, Russo, Bowles, & Dutton, 2001; Fox, Russo, & Dutton, 2002; Georgiou et al., 2005), suggests that threat-signaling stimuli are not necessarily detected faster, but rather they tend to *hold* attention, making disengagement more difficult for people with high anxiety.

4.1.2.2 Attentional Control Theory

Attentional Control Theory (ACT; Eysenck et al., 2007) is a recent attempt to look at the relationship between anxiety and cognitive performance from a more general – and at the same time more parsimonious – perspective. The main assumption of ACT is that anxiety affects performance through its negative effects on attentional control. Although attentional control is not clearly defined in Eysenck et al.'s (2007) presentation of ACT, based on the different contexts where the term is used in the original article and in other sources (Derakshan & Eysenck, 2009), attentional control can be seen as the implementation of the functions of the central executive during cognitive tasks (mostly those involving WM and attention).

One of the main hypotheses of ACT states that the disruptive effects of anxiety upon attentional control are the result of an impairment in the balance between bottom-up (or stimulus-driven) and top-down (or goal-driven) attentional mechanisms. Eysenck et al. have based their conceptualization of the two systems on models from fundamental research on attention, such as the model of Corbetta and Shulman (2002) or Posner and Petersen (1990) (to be detailed below). Eysenck et al. (2007) postulate that the stimulus-driven attentional system *dominates* in anxious individuals, at the expense of the goal-driven attentional system. This implies that individuals with higher anxiety levels are more vulnerable to having their attentional resources captured by salient stimuli, whether these are task-relevant or not. Stimuli can be salient either due to their sensory properties or due to their motivational/emotional content. Since emotionally threatening stimuli are more salient for anxious individuals, it is likely that their effects will be more pronounced than those of stimuli that are salient based on purely sensory grounds.

Another important set of hypotheses of ACT relates to the functions of the central executive, namely inhibition, shifting and updating, as identified by Miyake et al. (2000; see also Friedman & Miyake, 2004). Out of the three main central executive functions, Eysenck and collaborators predicted that anxiety would mostly impair the inhibition and shifting functions, with effects on updating seen most often under stressful circumstances (Eysenck et

al., 2007; see also Derakshan & Eysenck, 2009). Evidence up to this point tends to support these predictions, at least in the case of adults (Derakshan, Ansari, Hansard, Shoker, & Eysenck, 2009; Derakshan & Eysenck, 2009; Derakshan, Smyth, & Eysenck, 2009; Hopko et al., 1998).

Taking into account the main concepts of ACT and those involved in the first part of this thesis, some terminological clarifications are in order. To avoid confusion, throughout the rest of this thesis, we will only use the term "attentional control" in reference to the temperament dimension. When it comes to ACT, we will mainly focus on the issue of bottom-up versus top-down mechanisms; this will allow us to avoid using the term "attentional control" altogether in this context (since top-down mechanisms can be seen, in fact, as the implementation of executive functions in attentional performance).

4.2 What is attention?

Despite its importance in cognitive and emotional functioning, attention is probably one of the most elusive and difficult to define processes. While William James is often quoted as saying that "everyone knows what attention is" (James, 1890, p. 261), most researchers nowadays would be reluctant to give such a confident answer. In fact, a survey of current research would probably generate an answer closer to Harold E. Pashler's statement that "No one knows what attention is, and there may even not be an 'it' there to be known about (although of course there might be)" (Pashler, 1998a, p. 1). However, early modern attention research has been marked by attempts to generate a unitary definition and a unitary theory of attention.

4.2.1 Attentional metaphors: Classic models of attention

The initial stages of modern attention research were marked by a tendency to describe and explain attention as a unitary phenomenon. These early models are frequently referred to as "conceptual metaphors", because they often construed attention by taking systems described in other fields (e.g., information technology, economy, etc.), and assigning the properties of those systems as properties of attention (see Fernandez-Duque & Johnson, 1999, 2002; Miclea, 1999; Neumann, 1996; Sanders, 1997; Styles, 2006 for reviews). In this section we discussed the main conceptual metaphors that have dominated early attention research: attention defined as a *filter*, *limited resource*, *spotlight/zoom lens*, *competition* (see the original thesis for details).

4.2.2 Varieties (functions) of attention in current research

Current research acknowledges more than ever the fact that attention is not a unitary process and that attempting to formulate a single theoretical account of it is virtually impossible at this point (see Itti, Rees, & Tsotsos, 2005; Pashler, 1998b; Posner, 2004 for examples of the degree of diversity pervading the field). While this might have been a beneficial change for the progress of the field, it also had the effect of turning attention into an extremely fragmented phenomenon, with different functions and different "local" theories for them.

Here we present a tentative classification of attentional functions, based on sources from both the adult (e.g., Posner & Raichle, 1997; Sturm & Willmes, 2001) and developmental

literature (Plude et al., 1994; Ruff & Rothbart, 1996). We discussed intensive aspects of attention (alertness and sustained attention) and selective aspects of attention (orienting, searching, filtering and executive attention) (see thesis for details).

4.3 Development of attention

Most of the research in attentional development has focused on infancy (see Colombo, 2001; Johnson, 2002; Richards, 1998, 2003 for reviews), which is understandable considering the role of attention in early learning (e.g., Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Smith, Colunga, & Yoshida, 2010). While in infancy the scope of investigated attentional functions has been relatively wide, starting with toddlers and preschoolers, the focus has been mostly on executive attention, as a consequence of the general increasing interest in the development of executive functions (see e.g., Carlson, 2005; Davidson, Amso, Anderson, & Diamond, 2006; Gerardi-Caulton, 2000). However, based on the available literature, we attempted to sketch the developmental path of each attentional function discussed above in the case of adults (see thesis for details).

To conclude, it appears that for most attentional functions development begins in early infancy. However, the first signs of filtering, sustained attention, etc. are largely automatic, since they are driven mostly by characteristics of the external stimuli, and less by internal, voluntary control mechanisms. The development of more effortful (i.e., top-down) forms of attentional modulation begins after the age of 12 months – when the first signs of executive control start to emerge (Diamond, 1991; Wellman, Cross, & Bartsch, 1987) – and appears to continue until at least early adolescence (Davidson et al., 2006; Huizinga et al., 2006). These two aspects of attentional modulation – the automatic, effortless one, and the controlled one – have a great tradition in research on adult attentional functioning (although, as usually, there seems to be little overlap between the developmental and adult literatures). They are also the mechanisms that the ACT suggests might be out of balance in anxiety. Therefore, we next review the most important models of top-down and bottom-up attentional regulation.

4.4 Models of top-down and bottom-up attentional modulation

There are several models of bottom-up and top-down modulation of attention. In what follows we review some of them. Our choice is based on their relevance for attention research in general (the fact that they have generated clear lines of research and that they are frequently cited), and for ACT in particular (i.e., they have been cited by Eysenck et al., 2007, as essential for the way they conceptualize top-down and bottom-up processing). Here we discussed the Supervisory Attentional System (Norman & Shallice, 1986), the posterior / anterior attentional system (Posner & Petersen, 1990), biased competition models (Desimone & Duncan, 1995; Miller & Cohen, 2001), attentional capture models (Folk, Remington, & Johnston, 1992; Folk, Remington, & Wright, 1994; Theeuwes, Kramer, Hahn, & Irwin, 1998; Yantis, 1998), and models of top-down and bottom-up modulation of spatial attention (Corbetta, Patel, & Shulman, 2008; Corbetta & Shulman, 2002) (see thesis for details).

Very likely, most attentional functions discussed earlier are modulated by both bottom-up and top-down influences, although perhaps in different proportions (see Corbetta et al., 2008; Desimone & Duncan, 1995; Sarter et al., 2001; Theeuwes, Atchley, & Kramer, 2000; Wilson, Smith, & Holmes, 2007 for such discussion regarding the functions of searching,

filtering, orienting and sustained attention). While these modulating influences are no yet clearly understood for all attentional functions, approaching these functions from the perspective of top-down/bottom-up mechanisms, might facilitate their investigation from the perspective of anxiety.

4.5 Attentional functions, top-down/bottom-up modulation and anxiety

In Table 4.1, we have summarized – for each attentional function – the research that has investigated it in anxiety, using emotional or non-emotional stimuli, in adults and children (see the last two columns of the table). The first aspect that can be noticed from inspecting the table is the almost complete lack of research in children, at the level of almost every function. Searching and executive attention are the most well represented, but even here, there is less research than in the case of adults. However, even in the case of adults, with the exception of searching and executive attention which have been investigated in the context of threat-related attentional biases (see paragraph 4.1.1), research is relatively scarce and present mostly in the context of emotional stimuli.

Of course, lack of research on a topic does not necessarily represent a valid reason to start investigating it. However, we believe that better knowledge of the way attention works in anxious persons might help increase understanding of the threat-related bias phenomenon, as well as, possibly, other cognitive phenomena associated with anxiety (such as, for example, WM deficits; Ashcraft & Kirk, 2001; Hadwin, Brogan, & Stevenson, 2005; Visu-Petra, 2008). Additionally, knowing whether attentional development follows a different path in anxious individuals, might help us understand how some of these phenomena emerge, and might help design interventions for preventing them.

The investigations presented in the following two chapters are largely exploratory (especially the studies included in Chapter 5). However, we tried to approach them – as much as possible – from the perspective of ACT, and the hypothesized imbalance between bottom-up and top-down attentional mechanisms.

Table 4.1

A summary of the main attentional functions, tasks used to asses them, and research that has investigated these functions in anxiety.

	Function	Main experimental paradigm(s)	Investigated in anxiety?	
			Adults	**Children**
Intensive aspects of attention	**Alertness** (intrinsic and phasic)	Detection of a target stimulus (either its spatial location or some other attribute) presented at variable intervals, in the absence of a warning signal (intrinsic alertness). *Warning task*: Detection of a target stimulus (spatial location or some other attribute) proceeded by a warning signal (phasic alertness). (In both cases, the target stimulus is presented in each trial). *Adults:* Posner & Boies (1971); Fan et al. (2002); Coull & Nobre (1998); Callejas et al. (2004); Sturm et al. (1999); Mottaghy et al. (2006) etc. *Children:* Berger et al. (2000); Rueda et al. (2004).	*Non-emotional stimuli:* Yes- • Null findings (Moriya & Tanno, 2009). *Emotional stimuli:* Yes- • Higher phasic alertness linked to high state anxiety (Dennis et al., 2008)* • Null findings (Dennis & Chen, 2007, 2009; Finucane & Power, 2010)*	*Non-emotional stimuli:* No *Emotional stimuli:* No
	Sustained attention/ Vigilance	*Continuous Performance Tests (CPTs):* Detection of infrequent target stimuli, occurring at unpredictable intervals among other, non-target stimuli. Stimuli are presented sequentially, one at a time. They can be letters, numbers, geometric figures, etc. Examples: X-type CPT: Respond to "X"; ignore any other letter. AX-type CPT: Respond to "X", but only when it is preceded by "A". XX-type CPT: Respond to "X", but only when it is preceded by itself. *Adults:* DuPaul et al. (1992); Parasuraman et al. (1998); Riccio et al. (2002); Koelega (1996) etc. *Children:* Laurie-Rose et al. (2005); Lin et al. (1999); Llorente et al. (2008) etc.	*Non-emotional stimuli:* No *Emotional stimuli:* No	*Non-emotional stimuli:* No *Emotional stimuli:* No

	Function	Main experimental paradigm(s)	Investigated in anxiety?	
			Adults	**Children**
Selective aspects of attention	**Orienting**	*Spatial cueing task:* Detection of the location (up-down/left-right) of a target stimulus, preceded by an exogenous or endogenous, valid or invalid cue. (Usually, valid cues are more frequent than invalid ones; e.g., 80:20 %). *Adults:* Posner (1980, 1984); Corbetta (1998); Fan et al. (2002); Raz & Buhle (2006); Corbetta et al. (2000); Kincade et al. (2005) etc. *Children:* Pearson & Lane (1990); Berger et al. (2000); Rueda et al. (2004); Brodeur & Enns (1997); Ristic & Kingstone (2009) etc.	*Non-emotional stimuli:* Yes- • Slow orienting after a valid, exogenous cue (Moriya & Tanno, 2009b). *Emotional stimuli:* Yes- • Slow disengagement when angry or fearful faces are used as cues (Fox et al., 2001; Giorgiou et al., 2005) • Faster orienting after a valid, exogenous cue, after intertrial presentation of a sad or fearful face (Dennis & Chen, 2007)* • Null findings (Dennis & Chen, 2009; Dennis et al., 2008; Finucane & Power, 2010)*	*Non-emotional stimuli:* No *Emotional stimuli:* No
	Searching	*Visual search task:* Detection of the presence or absence of a target stimulus in a "crowd" of distractors. The target stimulus can be characterized by a single feature or a conjunction of features, and most often is present in 50% of trials. *Adults:* Treisman and Gormican, (1988); Wolfe (1998, 2010); Theeuwes, 2004; Leber & Egeth (2006); Lamy & Zoaris (2009) etc. *Children:* Trick & Enns (1998); Donnelly et al. (2007); Hommel et al. (2004); Booth et al. (2003) etc.	*Non-emotional stimuli:* No *Emotional stimuli:* Yes • Faster search for threatening stimuli (angry/fearful faces, spiders, etc.) versus neutral or positive ones (e.g., Öhman et al., 2001; Miltner et al., 2004**; Rinck et al., 2005** etc.). • Slower search for neutral targets among threatening distractors (e.g., Byrne & Eysenck, 1995; Gerdes et al., 2008**; Rinck et al., 2005** etc)	*Non-emotional stimuli:* Yes- • Null findings (Lubow et al., 2000**). *Emotional stimuli:* Yes- • Faster detection of presence (Waters & Lipp, 2008) or absence (Hadwin et al., 2003) of angry faces among neutral or happy distractors (7-11 years)

	Function	Main experimental paradigm(s)	Investigated in anxiety?	
			Adults	Children
Selective aspects of attention	**Filtering**	*Flanker task:* Detection of a target characteristic of a central stimulus (identity, direction, etc.), flanked by distractors. The relationship between the target and flankers can be manipulated in various ways. Any paradigm that requires the participant to focus on a target stimulus/task and ignore distracting stimuli. *Adults:* Lavie & Cox (1997); Schwartz et al. (2005); Reed et al. (1999); Eriksen & Eriksen (1974); Palmer & Moore (2009) etc. *Children:* Ridderinkhof et al. (1997); Enns & Akhtar (1989); Pastó & Burack (1997); Akshoomoff (2002); Roebers et al., 2010 etc.	*Non-emotional stimuli:* Yes- • Impaired frontal recruitment (activation) in the presence of distractors, but null behavioral findings (Bishop, 2009). *Emotional stimuli:* Yes- • Impaired frontal recruitment (activation) in the presence of fearful face distractors, but null behavioral findings (Bishop, 2004; Bishop et al., 2007). • Null findings (Peers & Lawrence, 2009; this study used only behavioral measures).	*Non-emotional stimuli:* No *Emotional stimuli:* No

	Function	Main experimental paradigm(s)	Investigated in anxiety?	
			Adults	**Children**
Selective aspects of attention	**Executive attention**	*Stroop task:* Naming the color of words that represent color names. *Spatial conflict task:* Responding (by pressing a left-hand or right-hand button) to the identity of a stimulus presented on the left or right side of the display. *Flanker task:* Detecting the target characteristic of a central stimulus (identity, direction, etc.), flanked by distractors. Distractors can be congruent (associated with the same response) or incongruent (associated with the opposite response) with the target stimulus. *Antisaccade task:* A target stimulus is presented in a peripheral location on the display. The requirement is to make a saccade to the opposite side of the display. *Adults:* Stroop (1935); Pardo et al. (1990); Bush et al. (1998); Botvinick et al. (1999); Ursu et al. (2009); van Veen et al. (2001); Eriksen & Eriksen (1974); Simon & Berbaum (1990); Fan et al. (2002, 2003); Hallett (1978); Everling & Fischer (1998) etc. *Children:* Davidson et al. (2006); Huizinga et al. (2006); Gerardi-Caulton (2000); Gerstadt et al. (1994); Carlson et al. (2005); Berger et al. (2000); Rueda et al. (2004a); Ridderinkhof et al. (1997) etc.	*Non-emotional stimuli:* Yes- • Stroop task: - • Spatial conflict task: - • Flanker task: Null findings (Moriya & Tanno, 2009b; Reinholdt-Dunne et al., 2009). • Antisaccade task: Longer saccade latencies in high anxiety (Derakshan et al., 2009). *Emotional stimuli:* Yes+ • Stroop task: Longer latencies to name the color of threatening words/faces/images (e.g., Mathews & MacLeod, 1985; Williams et al., 1996; Becker et al., 2001**; Ruiter & Brosschot, 1994; Reinholdt-Dunne et al., 2009 etc.) • Spatial conflict task: - • Flanker task: Better executive attention in participants with high state anxiety following intertrial fearful faces (Dennis et al., 2008) or threatening images (Finucane & Power, 2010)* • Flanker task: Null findings (Dennis & Chen, 2007, 2009)* • Antisaccade task: Longer saccade latencies in high anxiety; more pronounced with angry (vs. happy/neutral) faces used as cues (Derakshan et al., 2009).	*Non-emotional stimuli:* No *Emotional stimuli:* Yes • Stroop task: Longer latencies to name the color of threatening words/faces/images (e.g., Taghavi et al., 2003**; Richards et al., 2000; Heim-Dreger et al., 2006 etc.) • Stroop task: Similar latencies to name the color of threatening words/faces/images (e.g., Kindt et al., 1997; Kindt & Brosschot, 1999**; Benoit et al., 2007** etc.)

Note: Yes- = We were only able to identify a limited number of studies, and all of them are mentioned in the table; Yes = We were able to find a relatively high number of studies (a few examples are included in the parentheses); Yes+ = There is a very large number of studies on this topic (a few examples from this larger pool are included in the parentheses); No = We were unable to identify any published study on this topic. These estimates were based on searches carried within several scientific databases (PsycInfo, PubMed, SpringerLink, ScienceDirect and Ebsco).

*Emotional stimuli – faces or scenes – inserted between trials containing non-emotional stimuli.
**Study with clinical participants (The unmarked references represent studies that have only measured trait anxiety).

Chapter 5.
Attentional networks, anxiety and self-regulation

In this chapter we present three studies (focusing, as before, on three developmental samples: preschool, middle childhood and young adulthood) in which we are attempting to determine whether attentional functioning in these three networks is altered as a function of anxiety, whether EC moderates anxiety-related attentional performance, or whether these attentional mechanisms are linked to self-regulatory skills (EC and ER).

5.1 The model

Reviewing data from animal studies, human neuropsychological studies and imaging in healthy participants, Posner and Petersen (1990) have outlined three neuroanatomical networks that subserve three different functions of attention. Posner and Raichle (1997) have further described these three attentional networks as accomplishing the functions of alerting (or vigilance), orienting and executive attention.

5.1.1 The orienting network

The orienting function comes into play when relevant stimuli occur outside the current focus of attention (Posner & Fan, 2008). Efficient orienting relies on the proper functioning of three component mechanisms: *disengagement* of attention from the current focus, *shifting* attention to a new location and *engaging* attentional resources at the new focus (Posner, 1980; Posner, Walker, Friedrich, & Rafal, 1984). The classic experimental paradigm for investigating visual orienting is the well-known Posner spatial cueing task (Posner, 1980).

5.1.2 The executive attention network

The executive control function of attention comes into play in situations requiring planning or decision making, situations that require making novel or not well-learned responses, detecting and correcting errors, potentially difficult or dangerous situations, and overcoming habitual behaviors (Fan et al., 2009; Norman & Shallice, 1986; Posner & Fan, 2008). While this account of executive attention includes a rather diverse range of situations, what they have in common is the occurrence of conflicts between computations in different neural areas (Botvinick, Braver, Barch, Carter, & Cohen, 2001; Bush, Luu, & Posner, 2000; Posner & DiGirolamo, 1998).

Executive attention has been traditionally assessed using tasks that capture the ability to detect and resolve conflict between stimuli, between stimuli and responses or between different motor responses (see van Veen, Cohen, Botvinick, Stenger, & Carter, 2001 for an example of how the different levels at which conflict arises can be manipulated and assessed). The prototypical tasks used to measure executive attention are the Stroop task (Stroop, 1935; see also MacLeod, 1991 for a review), Eriksen's flanker task (Eriksen & Eriksen, 1974), and Simon's spatial conflict task (Simon & Berbaum, 1990).

5.1.3 The alerting network

The neural network subserving this function modulates the allocation of attentional resources in preparation for detecting and processing impending stimuli (Posner & Petersen, 1990; Posner & Rothbart, 2007; Raz & Buhle, 2006). Several authors distinguish between two types of alertness states: *intrinsic* (or *tonic*) *alertness* and *phasic alertness* (see e.g., Posner & Boies, 1971; Posner & Petersen, 1990; Sturm & Willmes, 2001). Intrinsic alertness has been equated to general wakefulness or arousal level (Sturm & Wilmes, 2001), but other authors indicate that this type of alertness might be more similar to sustained attention (the ability to maintain attentional focus on a task over an extended period), only assessed over a shorter time span (Oken, Salinsky, & Elsas, 2006). Phasic alertness arises in situations when a warning stimulus temporally precedes the occurrence of the target stimulus, but without giving any information regarding the location where that stimulus will occur. Intrinsic alertness is regulated endogenously whereas phasic alertness can be seen as extrinsically (or exogenously) regulated (Mottaghy et al., 2006; Sturm et al., 1999, 2004).

Based on this triadic model of attention, Posner and collaborators (see Fan, McCandliss, Sommer, Raz, & Posner, 2002) have designed the *Attention Network Test* (ANT), which allows for the simultaneous assessment of the efficiency of all three attentional networks (see Figure 5.1 for an illustration of the conditions involved in ANT). The ANT requires participants to respond to the orientation (left/right) of a target arrow presented centrally, above or below fixation, by pressing a button corresponding to it (e.g., the left or right mouse button). The target display is preceded by one of four types of cueing conditions: No Cue (the target stimulus appears without prior warning), Center Cue (an asterisk presented at fixation), Double Cue (two asterisks presented above and below fixation, at the levels where the target would normally appear), and Spatial Cue (an asterisk is presented above or below fixation, at the location where the target will appear). The cueing conditions are combined with three conditions of the target display: Neutral Flankers (the target arrow is presented alone), Congruent Flankers (the target arrow is flanked by two arrows on each side, pointing all in the same direction), and Incongruent Flankers (the target and flanking arrows point in opposite directions).

Based on these task conditions, performance indexes can be computed for each of the three attentional networks. An *alerting score* is obtained by subtracting the reaction times obtained in the Double Cue condition (i.e., phasic alertness) from reaction times obtained in the No Cue condition (i.e., intrinsic alertness). The *orienting score* results from the difference between reaction times in the Center Cue condition (which has only an alerting value) and reaction times in the Spatial Cue condition (in which the cue is always valid). The *conflict score* (corresponding to the efficiency of the executive attention network) is computed as the response time difference between the Incongruent Flanker and Congruent Flanker conditions.

5.2 Attentional networks and anxiety

The question of whether high levels of trait anxiety are associated with alterations in any of the three attentional networks has recently gained interest. Only a handful of studies have been published thus far and we are not aware of any research investigating these mechanisms in children. In addition, there is little theoretical background to support any specific hypotheses regarding basic attentional mechanisms that might be affected (or at least working differently) in

anxiety. As already mentioned in the previous chapter, the Attentional Control Theory (ACT; Derakshan & Eysenck, 2009; Eysenck, Derakshan, Santos, & Calvo, 2007) is the main current theory attempting to describe the way attention functions in persons with high trait anxiety in general, not just in emotionally laden environments. Based on the predictions of ACT, might expect to find deficits associated with anxiety in all three attentional functions: (1) impaired ability to maintain intrinsic alertness and/or faster responding after a warning cue (phasic alertness), i.e., higher alerting scores; (2) faster reactions to exogenous orienting cues, and possibly higher validity scores; (3) impaired executive attention (although this might be true only in emotional contexts).

Research regarding the three attentional functions and their potential involvement in anxiety presents a somewhat confusing picture. However, we might try to summarize the studies. Thus, improved executive attention appears to be linked to high anxiety but only in emotional contexts (Dennis, Chen, & McCandliss, 2008; Finucane & Power, 2010; Reinholdt-Dunne, Mogg, & Bradley, 2009), and adults with high trait anxiety tend to over-monitor conflict (Dennis & Chen, 2009). The relationship between orienting and anxiety seems to depend on whether emotional cues are used or not [orienting is slow in neutral contexts (Moriya & Tanno, 2009b), but fast when the cue is preceded by an emotionally negative stimulus (Dennis & Chen, 2007)] and possibly on SOA manipulations. Lastly, there is some limited indication of a link between alerting and anxiety/negative affect, irrespective of emotional/neutral context (Compton et al., 2004; Dennis et al., 2008).

5.3 The present research

Our main objective was to investigate the links between anxiety and the three attentional networks in preschoolers, school age (middle childhood) children and adults. We were interested whether anxiety would be *directly* associated with functional alterations in attention, but also whether such a link would be moderated by EC (or any of its sub-dimensions). Second, since previous research suggests a relationship between attentional mechanisms and self-regulation, we looked at whether the functioning of the three attentional networks is related in any way with EC or ER strategies. Here we expected that high EC would be linked to good executive attention performance at all ages, but we were unable to make any other specific predictions due to the lack of previous research. As a third and minor objective, we were also interested in the pattern of ANT performance (including network interactions) specific for each age sample.

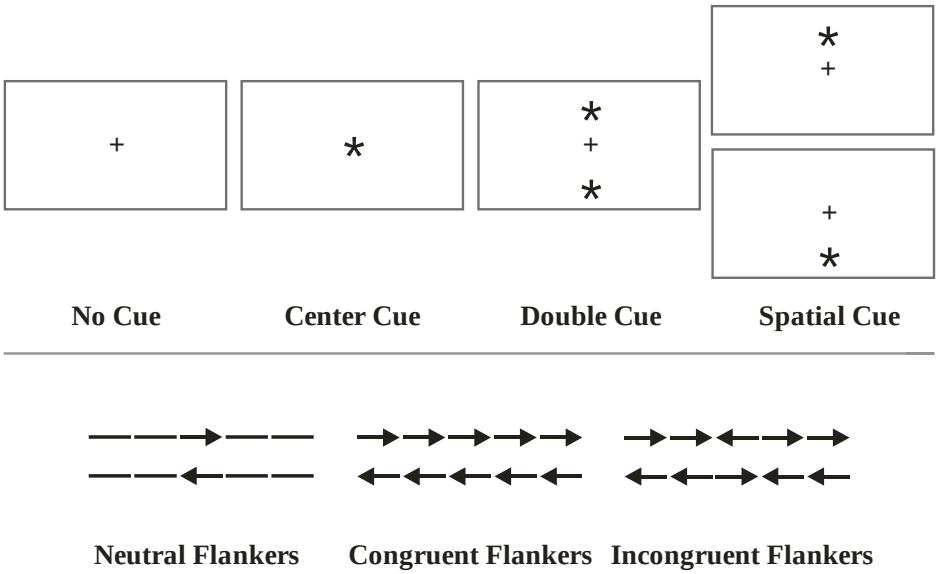

Figure 5.1. Illustration of the cue and flanker conditions involved in ANT (figure reconstructed after Fan et al., 2002).

5.4 Study 2A: Attentional networks and anxiety in preschoolers

5.4.1 Method

5.4.1.1 Participants

The final sample consisted of 97 children (48 girls) aged 4-7 years (M = 67.28 months; SD = 9.97; range = 50-86 months).

5.4.1.2 Measures

Anxiety

The Romanian version of the *Spence Preschool Anxiety Scale* (SPAS) was used as a measure of anxiety symptoms (Spence, Rapee, McDonald, & Ingram, 2001; see Benga, Ţincaş, & Visu-Petra, 2010 for the Romanian version). A detailed description of the SPAS can be found in Chapter 3, Study 1A. In the current sample, Cronbach's α coefficient for the total scale was .86.

Temperament

Parents were administered the Romanian version of the *Children's Behavior Questionnaire* (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001; see Benga, 2004 for the Romanian version; see Chapter 3, Study 1A for a detailed description of the questionnaire). For the purposes of the present study, we selected the sub-scales measuring Fearfulness (α = .67), Sadness (α = .60), Attentional control (α = .62) and Inhibitory control (α = .80), as well as the higher-order dimensions NA (α = .80) and EC (α = .82).

Emotion regulation

Children's ER strategies were assessed using Eisenberg's *Children's Coping Styles Questionnaire* (CCSQ; Eisenberg et al., 1993, 1995), described in more detail in Chapter 3, Study 1A. ER strategies were grouped here exactly as in Chapter 3, but we decided to include only the first three strategies from the previous study: (1) Active ER (Cognitive restructuring, Distraction, Instrumental coping; α = .79); (2) Passive ER (Emotional intervention, Avoidance, Venting; α = .82); (3) Aggressive ER (Emotional aggression, Instrumental aggression; α = .85).

Attentional networks

The child version of the Attention Network Test (Rueda, Fan et al., 2004) was used to assess the efficiency of the three attentional networks. The task is an adaptation of the adult ANT (Fan et al., 2002; see Figure 5.1). Rueda, Fan et al. (2004) replaced the arrows with yellow fish pointing right or left. The child is told that his/her task is to "feed" the target fish by pressing the mouse button corresponding to the direction in which the target fish "swims". Each trial starts with a central fixation cross (presented for 400-1600 ms), followed by a warning cue (an asterisk displayed for 150 ms), present in 75% of the trials, and then the target display (presented 450 ms after the offset of the warning cue). The target display consists of the target fish, presented centrally above or below fixation, alone or flanked by two other fish on each side. The child must respond within 1700 ms by pressing the left or right mouse button. The response is followed by a positive or negative visual and sound feedback.

Two variables are manipulated within the task: the type of warning cue given and the type of flankers used. The *cue conditions* are as follows: (1) No Cue; (2) Center Cue (one asterisk is displayed in the center of the screen); (3) Double Cue (two asterisk are displayed – one below, one above fixation) and (4) Spatial Cue (one asterisk, presented either above or below fixation, signaling the location of the target stimuli). The *target display* can be composed of either (1) the target fish presented alone (Neutral Flanker condition) or the target fish flanked by other fish (2) pointing in the same direction (Congruent Flankers), or (3) in the opposite direction (Incongruent Flankers).

The efficiency of the three attentional networks is determined by taking into account children's median RTs from correct trials and computing the differences between the different task conditions. More precisely, the scores for the three attentional networks are computed as follows:

$$\textit{Alerting} = RT_{\text{No Cue}} - RT_{\text{Double Cue}}$$

$$\textit{Orienting} = RT_{\text{Center Cue}} - RT_{\text{Spatial Cue}}$$

$$\textit{Conflict} \text{ (executive attention)} = RT_{\text{Incongruent Flanker}} - RT_{\text{Congruent Flanker}}$$

5.4.1.3 Procedure

Parents were contacted with the help of teachers. Each parent received a set of three questionnaires (SPAS, CBQ, and CCSQ) and an informed consent letter. Children whose parents agreed to take part in the study and returned all three questionnaires filled-in were further selected for testing with the child ANT.

Each child was tested individually by a female experimenter, in a quiet room inside the kindergarten. The task was administered using a laptop computer with a 15-inch display, with the screen resolution set to 1024 × 768. The left and right buttons of the mouse pad were used to collect responses. Children placed the index finger of each hand on the corresponding button. They were allowed to use more than one finger on each button if it was more comfortable for them. Instructions were given before the start of the task using cards depicting the possible target displays. The task started with a practice block consisting of 24 trials, during which each child received feedback and encouragement from the experimenter. The practice block was followed by three blocks consisting of 48 trials each. The entire task lasted approximately 30 minutes (including instructions and breaks). Upon task completion, each child received three stickers.

5.4.2 Results

We found no direct relationship between attention network scores and intensity of Anxiety symptoms.

We next investigated whether EC or its sub-dimensions had any moderating contribution to the Anxiety–attention link. For each attention score, we tested the moderating role of each variable in a separate hierarchical regression analysis, conducted according to the guidelines put forward by Aiken and West (1991; see also Cohen, Cohen, West, & Aiken, 2003; Sava, 2004).

We only present the parameters of the analysis where the moderating effect was statistically significant here, namely the one including Inhibitory control as a moderator of the relationship between Anxiety and the Alerting score. The Alerting effect was significantly

predicted by the interaction of anxiety and inhibitory control in girls. The entire model predicted 8% ($f^2 = 0.09$) of the variance in alerting scores in the case of the total sample, 4% ($f^2 = 0.04$) in the case of boys and 11% ($f^2 = 0.12$) in the case of girls. Inhibitory control was a direct predictor of Alerting at the level of the entire sample ($\beta = .20$, $p < .05$). The interaction effect added 9% of explained variance ($f^2 = 0.10$) and it significantly predicted the Alerting score ($\beta = -.31$, $p < .05$) in the girls sample. As Figure 5.5 indicates, while at lower levels of Inhibitory control high Anxiety is associated with a high Alerting score, high Inhibitory control tends to attenuate (and indeed even reverse) this relationship. Post-hoc probing (using ModGraph; Jose, 2008) indicated, however, that none of the three slopes was significantly different from zero: $t(44) = 1.75$, $p = .09$; $t(44) = 0.18$, $p = .86$; $t(44) = -1.06$, $p = .29$ for low, medium and high Inhibitory control, respectively.

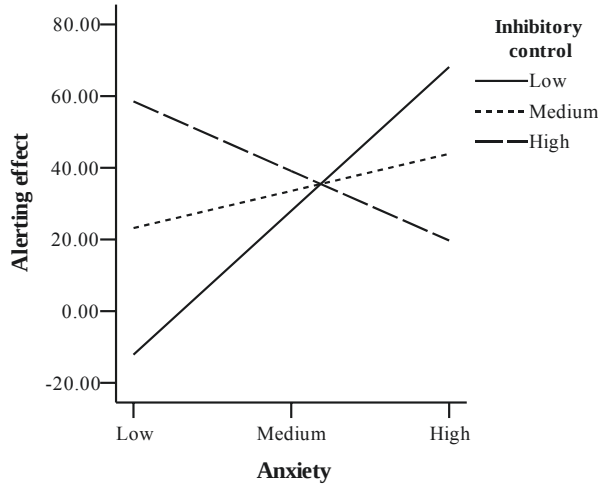

Figure 5.5. Interaction between Anxiety and Inhibitory control in predicting the Alerting effect in girls.

We found a significant relationship between temperamental Fear and the Alerting score ($r = .33$, $p < .05$) in the case of girls. A 2 (high vs. low fearfulness) × 2 (No Cue vs. Double Cue) mixed ANOVA with RT as the dependent variable found a marginally significant effect: $F(1, 46) = 3.98$, $p = .05$, $\eta_p^2 = .08$. Pairwise comparisons were not statistically significant, but, as can be seen in Figure 5.6, compared to their less fearful peers, highly fearful girls tend to have slower responses in the absence of a warning cue, and faster responses when the cue is present. Sadness was only marginally linked to Alerting in boys ($r = -.25$, $p = .08$). Note that the Fear–Alerting relationship is an incidental finding.

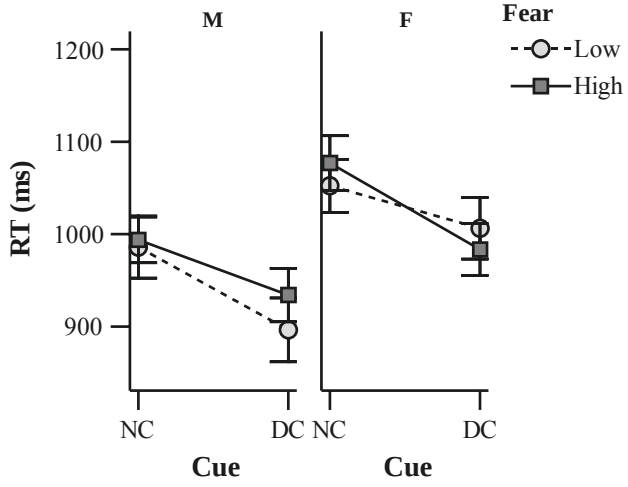

Figure 5.6. Mean RT (± 1 SE) plotted separately for boys (left panel) and girls (right panel) as a function of cue type and Fear.
Note: NC = No Cue; DC = Double Cue.

5.4.3 Discussion

The present study aimed to investigate the links between attentional networks and anxiety in preschool children, as well as the degree to which EC affected these potential links. As secondary objective, we were interested whether attentional network performance was related to EC and ER.

Turning to our main objective, while we did not find any direct links between anxiety and efficiency of the alerting, orienting or executive attention networks in this age sample, we did find an anxiety–alerting relationship that was moderated by inhibitory control in girls. More precisely, high anxiety was associated with high alerting scores at low levels of inhibitory control. Although the effect was small, this finding indicates that girls with high anxiety and low inhibitory control tend to have deficits in maintaining intrinsic alertness but are more reactive when it comes to phasic alertness. Thus, it seems that a potential impairment in top-down modulation of alertness can be compensated by good inhibitory control abilities. Our findings are partially in line with Dennis et al. (2008) and Compton et al. (2004), who found associations between high anxiety/negative affect and high alerting in adults. However, they differ from other research (e.g., Moriya & Tanno, 2009b), indicating a relationship between slow orienting and high trait anxiety in adults. The discrepancy between our results and those of Moriya and Tanno is probably developmental in nature, and the next two studies included in this chapter should clarify this.

Incidentally, we also found a positive correlation between temperamental fearfulness and alerting in girls. A closer inspection of our results indicated that the larger alerting scores found in highly fearful girls were due to their tendency to respond to the presence of the warning cue faster than girls with low levels of fearfulness, and to respond slower when no warning cue was given. Thus, high fearfulness in girls is associated with somewhat reduced intrinsic alertness, but enhanced phasic alertness. If we take into account research suggesting a top-down regulation of intrinsic alertness in adults (i.e., Fan et al., 2007; Mottaghy et al., 2006; Sturm et al., 1999), these findings are congruent with ACT, since they suggest impaired top-down control on alertness in highly fearful girls (or those with high anxiety and low inhibitory control) and an overactive bottom-up system. The response pattern found in highly fearful girls in our study is indicative of precisely a dominance of the stimulus-driven attentional system overriding the goal-driven system. It is possible that during trials when there is no warning cue to draw their attention to the

task, fearful girls' attention "wanders off", delaying their reaction to the target stimulus when it appears. In fact, there is already evidence in adults showing that mind wandering episodes can be reliably measured, and they can best be captured using a sustained attention task. These episodes tend to be associated with reduced processing of task stimuli and are associated with reduced activation in the right inferior frontal gyrus, the middle frontal gyrus and the ACC (Smallwood, Beach, Schooler, & Handy, 2008). Another (complementary) interpretation is that highly fearful girls are more distractible by exogenous stimuli since they react faster when the exogenous warning cue is present. This interpretation is consistent with previous research showing higher levels of distractibility in adults with high levels of trait anxiety (e.g., Eysenck & Byrne, 1992). While these results regarding the alerting network raise some intriguing possibilities for future research, the reader should keep in mind that effects were small and should therefore be replicated to determine their reliability.

In summary, with respect to our objectives, the present study showed that in preschool children the relationship between good self-regulatory abilities and executive attention might not be as straightforward as previously thought and that the anxiety-related imbalance in bottom-up versus top-down processing postulated by the ACT might already be present in preschoolers (at least in girls), at the level of alerting mechanisms. However, both aspects need further studies to be fully clarified.

5.5 Study 2B: Attentional networks and anxiety in middle childhood

The present study had the same main objectives as the ones stated in section 5.6. Namely, we were interested to understand the links between self-regulation and attention (and in particular to determine whether our previous findings related to executive attention were likely to be of a developmental nature or not), anxiety and attention, and whether EC moderated any potential anxiety-attention relationship.

Since research presented in Chapter 3 indicated that after the preschool stage EC is more important as a predictor/moderator than its sub-dimensions, here only EC as a whole was used as a potential moderator.

5.5.1 Method

5.5.1.1 Participants

This study included 106 children (55 girls) aged 6-11 years (M = 105.69 months; SD = 14.03; range = 81-135 months).

5.5.1.2 Measures

Anxiety and depression

The Romanian version of the *Revised Child Anxiety and Depression Scales* (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to assess anxiety and depression symptoms in the middle childhood sample (see Chapter 3, Study 1B for details). In our current sample, internal consistency indices for the Anxiety sub-scales of the RCADS-P ranged between α = .60 and α = .81, while the full Anxiety scale had a Crombach's α of .89. The internal consistency of the Depression scale was α = .77.

Temperament

Parents were administered the Romanian version of the *Temperament in Middle Childhood Questionnaire* (TMCQ; Simonds, 2006; Simonds & Rothbart, 2006; see Chapter 3, Study 1B for details). For the purposes of the present study, we selected sub-scales for Fear (α = .78), Sadness (α = .78), Attentional focusing (α = .77), and Inhibitory control (α = .67), as well as the higher-order dimensions of NA (α = .79) and EC (α = .82).

Emotion regulation

The Romanian, parent version of the *Children's Coping Strategies Checklist, Revised version* (CCSC-R1; Ayers et al., 1996; Program for Prevention Research, Arizona State University, 1999; see Chapter 3, Study 1B for details) was administered to parents. For the current sample, CCSC-R1-P internal consistency indices were as follows: α = .93 for Active coping strategies, α = .75 for Distraction, α = .73 for Avoidance and α = .90 for Support seeking.

Attentional networks

As in our previous study, the child version of the Attention Network Test (Rueda, Fan et al., 2004) was used to assess the efficiency of the three attentional networks. However, since pilot testing indicated that the task was extremely simple for the children in our sample, and most perceived it as being relatively unchallenging and boring, we made a slight alteration to the task so as to make it more challenging. Namely, while we kept all parameters as in the original task, we limited the amount of time available for the child's response to 1000 ms (from the original 1700). This manipulation made the task more engaging while still maintaining the error rates relatively low and comparable to the ones reported by Rueda, Fan et al. (2004). Additionally, a similar interval was previously used without difficulty in 5-year-old children by Berger et al. (2000). Apart from this modification, everything was kept as in the original task; and attention network scores were computed exactly as in the previous study.

5.5.1.3 Procedure

Permission for conducting the study inside the school was obtained from the school principal. Parents were contacted with the help of teachers. Each parent received an informed consent letter and three questionnaires assessing child characteristics (RCADS-P, TMCQ and CCSC-R1-P). Children whose parents agreed to take part in the study and returned the questionnaires were further selected for testing with the child ANT.

The child ANT was administered as already described in the previous study. Each child was tested individually by a female experimenter, in a quiet room inside the school. The entire task lasted approximately 20-25 minutes (including instructions and breaks). Upon task completion, each child received a colored badge.

5.5.2 Results

In a manner similar to the analysis presented in the previous paragraph, we started out by investigating the correlations between Anxiety / Depression and indicators of overall ANT performance. This analysis revealed that both RT and error rates were significantly correlated with Anxiety (r = .22, p < .05 for RT; r = .28, p < .01 for errors), but not with Depression. However, when controlling for age only the correlation between Anxiety and error rates remained significant: r = .17, *ns* for RT; r = .25, p < .05 for errors. This indicated that the relationship between Anxiety and RT was partially explained by children's age, and that higher levels of Anxiety are related with higher error rates.

There were no significant correlations between Anxiety or Depression and attention network scores at the level of the entire sample. In the gender-split analysis we found statistically significant results only for the boys' group, where high Anxiety was related to a low Orienting score (r = -.32, p < .05). We carried out two more correlational analyses between anxiety and Orienting in the case of boys: once controlling for Sadness and once for Depression. When we controlled for Sadness, the relationship between Anxiety and Orienting disappeared (r = -.18, *ns*); when controlling for Depression it became marginally significant (r = -.27, p = .06). These results indicate that the relationship between Anxiety and Orienting in the case of boys is at least

in part explained by the negative emotionality that is common to Anxiety, Sadness and Depression.

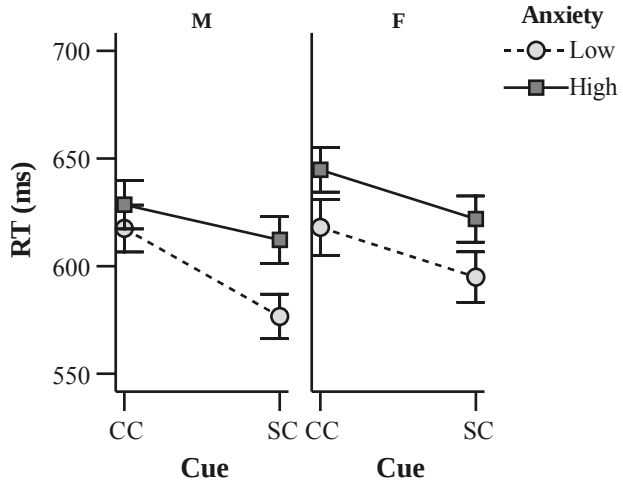

Figure 5.9. Mean RT (± 1 SE) plotted separately for boys (left panel) and girls (right panel) as a function of cue type and anxiety. *Note:* CC = Center Cue; SC = Spatial Cue.

We further explored the Anxiety–Orienting correlation found in boys through a 2 (high vs. low Anxiety) × 2 (Center Cue vs. Spatial Cue) mixed ANOVA with RT as a dependent variable. This analysis revealed a statistically significant Anxiety × Cue type interaction: $F(1, 49) = 6.67$, $p < .05$, $\eta_p^2 = .12$. Post-hoc *t*-tests found no significant differences between boys with high versus low Anxiety in the Center Cue condition: $t(49) = .70$, *ns*. However, boys with high Anxiety were significantly slower compared to their less anxious peers in response to the Spatial Cue: $t(49) = 2.35$, $p < .05$ (see Figure 5.9).

Since our preliminary analyses indicated the presence of an interaction between Alerting and Executive attention, we investigated whether this interaction was influenced by Anxiety. We carried out a 4 (cue) × 3 (flanker) ANCOVA with Anxiety as a covariate and RT as the dependent variable, but found no cue × flanker × Anxiety effect: $F(6, 624) = 1.37$, $p = .22$, $\eta_p^2 = .01$. However, when looking at correlations between the three attentional networks in children with high versus low Anxiety, we found that the Alerting–Conflict correlation was present in high Anxiety ($r = .32$, $p < .05$), but not low Anxiety ($r = .19$, *ns*).

The next step in our analysis was to determine whether EC moderated the relationship between Anxiety and attention network scores. Significant results were found only when the Orienting effect constituted the outcome variable. Therefore, we only present these results here. The Orienting effect was significantly predicted by Anxiety and its interaction with EC. The complete model explained 12% ($f^2 = 0.14$) of the variance in Orienting scores when the entire sample was included, 14% ($f^2 = 0.16$) when only boys were included in the analysis and 13% ($f^2 = 0.15$) when only girls were included. In the case of boys, Anxiety was a significant direct predictor of the Orienting effect even when taking age into account ($\beta = -.30$, $p < .05$). EC significantly moderated the relationship between Anxiety and Orienting in the total sample ($\beta = -.32$, $p < .01$; $\Delta R^2 = .08$, $f^2 = 0.09$) and in the case of girls ($\beta = -.46$, $p < .05$; $\Delta R^2 = .12$, $f^2 = 0.14$). Thus the effect of the added variance was relatively small in the case of the total sample and moderate in the girls' sub-sample.

The plots for the interaction between anxiety and EC in predicting the orienting score are displayed in Figure 5.10. As can be seen, the relationship between Anxiety and Orienting is strongest at *high* levels of EC. The model predicts that children with high levels of Anxiety but

also high levels of EC will have the lowest Orienting scores. Probing the interaction (using ModGraph; Jose, 2008) indicated that for the overall sample the slope was statistically significant only at high levels of EC [$t(101) = -3.19$, $p < .01$], but not medium [$t(101) = -1.71$, $p = .09$] or low levels [$t(101) = 0.77$, *ns*]. A similar pattern emerged in the case of the girls sub-sample: the slope for high EC was statistically significant [$t(51) = -2.15$, $p < .05$], while the slope for medium and low EC were not: $t(51) = -0.95$, $p = .35$ and $t(51) = -0.98$, $p = .33$, respectively.

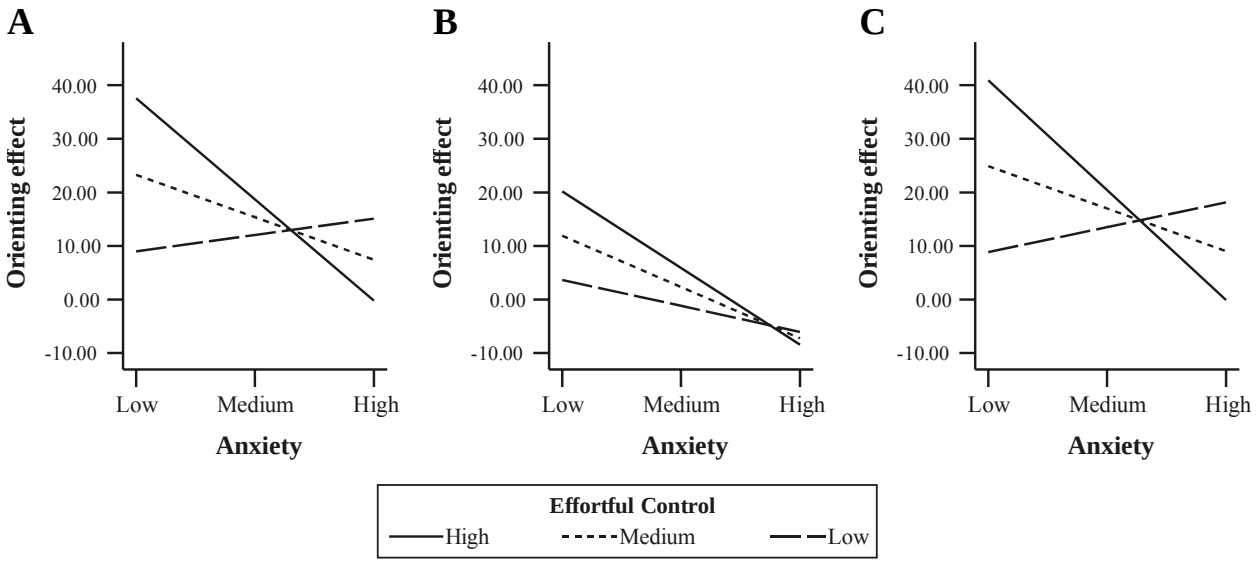

Figure 5.10. Interaction between anxiety and EC in predicting the orienting score in middle childhood for the entire sample (A), for boys (B) and for girls (C).

In other words, it seems that the direct negative relationship between Anxiety and Orienting found in the case of boys holds in the case of girls only at high levels of EC. To better understand this relationship, we plotted girls' RTs in the Center Cue and Spatial Cue conditions as functions of high vs low anxiety and EC, respectively. As Figure 5.9 indicates, girls with both low levels of Anxiety and low levels of EC appear to have the smallest Orienting scores. In fact, in their case the Center Cue–Spatial Cue manipulation appears to have no effect: Wilcoxon's test for two related samples: $z = -0.98$, *ns*, *M Orienting score* = 8.41 ms. In girls with high Anxiety, the orienting manipulation is effective whether children have high or low EC: $z = -2.27$, $p < .05$, *M Orienting score* = 23.57 ms for low EC, and $z = -2.31$, $p < .05$, *M Orienting score* = 22.08 ms for high EC. Furthermore, the orienting effect was virtually identical irrespective of EC abilities: Mann-Whitney U = 91.00, $p = .77$. The largest Orienting effect was found in children with low Anxiety and high EC: $z = -3.26$, $p < .01$, *M Orienting score* = 33.16 ms. Thus, the interactive effects of Anxiety and EC in the girls' sub-sample can be summarized as follows: the most well regulated children (with low anxiety and high EC) orient most efficiently. Girls with low Anxiety and low EC profit the least from the spatial, predictive cue. In children with high Anxiety, the level of EC a child possesses does not seem to matter. These children's Orienting scores are intermediate between the other two groups, but they have similar values irrespective of EC level.

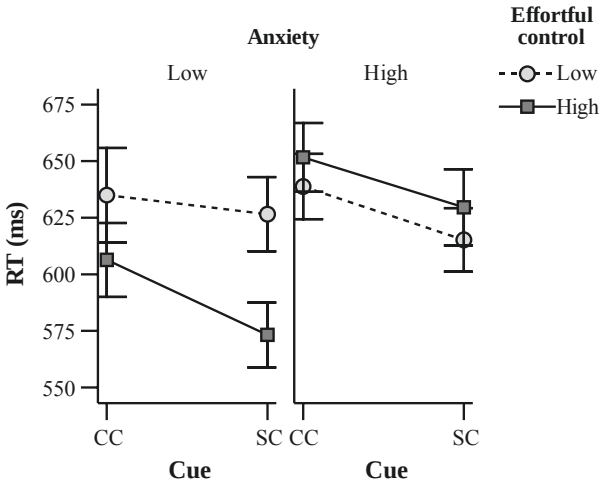

Figure 5.11. Mean RT (± 1 SE) for girls from the middle childhood sample, plotted separately for low anxiety (left panel) and high anxiety (right panel) as a function of cue type and EC. *Note:* CC = Center Cue; SC = Spatial Cue.

5.5.3 Discussion

The present study took investigated the two main objectives stated at the outset while taking into account the results of the previous study, and using a similar methodology.

Regarding attentional networks and anxiety, there are several aspects that need to be discussed. First, when investigating the interactions (correlations) between the three attentional networks separately for high- and low-anxiety children, we found that the interaction between alerting and executive attention previously found in the entire group was in fact present only in the high-anxiety group. This possibly indicates that the alerting system is more disruptive of executive attention, in high anxiety, which, again, would be in line with the predictions of the ACT. This might be due to an overactive phasic alertness mechanism like the one found in preschoolers, but it might be more subtle as we did not find a direct (or moderated) relationship between anxiety and alerting in this sample. However, due to the fact that the cue by flanker by anxiety interaction effect was not statistically significant, this result must be interpreted with caution.

Beyond these effects, the most important finding related to anxiety was the replication of Moryia and Tanno's (2009b) anxiety–orienting relationship in a much younger sample. Although in our data this relationship was a direct one only in the boys sub-sample, our findings indicate, like those of Moryia and Tanno, that in boys high trait anxiety is associated with a diminished orienting effect. This result points to a potential deficit in moving and engaging attention to an exogenously cued location (and probably also in disengaging attention from fixation) in boys with higher anxiety, i.e., in taking advantage of the spatial cues for the purpose of more efficient performance. These results are reminiscent of data showing deficits in disengagement from threat in anxious participants (Fox, Russo, Bowles, & Dutton, 2001; Georgiou et al., 2005), but they are all the more interesting considering that the ANT is a neutral, non-emotional task. Our data indicates that at least in the case of boys, higher levels of anxiety are associated with what appear to be difficulties in efficient orienting of attention to exogenous, task-relevant cues. Lastly, our results showed that although there was no direct relationship between anxiety and orienting in the case of girls, the relationship between the two was moderated by EC. More precisely, the negative link between anxiety and orienting was only significant at high levels of EC. While this might constitute an apparent paradox (we would expect this effect to occur at *low*

levels of EC), further analyses indicated that in fact at high levels of anxiety, girls had similarly small orienting scores (the same pattern as the one seen in boys). However, in girls this effect appears to be less specific, as it is also present in those with low anxiety and low EC.

In conclusion, our results indicate that in middle childhood executive attention is related to temperamental inhibitory control, that high alerting is linked to the use of adaptive ER strategies, that children with higher anxiety tend to orient more slowly in response to exogenous cues, and tend to manifest higher interference between alerting and executive attention.

5.6 Study 2C: Attentional networks and anxiety in adulthood

5.6.1 Method

5.6.1.1 Participants

The final sample consisted of 85 participants (73 females), aged 19-44 years (M = 23.09, SD = 5.83). However, it should be noted that due to the source of our participant pool and the nature of the selection process, the majority of our participants (i.e., N = 67) were below 25 years of age.

5.6.1.2 Measures

Anxiety and depression

Trait anxiety was assessed using the Romanian version of the *State Trait Anxiety Inventory,* form Y[10] (STAI; Spielberger, 1983; see Pitariu & Peleasa, 2007 for the Romanian version) and depression was assessed using the *Beck Depression Inventory* (BDI; Beck, Steer, & Carbin, 1988; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

Temperament

Participants completed the Romanian version of the *Adult Temperament Questionnaire* (ATQ; Derryberry & Rothbart, 1988; Evans & Rothbart, 2007). Details regarding this instrument can be found in Chapter 3, Study 1C. For the purposes of the present study, we selected sub-scales for Fear (α = .83), Sadness (α = .86), Attentional control (α = .86), and Inhibitory control (α = .64), as well as the higher-order dimensions of NA (α = .90) and EC (α = .90).

Emotion regulation

Participants completed the Romanian version of the *Cognitive Emotion Regulation Questionnaire* (CERQ; Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002; Perța et al., in preparation; see Chapter 3, Study 1C for details). In the current sample internal consistency indices ranged between .66 and .90. In the present study we did not include the higher-order Maladaptive and Adaptive ER dimensions.

Attentional networks

The adult version of the Attention Network Test (Fan et al., 2002) was used to assess the efficiency of the three attentional networks in our adult sample. Each trial starts with a central fixation cross (presented for 400-1600 ms), followed – in 75% of the trials – by a warning cue (an asterisk displayed for 100 ms) and then (after 400 ms) by the target display. The target display consists of the target arrow, pointing right or left and presented centrally above or below fixation, alone or flanked by two other arrows on each side. The participant must respond within 1700 ms by pressing the left or right mouse pad button.

Two variables are manipulated within the task: the type of warning cue given and the type of flankers used. The *cue conditions* are as follows: (1) No Cue; (2) Center Cue (the asterisk is displayed in the center of the screen);

[10] D&D Consultants / Testcentral gave us permission to use the Romanian version of *State-Trait Anxiety Inventory*™, *form Y* for research purposes.

(3) Double Cue (two asterisk are displayed – one below, one above fixation) and (4) Spatial Cue (one asterisk, presented either above or below fixation; the cue is 100% valid). The *target display* can be composed of either (1) the target arrow presented alone (Neutral Flanker condition) or the target arrow flanked by two other arrows on each side (2) pointing in the same direction (Congruent Flankers), or (3) in the opposite direction (Incongruent Flankers). The efficiency of the three attentional networks was determined exactly as in the two previous studies involving children.

5.6.1.3 Procedure

The experiment took place at the Developmental Psychology Lab in the Psychology Department of the BBU. Each participant completed the four questionnaires described above and was tested using the ANT. As in the case of children, the task was administered using a laptop computer with a 15-inch display, with the screen resolution set to 1024 × 768. The left and right buttons of the mouse pad were used to collect responses. The task started with a practice block consisting of 24 trials, during which participants received written feedback after each trial. The practice block was followed by three blocks consisting of 96 trials each. No feedback was given during the three experimental blocks. The entire task lasted approximately 20 minutes (including instructions and breaks).

5.6.2 Results

Neither Anxiety nor Depression scores were related to general ANT performance (RT and error rates). Anxiety was not related to any of the three attention network scores. However, high Depression scores were related to low Orienting scores (the correlation was significant only in the female sample when we used the normalized version of Depression scores).

We further explored the Depression-orienting correlation through a 2 (high vs. low Depression) × 2 (Center Cue vs. Spatial Cue) mixed ANOVA with RT as a dependent variable. The Depression × cue type interaction was statistically significant: $F(1, 83) = 5.05$, $p < .05$; $\eta_p^2 = .06$. Post-hoc comparisons were not statistically significant (see Figure 5.11).

We investigated whether anxiety influenced the interaction between attentional networks through a 4 (cue) × 3 (flanker) ANCOVA with anxiety as a covariate and RT as the dependent variable. No interaction effect was found: $F < 1$, *ns*. A similar result was found when Depression was used as a covariate ($F < 1$, *ns*.). However, high Alerting was related to high Orienting in participants with high Anxiety ($r = .31$, $p < .05$), but not those with low anxiety ($r = .11$, *ns*), and with both high Orienting and high Conflict scores in high Depression ($r = .39$, $p < .05$ with Orienting, $r = .35$, $p < .05$ with Conflict), but not low Depression ($r = .08$, *ns* with Orienting, $r = -.13$, *ns* with Conflict).

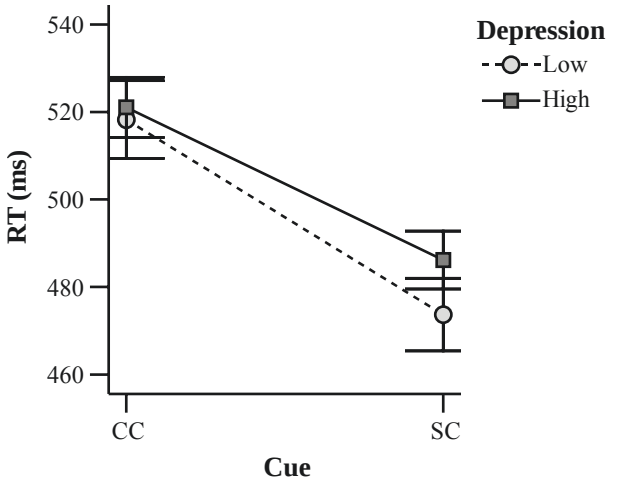

Figure 5.16. Mean RT (± 1 SE) for the adult sample, plotted as a function of cue type and depression. Description. *Note:* CC = Center Cue; SC = Spatial Cue.

Moderation analyses were conducted with a methodology identical to the one described in the two previous studies included in this chapter. However, in adults EC did not moderate the relationships between either Anxiety or Depression and attentional networks.

5.6.3 Discussion

Anxiety was not related to the three attentional networks, neither directly or through the moderation of EC. However, depression was related here to low orienting scores. This finding was similar to the one present in Moria and Tanno's (2009b) study and in our middle childhood sample (in the case of anxiety). Namely, adults with higher depression scores oriented more slowly after the presentation of the exogenous spatial cue. In our previous study, we linked the high anxiety–slow orienting with previous research regarding the threat-related slow attentional disengagement found in high anxiety (E. Fox et al., 2002). Since this is an adult sample, one more interpretation is possible. Research shows that, apart from the type of cueing and cue validity, orienting performance is also affected by timing manipulations. More precisely, the interval between cue and target (i.e., the SOA) influences the effect of cueing on performance. While short SOAs (< 200 ms) facilitate performance (resuting in faster RTs), SOAs higher than 300 ms tend to be associated with longer RTs (sometimes even reversing the validity effect). This phenomenon is know as *inhibition of return* (IOR; Posner & Cohen, 1984) and evidence suggests that it is caused by oculomotor programming, which tends to favor exploration of novel spatial locations at the expense of the ones already "visited" (see Klein, 2000; Lupiáñez, Klein & Bartolomeo, 2006 for reviews). Thus, it is possible that the slower orienting associated with higher depression found here might be a side-effect of differences in IOR associated with different levels of depression. This is a possibility that remains to be investigated in future research.

As in our middle childhood sample, the interaction between cues and flankers was not modified as a function of anxiety (or of depression). However, high alerting was related to high orienting in participants with high anxiety and those with high depression, and to high conflict scores in participants with high depression. Thus, it seems that as we move from preschoolers to adults alerting stops being related to anxiety directly, but it increasingly affects the other two attentional networks in persons with high anxiety.

5.7 General discussion

The research presented in this chapter aimed to determine primarily whether high anxiety is related to alterations in the three essential attentional functions postulated by Posner and Petersen's (1990) model (alerting, orienting and executive attention). We considered this model relevant since it allowed us to look at anxiety-related attentional functioning in a non-emotional context, and through the lens of a set of mechanisms with clearly specified behavioral and neurofunctional correlates. As a second objective, we were interested in whether we could find any links between attention and self-regulatory abilities (namely EC and ER strategies). This objective was considered relevant especially in the case of ER, since very little previous research has investigated the role of attentional mechanisms (assessed with objective attention tasks) in its development. Both of these objectives were followed from a developmental, cross-sectional perspective, as we focused on three age samples: preschool, middle childhood and young adulthood.

Taken together, our results indicate that the alerting and orienting systems play a more important role in anxiety than executive attention does, at least as far as neutral contexts are concerned. In preschoolers (in girls) higher alerting was linked to fearfulness, and to anxiety when inhibitory control was low. In both cases the higher alerting scores reflected impaired intrinsic alertness (i.e., reduced ability to maintain attentional focus on the task endogenously) and overactive phasic alertness. In other words, as predicted by ACT, in girls who were prone to anxiety and had reduced inhibitory control abilities attention was more stimulus-driven and less goal-driven. In middle childhood, high anxiety was associated with slow orienting to the spatial stimulus. The relationship was relatively specific in that in was not related to depression. However, the same pattern was present in girls with low anxiety and low EC. In adults, anxiety was no longer associated with any attentional alterations, but we found links between slow orienting and depression. In other words, the orienting pattern that had been linked to anxiety in middle childhood was now linked to depression. Research indicate that developmentally depression tends to follow anxiety (Muris, Merckelbach, Schmidt, Gadet, & Bogie, 2001), which might explain the developmental pattern we found. As already mentioned, executive attention (measured as flanker interference) played little role in relation to anxiety. Except for a link between executive attention and self-reported anxiety in middle childhood (where high anxiety was actually related with *better* executive attention), none of our findings indicated that high anxiety might be associated with impairments in the ability to inhibit a prepotent response and activate the appropriate one. This is not necessarily surprising, as Eysenck et al. (2007) have already suggested that inhibitory mechanisms might be affected especially when emotional processing is involved (which was not the case here). However, inhibitory and EC abilities were involved in a different manner, as they moderated the anxiety-attention links.

One interesting result was represented by the interactions/correlations between attentional networks. Even more interesting is the fact that these relationships are stronger in high anxiety and their links tend to strengthen as anxious people get older. In young children alerting is more directly linked to anxiety (especially in girls), while the three neural networks do not interact. The fact that an imbalance in bottom-up versus top-down regulation of alertness is associated with anxiety at such a young age is extremely relevant from a developmental point of view, as alerting is considered a basic attentional mechanism, one that contributes to the development of later, more complex attentional functioning (Sturm & Willmes, 2001). And as our results indicate, this appears to be true especially in the case of high anxiety. Based on our data it is possible to hypothesize an early anxiety-related imbalance in alertness mechanisms,

which then cascades to affect the development of (at least) orienting and executive attention. In other words, after the preschool years, we do not see any more links between anxiety and alerting on the surface, but these mechanisms continue to affect attentional functioning in high anxiety in more subtle ways.

Another interesting aspect of our data, and worthy of further research, regards gender differences (especially in children) in the way attentional networks were related to self-regulation and to anxiety. There is little research regarding gender-related differences in attentional functioning. One recent study (Neuhaus et al., 2009) found almost no behavioral differences, but found larger ERP amplitudes at Cz for double cues, and for all target conditions (neutral, congruent, incongruent) in females. In our own studies, the only difference we found was in middle childhood, where girls had smaller conflict scores when compared to boys. However, the patterning of relationships between attention and anxiety/self-regulation was more complex, which indicates the need to investigate these differences even when scores across individual variables are relatively similar.

Our results and their interpretation must be regarded keeping in mind certain constraints and limitations. First, it should be noted that most effects that were related to our main objectives were small or moderate. However, this is not necessarily a limit in itself, as this magnitude is to be expected in this type of research focusing on individual differences. Second, the gender distribution in our adult sample was very uneven. Results did not change when we eliminated male participants, but it is still possible that in a larger male sample we would have found different links between anxiety/depression and attentional networks than we found in this sample. Third, the order in which we took the relevant measures (questionnaires followed by ANT testing) limited the directionality of the relationships we could test. For example, although it is likely that attentional mechanisms play an important role in the development of ER strategies, we could not test an attention → ER relationship. On the other hand, the opposite ordering would have been difficult to justify theoretically (it would have been feasible had we manipulated emotional state, so as to reasonably expect significant ER efforts during the task). Therefore, we limited our analyses to running simple correlations. Lastly, like all studies included in this thesis, this research has the limits inherent in cross-sectional research (as opposed to longitudinal research). Since we did not follow participants for an extended period of time, we do not know whether some of our interpretations (e.g., the one regarding the influence of alerting on the development of orienting and executive attention) would stand the test of a longitudinal approach.

These limitations notwithstanding, our results have important implications for the development of attentional networks from preschool on, and especially for building a better theory of how attentional mechanisms are altered in anxiety, even when no (measurable) emotional processing is involved. Understanding these mechanisms is extremely important as these are the attentional "tools" children and adults use in everyday activities such as learning, working or studying, and they further influence the way information is processed and memorized. In fact, a few studies suggest that children with higher anxiety tend to have lower school performance (e.g., Ialongo et al., 1995) and that this link is mediated at least by working memory processes (see Visu-Petra, Ciairano, & Miclea, 2006 for a review). Our results raise the possibility of preventive interventions through attentional training. Recent attempts to train attentional mechanisms through the use of specially designed video games in preschoolers (Rueda et al., 2005) or through the use of meditation in adults (Tang et al., 2007) have met with

notable success, i.e., improved executive attention in both children and adults, and a reduction of anxiety and depression scores in adults.

Chapter 6.
Anxiety and distractibility: Attentional filtering and perceptual load

In the present chapter, we investigate distractibility associated with emotionally-valenced stimuli in the context of anxiety. We chose to approach the issue from the perspective of a theoretical model that explains attentional filtering by taking into account the processing resources engaged by the task. As already mentioned, the more general term "selective attention" is often used by researchers in the field (see e.g., Desimone & Duncan, 1995; Lavie, 2005). Therefore, in this chapter we will use the two terms – "filtering" and "selective attention" – interchangeably.

6.1 Selective attention / Filtering

As discussed already, filtering is one of the most important functions of attention; it involves selecting out stimuli (external or internal) that are irrelevant for one's goals. This means that good filtering abilities should be associated with less interference from such stimuli and therefore less distraction. In the context of the already discussed evidence for increased distractibility in anxiety, it is therefore relevant to investigate the filtering function of selective attention, and potential individual and task-related factors that might influence it. In what follows, we discuss what is probably the most widely accepted current model of selective attention – a model proposed by Nilli Lavie (Lavie & Tsal, 1994; Lavie, 2005, 2010). Despite its potential for generating testable predictions and advancing knowledge about attentional functioning in anxiety, the model has been rarely used in this context, and, as usually, no research using this model has focused on anxiety in children.

6.1.1 Perceptual load theory

Lavie (Lavie & Tsal, 1994; see Lavie, 2005, 2010 for reviews) proposed a resolution to the classic "early versus late" selection debate. Lavie and Tsal (1994) proposed that the locus of selection was a function of the *perceptual load* involved in the relevant task. Tasks with higher perceptual loads typically require more attentional resources than tasks with lower loads (see Norman & Bobrow, 1975). Lavie proposed that early selection is possible only when load is so high as to approach or exceed the upper limit of available resources. Any stimuli (such as irrelevant distractors) that go beyond this capacity will be ignored. In situations of low perceptual load, since not all processing resources are engaged in the target task, some are automatically allocated to the processing of distractors. In other words, when the relevant, target stimuli are not engaging enough to exhaust all attentional capacity, additional resources tend to "spill" to the processing of irrelevant, distractor stimuli. In short, selection can occur either early or late in the processing stream depending on the perceptual load involved in the central task.

One of the prototypical experimental paradigms associated with load theory was initially used by Lavie and Cox (1997), who combined elements from a visual search task with elements of a flanker task. They manipulated perceptual load by varying the number of relevant stimuli displayed. Participants were presented with a set of stimuli (letters) in the center of the display and asked to detect as quickly and accurately as possible the presence of one of two potential targets ("X" or "N"). Load was manipulated by varying the number of relevant letters (i.e., the set size: between 1 and 6). Participants were also instructed to ignore distractors displayed peripherally. Distractors were either *incompatible* with the target present in the display (e.g., the target was an "X" and the distractor an "N"), *compatible* (e.g., the target and the distractor were both "X") or *neutral* (e.g., the target was an "X" and the distractor an "S"), thus manipulating response conflict. The hypothesis was that if perceptual load affects the degree to which distractors are processed, then interference from incompatible distractors should be significantly reduced at higher loads (where all attentional resources are occupied by the central task). Results showed that the compatibility effect (i.e., $RT_{incompatible} - RT_{neutral}$) decreased with load and became non-significant once the maximum perceptual processing capacity was reached, i.e., at six elements (see Figure 6.1 for details).

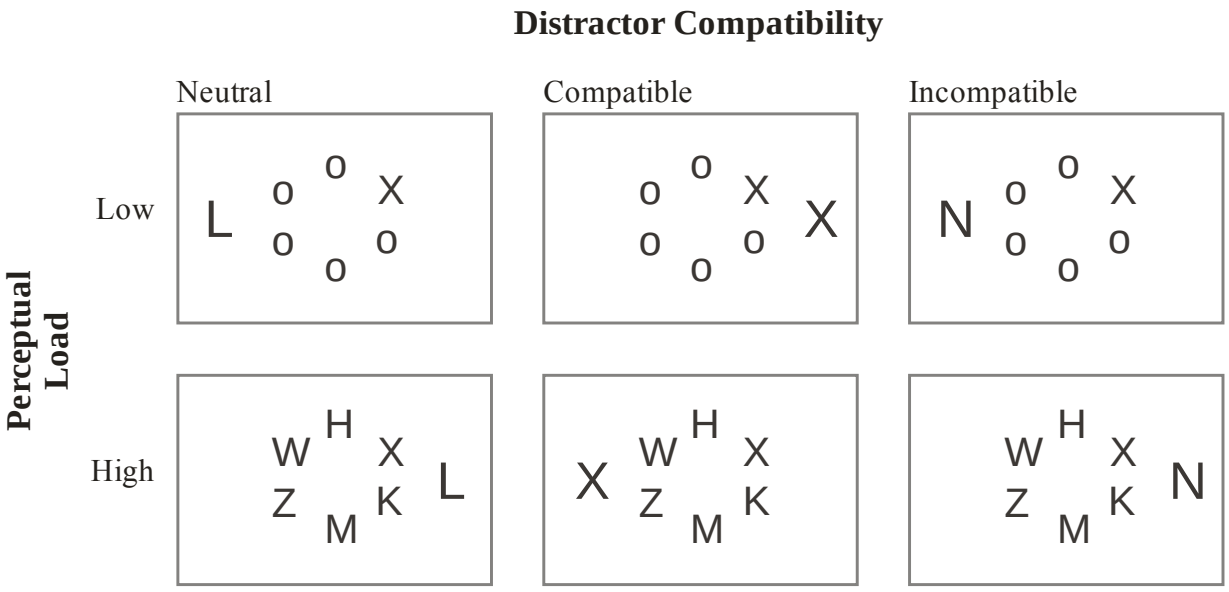

Figura 6.1. Exemple de stimuli ilustrând condițiile experimentale implicate în sarcina de atenție selectivă propusă de Lavie (Figură reconstruită după Lavie & Cox, 1997).

To date, we are aware of only two studies that have investigated the modulation of selective attention by perceptual load in typical development: one has compared the effect in young versus older adults (> 65 years; Maylor & Lavie, 1998), while the other has investigated the same effect in young adults versus children aged 7-12 years (Huang-Pollock, Carr, & Nigg, 2002). Both studies used Lavie's classic experimental paradigm. Maylor and Lavie (1998) found that while older adults were more distractible even at the lowest load level (one element), the compatibility effect dropped significantly in their case when set size included four elements (compared to six in the case of younger participants). A similar effect was present in the case of children (Huang-Pollock et al., 2002): they showed more distractibility at low loads, and the decrease in interference occurred earlier compared to young adults (between set sizes 1 and 2 in

the case of 7-8-year-olds; between set sizes 2 and 6 in the case of 9-10-year-olds; 11-12-year-olds showed a more gradual decrease). This indicates that, when compared to young adults, children have limited attentional processing resources, or that they use more resources than adults do to process the same display. In either case, children's attentional resources are exhausted faster, and thus a lower perceptual load is needed to suppress distractor processing.

6.2 Perceptual load theory and anxiety

Starting from the biased competition model of Desimone and Duncan (1995), Bishop (2008) suggested that emotional valence represents one dimension of stimulus salience (along with color contrast, movement, abrupt onset, novelty, etc.). When signaling threat, this dimension might have an important competitive advantage in the case of anxious persons (resulting in failure to filter out threatening stimuli when they are used as distractors). One way in which this competitive advantage might be overridden is through adequate top-down control, that would allocate attentional resources preferentially to the target task, resulting in inhibition of distractors. However, another strategy to override the influence of threat-related distractors might be to increase the perceptual load of the target task.

The only research we are aware of that has manipulated perceptual load in relation to anxiety has been conducted by Sonia Bishop and collaborators (Bishop, Duncan, Brett, & Lawrence, 2004; Bishop, 2009; Bishop, Jenkins, & Lawrence, 2007). Bishop et al. (2007) showed that while high state anxiety was associated with increased amygdala activity in response to fearful face distractors, high perceptual load suppressed this response in all participants (the task used in this study was a letter search task with letters displayed in a horizontal line superimposed on one distractor face). In addition to the enhanced amygdala activity in high state anxiety, there is evidence to suggest that trait anxiety is associated with poor prefrontal recruitment under conditions of low perceptual load (i.e., when top-down control would be essential) (Bishop, 2004, 2009; Bishop et al., 2007). Using a modification of the task previously employed by Vuilleumier et al. (2001), Bishop (2004) found that when fearful faces were used as infrequent distractors, there was significant rostral ACC and lateral PFC activation in the low anxiety group. However, this activity was absent in the high anxiety group, indicating that anxious persons tend to recruit top-down control mechanisms to a lesser degree. This result was later replicated in a study with no emotional distractors (i.e., a letter search task with compatible, incompatible or neutral distractor letters) (Bishop, 2009). There is evidence that this PFC activation in low perceptual load situations can be modulated by temperamental attentional control; in other words, higher attentional control abilities are associated with increased PFC activity (Bishop et al., 2007). A more recent study found increased interference from face distractors (especially emotional ones) in participants with low attentional control, but failed to find such an effect in participants with high anxiety (Peers & Lawrence, 2009).

6.3 The present study

Our main aim was to investigate distractibility in anxiety and to determine whether high perceptual load might decrease this distractibility. We were additionally interested to determine whether EC might also regulate distractibility in low perceptual load situations. We investigated these aspects in middle childhood and young adulthood. Because the task we used (see below)

was unfeasible for testing with preschoolers (and was difficult to adapt for this developmental group), no preschool sample was included in the present research.

Our expectations were relatively straightforward. First, based on research discussed previously, we expected that higher anxiety would predict higher distractibility for angry faces (versus neutral faces), especially at low perceptual loads (one or two elements; the exact set size might vary for children and adults). Second, we set out to test the potential regulatory influences of high perceptual load (a passive – stimulus-driven – mechanism) and good EC skills (active – goal-driven control). We expected that a high perceptual load would be successful in suppressing distractor interference for all participants, irrespective of anxiety and/or EC status (again, "high" perceptual load might differ for children versus adults). We also predicted that EC might moderate the relationship between anxiety and distractor interference: participants with good EC skills should be less distractible at low perceptual loads irrespective of their anxiety status.

6.4 Study 3: Anxiety and perceptual load in middle childhood and adulthood

6.4.1 Method

6.4.1.1 Participants

Children. The final sample consisted of 78 children (42 girls) aged 7-11 years (M = 113.46 months; SD = 14.41; range = 84-133 months). These children represent a sub-sample of the group involved in study 1B; they do not overlap at all with the sample involved in study 2B.

Adults. The final sample consisted of 112 participants (100 females), aged 19-39 years (M = 21.39, SD = 3.40). These participants constitute a sub-sample of the group involved in study 1C.

6.4.1.2 Measures

Anxiety

Children. The Romanian parent-report version of the *Revised Child Anxiety and Depression Scales* (i.e., RCADS-P; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to assess anxiety symptoms in the middle childhood sample (see Chapter 3 for a description of this instrument). In the present sample, internal consistency indices for the anxiety sub-scales of the RCADS-P ranged between α = .68 and α = .78, while the full anxiety scale had a Cronbach's α of .88.

Adults. Trait anxiety was assessed using the Romanian version of the *State Trait Anxiety Inventory*, form Y[11] (STAI; Pitariu & Peleasa, 2007; Spielberger, 1983; α = .93).

Effortful control

Children. Parents were administered the *Temperament in Middle Childhood Questionnaire* (TMCQ; Simonds, 2006, Simonds & Rothbart, 2006); this instrument has been described in detail in Chapter 3. In the current sample, internal consistency for the EC dimension was α = .85.

Adults. Participants completed the *Adult Temperament Questionnaire* (ATQ; Derryberry & Rothbart, 1988; Evans & Rothbart, 2007). A detailed description of this questionnaire can be found in Chapter 3. We selected the sub-scales composing the EC dimension (i.e., attentional control and inhibitory control), for which Cronbach's α = .90.

Selective attention task

The task used here was programmed by the author of this thesis and run using E-Prime version 1.2. It was based on the selective attention experimental paradigm created by Nilli Lavie (see Lavie, 1995; Lavie & Cox, 1997; Maylor & Lavie, 1998) and the version subsequently used to compare performance in young adults versus children

[11] D&D Consultants / Testcentral gave us permission to use the Romanian version of *State-Trait Anxiety Inventory*™, *form Y* for research purposes.

by Huang-Pollock et al. (2002). The main difference between the original task and our version was the replacement of the letter distractors with face distractors displaying neutral, happy or angry emotional expressions (see Figure 6.2 and the thesis for further task details).

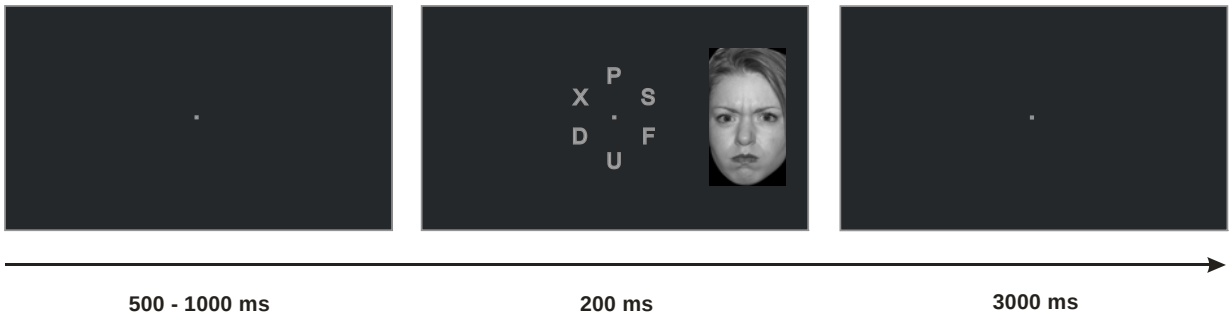

Figure 6.2. Sequence for one trial of the selective attention task. The example illustrates a trial with a set size of 6 and an angry face distractor.

6.4.1.3 Procedure

Children. Permission for conducting the study inside the school was obtained from the school principal. Parents were contacted with the help of the school counselor and teachers. Each parent received an informed consent letter and three questionnaires assessing child characteristics (RCADS-P and TMCQ). Children whose parents agreed to take part in the study and returned the questionnaires were further selected for testing with the selective attention task.

The task was administered individually by a female experimenter, in a quiet room inside the school. Children sat at an approximate distance of 60 cm from the display. The task was created and run using E-Prime on a laptop computer with a 15-inch display, with the screen resolution set to 1024 × 768. The left and right buttons of the mouse pad were used to collect responses. Stickers with an "X" or "N" printed on them were placed on each button to diminish any potential memory load. The experimenter asked children to place the index finger of each hand on the corresponding button, but children were allowed to use more than one finger on each button if it was more comfortable for them. Before starting the task, the experimenter presented the instructions verbally, using cards with examples of possible stimulus displays. The task started with three practice blocks consisting of 6 trials each. In the first practice block, the target display was kept on screen until the child responded, while in the second and third blocks stimuli were displayed for 500 and 200 ms, respectively. Each child was given verbal feedback and encouragement during the practice blocks. The distractor faces were not presented during the instructions and the practice blocks (to prevent familiarity effects), but the child was told that they would appear during the experimental blocks. The main task consisted of three experimental blocks composed of 96 trials each. The entire task lasted approximately 20 minutes (including instructions and breaks). Upon task completion, each child received a colored badge.

Adults. The experiment took place at the Developmental Psychology Lab in the Psychology Department of the BBU. Upon arriving at the laboratory, each participant was asked to fill in a set of questionnaires (see above). The task was administered subsequently using a laptop computer with a 15-inch display, with the screen resolution set to 1024 × 768. As in the case of children, participants sat at a distance of 60 cm from the screen, and the left and right buttons of the mouse pad were used to collect responses. The task was identical to the one used in the case of children, with the exception that adults only received auditory feedback for incorrect responses.

6.4.2 Results

In order to determine the degree to which emotional faces interfered with processing, we used the neutral face distractors as a baseline condition and computed – for each participant – an

angry-neutral (AN-NE) and a happy-neutral (HA-NE) interference score using the following formulas:

$$\text{AN-NE score} = RT_{Angry} - RT_{Neutral}$$

$$\text{HA-NE score} = RT_{Happy} - RT_{Neutral}$$

6.4.2.1 Filtering and anxiety: child sample

We found no statistically significant correlations between anxiety and overall RT or error percentages: both $|rs| < .15$, *ns*. However, there was a statistically significant correlation between anxiety and the AN-NE score ($r = .28$, $p < .05$) and HA-NE score ($r = .25$, $p < .05$), respectively, at a set size of 6.

In order to investigate the effects of anxiety, EC and their interaction upon selective attention, we carried out the equivalent of a moderation analysis using GLM. This type of analysis has the advantage that it allows us to test interactions between both categorical (load, valence effect) and continuous variables.

Anxiety and EC were first centered to reduce multicollinearity, and the interaction term was computed as the multiplicative product of the two centered variables. We then conducted a 4 (load) × 2 (emotional valence effect) repeated measures ANCOVA with gender, age (in months), anxiety, EC and the interaction term as covariates, and the interference score as the dependent variable. The analysis was run in four steps, entering gender and age in the first step, anxiety in the second step, EC in the third, and the interaction term in the final step. This type of analysis is the more economical equivalent of running eight different hierarchical regression analyses (for the eight valence effect scores) to test for moderation (Grace-Martin, personal communication, November 20, 2009). The results of the two types of analyses are identical.

Overall, we found a statistically significant set size × anxiety × EC interaction: $F(3, 204) = 3.22$; $p < .05$; $\eta_p^2 = .05$. However, there was no set size × valence × anxiety × EC interaction effect ($F < 1$, *ns*). This indicates that the effect of set size was modulated by the interaction between anxiety symptoms and EC, but not by the emotion interference condition. It indicates that the interaction of anxiety and EC has a different impact depending on set size.

In the first step of the analysis, age was a significant predictor of the AN-NE score at a set size of 1 ($B = 1.60$, $p < .01$, $\eta_p^2 = .14$), indicating that this score was larger in older children. Younger children were more distracted by *neutral* (versus angry) face stimuli, and this tendency decreased with age. In the second step of our analysis – in line with the previously found correlations – high anxiety predicted higher AN-NE and HA-NE interference scores at a set size of 6: $B = 2.53$, $p < .05$, $\eta_p^2 = .08$ and $B = 2.21$, $p < .05$, $\eta_p^2 = .07$, respectively. This indicates that children with higher anxiety levels were more prone to be distracted both by angry and happy faces (compared to neutral faces) at a set size of 6, but not at other set sizes. EC did not represent a statistically significant independent predictor in the third step of the analysis for any of the set size × valence effect combinations, indicating that children's reactions to the varying load and valence effect manipulations was not a function of EC. The interactive effect of anxiety and EC was statistically significant only for a set size of 1, both for the AN-NE score ($B = 4.60$, $p < .01$, $\eta_p^2 = .11$) and HA-NE score ($B = 3.30$, $p < .05$, $\eta_p^2 = .07$).

To further clarify this interaction, we conducted two hierarchical regression analyses having the two set size 1 valence scores as criterion variables. The full model explained 25% (R^2

= .25, f^2 = 0.33; adjusted R^2 = .19; f^2 = 0.23) of the variability in the AN-NE score, and 10% (R^2 = .10, f^2 = 0.11; adjusted R^2 = .04, f^2 = 0.04) of the HA-NE score variability. As can be seen, the entire model has a medium-large effect upon AN-NE interference at a set size of 1, but a small one on HA-NE interference. However, as the differences between the coefficients of determination and their adjusted values indicate, it should be noted that in both models there is a certain degree of shrinkage (6% in both cases), indicating that they might generalize less well to a different sample.

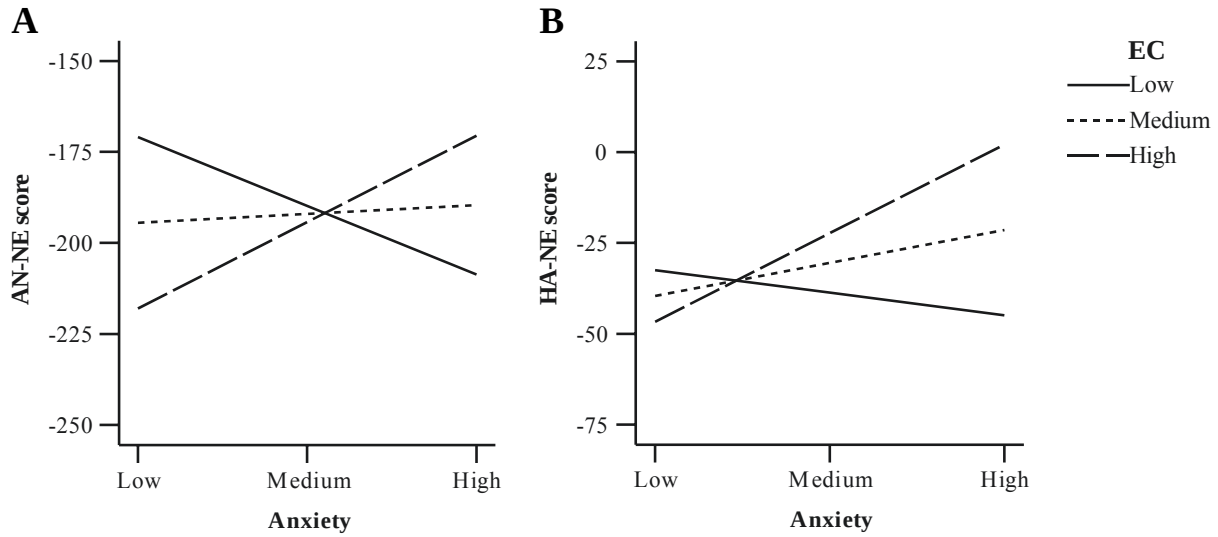

Figure 6.4. Interaction between anxiety and EC in predicting the AN-NE (A) and HA-NE (B) scores for a set size of 1 in the child sample. (Note that the scale is not identical on the y axis.)

As can be seen, in both models, the interaction term added a significant amount of variance to the model (i.e., 10% in the case of the AN-NE score, f^2 = 0.13; and 6% in the case of the HA-NE score, f^2 = 0.07). While neither anxiety nor EC constituted independent direct predictors of either interference score, in each case the interaction term was a significant predictor: β = .34, p < .01 and β = .27, p < .05, respectively. We probed both interactions using ModGraph (Jose, 2008). For AN-NE interference, the slope was statistically significant only at low EC values [$t(70)$ = -2.33, p < .05], marginally significant at high values and non-significant at medium values: $t(70)$ = 1.98, p = .05 and $t(70)$ = 0.09, p = .93, respectively. As can be seen in Figure 6.4A, the model predicts that a combination of high anxiety and low EC is associated with a higher interfering effect of *neutral* faces compared to angry faces at the lowest perceptual load level. In the case of the HA-NE interference, the slope was only significant at high EC levels [$t(71)$ = 2.21, p < .05], but not medium or low levels: $t(71)$ = 1.15, p = .26 and $t(71)$ = -0.72, p = .48 respectively. In other words, anxiety is positively correlated with the HA-NE score at high EC levels (see Figure 6.4B), indicating that children with high anxiety and high EC tend to be more distracted by happy faces when compared to neutral faces.

6.4.2.2 Filtering and anxiety: adult sample

As in the case of the children sample, we conducted a 4 (set size) × 2 (valence effect) repeated measures ANCOVA, with the centered predictors (anxiety, EC) and their interaction term as covariates and RT as the dependent variable.

We found a statistically significant overall interaction effect of valence and anxiety [$F(1, 108) = 6.71$, $p < .05$, $\eta_p^2 = .06$], indicating that the effect of anxiety manifested differently in the two valence conditions. More precisely, there was a tendency for neutral versus angry faces to be more disruptive in participants with lower anxiety ($M = -4.77$, $SD = 44.37$ for the AN-NE score) compared to those with higher anxiety ($M = -0.90$, $SD = 44.84$ for the AN-NE score).

In the first step of the analysis, anxiety significantly predicted the AN-NE score at a set size of 2, $B = 0.78$, $SE = 0.36$, $p < .05$, $\eta_p^2 = .04$. In the second step, EC did not constitute a significant predictor for any of the valence effect scores. In the last (third) step, parameter estimates indicated that the anxiety × EC term was a significant predictor of the HA-NE effect for a set size of 1: $B = -0.85$, $SE = 0.38$, $p < .05$, $\eta_p^2 = .04$.

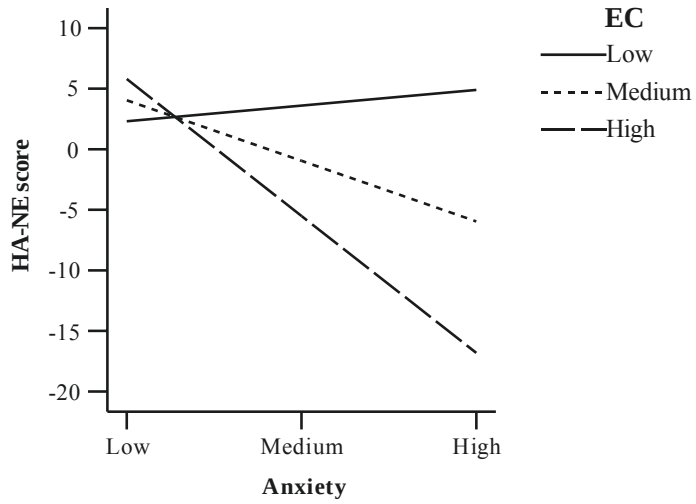

Figure 6.5. Interaction between anxiety and EC in predicting the HA-NE score for a set size of 1 in the adult sample.

When we conducted a hierarchical regression analysis predicting the HA-NE score at a set size of 1, the full model explained 6 % ($R^2 = .06$, $f^2 = 0.06$; adjusted $R^2 = .03$, $f^2 = 0.03$) of the entire variance at the level of HA-NE interference. Thus, the combined effect of the predictors was rather small. Neither anxiety nor EC were significant direct predictors of the anger score. The interaction term was a significant negative predictor of the HA-NE score ($\beta = -.21$, $p < .05$), but it predicted only an additional 4% ($f^2 = 0.04$) of the total variation in the HA-NE score at a set size of 1. Probing the interaction indicated that the slope was statistically significant only for high EC values [$t(108) = -2.23$, $p < .05$], but not for medium or low values: $t(108) = -1.27$, $p = .21$ and $t(108) = 0.30$, $p = .77$, respectively. As can be seen in Figure 6.5, anxiety was negatively related to HA-NE interference in participants with high EC. In other words, neutral faces had a more distracting effect (compared to happy faces) in adults with high anxiety and high EC.

6.4.3 Discussion

It is noteworthy that high EC was associated with faster responses at the lowest perceptual load level in children, especially in the case of angry faces. While this effect was not

found in our adult sample, it is somewhat in line with previous research reporting associations between higher attentional control and lower distractibility to emotional faces (Peers & Lawrence, 2009), or attentional control and higher PFC activation in response to fearful versus neutral faces (Bishop et al., 2007) at low perceptual loads in adults. In our child sample, EC was also related to lower distractibility in the presence of neutral face distractors, but this effect was – to a certain degree – explained by the children's age. The absence of any contribution from EC in adults indicates that this trait is probably more relevant in the case of children, whose abilities for top-down attentional control are reduced.

The previously found contribution of age to neutral face interference at the lowest perceptual load was corroborated by the regression (GLM) analysis, where age predicted (with a moderate strength) the AN-NE interference score. More precisely, younger children were more distracted by neutral faces (compared to angry faces); this tendency decreased with age, as indicated by the fact that RTs were virtually equal in the older groups. These results are not entirely in line with previous research, which showed that children within this age range recognize and process happy faces faster (De Sonneville et al., 2002; Gao & Maurer, 2009, 2010) or they detect threat-related faces (angry or fearful) faster than neutral faces or faces with other emotional expressions (LoBue, 2009; Waters & Lipp, 2009). However, it is difficult to compare our results with this data, since, as already mentioned, research into the processing of unattended face distractors is lacking in children. On the other hand, more in line with our results, there is some data (Durand et al., 2007) indicating that until around the age of 9 years, neutral faces are more difficult to discriminate (children tend to mistake them for happy or sad faces), and some evidence (Thomas et al., 2001) for increased amygdala activation in response to neutral faces (in 11-year-olds versus adults). Thomas et al. interpreted their data from the perspective of Whalen's (1998) proposal that the amygdala activates in response to uncertainty and ambiguity. Neutral faces might be more ambiguous for children, as they are not yet perceived as signals of neutrality. Instead, in children they might be associated with increased vigilance and "continued attempts to decode or interpret" (Thomas et al., 2001, p. 313). It is therefore possible that neutral faces are more salient for younger children (although other research seems to indicate that they are not, when compared to happy or angry faces: e.g., Gao & Maurer, 2009, 2010, LoBue, 2009) or they simply engage more attentional resources, taking them away from the task than children should be focusing on. It is also noteworthy that this effect disappeared from a set size of 2 and up, which might indicate that higher perceptual loads cancelled age-related distractor biases.

As a direct predictor, anxiety predicted both the AN-NE as well as the HA-NE interference scores at a set size of six in children. In adults, anxiety predicted the anger effect at a set size of two items, but not other set sizes. In other words, higher anxiety was associated with higher interference from angry *and* happy faces in children and only angry faces in adults. However, in the case of children this took place at the highest perceptual load level, contrary to our hypothesis that higher perceptual loads should diminish distractibility. In the case of adults, the result was more in line with our prediction since the effect occurred at a low load level and it was emotion-specific (it only occurred for angry faces).

There are two aspects that need to be discussed here. First, our results show that (provided certain perceptual load levels) higher anxiety is associated with interference from emotional faces (both angry and happy) in children, and interference from only angry faces in adults. This indicates that children with higher anxiety are more distracted by emotional faces in general, while the effect is more specific in adults, who are only distracted by angry faces. In the

case of adults, our results are in line with previous research showing threat-related biases in adults with high levels of anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & IJzendoorn, 2007; Cisler & Koster, 2010). As discussed in Chapter 4, data regarding children is more mixed (Ehrenreich & Gross, 2002; Heim-Dreger, Kohlmann, Eschenbeck, & Burkhardt, 2006; Kindt, Bierman, & Brosschot, 1997; Vasey, El-Hag, & Daleiden, 1996; Waters, Lipp, & Spence, 2004), and there is (to our knowledge) no published research informative to the way children react when emotional faces act as peripheral distractors. However, recent unpublished data from our laboratory supports our findings: in a visual search task, children aged 9-15 years with high anxiety showed increased distraction when they were presented with a neutral face among "crowds" of angry or happy faces and were asked to find the discrepant face (Susa, personal communication, August 2010).

Second, contrary to our prediction, the highest levels of anxiety-related distractibility were present at the maximum load level, when – according to perceptual load theory – all available attentional resources should be occupied by the central task (Lavie, 1995, 2005; Lavie & Tsal, 1994). In addition, no such effects were found at lower loads. A similar "atypical" result has previously been obtained by Huang-Pollock, Nigg, and Carr (2005) in ADHD children with sluggish cognitive tempo (SCT)[12]. They used a letter search task with letter distractors (the task used in Huang-Pollock et al., 2002; discussed in paragraph 6.1.1.1), and found a pattern of performance similar to the one we found: children with SCT were more distractible compared to those without SCT only at a set size of six elements. The authors interpreted this pattern of performance as indicating possible early selection deficits, but did not clarify precisely what such a deficit would entail. In a very recent study using Lavie and Cox's (1997) experimental paradigm, Moriya and Tanno (2010)[13] found that while interference from incompatible distractors was similar in participants with high and low social anxiety at the lowest set size, a high perceptual load suppressed distractor interference only in those with low anxiety. Participants with high anxiety were just as distracted at a set size of six. According to the authors, these results were an indication that executive inhibition of distractors might not be deficient in anxiety, but instead people with high (social) anxiety might have larger "pools" of processing resources or they distribute them differently compared to low anxious people. Lastly, Eltiti and collaborators (Eltiti, Wallace, & Fox, 2005; see also Paquet & Craig, 1997) showed that, on the one hand, distractor interference can be suppressed even at low perceptual loads if target stimuli are distinctive enough, and on the other hand, distractor stimuli can interfere with target processing even at high loads if they are salient enough. Taking into account this previous data, our results can be interpreted as indicating either that high anxiety is associated with more perceptual processing resources, or that emotional faces are such salient distractors for anxious children, that they fail to be filtered out by the highest perceptual load of the central task. While the first possibility is an intriguing one, we would need evidence that higher emotion-related distractibility is also present at low perceptual loads. And such evidence is lacking from our data. The second hypothesis has the same problem as the first. However, it is possible that in set sizes 1 to 4 the target letter appeared so salient to children that it suppressed the effect of the distractors (in line with the ideas put forward by Eltiti et al., 2005). However, this is a possibility

[12] "Sluggish cognitive tempo" is an informal descriptive term for a subgroup within the ADHD-Predominantly Inattentive subtype.

[13] We had formulated our hypotheses and had gathered our data before this paper was published. Since it played no role in generating our hypotheses, we chose not to mention it in the theoretical part of this chapter.

that needs to be investigated further in future studies, in conjunction with determining why this phenomenon is present only in children.

While anxiety predicted variation in distractibility at different perceptual loads in children and adults, EC moderated the effect of anxiety on distractibility at the same load level (i.e., a set size of 1) in both groups. Anxiety predicted increased distractibility for neutral faces compared to angry faces in children who had low EC abilities and less neutral face distractibility – compared to both angry and happy faces – in children with high EC (but note that the effect for angry faces was on the edge of significance). This latter effect was reversed in adults: higher anxiety was associated with higher neutral face distractibility (compared to happy face distractors) at high EC levels. Thus, it seems that in this case our hypothesis is only partially supported: the perceptual load level where EC acts as a moderator is – as expected – low. However, the pattern of effects is not as predicted, since children with high anxiety and low EC appear to be distracted by neutral faces more than by angry faces, while children with high EC and high anxiety are less distracted by neutral faces overall. Considering the pattern of our data, we can conclude that EC tends to modulate distractibility for neutral faces in the more anxious children (since predicted values tend to approach zero at higher anxiety scores): higher EC abilities equal less distractibility. However, this leaves open the question of why less anxious children would be less distractible when they have low EC abilities and more distractible when their EC abilities are high. In adults with high EC levels, low anxiety was associated with less distractibility while more anxiety with more distractibility. To conclude, it is clear that although we have found evidence for a moderating role of EC, the pattern of results is rather complex, and does not support our hypothesis. These results clearly need further research, perhaps in the context of a different experimental design, which would allow for a clearer assessment of the effect of neutral face distractors.

Our results must be regarded taking into account certain limitations. First, all effects found in this study are small or moderate at best. This is probably the reason why we found very few interactions between trait measures (anxiety, EC) and within-subject measures (set size, interference scores or distractor valences). Therefore, future studies should probably use larger samples to detect these effects. Second, since neutral faces appear to have a distracting effect especially in children (at least under some circumstances), they might not constitute an adequate baseline condition for this group in this type of task. A more adequate baseline might be a "no distractor" condition, or a condition using non-face stimuli as distractors.

Keeping in mind these limitations, we can conclude that we did find evidence for higher emotion-related distractibility in participants with higher levels of anxiety. However, this tendency was emotion-specific only in adults. Second, increasing perceptual load as a strategy for improving focus on the central task had the expected effect only in adults (but note that even here effects were weak). This manipulation was ineffective in children, as it appeared to increase distractibility. However, this paradox in our results should be an interesting challenge for future research, as it might help us understand how attentional resources are managed across different developmental levels, and how they are influenced by anxiety, processing load and distracting stimuli. Lastly, our data indicates that having better EC skills is relatively ineffective in modulating distractor interference at the lowest perceptual load, as high EC sometimes appeared to favor distractibility (especially in the presence of neutral faces). Future research should clarify the reason for this discrepancy.

Chapter 7.
Anxiety across development: Final conclusions and implications

The present thesis has focused on anxiety, one of the most prevalent forms of emotional problems, affecting children as well as adults, with important long-term consequences at the level of psychopathology, academic achievement, and general quality of life. We chose to investigate anxiety from two perspectives: its potential predictors (here we focused on temperament and ER strategies) and its links to attentional functioning. We also employed a developmental approach, in the form of a cross-sectional design.

7.1 Summary of the thesis and main findings

In *Chapter 1*, we introduced the problem of anxiety, by discussing data on the worldwide prevalence of anxiety disorders in adults, as well as children and adolescents. We discussed the two ways in which anxiety has been conceptualized in the research literature, namely as a *disorder* (the clinical perspective) or as a *trait* (i.e., a characteristic varying continuously in the general population that reflects the predisposition to react with a state of anxiety even in the face of mild threats or novel situations; e.g., Endler & Kocovski, 2001; Spielberger, 1983). We next discussed developmental aspects associated with anxiety symptoms, such as the way they evolve over the lifespan up to adulthood, and the impact they have on general mental health, academic achievement, quality of life and work performance. Finally, we discussed briefly some of the most important correlates of anxiety, such as individual differences in temperament, cognitive correlates (memory, attention, cognitive interpretation of ambiguous situations) and general aspects regarding the brain substrate of anxiety.

The rest of the thesis can be divided into two parts: Chapters 2 and 3 focus on individual differences in temperament and ER, and their role in predicting anxiety symptoms in children and adults, while Chapters 4-6 focus on the links between anxiety and attentional functioning.

Recent years have seen an increasing interest in individual characteristics that might predispose children to current or future emotional and behavioral problems, and this research trend has likewise affected the study of anxiety. Thus, in *Chapter 2* we conducted a theoretical review of the literature focusing on two aspects that are more and more in the focus of anxiety researchers, namely temperament (i.e., biologically based individual differences in reactivity/arousal and self-regulation; Goldsmith et al., 1987; Kagan, 1998; Rothbart, Ahadi, & Evans, 2000) and ER (extrinsic and intrinsic mechanisms that help modulate the characteristics of emotional reactions; Thompson, Lewis, & Calkins, 2008; Thompson, 1994). We discussed two models of temperament that have dominated the developmental literature in the past two decades, namely Kagan's behavioral inhibition (BI) model (Kagan, 1998; Kagan, Reznick, & Gibbons, 1989) and Rothbart's multidimensional model (Rothbart, 1981; Rothbart & Bates, 1998, 2006). Both models have been involved in developmental research on anxiety. Kagan's model has generated longitudinal studies showing that children characterized by temperamental inhibition in the face of novel social situations where primarily at risk for social anxiety, but also

other types of anxiety disorders in adolescence or adulthood. Rothbart's model has a shorter history in the study of anxiety. However, it has the advantage that it takes into account not only emotional reactivity (through the dimensions of Surgency/Extraversion – SE and Negative Affect – NA), but also an individual's ability to regulate his/her own behavior (Effortful Control – EC). Anxiety research focusing on this model has investigated the independent or interactive roles that NA and EC might play in the development of anxiety, and has emphasized the potentially protective effects of a high EC. Another aspect of self-regulation – ER – has been investigated only recently, in research that has found links between a tendency to use passive or generally maladaptive ER strategies and anxiety.

Based on the research reviewed in Chapter 2, we formulated a set of objectives and hypotheses which were investigated in *Chapter 3*. These objectives and hypotheses are summarized, together with the corresponding results, in Table 7.1. Overall, the studies included in this chapter showed that the pattern of relationships between NA, EC and anxiety changes across the three developmental groups included in our study. NA is a clear predictor of high anxiety symptoms in all age groups (although its effect is reduced in adulthood). However, our results indicate that the role and importance of EC tends to change over development. While high EC/inhibitory control is associated with increased risk in preschoolers (in girls), high EC acts as a protective factor, cancelling out the relationship between NA and anxiety in middle childhood (especially in girls). In adults, our results indicate that the importance of EC might be even stronger, as EC potentially modulates NA itself and thus indirectly influences anxiety. The role of ER in anxiety was generally as expected, at least on a correlational level: passive ER, avoidance and maladaptive ER were related to higher anxiety. However, we found less evidence for a mediating or moderating role of ER. Additionally, our data in the case of schoolchildren indicated the value of obtaining *self*-report (as opposed to parent-report) from children.

Chapter 4 introduced the second part of the thesis, with a focus on attention and its relationship to anxiety. While a large part of research has focused on threat-related attentional biases, we were interested to go beyond this topic, and to focus instead on more general and fundamental attentional mechanisms. Therefore, we discussed Attentional Control Theory (ACT; Eysenck et al., 2007), which has a broader scope than most models focusing on threat-related attentional biases, and which postulates that anxiety-related attentional functioning is characterized by an imbalance between top-down and bottom-up mechanisms, with a dominance of the latter. Additionally, we reviewed some of the fundamental research on attention, the main functions accomplished by it (and their development). Because we considered that the characteristics of top-down and bottom-up attentional mechanisms were insufficiently specified in ACT, we reviewed the most important models for these processes in fundamental attentional research. Finally, we returned to the anxiety–attention relationship; by reviewing the literature, we concluded that most functions of attention have not been adequately investigated in the context of anxiety (especially in the case of children).

In *Chapter 5* we focused on Posner and Petersen's (1990) model of three attentional networks – alerting, orienting and executive attention – and investigated their functioning in anxiety, in children and adults (see Table 7.1 for details on the studies). Interest in this model in the context of anxiety has emerged only within the past three years, and there is at present no published data involving children. Therefore, although we were guided by predictions of the ACT, our approach was largely exploratory, with few clearly formulated hypotheses. Our data indicated that the alerting and orienting networks were more relevant for anxiety than executive attention. We found some indication for a possible anxiety- or fearfulness-related imbalance

between bottom-up and top-down mechanisms regulating alertness in preschool girls, while anxiety was associated with slow orienting in middle childhood. In adults, there was no link between attention and anxiety; instead, depression was associated with slow orienting here. Our secondary interest in attentional network functioning and self-regulatory mechanisms (EC and ER) generated a more complex pattern of results, and pointed toward the need for further research in this area (see Table 7.1 for details).

In *Chapter 6*, we approached the problem of distractibility from the perspective of Lavie's (Lavie, 2005, 2010; Lavie & Tsal, 1994) model for the filtering function. Lavie's model attributes a very important role to perceptual load. We thus investigated whether high perceptual load – by exhausting attentional resources – would reduce distractibility in the presence of threatening faces in participants with high anxiety. Additionally, we were interested whether high EC would have the same effect at low perceptual loads (see Table 7.1 for details). Results of this study showed that high anxiety was associated with general emotion-related distractibility in children, but this took place – contrary to our expectations – at the highest perceptual load level, indicating the possibility that high anxiety was associated with deficits in controlling the width of the attentional "spotlight" in children. In adults, results were more specific and more in line with our expectations, as anxiety-related distractibility was high only in the presence of angry face distractors, presented at a low perceptual load. We failed to find a clear, hypothesis-congruent involvement of EC.

Apart from these main results, two further aspects that we focused on were the degree to which our findings were specific for anxiety (for this reason, in Chapters 3 and 5 we included measures of depression) and the degree to which the patterns of relationships we found were moderated by gender. The first issue was motivated mainly by the fact that many studies focusing on children tend to use general measures of internalizing problems. While we found many similarities between anxiety and depression, there were enough differences to justify an empirical approach that separates the two. In the case of gender, our data shows that different patterns of predictors hold true for anxiety in girls and boys. Taking into account the different prevalence and intensity in adults, this approach is justified.

Table 7.1

Summary of main thesis findings.

Chapter	Objectives / Hypotheses tested	Results		
		Preschool	**Middle childhood**	**Adulthood**
3		*N* = 119; 4-7 years	*N* = 221; 6-11 years	*N* = 175; 19-36 years
	O1. Temperament – Anxiety relationships			
	H1: NA and EC predict anxiety independently (High NA predicts high anxiety; high EC predicts low anxiety).	▪ **H1:** supported for NA ▪ **H1:** not supported for EC; EC and inhibitory control predict *high* anxiety	▪ **H1:** supported for NA ▪ **H1:** not supported for EC.	▪ **H1:** supported for NA ▪ **H1:** not supported for EC
	H2: EC moderates the relationship between NA and anxiety (NA and EC interact); at high EC levels, the NA-Anxiety relationship is annulled or diminished	▪ **H2:** not supported; inhibitory control *amplifies* the NA-Anxiety relationship in girls	▪ **H2:** supported; at high EC, the NA-Anxiety relationship is cancelled (especially in girls).	▪ **H2:** not supported ▪ Incidental finding: EC modulates NA and (indirectly) anxiety
	O2. ER – Anxiety relationships			
	H3: Anxiety symptoms correlate with use of passive / maladaptive ER strategies in general.	▪ **H3:** supported; Passive ER strategies (avoidance, venting, emotional intervention) are related to anxiety in boys	▪ **H3:** supported only when using child self-reports; Avoidance related to anxiety (especially in girls)	▪ **H3:** supported; anxiety related positively to maladaptive ER and negatively to adaptive ER.
	H4: Some ER strategies mediate the relationship between NA and anxiety.	▪ **H4:** not supported	▪ **H4:** not supported	▪ **H4:** not supported
	H5: Some ER strategies moderate the relationship between NA and anxiety.	▪ **H5:** supported; Passive ER amplifies the NA-Anxiety relationship	▪ **H5:** not supported	▪ **H5:** not supported ▪ Incidental finding: maladaptive ER modulates NA and (indirectly) anxiety
	O3*. EC – ER relationships			
	H6*: Good EC skills are positively correlated with adaptive/active ER strategies and negatively related to maladaptive/passive ER strategies.	▪ ***H6:*** Generally supported; EC negatively related to Aggressive ER	▪ ***H6:*** Generally supported; EC positively linked to active coping	▪ ***H6:*** Generally supported; EC positively related to adaptive ER, negatively related to maladaptive ER

Chapter	Objectives / Hypotheses tested	Results		
		Preschool	**Middle childhood**	**Adulthood**
5		*N* = 97; 4-7 years	*N* = 106; 6-11 years	*N* = 85; 19-44 years
	O1. Anxiety – attentional networks			
	Direct anxiety–attention relationships? Moderated anxiety–attention relationship?	▪ No direct relationship ▪ Inhibitory control moderates the anxiety-*alerting* relationship in girls ▪ Incidental finding: fearfulness is related to efficient *phasic alertness* and inefficient *intrinsic alertness* in girls	▪ Anxiety–*orienting* relationship in boys; slow orienting to exogenous valid cues ▪ Anxiety–*orienting* relationship in girls, moderated by EC	▪ No relationship ▪ (Depression linked to slow orienting).
	O2*. Attentional networks and self-regulation (EC and ER)			
	EC – executive attention	▪ Inhibitory control linked to high *conflict* scores	▪ EC linked to low *conflict* scores (i.e., good executive attention performance)	▪ No relationship
	ER – attentional networks	▪ High *conflict* linked to low aggressive ER and high active ER in boys	▪ High *alerting* linked to low avoidance	▪ High *conflict* linked to high self-blame and low acceptance

Chapter	Objectives / Hypotheses tested	Results		
		Preschool	**Middle childhood**	**Adulthood**
6		-	*N* = 78; 7-11 years	*N* = 112; 19-39 years
	O1. Anxiety – attentional filtering **H1:** Anxiety associated with slower performance in the presence of angry face distractors (compared to neutral face distractors), at low perceptual loads (set sizes of 1 or 2). **H2:** This higher distractibility should disappear at high perceptual loads; i.e., at high perceptual loads anxiety should not be related to speed of response in the presence of angry face distractors. **H3:** EC moderates anxiety-related performance at low perceptual loads; i.e., in participants with high EC, the relationship between anxiety and distractibility should be diminished or absent.	-	▪ **H1:** not supported; anxiety is associated with higher distractibility by angry *as well as* happy face distractors, *at the highest perceptual load level* (set size 6). ▪ **H2:** not supported; anxiety is related to distractibility *only* at the highest perceptual load. ▪ **H3:** not supported; high EC appears to promote distractibility.	▪ **H1:** supported; anxiety is associated with higher distractibility only in the presence of angry face distractors, *at a low perceptual load* (set size 2). ▪ **H2:** supported ▪ **H3:** not supported

* Secondary objective/hypothesis.

7.2 Original contributions

Regarded in the context of previous studies, our thesis makes a few important contributions to developmental research on anxiety, its predictors and its attentional correlates.

First, while the cross-sectional methodology is by no means new in developmental research (see Robinson, Schmidt, & Teti, 2005 for a review), this is – to our knowledge – the first cross-sectional approach to both topics investigated in this thesis. Previous similar approaches have used a longitudinal methodology to investigate the temperament–anxiety link from the perspective of BI (e.g., Biederman et al., 2001, 1993). However, this is the first cross-sectional approach focusing on the multidimensional model of temperament, ER and attention in relation to anxiety. This approach has proven useful in providing a clearer understanding of some of the potential changes that occur across developmental stages.

Second, research interest in ER strategies and their relationship to anxiety is relatively new. And while there have been a few studies focusing on adults or adolescents (e.g., Garnefski, Kraaij, & Spinhoven, 2001; Garnefski, Kraaij, & van Etten, 2005; Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002; Tortella-Feliu, Balle, & Sesé, 2010) research in children is much more limited, and nearly absent in preschoolers (we were able to identify only one study involving preschoolers: Blair, Denham, Kochanoff, & Whipple, 2004).

Third, the thesis contains a theoretical analysis on attentional functions and the degree to which they have been investigated in anxiety (see Chapter 4). While most research on attentional performance in anxiety has focused on threat-related biases, our analysis points to the need for expanding the range of attentional mechanisms investigated. At the same time, such an analysis can constitute a foundation for a more systematic research program into general attentional functioning in anxiety.

Fourth, the focus on general attentional mechanisms and their functioning in anxiety is a relatively new topic, for which only a handful of studies have been published thus far, and all of them over the past three years (e.g., Dennis & Chen, 2007; Dennis, Chen, & McCandliss, 2008; Moriya & Tanno, 2009a, 2009b). However, to our knowledge this is the first attempt to investigate this topic in children. While our exploratory studies using the ANT in the three developmental samples have generated more questions than answers, we see the results as promising, and indicating the need for further research on the topic. Our thesis also contains the first attempt to use Lavie's perceptual load model to study anxiety-related attentional filtering in children. Previous studies inspired by this model have focused exclusively on adults (Bishop, Duncan, Brett, & Lawrence, 2004; Bishop, 2009; Bishop, Jenkins, & Lawrence, 2007). We have been able to identify only two previous studies that have investigated the impact of perceptual load in children, and neither involved anxiety; one focused on typical development (Huang-Pollock, Carr, & Nigg, 2002), the other on ADHD (Huang-Pollock, Nigg, & Carr, 2005).

Fifth, the thesis includes the first attempt to investigate the links between general attentional functioning and ER strategies. While this was probably the most exploratory aspect of our thesis, it is one worthy of further investigation.

Finally, at the level of statistical methodology, we decided to avoid the popular median-split strategy. This strategy is very common in research investigating anxiety and

cognitive performance, and despite its documented disadvantages in terms of statistical accuracy (Cohen, 1983; Irwin & McClelland, 2003; MacCallum, Zhang, Preacher, & Rucker, 2002), contimnues to dominate the field.

7.3 Implications of thesis findings and future directions

Although it was not our initial intention, the two parts of the thesis have a common theme (apart from anxiety), namely the dichotomy, or balance between automatic / bottom-up processes and controlled / top-down processes. While this dichotomy was discussed explicitly in the case of attention, it is implicit in the first part of the thesis as well, more precisely in the balance between negative emotional reactivity and processes that regulate this reactivity (mainly EC). Our results brought some partial support to the idea that reactive / bottom-up mechanisms dominate in anxious individuals, but that regulatory / top-down mechanisms can modulate this reactivity. Although our research has generated – especially in its second part – more questions than answers, we believe that the idea of an imbalance between the two types of systems is highly relevant from a developmental perspective. More precisely, if bottom-up emotional and attentional systems are indeed overactive in individuals with high anxiety or at risk for an anxiety disorder, it would be very relevant to understand *if* and *how* this affects the development of top-down systems. For example, NA and EC systems might develop independently of each other, or might interact during development. It is possible that high negative emotional reactivity might impair the development of adequate EC skills, or, on the contrary, might promote EC development as a compensatory mechanism. It would be interesting to know under what circumstances these scenarios are possible. The same questions apply to attentional mechanisms; as we have seen in Chapter 5, the three attentional networks interact more and more across development. Therefore, it would be interesting to know whether and how a highly reactive stimulus-driven system might affect the development of attention in general.

It is more difficult to include ER in this bottom-up / top-down dichotomy, as current research tends to see ER strategies as involving both automatic and controlled processes, although probably in different proportions (Compas, 2009; Eisenberg & Spinrad, 2004; Gross & Thompson, 2007; Skinner, Edge, Altman, & Sherwood, 2003). However, in the case of ER, any future cross-sectional or longitudinal study should first solve a limitation our research had at the level of assessed ER strategies. More precisely, we lacked measures that focused on the same types of ER strategies in all developmental groups. Such instruments would be extremely useful in understanding the development of ER strategies, as well as their impact on other areas of development.

Our data does not allow us to infer clear causal relationships. However, our results raise the possibility for interventions at the level of factors that might have a protective role. For example, it would be interesting to determine if trainings aimed at developing better EC abilities might help children with high NA, and decrease their risk for high anxiety. Our data, as well as data from other studies (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Kochanska, Tjebkes, & Forman, 1998; Thorell, Bohlin, & Rydell, 2004) indicates that such an intervention might prove effective only starting in middle childhood, and that such an intervention should probably be tailored taking into account gender differences. Similar interventions might be used to diminish the use of passive/maladaptive ER and to promote effective and adaptive ER strategies. In fact, such suggestions already exist in the literature.

One example is *Emotion Regulation Therapy* (ERT) proposed by Mennin (2004) for the treatment of generalized anxiety disorder. In children, the training of adaptive ER strategies might also take the form of preventive intervention.

With respect to attention, our results indicate that alertness and orienting, as well as filtering are worthy of further investigation in anxiety. After determining the extent to which these functions are affected in anxiety, future studies might also investigate whether and how much potentially impaired attentional functioning is involved in academic achievement and work performance. Additionally, anxiety-related impairments in general attentional functioning point towards the potential usefulness of attentional training interventions. Such forms of training already exist for attentional biases (e.g., Harris & Menzies, 1998; Pitica, Susa, & Benga, 2010; Schmidt, Richey, Buckner, & Timpano, 2009; Wells, White, & Carter, 1997), and some studies have also focused on more general forms of attentional training, using either computer programs or games (see Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005 for such training in children; see Tang et al., 2007; Tang & Posner, 2009 for examples in adults).

To conclude, throughout the present thesis we have attempted to investigate anxiety and its development cross-sectionally, and from a double perspective: that of individual differences that might act as predictors of anxiety symptoms, and that of attentional mechanisms that might be negatively affected in anxiety. Our results open interesting possibilities for future research, and indicate potential areas of intervention.

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