Dear future me: behavioral and neural mechanisms underlying self-concept development in relation to educational decision-making in adolescence

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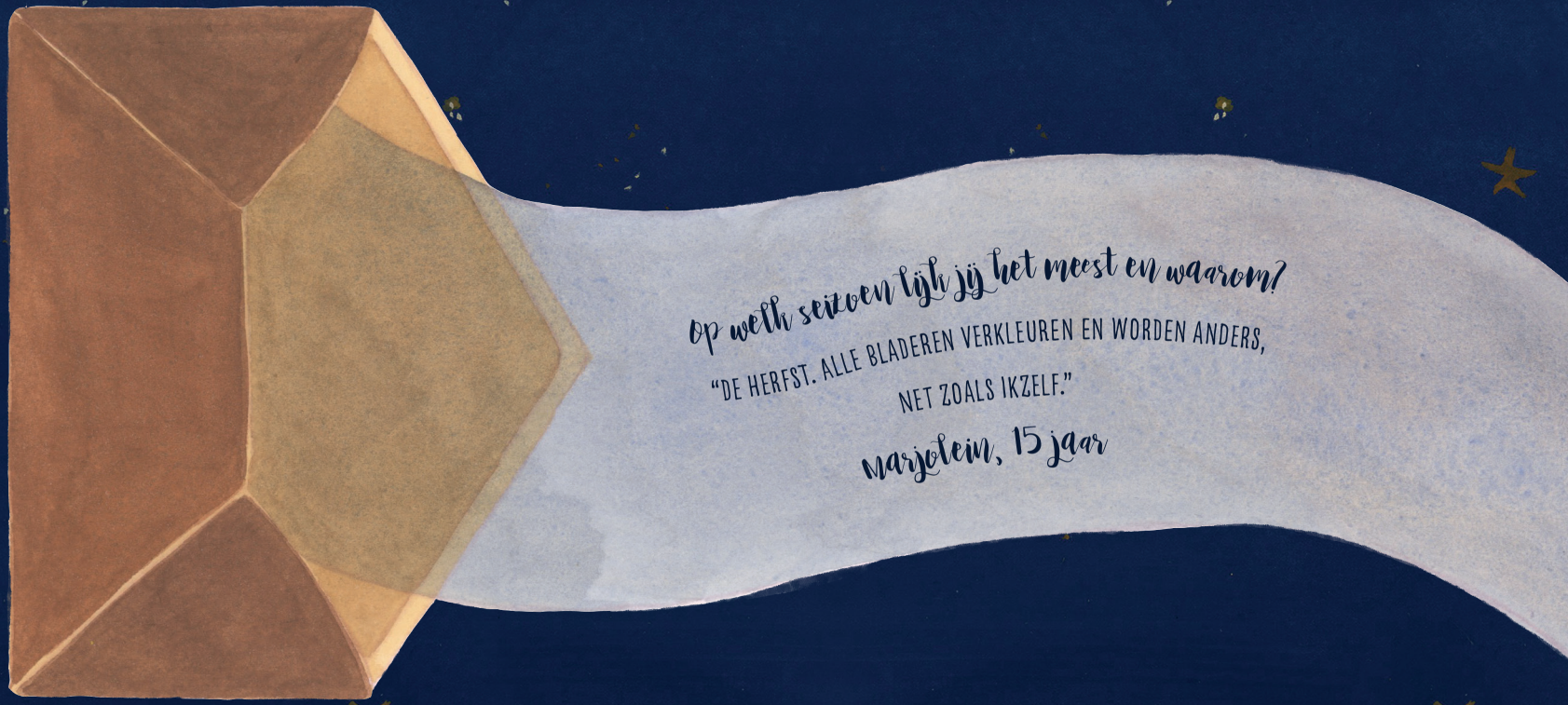

Op welk seizoen lijk jij het meest en waarom?

"DE HERFST. ALLE BLADEREN VERKLEUREN EN WORDEN ANDERS,
NET ZOALS IKZELF."

marjolein, 15 jaar

Chapter 1

GENERAL INTRODUCTION

This chapter is partly based on:
van der Aar, L.P.E., van der Cruijsen, R., & Crone, E.A. (2021). Hvem er jeg? Utvikling av selvbegrep i ungdomstiden [Who am I? Self-concept development in adolescence]. *In Nevrokognitiv utviklingspsykologi [Neurocognitive developmental psychology]* (Ed. Christian K. Tamnes). Gyldendal Akademisk. Oslo, Norway.

GENERAL INTRODUCTION

"Describe yourself in three words". You might recognize this as an assignment from school or a job interview at some point in your life. To describe yourself, it is necessary to reflect upon your traits, and ask yourself questions such as: "Who am I?" and "What am I good at?"

The way we view and evaluate ourselves, our self-concept, has been a topic of interest for centuries. This is not surprising as our self-concept has a large influence on the way we think, feel, behave, and make decisions in our daily lives (Orth, Robins, & Widaman, 2012). The outcomes of these decisions can have short-term effects. For example, I generally see myself as a social and outgoing person, so I would probably choose to take the invite for a party rather than staying in and reading a book. And although I would love to describe myself as adventurous, I know that I am not (excluding the one time I intentionally jumped out of a plane when I was 21). So when faced with the choice of a fun holiday, I would most likely take a safe city trip over a bold backpacking experience.

Not only does our self-concept have an influence on these short-term decisions, such as how to spend our evenings or holidays, it also serves as an important guide when it comes to making bigger decisions with more long-term consequences, for example when choosing which college to go to, what topic to study or career path to take (Fenning & May, 2013; Germeijs, Luyckx, Notelaers, Goossens, & Verschueren, 2012; Rogers & Creed, 2011). A developmental period during which many of these important life decisions are made is adolescence, the transitional phase between childhood and adulthood, roughly covering an age-range between 10 – 25 years (Crone & Dahl, 2012). Adolescence is widely regarded as a special time for self-exploration and identity development (Erikson, 1968). Compared to children, adolescents increasingly seek autonomy, experiment with different roles and selves, report greater self-consciousness, and become more concerned with opinions of others about the self (Pfeifer & Peake, 2012). This heightened focus on the self is stimulated by the school environment as well, as from a relatively young age adolescents are expected to make decisions regarding their academic future that require a significant amount of self-reflection (e.g. what courses should I choose in high school? What are my skills and interests and how can I align these with possible programs in higher education?)

However, making these future-oriented educational decisions can be complex, which is reflected in the large number of adolescents who experience difficulties when faced with the task to choose a suitable major in higher education (Dutch Ministry of Education, 2018). They delay the need to make a decision (e.g., by taking a gap year), do not make a decision at all (career indecision), or make the wrong decision and, as a result, may drop out from college. Because adolescence

is particularly a phase in which the ability for self-reflection is still developing, how adolescents think about and evaluate themselves could play an important role in explaining individual differences in the process of future-oriented educational decision-making. Additionally, recent neuroimaging research indicates that developmental changes in self-concept might co-occur with changes in neuroanatomical development and functional brain activity in regions involved in self-processing (Burnett, Bird, Moll, Frith, & Blakemore, 2009; Pfeifer & Peake, 2012; Sebastian, Burnett, & Blakemore, 2008). Therefore, in this thesis I aim to investigate the development of self-concept during adolescence from both a behavioral and neuroscientific perspective. Within this topic, I particularly focus on the role of self-concept in the process of future-oriented educational decision-making in the transitional period from high school to higher education.

The current introduction starts out with a background of self-concept as a complex and multifaceted construct. This is followed by a section on factors influencing self-concept development during adolescence. Finally, I focus on the neural correlates of self-processing and highlight how measures of individual differences and training could contribute to a better understanding of the role of self-concept in the context of educational decision-making. I end the introduction with an outline of the empirical chapters.

What is self-concept?

Self-concept is defined as a person's self-perceptions which are formed through experiences with and interpretations of one's social environment (Shavelson, Hubner, & Stanton, 1976). As this definition underlines, self-concept development always occurs in interaction with the social environment, and one might argue that developing a sense of self is not possible in the absence of social contact. Therefore, self-concept is also often referred to as a "social construct" (Harter, 2012).

Self-concept is subjective, meaning that aspects of our self-concepts are based on our own impressions of ourselves (e.g. 'I am attractive') rather than objective facts (e.g. 'I have brown hair'). As self-concept is a subjective experience, it is often non-visible and can be difficult to measure. Researchers therefore investigate self-concept by asking people about their self-perceptions. These perceptions can describe how you see yourself, and how you think other people see you. They can take the form of, for example, character traits (e.g. being curious) or competencies (e.g. being good at math). It is notable that these descriptions are generally evaluative in nature; we view them as relatively positive or negative. Therefore, self-descriptions or perceptions can also be referred to as 'self-evaluations' and research often focuses on investigating the valence, or positivity, of the self-concept. This positivity can be examined by categorizing self-evaluations into certain domains (Marsh & Shavelson, 1985). For example, these

domain-specific self-evaluations could refer to someone's abilities in a school context (academic self-concept), behavior in groups or social skills (social self-concept) or to an evaluation about one's appearance (physical self-concept).

Other than examining the valence of the self-concept on a domain-specific level, one could also investigate the overall evaluation of the self, better known as "self-esteem". Self-esteem is defined as an individual's general attitude towards the self and reflects the overall feeling of worth or value (Rosenberg, 1965). It is considered as the central evaluative component of the self and is regarded as a fundamental psychological construct (von Soest, Wichstrøm, & Kvalem, 2015). Although self-esteem is less concrete than the more domain-specific self-evaluations that make up the self-concept, it does interconnect with these self-evaluations. According to the competencies model by William James (1890), global self-esteem is based on people's own perceptions of their accomplishments in certain areas where they consider success to be important. For example, the math grades of someone who thinks math skills are very important to possess will influence their self-esteem to a greater extent than for someone who does not share these beliefs. The sociometer model of self-esteem, on the other hand, emphasizes the social nature of self-esteem (Leary, Tambor, Terdal, & Downs, 1995). It predicts that self-esteem is primarily rooted in our relationships with others. Therefore, it is expected that self-esteem would be most influenced by self-evaluations in domains of social relevance, such as feeling socially included. As beauty and attractiveness have a central focus in Western societies and have been linked to social acceptance, it is unsurprising that in many studies with different kinds of target groups the evaluation of one's physical appearance was found to be the strongest predictor for general self-esteem (Harter, 2012).

Both domain-specific self-evaluations and general self-esteem have been studied in relation to important psychosocial outcomes. Whereas self-esteem has often been related to mental health outcomes, such as positive relations with life satisfaction and negative relations with mental illnesses such as anxiety and depression (Orth et al., 2012; Steiger, Allemand, Robins, & Fend, 2014; von Soest et al., 2015), domain-specific self-evaluations have been linked to outcomes in more specific contexts. For example, there is a large body of research that has shown relations between academic self-concept and educational outcomes, such as students' school engagement and interests (Marsh & Martin, 2011), motivation (Valentine, Dubois, & Cooper, 2004) academic adjustment or wellbeing (Wouters, Germeijs, Colpin, & Verschueren, 2011), and school achievement or performance (Huang, 2011). However, the role of both academic self-concept and general self-esteem in the context of future-oriented educational decision-making remains less well understood.

In addition to examining the *valence* of the contents of self-concept on a domain-specific or global level, another way of studying the self is by investigating the *structure* of how these contents are organized, also referred to as self-concept clarity.

Self-concept clarity (SCC) is the extent to which beliefs about the self are clearly and confidently defined, stable over time, and internally consistent (Campbell, 1990). It can be viewed as a clear indication of self-certainty; the degree of confidence with which self-descriptions can be held. To date, research has linked SCC to a number of positive indices of psychosocial adjustment such as mental health, relationships with parents and peers, and commitment-making (Schwartz, Klimstra, Luyckx, Hale, & Meeus, 2012; Van Dijk et al., 2013). SCC has also often been associated with self-esteem. That is, individuals with higher self-esteem also tend to be more consistent in their self-ratings and hold their self-views with more confidence (Story, 2004). Although there seems to be a large overlap between self-esteem and SCC, recent research suggests that both constructs can have unique associations with future adjustment (Findley & Ojanen, 2013). However, studies investigating both constructs in relation to educational outcomes are limited.

In this thesis, I focus on examining both the valence of the self-concept (on a domain-specific and global level) as well as the structure of the self (concerning self-certainty and self-concept clarity) during the developmental phase in which the sense of self changes profoundly: the period of adolescence.

Factors influencing self-concept development during adolescence

Many people are preoccupied with the fundamental question "Who am I?". The idea of being 'someone', the concept of having a 'self', develops very early on in life. Around the age of eighteen months, babies can already start to recognize themselves in the mirror. When children are around three years old, they start to understand that what they want can differ from what somebody else wants (Harrigan, Hacquard, & Lidz, 2018). Yet, the self-concept in all its complexity does not fully unfold until adolescence. Not only do adolescents acquire more complex cognitive abilities that allow for more abstract perspectives of the self (Elkind, 1967; Selman, 1980), they also become increasingly sensitive to the peer context and show greater interest in the opinions of others about the self (Gunther Moor, van Leijenhorst, Rombouts, Crone, & Van der Molen, 2010; Nelson, Leibenluft, McClure, & Pine, 2005; Pfeifer & Peake, 2012). In this section, I will discuss two important aspects that characterize the changes that occur in the way adolescents view themselves: increases in self-concept complexity and social influences.

Self-concept becomes more complex

From the onset of adolescence, teenagers start evaluating themselves in more refined and diverse ways. Adolescents will also describe themselves in increasingly complex and abstract terms. Before the onset of adolescence, children still use very basic descriptions of themselves, often in terms of general group memberships, such as 'I'm

six years old' and 'I'm a girl'. Or they make use of labels instead of trait characteristics. For example, they might use sentences like "being good at 'running', 'jumping' or 'climbing". However, due to an increase in cognitive abilities, adolescents are able to make higher-order abstractions that integrate these labels into one trait: being athletic. Adolescents are also increasingly capable of describing their own strengths and weaknesses such as 'I'm good at swimming, but not good at drawing'. They, to a larger degree than children, additionally describe themselves according to how they think other people see them (e.g. 'I am a nice person, because I often babysit'). The factor driving this development is an increase in the ability to take the perspective of others. Perspective-taking allows adolescents to integrate perspectives of others in their perspective of the self (Pfeifer et al., 2009; Sebastian et al., 2008; Selman, 1980) and gives rise to a more all-round self-concept.

Another important development during adolescence that stimulates an increasingly versatile self-concept is related to the increasing set of social contexts adolescents find themselves in. They are not only at home with their parents anymore, but have to be in school, spend time with friends, maybe get a first part-time job, or start to develop romantic relationships. All these different contexts require different roles and behaviors, and thus different selves. Consequently, adolescents may view themselves differently in school (being a student), at home (being a child) or with peers (being a friend). Studies that have investigated this topic indeed found that self-concept becomes increasingly multidimensional with age, with more differentiated self-evaluations across social contexts and domains (Marsh & Ayotte, 2003).

Although the increase in differentiation facilitates a more complex self-concept, this development can at the same time be a cause of confusion, as adolescents are also becoming more aware of the possibility of having several conflicting personality traits (e.g. being outspoken with a best friend but quiet at home). Even though the identification of having different, potentially opposing traits can be contradicting and conflicting at first, adolescents gradually learn to integrate these separate traits into a higher order self-concept (e.g. being shy and cheerful can be integrated to being adaptive) and they can understand that it is okay to be slightly different versions of themselves in different contexts (Harter, Bresnick, Bouchey, & Whitesell, 1997; Harter & Monsour, 1992). The fact that young people are able to indicate whether their traits depend on a certain social situation or on who is describing them, shows that they have started to think about who they are in a differentiated way.

Influence of the social environment on self-concept

As stated earlier, self-concept cannot be seen or formed without an important role for the social environment. This environment can take many different forms, and the ways the environment is used to gain more knowledge about the self also change during adolescence.

First, the influence of the social environment can be expressed in the *feedback* we get from others. This can happen both directly (e.g. in a conversation) and indirectly (e.g. how we think others perceive us). This indirect form of self-perception is also called 'reflected self-concept' (Pfeifer & Peake, 2012). When we are still young, most of the feedback we receive about ourselves comes from our parents and is generally very positive. When we get older, the school context starts to play a larger role as an environmental factor influencing how we view ourselves. For the academic domain specifically, the feedback you get from your teacher or the grades that you receive can give you an indication of your academic skills. In addition, the transition into adolescence is marked by a shift in social focus towards the peer group (Nelson et al., 2005). Not only do adolescents spend more time with peers, they also show a greater interest in the perceived opinions of their peers and start to use their feedback as an important source for self-evaluation (Sebastian et al., 2008). Finally, an important but more indirect form of environmental feedback comes from norms and values in the society we live in. Think back about the babysitting example, where the societal norm is used that it is good to take care of someone else leading to the conclusion that you are a nice person.

A second way of how the environment can serve as a mechanism for self-evaluation is by using it as a reference point to compare oneself to, also known as *social comparison*. Although young children often base their self-concept on changes in their performance or behavior over time (also known as temporal comparisons, e.g. 'I am good at drawing because I am better than I was last year'), they increasingly use cues from the social environment as a means of self-evaluation as they grow into adolescents (e.g. 'I am good at drawing because I am better than my classmates'; Dijkstra, Kuyper, van der Werf, Buunk, & van der Zee, 2008; Harter, 2012). These social comparisons have been found to be an important method to gain more information about one's abilities and characteristics, and as a result develop a more accurate self-concept (Festinger, 1954). However, it remains difficult to disentangle the specific influence of these social comparisons on the development of self-views across adolescence. Moreover, it is still unclear whether social comparisons impact self-evaluations in different domains in similar or distinctive ways. Therefore, an important first aim of this thesis was to test the influence of the social environment within the development of an increasingly complex self-concept during adolescence by using a novel experimental paradigm **(chapter 2).**

Finally, an important factor influencing the development of self-concept concerns the *school environment*. Research has shown that the period surrounding school transitions can especially impact adolescents' self-concept, as these transitions coincide with the need to adapt to a new school system, new obligations, teachers, classmates, and peers (Cole et al., 2001). Subsequently, these changes can temporarily negatively influence the positivity of the self, for example in academic and social domains.

However, not only is the school context full of possibilities to gain more information about the *current* self, it also stimulates adolescents to start to think about their *future* selves. During high school, adolescents face all sorts of choices; from deciding about which graduation subjects to choose, to what major to pursue after high school– a choice that will strongly affect their future career options (Rogers & Creed, 2011). In order to make these decisions successfully, having positive and clear self-perceptions could help adolescents in directing them towards a future choice that fits their personality, interests and skills. As a second aim, I investigate this topic by focusing on how multiple aspects of self-concept can relate to successful future-oriented educational decision-making, and how they can help to explain individual differences in this process. Here, I combine behavioral self-report and experimental measures with neuroimaging techniques to increase our understanding of the underlying neural processes of self-concept in this relationship **(chapter 3 – 5).**

Neural correlates of self-concept

For a long time, it was thought that it would not be possible to retrace something as complex as self-concept to the brain, that is, to identify the neural basis of the self. With the advances in brain imaging techniques, such as functional magnetic resonance imaging (fMRI), it has become possible to examine which brain regions are engaged during rest or when performing a certain task. The use of fMRI can be especially helpful to study the self, as self-concept is not directly observable and self-report may be sensitive to response-bias. Neuroimaging is therefore a useful method for gaining insight in the processes underlying self-reflection.

To date, research examining the neural underpinnings of self-concept has mostly been focused on adults, although more recent studies included adolescents as well. In these studies, self-concept is generally examined by asking participants lying in the MRI scanner whether or not or to what extent a number of trait-adjectives (e.g. 'I am funny') apply to them. Brain activation during the evaluation of these self-referential stimuli is then compared to activation during non-self-referential tasks (e.g. thinking about the traits of other people, or the desirability, malleability or categorization of traits). This allows researchers to closely examine the degree to which activation in these brain regions is associated with thinking about the self, relative to thinking about character traits in general. This body of literature has consistently shown that there is a network of specific brain regions, spanning from the medial prefrontal cortex (mPFC), anterior cingulate cortex (ACC) to posterior cingulate cortex (PCC) and precuneus, that appears to mediate self-referential thoughts (see **Figure 1**; for comprehensive reviews and meta-analyses see Denny, Kober, Wager, & Ochsner, 2012; Murray, Schaer, & Debbané, 2012; Northoff et al., 2006). As these regions are located in the middle of the human cerebral cortex, they are often referred to as cortical midline structures

(CMS; Northoff & Bermpohl, 2004). Self-processing does not solely engage the CMS, but also regions involved in perspective-taking, such as the temporo-parietal junction (TPJ; Saxe & Kanwisher, 2003), striatal regions responsive to salience and reward processing (Jankowski, Moore, Merchant, Kahn, & Pfeifer, 2014; Somerville et al., 2013), and the hippocampus, involved in memory retrieval (Pauly, Finkelmeyer, Schneider, & Habel, 2013).

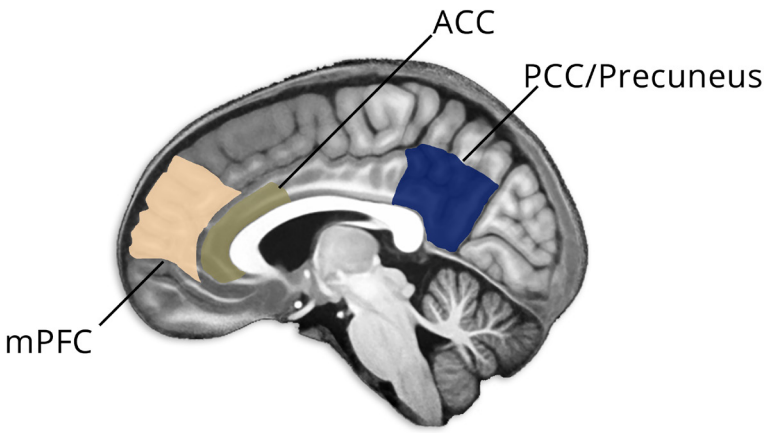

Figure 1. Cortical Midline *Structures (CMS) implicated in self-referential processing. mPFC = medial prefrontal cortex; ACC = anterior cingulate cortex; PCC = posterior cingulate cortex.*

Interestingly, the network recruited during self-referential thought shows a large overlap with brain regions involved in social cognition, also known as the social brain network (Blakemore, 2008). The idea that thinking about or evaluating the self is inherently social (we think about ourselves within a social context; we compare ourselves to others, or ponder over how others view us) is thus also reflected in the brain. Within this network of brain regions involved in self-processing as well as social cognition, there has been an especially great interest in the mPFC, which has been shown to play a key role in the process of mentalizing (attributing mental states to self and others), and is viewed as the core region regarding self-reflective processing (Lieberman, Straccia, Meyer, Du, & Tan, 2019). As the mPFC comprises a large area of cortex, covering multiple Brodmann Areas, researchers have sought for a degree of specialization within the mPFC. That is, whether certain sub regions of the mPFC could be more responsive to thinking about the self versus others, or for thinking about the self from different reflective or temporal perspectives. These studies have suggested that mPFC activity is modulated by self-relevance (Moran, Macrae, Heatherton, Wyland, & Kelley, 2006). For example, thinking about the self

and close others (such as one's mother, or close friends) engages a more ventral part of the medial prefrontal cortex (vmPFC), whereas thinking about distant or public others involves a more dorsal part of the medial prefrontal cortex (dmPFC). According to the valuation hypothesis, the vmPFC is associated with affective and motivational processes and may therefore encode the personal significance or value of self-related contents (D'Argembeau, 2013). Interestingly, vmPFC activation during self-processing is often confounded with emotional valence. That is, the vmPFC is often more active for the evaluation of positive traits specifically, as this could reflect the tendency of people to view positive traits as more self-descriptive and therefore more self-relevant (Pauly et al., 2013). With regard to perspective-taking, research has shown that the mPFC responds to self-evaluations from both direct (am I smart?) and reflective perspectives (do my peers think I am smart?), as well as self-evaluations from different temporal perspectives (e.g. thinking about past, present, and future selves) (Packer & Cunningham, 2009; Pfeifer & Peake, 2012). However, the (v)mPFC showed the highest activation for task perspectives most relevant to the self (e.g. thinking about the present self, or from a direct perspective), again demonstrating a sensitivity to the degree of self-relatedness (D'Argembeau et al., 2010).

Although the mPFC has been found to be involved in the processing of a variety of self-related information, it has been questioned whether other regions of the CMS or social brain would differentiate more in responding to trait-evaluations from different domains. This could be especially relevant as earlier studies have shown that self-concept becomes increasingly domain-specific with increasing age (Harter et al., 1997; Marsh & Ayotte, 2003). Recent studies have indicated that, indeed, there are dissociable neural patterns mediating domain-specific self-reflection. For example, in both adults and adolescents it has been found that evaluating social traits specifically activates brain regions that are part of the social brain network, such as the TPJ (Jankowski et al., 2014; van der Cruijsen, Peters, & Crone, 2017). In addition, the evaluation of more 'external', physical traits recruits a large region of both mPFC and PCC, often implicated in autobiographical memory, whereas the evaluation of academic or competence traits is more specifically associated with PCC and precuneus activation (Ma, Wang, Yang, Feng, & Van Overwalle, 2016; van der Cruijsen et al., 2017). Together, these studies suggest there are partly overlapping, and partly separable brain networks involved in the evaluation of self-traits in different domains. Understanding more about the neural underpinnings of domain-specific self-concept, especially the academic domain, could provide additional information in relation with educational outcomes. Yet crucially, the role of the neural correlates of domain-specific self-evaluation in future-oriented educational decision-making remains unexplored.

Individual differences and training in adolescence

It is important to note that the neuroimaging studies described here have generally relied on group analyses to examine common activation during self-processing across subjects. Although examination on a group level allows for statistical benefits to robustly detect general patterns of activity for certain self-related tasks, it is less attentive to individual differences between subjects that could possibly modulate neural responses during self-processing (Dubois & Adolphs, 2016). For example, individuals with different levels of self-positivity or clarity of the self-concept might recruit brain regions during self-evaluation to a different extent. As during adolescence the self-concept becomes more complex and differentiated, differences between individuals can become more pronounced. Therefore, in addition to examining the neural correlates of adolescents' self-concept on a group level, I also adopt a complementary approach of including individual differences in behavioral measures of valence (e.g. self-esteem or domain-specific positivity) and structure (self-concept clarity) of the self to uncover brain regions whose activity covaries with these measures. This method could be especially helpful in relation to the process of successful future-oriented educational decision-making, as it can give insight in possible differences in neural mechanisms underlying self-processing in individuals who do or do not experience difficulties matching their self-views to suitable programs in higher education.

Finally, although studies have indicated that adolescents recruit a similar neural network for self-processing as adults, with a strong involvement of the mPFC (Pfeifer & Peake, 2012; Sebastian et al., 2008), it is not yet understood how these regions are sensitive to changes in self-concept over time. These changes can be related to normative self-concept development. However, within the context of adolescents struggling with educational decision-making, a more interesting question would be whether *actively stimulating* self-development could have beneficial effects for the positivity and clarity of self-perceptions, and additionally, how these changes are reflected in the brain. As adolescence is particularly a period where both self-concept and the brain are highly susceptible to environmental influences, this can have considerable implications for treatment and intervention (Jolles & Crone, 2012). Consequently, creating positive circumstances for optimal self-concept development could have significant beneficial outcomes, especially during this sensitive developmental period. Therefore, I examine whether during (late) adolescence, self-concept can be fostered through training and which underlying neural mechanisms would drive these changes. And, most importantly, I test whether improvements in self-concept could in the end be predictive of better suited educational choices.

Outline of this thesis

In this thesis, I report the results of four empirical studies that I have conducted to investigate the development of self-concept during adolescence with a specific focus on the role of self-concept in the process of future-oriented educational decision-making. All studies are part of "The Leiden Self-concept Project". The main aim of this project was to longitudinally examine behavioral and neural correlates of self-concept development in typically – and atypically developing adolescents. The project consists of multiple samples, including a cross-sectional behavioral sample (N = 202, 9 – 25 years, 1 time point, behavioral measures), an adolescent sample (N = 160, 11 – 21 years, 3 time points, fMRI and behavioral measures), and a sample of adolescents/young adults who all experienced difficulties with future-oriented educational decision-making (N = 38, 16 – 24 years, 4 time points, fMRI and behavioral measures). The latter sample was recruited in collaboration with Foundation Gap Year (Dutch: Breekjaar), an organization in the Netherlands that provides self-concept training programs for adolescents who have dropped out of higher education and experience difficulties with making suitable academic and career choices. Studies with the longitudinal adolescent sample and Gap Year sample have been pre-registered on https://osf.io/8mspn/. In all studies reported here, a similar self-concept task was used (inside or outside the MRI scanner) where adolescents were asked about their evaluation of self-traits in different domains, and from different perspectives. Together, with these studies I aim to (1) shed light on the behavioral development of domain-specific self-concept across adolescence and its interaction with the social environment, and (2) investigate the role of various aspects of self-concept and its neural mechanisms in the context of future-oriented educational decision-making.

In **chapter 2** I present a new paradigm to examine the development of self-evaluations in different domains across adolescence, and to experimentally test how the development of these self-evaluations is altered by an explicit social comparison context. First, participants (N = 202, 9 – 25 years) were asked to evaluate themselves on trait-adjectives in academic, social, and physical domains, and to rate the certainty of their self-evaluations and subjective importance of possession of the traits. Second, participants were again presented with the same trait-adjectives but were now asked to evaluate themselves compared to an unknown peer. This shift in social context allowed me to disentangle the specific influence of social comparison outcomes within developmental patterns of self-evaluation.

Chapters 3 – 5 focus on the role of behavioral and neural indices of adolescents' self-concept in relation to educational decision-making. In **chapter 3**, I start out by examining the role of behavioral and neural indices of *academic* self-concept specifically, in relation to the orientation process leading up to the decision for a future study or career. For this purpose, I included a subsample of adolescents who were in the final years

of high school (*N* = 48, 14 - 20 years). In addition to academic self-concept measures, I also tested whether other academic variables, such as academic performance and the subjective importance of academic traits, would relate in a similar or different way to the orientation process. This way, I aimed to investigate to what extent academic self-concept could be unique in its relation with future-oriented educational decision-making.

In **chapter 4**, I move from the general population to a specific sample of adolescents who all experience clear difficulties with future-oriented educational decision-making. That is, they started a major but dropped out of higher education or remained undecided after high school. This sample was recruited in collaboration with Foundation Gap Year. I focus on what characterizes these individuals (*N* = 38, 16 – 24 years) in terms of self-concept by comparing their self-esteem, self-concept clarity, and domain-specific self-evaluations to those of adolescents who already successfully transitioned into higher education (*N* = 46, 17 – 21 years). In addition, I examine group differences on a neural level and test whether brain activity during self-processing could be dependent upon individual differences in self-esteem and self-concept clarity.

In **chapter 5**, I follow the same adolescents who struggled with educational decision-making in chapter 4 throughout a naturalistic self-concept training program within a gap year context. Across three time points during this gap year (each 5 months apart), I investigate whether different aspects of their self-concept could be improved by training and examine the specific trajectories of these changes. In addition, I examine changes in the neural circuitry associated with self-processing and test whether these neural changes are related to co-occurring improvements in self-positivity. Lastly, I assess whether individual differences in self-concept changes during the gap year could be predictive of positive outcomes related to educational decision-making and indices of successful adjustment on a follow-up measurement 6 months later.

Finally, in **chapter 6** I summarize and discuss the findings of the empirical studies presented in this thesis and provide an overview of the implications of these results.