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

Aar, L.P.E. van der

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Author: Aar, L.P.E. van der
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Hoe ben je veranderd sinds de eerste keer
dat je mee deed aan dit onderzoek?

"Veel meer zelfvertrouwen, veel meer durven,
veel meer zelfvertrouwen, veel meer durven,
veel minder geven om de meningen van anderen."

Maaike, 20 jaar

Chapter 6

SUMMARY AND GENERAL DISCUSSION

SUMMARY

The main goal of this thesis was to investigate the behavioral and neural processes involved in self-concept development in adolescence within the context of future-oriented educational decision-making. First, I examined the development of domain-specific self-evaluations across adolescence within a social context, by testing how the positivity of these self-evaluations is influenced by the use of social comparisons (**chapter 2**). Second, I focused on the role of behavioral and neural indices of adolescents' self-concept in relation to future-oriented educational decision-making (**chapter 3, 4, and 5**). I studied this topic by focusing on the role of different aspects of self-concept (related to both its valence and structure, on behavioral and neural levels), including multiple samples of adolescents (differing in the problems they encounter with educational decision-making) and using various approaches (e.g. group comparison, training, and prediction). The current discussion starts out with a brief summary of the main findings of each chapter. This summary is followed by a general discussion, including recommendations for future research. Finally, I highlight the practical implications of the findings, and end the discussion with general conclusions.

Self-concept development and social comparison across adolescence
The first empirical chapter (**chapter 2**) describes developmental patterns of domain-specific self-evaluation across adolescence with and without the presence of an explicit social context. Prior research has indicated that adolescence is a unique period for self-concept development, with a heightened sensitivity for social comparison as a mechanism that can be used to evaluate the self (Sebastian, Burnett, & Blakemore, 2008). However, it remains unclear how these social comparisons impact the development of self-evaluations in different domains, and across different ages in adolescence. In order to disentangle the specific influence of social comparison outcomes within developmental patterns of self-evaluation, I developed two tasks that that both asked participants about trait self-descriptions (e.g. 'Am I spontaneous?'), but differed in the salience of the presence of a social comparison with an unknown peer (e.g. 'Am I more spontaneous than this peer?'). Traits could be either positive or negative and were categorized into three domains: academic (e.g. 'intelligent' or 'unmotivated'), social (e.g. 'friendly' or 'jealous') and physical appearance (e.g. 'attractive' or 'skinny'). As a first aim, I investigated the development of self-evaluations in a task *without* an explicit social comparison in four age groups: late childhood (9–11 years), early adolescents (12–14 years), mid adolescents (15–17 years) and young adults (18–25 years). Second, I focused on the development of self-evaluations *within* an explicit social-comparison to examine how this shift in context influenced the positivity of self-evaluations across domains and age groups.

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Findings for the first task (without a social comparison context) indicated that children and adolescents in the younger age groups (9 – 14 years) consistently showed more positive as well as less negative self-evaluations compared to the two older age groups. These differences could be a reflection of a positivity bias (Harter, 2012), indicating that younger children and adolescents often hold favorable self-views and can overestimate their abilities. Compared to the first task, the second task with an explicit social comparison yielded similar as well as additional results. The youngest age groups continued to rate themselves more positively compared to the older adolescents. That is, they generally attributed positive traits to themselves, and negative traits to the peer. In addition to the findings for the first task, there were more pronounced age-differences that became more strongly dependent upon domain. Especially the mid adolescents (15-17-year olds) were negatively affected by the context of social comparison, attributing more negative and less positive traits to themselves. This effect was most apparent for the academic domain. Possibly, the academic school environment is characterized by a strong evaluative atmosphere where comparison of performance and grades with others is often emphasized (Wehrens et al., 2010). Particularly with an increased performance-focus during the final years of high-school, where most 15 – 17 years will find themselves in, this could increase the use of social comparisons and negatively influence the self-concept.

Together, these findings support the idea of a 'social reorientation' that takes place during mid-adolescence (Nelson, Leibenluft, McClure, & Pine, 2005) where greater sensitivity to the social context could affect the positivity of self-evaluations to a larger extent. In the next chapter, I further zoom in on the age group of mid-adolescence in their final years of high school, as I examine the role of behavioral and neural correlates of academic self-concept in the orientation process leading up to the decision for a future study.

Academic self-concept and future-oriented educational decision-making
In chapter 3, I started my investigation regarding the role of behavioral and neural indices of self-concept in future-oriented educational decision-making. Here, I focused on the orientation process towards a future study. This reflects students' first awareness of the need to make this future-oriented decision and consequently take relevant actions regarding planning and exploration of options (Germeijs & Verschueren, 2006). Within this process, I was specifically interested in the role of academic self-concept on both a behavioral and neural level. First, I examined how the positivity of academic self-concept and activity of brain regions involved in academic self-evaluations would relate to problems adolescents could experience with future orientation. Additionally, I tested whether academic self-concept could be unique in its relation to future orientation by also including other academic measures such as academic performance or the subjective importance of academic traits.

Participants were 48 adolescents between 14 – 20 years in the final years of high school, who therefore needed to start thinking about future academic or career options they would want to pursue after graduation. They evaluated themselves on positive and negative academic trait sentences (e.g. 'I am a fast learner' or 'I think school is hard') in an fMRI session. In addition, they evaluated the importance of these traits, completed a questionnaire on problems with future orientation, and performed a reading test and shortened IQ test as an index of cognitive performance. Behavioral findings indicated that a more positive academic self-concept was associated with fewer problems with future orientation. Moreover, academic self-concept was a better predictor for future orientation compared to academic performance or subjective importance of academic traits. These findings could be reflective of an underlying motivational component. That is, future orientation can be viewed as a 'motivation for the future', and academic self-concept is considered to be more closely related to motivation than performance (Guay, Ratelle, Roy, & Litalien, 2010). On a neural level, I found increased activation in mPFC for the evaluation of academic traits compared to a control task, which is consistent with prior studies (Ma, Wang, Yang, Feng, & Van Overwalle, 2016; Moran, Lee, & Gabrieli, 2011). Interestingly, the precuneus was sensitive to individual differences in academic positivity. That is, individuals who rated themselves more positively on academic traits also showed increased activity in the precuneus. This region is part of the cortical midline structures and is engaged in perspective taking through mental imagery, such as imagining oneself in multiple social contexts (Cavanna, 2006; Schurz, Radua, Aichhorn, Richlan, & Perner, 2014). This precuneus activity additionally mediated the relation between academic self-concept and problems with future orientation. These findings suggest that the precuneus is an important brain region that processes how adolescents evaluate academic traits, and subsequently influences how adolescents think about their future academic self through future orientation. After studying the relation between self-concept and educational decision-making in the general population, I now turn to a more specific group of adolescents who all experience serious problems with future educational decision-making in chapter 4.

Self-concept in adolescents struggling with educational decision-making
The main aim of **chapter 4** was to examine self-concept characteristics in a specific group of adolescents who reported difficulties with choosing a suitable major in higher education. In the Netherlands, there is an increasing number of adolescents who delay the need to make this future-oriented decision by taking one or multiple gap years (from 6% in 2015 to 12% in 2017). Many others appear to make a wrong decision which can result in dropping out or changing programs (33% drop out in their first year, Dutch Ministry of Education, 2018). To understand more about various aspects of the self-concept of these individuals and how these might differ from individuals who do not

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experience these difficulties, I recruited a sample of 38 adolescents (16 – 24 years) in collaboration with Foundation Gap Year. This is an organization in the Netherlands that provides structured one-year self-concept training programs for adolescents who have dropped out of higher education or remain undecided after high school. Before the start of their training, I tested these adolescents on behavioral measures of self-esteem, domain-specific self-evaluations, self-concept clarity and neural mechanisms underlying self-processing. I compared these measures to those of individuals who reported to have already successfully chosen a major (N = 46, 17 – 21 years), and additionally tested for brain regions that co-varied with individual differences in self-concept measures across both groups.

Behavioral findings showed that adolescents struggling with educational decision-making reported lower levels of self-esteem and self-concept clarity compared to their peers. Interestingly, groups did not differ on domain-specific evaluations. For example, the gap year individuals did not evaluate themselves more negatively on academic traits. These results possibly indicate that self-insight and self-esteem are important factors needed to successfully choose a suitable major. Neurally, both groups recruited cortical midline regions such as the mPFC and ACC during self-processing, but there were no group differences in brain activity. However, the strength of mPFC activity was related to individual differences in self-esteem. That is, individuals with lower self-esteem recruited the mPFC to a lesser extent compared to individuals with higher levels of self-esteem, especially for the evaluation of academic and physical traits. These results suggest that self-esteem could serve as an important condition to help individuals mentalize about the self (for further reading see Lieberman, Straccia, Meyer, Du, & Tan, 2019). Together, these findings contribute to our understanding what characterizes individuals struggling with educational decision-making. Given that differences were most pronounced for self-esteem, an important next step was to test whether training self-esteem could help adolescents to make a well-suited educational choice. I investigated this question in chapter 5.

Self-concept training and better future educational choices
Chapter 5 aimed to speak to the societal problem concerning the large number of adolescents who experience difficulties in choosing a suitable program in higher education which matches their self-views. Possibly, stimulating self-concept development could help adolescents to increase their chances of finding a suitable major. Therefore in this chapter, I examined the effects of a naturalistic self-concept training within a gap year context on behavioral and neural correlates of self-evaluations. Additionally, I examined the predictive value of changes in behavioral indices of self-concept during this gap year for successful future educational decision-making. I followed the same individuals who started their training with Foundation Gap Year in

chapter 4 across four time points. Participants were tested on levels of self-esteem, domain-specific self-evaluations and self-concept clarity before, during, and after the training (each 5 months apart). There were two fMRI sessions before and after training to examine changes in the underlying mechanisms of self-processing. At an additional follow-up measurement (6 months later) participants filled out questionnaires related to their current academic situation, in order to examine long-term consequences of the training for educational decision-making.

This study resulted in four main findings. First, the one-year training period was associated with increases in all self-concept measures (self-esteem, self-concept clarity and positivity of domain-specific self-evaluations). However, the specific trajectories of these variables differed. For example, self-esteem showed linear increases across the year, whereas self-concept clarity only improved in the second half of the year. With regard to the domain-specific self-evaluations, changes were most significant for the social domain, which suggests that the difficulties this group experiences may be broader than academic decision-making and may reflect a general difficulty with fitting in. Together, these behavioral results seem promising for the malleability of self-concept during late adolescence. As a second main finding, neural results demonstrated that mPFC activity during self-evaluation pre-training predicted self-esteem change across the gap year. That is, participants with lower mPFC activity before training showed larger self-esteem increases over the year. These findings extend the cross-sectional association between self-esteem and mPFC activity previously reported in chapter 4, and indicate that mPFC activity not only correlates with, but also predicts self-esteem change. Third, mPFC also showed a time-related effect of valence, as activity increased after training for the evaluation of positive, but not negative traits. These findings fit well with the general increase in behavioral positivity ratings, as research has shown that mPFC activity is modulated by self-relevance. Therefore these results could possibly reflect that positive traits are considered more applicable to the self. Finally, individual differences in changes in self-concept clarity and social self-evaluations, but not self-esteem, positively predicted outcomes related to future-oriented educational choices, such as better social adjustment to college and academic performance. Overall, the results emphasize that a naturalistic gap year program focused on the self can increase positivity as well as clarity of the self-concept and associated activity in the mPFC, and in turn, can help adolescents with their adjustment in higher education.

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GENERAL DISCUSSION

The studies presented in this thesis all highlight that self-concept is a multifaceted and complex construct that not only develops in *interaction* with the social environment, but can also have an *impact* on someone's future environment. For example, results from **chapter 2** indicated that the social environment, expressed in the outcomes of social comparisons, can affect the positivity of the self to a different extent across multiple domains and different stages of adolescence. **Chapter 3** showed how adolescents' academic self-concept can influence their motivation to stay committed to goals important for their future educational environment, whereas **chapter 4** illustrated differences in self-esteem and self-concept clarity in individuals who differed in their experienced problems with choosing this future educational environment. Finally, **chapter 5** demonstrated that in late adolescence, sensitivity to outside influences can be used to stimulate self-concept development through training which can ultimately help adolescents in their educational decision-making and adjustment in higher education. Together, these studies provide a comprehensive view on self-concept development in adolescence that takes place within a broader social, and educational context. In the following sections, I discuss several main findings that stand out across these different studies, and provide recommendations for future research and practical implications.

Self-concept within an educational context
A first finding that emerges from this thesis is related to the academic domain of self-concept in the specific period of mid-adolescence (14 – 17 years; Harter, 2012). In the Netherlands, most adolescents in this developmental stage are still in (one of the final years of) high school, working towards final examinations and possibly preparing for future educational decision-making. I studied the academic self-concept of this group of mid-adolescents in two separate samples in **chapter 2** and **chapter 3**. In **chapter 2**, I showed that for mid-adolescents, the positivity of academic self-evaluations was most negatively influenced by social comparisons compared to other age groups. This finding extends the result from a separate adolescent sample of the Leiden Self-Concept Study (van der Cruijsen, Peters, van der Aar, & Crone, 2018) where it was found that the academic domain showed a dip in positivity during mid-adolescence, whereas the physical or social domain did not show any age-related changes in positivity across adolescence. Research has suggested that academic self-concept is profoundly formed by actively comparing one's own achievements to those of peers in the same classroom, also known as the "Big-Fish, Little-Pond" effect (Marsh & Hau, 2003). The use of these comparisons is triggered even more as there is an increased emphasis on grades during (the final years of) high school, and through additional teacher practices such as giving

verbal feedback in front of other classmates. Together with the heightened sensitivity to social influences on the self, this can make mid-adolescents more vulnerable to negative outcomes of these social comparisons and may therefore temporarily decrease the positivity of their academic self-evaluations.

Critically, having a positive academic self-concept could be especially relevant during mid-adolescence as it can not only influence adolescents' current academic goals, motivation or achievement, but could also affect processes involved in their orientation to future academic goals, a topic I focused on in **chapter 3**. Here I showed that in a separate sample of mid-adolescents in their final years of high school, a more positive academic self-concept was related to the experience of fewer problems with future orientation. That is, adolescents who evaluated their current academic motivation, interests and achievement more positively, also displayed more awareness and motivation to start their orientation and planning towards a suitable future educational choice. This process is an important first step towards successful educational decision-making and with a timely start could increase adolescents' chances of finding a suitable major in higher education. A large body of research has already indicated strong links between adolescents' academic self-perceptions and their motivation concerning short-term goals that take place within the walls of high school (Bong & Skaalvik, 2003; Guay et al., 2010). The current finding extends this relationship by showing that the positivity of these perceptions can be beneficial for the motivation regarding future, long-term academic goals as well.

Together these results indicate that mid-adolescence is a developmental phase where positive academic self-evaluations could be an important motivator in the orientation process for their academic future, but that at the same time it can be difficult to maintain these positive self-evaluations due to a concurrent heightened sensitivity to social influences on the self. This is underscored by a recent national report from UNICEF, that examined mental health, stress, and happiness in a large sample of Dutch adolescents between 10 – 18 years (UNICEF, 2020). Here, more than 50 % of mid-adolescents reported that their main source of stress was related to the school environment. Causes of this stress that were cited were, amongst others, high expectations from others and themselves, feeling pressured to perform well, a high degree of social comparison, and worries about their future.

Interestingly, a proposed protective factor against these feelings of stress and worries put forward by the participating adolescents themselves was having a strong sense of an own identity, with overall feelings of self-acceptance and self-worth (UNICEF, 2020). These aspects of self-concept could not only function as a buffer against stress during high school, but also help adolescents later in the process of educational decision-making, a topic I focused on in **chapter 4** and **5**. Here I examined self-concept in a sample of slightly older adolescents (M = 18-19 years) who had just finished high school and

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therefore urgently needed to make a decision regarding their academic future. I showed that both self-esteem and self-concept clarity were significantly lower in adolescents who visibly struggled with finding a suitable educational major (e.g. they had dropped out or took a gap year) compared to adolescents who reported to have successfully made the transition into higher education (**chapter 4**). Additionally, both self-esteem and self-concept clarity showed large improvements during a year of self-concept training in a gap year context (**chapter 5**). Finally, self-concept clarity was revealed as a possible key self-concept variable in the process of successful educational-decision making, as increases in self-concept clarity were predictive of positive outcomes such as better social adjustment and academic performance in higher education (**chapter 5**). Interestingly, within these late adolescents, academic self-concept did not differ in positivity between groups, nor were changes in academic positivity predictive of positive academic outcomes in higher education, such as better motivation, performance or adjustment. Together, these findings suggest that multiple aspects of self-concept could have different roles within the context of future educational decision-making. That is, the positivity of self-evaluations in the academic domain could be related to the more (intrinsic) motivational aspects of the start of the educational decision-making process, but it may not be the most decisive factor later on in the process. Furthermore, although self-esteem and self-concept clarity differentiated between adolescents with or without problems with educational decision-making and both these aspects were sensitive to improvement, only self-concept clarity was predictive of positive educational outcomes in higher education. These findings are in line with earlier studies indicating that self-esteem and self-concept clarity are separate constructs with unique associations with adjustment (Campbell, 1990; Findley & Ojanen, 2013). With regard to self-esteem, relationships with academic variables have been inconsistent or unclear, and it has been questioned whether boosting self-esteem always has a positive effect, since it may also lead to overconfidence which has been associated with underperformance and decreased motivation (Baumeister, Campbell, Krueger, & Vohs, 2003). On the contrary, self-concept clarity has generally been linked to positive outcomes only (Findley & Ojanen, 2013). The current findings add to this research by suggesting that having a clear understanding of the self is needed and possibly most important in the process of successful educational decision-making and adjustment in higher education.

Neural signature of self-concept and future-oriented educational decision-making
In order to increase our understanding of mechanisms underlying self-processing, I additionally examined self-concept and its relation with future-oriented educational decision-making on a neural level. Across the studies in this thesis, these brain imaging data highlighted two main findings. First, on a group level, thinking and evaluating the self during (mid and late) adolescence was associated with activation in the cortical

midline structures such as the mPFC and precuneus, which is consistent with earlier studies examining self-processing in both adults and adolescents (Denny, Kober, Wager, & Ochsner, 2012; Pfeifer & Berkman, 2018). However, with regard to the context of future-oriented educational decision-making, the most interesting results were found in relation to brain regions sensitive to *individual differences* in self-concept. First, in mid-adolescence, precuneus was more active for adolescents with more positive academic self-evaluations and this increased activation was related to the experience of fewer problems with future orientation (**chapter 3**). Second, during late adolescence, I found that mPFC-activity was reduced for individuals with lower levels of self-esteem, a characteristic of adolescents struggling with educational decision-making (**chapter 4**). Together, these findings suggest that activity in these cortical midline structures during self-processing may be dependent on individual characteristics. Intriguingly, these brain-behavior relations were only observed for valence aspects of the self-concept (on a domain-specific or a more general level), but not structural aspects of the self (self-concept clarity). Possibly, self-positivity is coded by both anterior and posterior regions of the CMS as more salient, which is in agreement with studies suggesting that positive affect may be a central component of the mental representation of the self (Chavez, Heatherton, & Wagner, 2017; Moran, Macrae, Heatherton, Wyland, & Kelley, 2006). Conversely, differences in self-concept clarity could correspond to a lesser extent to salience coding in the brain as it represents an indication of overall stability and consistency of the self-concept instead of a direct self-relevant response (e.g. "Yes, this trait describes me"). Together, these findings emphasize that including individual differences is a useful approach to better understand the underlying neural mechanisms of self-processing within the context of future-oriented educational decision-making.

Second, findings from **chapter 5** further suggest that activity in these cortical midline structures may change when creating positive circumstances for optimal self-concept development, as was demonstrated with the Gap Year program. Here, I observed on a group level that participating in a structured self-concept training was associated with increased activity in mPFC for the evaluation of positive-valenced traits specifically. That is to say, mPFC activity increased over time when evaluating oneself on positive-valenced traits but not on negative-valenced traits. This is consistent with the general increase in behavioral positivity ratings and the notion that the ventral part of the mPFC responds more strongly to stimuli that have a larger personal significance (D'Argembeau, 2013). This hypothesis was further reinforced by the finding that at the individual level lower mPFC activity prior to the Gap Year program was associated with lower self-esteem at the first measurement, but larger self-esteem change over time, possibly reflecting room for development. This latter finding is important because it shows that low mPFC activity should not be taken as a fixed state, as in the context of environmental enrichment it can predict who are the individuals who show potential

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for change. These findings provide the first steps in unraveling experience-related changes in neural activity in a naturalistic training environment. The current design should be followed up in a structured randomized-control design, including multiple age groups. Nonetheless, it provides a proof of concept to build future larger scale programs examining the role of social and personal enrichment on self-concept development and educational outcomes.

Recommendations for future research

The studies in this thesis made a first important step in the investigation of the role of multiple aspects of self-concept in the context of future educational decision-making, and provide a starting point for future studies to address several outstanding questions. In this section, I discuss ideas for extending the current research methods and introduce new research approaches that could help to increase our understanding of adolescents' self-concept in relation to future-oriented educational decision-making.

Extending current research methods

First, although I demonstrated differences in self-concept in relation to future-oriented educational decision-making on both the individual level (by including individual differences) and group level (by examining a specific group struggling with this process), the samples were too small to test for possible additional important differences between categorical variables such as gender, educational track, or social economic status (SES). For example, the report by UNICEF (2020) indicated that girls, adolescents with a migration background, and adolescents in a higher academic track were all more vulnerable to experiencing increased levels of stress due to school. Additionally, these Dutch educational tracks do not only differ in their academic level, but also in their duration and number of possible future options after graduation, which could all have a significant influence on later experienced problems with educational decision-making. Future studies would benefit by including these additional variables and testing relations with educational decision-making in larger samples, using longitudinal designs.

Second, with regard to the multifaceted and complex structure of self-concept, it is important to note that the studies in this thesis examined the behavioral and neural correlates of only a selection of all possible self-concept domains. The focus on self-evaluations within academic, (pro)social, and physical domains was chosen because these domains have been shown to be of particular relevance to the lives of adolescents (e.g. resembling traits needed in a school or social context with peers) and are similar to what other studies examining adolescent self-concept development have focused on (Pfeifer & Peake, 2012). However, within an educational context not all examined domains are as relevant for future-oriented educational decision-making and important aspects might have been overlooked. For example, the academic domain consists of

trait words that are mostly focused on cognitive skills; they ask adolescents about an evaluation of their intelligence, grades or work attitude. However, this approach can be limited as it does not attend to adolescents' evaluation of aspects such as creativity or practical skills that can be important for someone's view of "being intelligent" (Henry, Sternberg, & Grigorenko, 2005; Nusbaum & Silvia, 2011) and could be helpful in dealing with the complex task of choosing a suitable future education. Therefore, future studies may address this issue by incorporating these traits to the academic domain or including an additional domain on creative self-concept (Karwowski, 2017). Similarly, self-concept research could be extended to include the investigation of adolescents' interests, as research has shown that someone's self-concept can affect their interests (e.g. 'I am good at math, I like math'; Denissen, Zarrett, & Eccles, 2007) and these interests, in turn, play an important role in adolescents' process of deciding which program to pursue in higher education (Vulperhorst, van der Rijst, & Akkerman, 2020).

Theoretical advancements

In this thesis, I examined the relation between self-concept and future-oriented educational decision-making by focusing on adolescents' evaluations about their *current* self and how this relates to (difficulties with) achieving their future academic goals. However, these future goals indirectly reflect a clear vision of a *future self*. Research has indicated that there are large individual differences in the degree to which people identify and feel connected to their future self, also known as future self-continuity (Chishima & Wilson, 2020). Importantly, research has also shown that people with more future self-continuity are more likely to make decisions in the present that will benefit their future outcomes (Ersner-Hershfield, Garton, Ballard, Samanez-Larkin, & Knutson, 2009). Therefore, an important next step would be to foster adolescents' future self-continuity, which could in turn benefit their planning and decision-making towards a suitable educational choice. The use of novel technology such as virtual reality (VR) could be a fruitful new research approach to increase the vividness of the future self, thereby possibly strengthening the relation between the current and future self and foster adaptive future-oriented behavior (van Gelder, Otte, & Luciano, 2014). Additionally, an interesting future direction would be to test whether the effect of an increased future self-continuity can be detected on a neural level. For example, earlier studies have shown that reflecting on representations of future selves elicited less activity in mPFC and ACC compared to thinking about the present self, which has been interpreted as a process of perceived degree of self-relatedness (D'Argembeau et al., 2010; Ersner-Hershfield, Wimmer, & Knutson, 2009). Therefore, increased activity in these brain regions when adopting a future perspective of the self could be an indication of the future self being viewed as less distant, and more closely connected to the present self.

Finally, in this thesis I studied the underlying neural correlates of self-evaluation as separate brain regions of the CMS. However, it is well known that brain regions do not operate in isolation, but that brain function depends on a large-scale network of interacting neural regions (Stevens, 2016). Research on task-based functional connectivity related to self-evaluation is limited, although one recent study in emerging adults suggested that reduced connectivity between anterior CMS regions such as the mPFC and the more posterior region IPL (involved in mentalizing and perspective taking), possibly indicating more efficiency, could be an indication of having easier access to self-representations (Davey et al., 2019). Following this approach, it would be an interesting next step to examine how task-based functional connectivity differs in individuals who experience different levels of self-concept clarity and struggle with matching their self-views to a suitable future education.

Implications for practice

The findings in this thesis provide important practical implications on the individual as well as societal level. First, the results highlight that during late adolescence, various aspects of self-concept such as self-esteem, self-concept clarity and social self-evaluations can be enhanced through training and, in turn, can help adolescents with their social adjustment and academic performance in higher education. These results were obtained with an existing structured self-concept training program (the Gap Year program) which takes place within a gap year context after high school. Although the Gap Year program has beneficial effects for adolescents' self-concept development and future orientation, which was recently confirmed in a report of the independent research institute Noorda & Co (2019), participation in such a program that operates independently from high school can be very expensive (e.g. costs for the 10-month program are € 9000). To avoid these costs and make the benefits of a program such as the Gap Year program more easily accessible to a larger group of adolescents and at an earlier stage, I recommend schools to invest more in the self-concept development of students already within the high school years. This idea resonates well with suggestions from other educational researchers who indicate that within the high school curriculum there is currently a lack of attention to "advanced skills". These are skills, attitudes or knowledge that can contribute to personal wellbeing and are important for students' futures (e.g. social competence, planning, problem solving, self-esteem and self insight;(Chatterjee Singh & Duraiappah, 2020; Dutch Ministry of Education, 2016). In the Brain & Development Research center, we already took a first step in broadening the knowledge and skills of young people by developing course material for elementary and secondary education that targets topics that are not normally covered within the normal school curriculum, such as self-concept development (see http://breinkennisleiden. nl/onderwijs .With these course materials, we aim to increase adolescents' awareness

of their own self-concept. This is achieved by, for example, stimulating adolescents to explore together with their classmates how others can influence their self-concept and think about which domains of self-concept matter most to them and why. Ultimately, this attention to self-concept development together with other advanced skills such as future-oriented planning could be incorporated within the curriculum such that it becomes a structural element within high school education. Together, stimulating adolescents to actively reflect on both who they are now and who they aspire to be could help to increase adolescents' self-insight and thereby their chances of finding a suitable major in higher education.

Lastly, it is important to note that in this thesis "making the wrong choice for a future education" is approached as something that should be avoided, as findings showed that experiencing difficulties with this decision-making process or failing to find a suitable major was associated with unfavorable measures such as low self-esteem or self-concept clarity. However, is choosing a major that turns out to not be the right fit something that should necessarily be perceived as bad? With adolescence being a phase of uncertainty and exploration (Becht et al., 2016), it could be argued that trying multiple options and sometimes failing them is part of normative adolescent development and these experiences can function as a learning opportunity and are important for informing and updating someone's self-concept. Currently however, the Dutch educational system is not set up to support this kind of explorative behavior. For example, adolescents are expected to make important educational choices with long-term consequences already in an early stage of high school, as by the third grade of secondary education 14-year-olds already need to decide on a selection of subjects that exclude the option of some study programs later on. In addition, the current Dutch student loan system discourages the possibility to explore options or switch between programs in higher education. Instead, it increases the pressure for adolescents to make the "right" decision for their future straight away, as dropping out or switching between programs can come with significant financial costs. Indeed, a recent study from the research institute Motivaction examining the relation between the student loan system and students wellbeing indicated that the loan system increased students feelings of stress, worry, and pressure to achieve and finish their study in time (van Vreden & Thijssen, 2019). Together, these educational policies pressure adolescents into making the right decision about their academic future from a very young age on, without much room to change paths. This limits further exploration and could increase stress around the process of future educational-decision making which both can go hand in hand with negative outcomes such as low self-esteem and self-concept clarity. Changing these systems by giving adolescents more time and tools to develop their self-concept and make it more acceptable and feasible to explore or switch between programs could possibly help to reduce these negative outcomes.

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Concluding remarks

In conclusion, this thesis generates novel insights into the role of self-concept as a complex and multifaceted construct within the context of future-oriented educational decision-making. The findings highlight that adolescence is an important period for self-concept development, that is characterized by an increased sensitivity to the social environment. Although this sensitivity can lead to more negative self-evaluations, it importantly can also function as an *opportunity* to stimulate adolescents' self-concept development. Ultimately, this may help adolescents to accomplish their future educational goals, or, in other terms, find their "*future me*".