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The Role of Metacognition in the Relationship between Neurocognitive Abilities and Identity Coherence

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Abstract

Objective: Adolescence represents a critical period for identity development, which is influenced by both cognitive and metacognitive processes. Executive functions are considered a crucial component of metacognitive skills and are suggested to support the process of forming and integrating parts of one's identity, also called identity consolidation. This study examined whether executive functioning ability predicted identity consolidation, and whether metacognitive ability mediated this relationship. *Method*: First-year psychology students performed neurocognitive tests (Trail Making Test, Task Switch Test, N-Back Verbal, Stroop Interference Test) and completed two questionnaires assessing metacognitive skills (Metacognitive Awareness Inventory, MAI; Self-reflection and Insight Scale, SRIS). Consolidated identity was assessed using the questionnaire Self-Concept and Identity Measure (SCIM). Finally, a multiple regression mediation analysis was conducted with the PROCESS macro in SPSS. *Results*: Findings revealed no significant direct effects of executive functioning ability on consolidated identity. Metacognitive ability, assessed separately with the MAI and the SRIS, did not significantly mediate this relationship. However, a positive significant association was found between metacognitive ability and consolidated identity, when measured with the MAI, but not the SRIS. *Conclusions*: Overall, our hypotheses were not confirmed. Nevertheless, the positive association found between metacognitive ability, assessed with the MAI, and consolidated identity indicates that certain metacognitive components may still contribute to maintaining a stable sense of identity. It is important to note that this study had several limitations, including measurement constraints, methodological differences, and potential context-dependent influences on cognitive and

metacognitive assessment. Consequently, future research should focus on assessing more targeted measures and further exploring this three-way relationship.

Keywords: adolescents; executive functions; metacognition; consolidated identity.

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Defining and Exploring Identity

Identity is a broad concept that fundamentally answers the question "Who am I?". To capture the different ways in which individuals define themselves, Sedikides and Brewer (2001) distinguished three components of identity: personal, relational, and collective identity. Personal identity refers to an individual's goals, values, beliefs and all events that have happened in their life until now. Relational identity describes an individual's role in relation to their surroundings. And lastly, collective identity refers to an individual's identification with groups and social categories. For an individual, not every characteristic or domain of identity is of equal importance. Rather, an individual's self-perception is shaped by those characteristics or domains that are most important to them (Stryker & Serpe, 1994). Making sense of all these aspects of the self can be challenging, especially during developmental periods marked by change and uncertainty, such as adolescence. Adolescence can be defined as a developmental stage characterized by rapid biological, cognitive and social changes, during which individuals begin to reflect on who they are and what they want to achieve (see Crocetti, 2017, for a review). According to Erikson's (1968) lifespan theory of development this stage represents a central psychosocial crisis in which adolescents face the task of integrating various aspects of the self into a coherent whole, called 'identity versus role confusion'. During this process of identity integration, individuals must form a stable sense of self over time (Dunkel & Sefcek, 2009). Elements such as memories, social roles and capacities represent different parts of one's personal, relational, and collective identity (Sedikides & Brewer, 2001). Commitments, in turn, reflect the degree to which certain elements of the self become central to a coherent identity, shaping the overall process of identity integration (Syed & McLean, 2016; Van Hoof & Raaijmakers, 2003). However,

before such integration can occur, adolescents must first explore and evaluate various options prior to making a commitment. This process, known as identity exploration, helps individuals determine which values, goals and roles align most closely with their developing sense of self. Although identity development begins in adolescence, it often continues into emerging adulthood. As Arnett (2014) confirms, the process of identity achievement almost never reaches its endpoint by the end of high school but persists into the late teens and twenties. During this period, young people gain greater autonomy as parental influence decreases, allowing for deeper exploration and self-definition (Crocetti et al., 2008).

Building on Erikson's theory, research by Lodi-Smith et al. (2017) further clarifies how this sense of coherence develops by focusing on the concept of self-concept clarity. Their study examined how self-concept clarity evolves across adulthood in relation to changes in personality traits and role engagement. They provide a more detailed definition of self-concept clarity, describing it as the extent to which individuals possess a stable and well-defined understanding of who they are, which reflects the degree of certainty and coherence in their identity. This concept aligns with Erikson's (1968) view of identity development, wherein adolescents navigate the critical stage of 'identity versus role confusion' to achieve a stable and coherent sense of self. Thus, achieving self-concept clarity over time indicates psychological maturity and a stable sense of self.

To further specify how individuals reach such clarity, Marcia (1966) elaborated upon Erikson's framework by introducing the identity status model. This model captures individual differences in the processes of exploration and commitment that underlie identity development. Depending on the extent to which adolescents engage in these processes, they can be categorized into one of four identity statuses, ranging from diffusion to achievement. These statuses are dynamic rather than fixed, as they may shift over time in response to various personal and contextual factors. While exploring their identity, adolescents may

encounter inconsistencies between various self-aspects or roles. Although some inconsistencies do not necessarily lead to internal conflict, they may evoke tension or confusion about one's sense of self when not successfully integrated. Adolescents manage their commitments to these self-aspects in two key ways: through in-depth exploration, in which they continuously monitor and reflect on their current commitments to maintain and clarify them, and through reconsideration, in which they compare existing commitments with alternatives and decide whether changes are needed (Meeus et al., 2012). Research of Meeus et al. (2012) suggests that these processes may have some implications for identity development. Commitment appears to be a strong indicator of positive identity development and is associated with a clear and stable self-concept. Furthermore, commitment is associated with lower levels of depression and anxiety symptoms, highlighting its role in promoting well-being. In contrast, in-depth exploration, referring to the active reflection on existing commitments, is negatively related to self-concept clarity and emotional stability. Finally, reconsideration of commitment, defined as the process of questioning or changing one's current commitments, is negatively associated with self-concept clarity and strongly related to both internal and external psychosocial problems.

Beyond these internal processes, adolescents' identity development is also shaped by external and contextual factors. Although identity exploration lays the foundation for a coherent identity that can later be consolidated through commitment, it can also evoke feelings of confusion and distress when individuals experience uncertainty about their identity, core beliefs and values (Côté, 2000; Luyckx et al., 2008). Moreover, unexpected life events can further interfere with identity formation and integration. Berntsen and Rubin (2004) identify a life script as "a normative developmental sequence across adulthood in most western countries" (p. 1982), that may include events such as marrying, becoming a parent or retiring, which are expected but still potentially challenging. In contrast, unexpected events

such as childhood trauma, the acquisition of a disability, or mental illness can be especially disruptive to identity continuity. Therefore, both expected and unexpected events across an individual's lifespan can affect mental health and psychosocial functioning (Mitchell et al., 2021).

Building on this, Merrill et al. (2016) emphasize that the way individuals interpret and integrate such life events into their life story is crucial for identity development and well-being. Individuals who form negative self-event connections when reflecting on stressful experiences tend to experience greater psychological and identity distress. Conversely, those who construct positive self-event connections report higher levels of psychological growth and stronger identity exploration and commitment. Interestingly, individuals experiencing identity distress often engage in more exploration but display lower commitment, suggesting an ongoing struggle with identity issues that can generate distress and foster personal growth at the same time. These findings indicate that when individuals successfully integrate their commitments and manage exploration effectively, they are more likely to achieve a coherent and stable self-concept. This process results in what is often referred to in the literature as a consolidated identity (Harter et al., 1997; Erikson, 1968). Feelings of self-coherence are the core of a consolidated identity, enabling individuals to behave consistently across situations, adapt to changing circumstances and pursue life goals. Moreover, a consolidated identity has been shown to support the formation of enduring relationships and overall-well being (Marcia, 1994; Mitchell et al., 2021).

The Role of Metacognitive Abilities in Identity

A coherent sense of identity not only guides who we are but also shapes how individuals navigate daily life and make decisions. Effectively managing challenges in this context requires metacognitive skills, which enable individuals to reflect on and regulate their own thinking and behaviour. According to Heyes et al. (2020) metacognition comprises

processes that involves the deliberate use of our working memory to monitor, evaluate and control cognitive processes. This enables someone to express either confidence or doubt in their perceptions, memories and decisions. Consequently, individuals are constantly reflecting upon themselves and their surroundings to better understand their experiences and their understanding of the world around them (Moritz and Lysaker, 2018). Two key components of metacognition are particularly relevant for identity exploration: knowledge of cognition and regulation of cognition (Spada et al, 2010; Batha & Caroll, 2007). Knowledge of cognition entails the knowledge an individual has of one's thoughts, capabilities and strategies. How one uses this knowledge, depends on the situation. Instead, regulation of cognition is associated with higher cognitive functions that include planning, evaluating and monitoring activities. These higher cognitive functions not only enable cognitive control in decision-making but also support the reflection and integration of experiences into a coherent sense of self. Balconi et al. (2023) suggest that, once individuals are aware of their own mental processes when regulating their attention, they can apply strategies to improve these processes if needed. Controlling and regulating your attention when making decisions is important for individuals to respond to novel and complex environmental demands (Balconi et al., 2005; Balconi et al., 2020; Koriat, 2015). From this perspective, metacognition contributes to resilience, enabling individuals to sustain meaningful relationships, making autonomous decisions and maintaining stability in their self-concept, despite environmental pressure. This view aligns with Marcia's (1994) observations on the role of self-coherence in navigating challenges in daily life.

In addition to shaping who we are, navigating daily challenges and decision-making, the role of metacognition is further examined in relation to identity by Yan & Oyserman (2018). According to Yan & Oyserman (2018), who discuss the identity-based motivation theory, it is evident that metacognition relates to identity. This theory is defined as "a social psychological

theory of motivation and goal pursuit that explains when and in which situations people's identities motivate them to take action toward their goals" (Yan & Oyserman, 2018, p. 4). These authors state that the overlapping constructs of self, self-concept and identity are important within this theory. The self is most important in relation to metacognition because this is the construct where individuals think about themselves and reflect upon what they are actually thinking. Just as Heyes et al. (2020) have stated earlier, individuals try to monitor, evaluate and control their own cognitive processes as effectively as possible. Then, an individual creates multiple concepts of themselves and with these concepts their identity is formed. So, taken together, all existing self-concepts are embodied in someone's identity and can be reflected upon. Yet, different social roles, relationships and memberships in groups all elicit different traits and characteristics (Oyserman et al., 2012). To elaborate, this suggests that people use their sense of identity to make meaning of situations and behave in a certain way. Moreover, this theory suggests that someone's sense of identity is shaped by something that is called a readiness component. The readiness component suggests that individuals interpret and respond to life events based on their self-concept and cognitive abilities (Oyserman et al., 2012). This connects to previously described research showing that both expected and unexpected events can challenge identity formation and provoke uncertainty or distress (Berntsen & Rubin, 2004; Côté, 2000; Luyckx et al., 2008; Mitchell et al., 2021). Metacognitive skills help individuals reflect on and regulate their responses, supporting the integration of these experiences into a coherent and resilient sense of self.

Alongside the regulatory and reflective aspects of metacognition outlined by Yan & Oyserman (2018), empirical evidence further supports the role of metacognitive processes in identity exploration. Holm et al. (2020) examined the interplay between narrative identity, metacognition and well-being. According to McAdams (1996), narrative identity refers to the story people create about themselves based on past experiences, present life and future goals

in a way that gives their life meaning and purpose. This construct highlights how individuals develop a coherent and psychologically integrated sense of self over time. Holm et al. (2020) found that narratives rich in agency themes were associated with enhanced metacognitive abilities, lower hopelessness and higher self-esteem. Notably, agency predicted hopelessness independently of metacognitive skills, suggesting that personal narratives contribute uniquely to well-being and the development of a coherent and resilient sense of self. Taken together, these findings indicate that both metacognitive skills and narrative processes are central mechanisms through which individuals monitor, evaluate and integrate their experiences, ultimately shaping the development of a stable and meaningful sense of self.

Executive Functions as a Core Component of Metacognitive Abilities

Having discussed the role of metacognitive abilities in identity exploration, it is essential to examine executive functions, the core cognitive processes that underpin these abilities. As highlighted earlier, adolescence represents a period in which individuals engage in identity integration and experience many cognitive, emotional and social challenges. These difficulties primarily arise in adolescence, since this period involves significant maturation of the brain, especially in regions supporting executive functioning (Welsh, 2001; Mairon et al., 2023). The transition from childhood to adulthood is accompanied by substantial changes in brain structure and function, with the frontal brain regions, particularly the prefrontal cortex, undergoing rapid development. Cognition is a multifaceted structure that encompasses several interrelated domains, including complex attention, executive function, learning and memory, language, perceptual-motor abilities, and social cognition (American Psychiatric Association, 2013). These domains are interrelated in a way that they dynamically interact and influence one another, rather than operating in isolation. From around the age of fourteen, adolescents develop executive skills that involve higher-order neurocognitive processes, such as planning, decision-making, working memory, responding to feedback/error correction, overriding

habits/inhibition and mental flexibility (American Psychiatric Association, 2013). Mental flexibility, in particular, allows individuals to adapt to changing circumstances while maintaining a coherent sense of self, highlighting the role of executive functions in supporting metacognitive processes (Kukla & Lysaker, 2020). Executive skills not only enable effective management of complex tasks and decision-making (Roebers, 2017), but also form the neurocognitive foundation of metacognitive processes, allowing individuals to monitor, evaluate and regulate their own thinking and behaviour. Moreover, Erikson (1986) emphasized that successful identity integration not only relies on executive skills, but also requires additional cognitive capacities, such as introspection and reality testing. These capacities enable adolescents to reflect on themselves and evaluate their experiences. Consequently, this maturation of executive functions during adolescence supports identity development and helps individuals navigate through identity- and role-related challenges (Erikson, 1968). Thus, this period is characterized by both the cognitive growth associated with higher-order functions and the developmental tasks inherent to forming a coherent sense of self (Dörrenbächer-Ulrich et al., 2023). In addition to these neurocognitive capacities, individual differences in intrinsic motivation, such as a 'high need for cognition', further facilitate identity formation. Individuals with a high need for cognition actively seek, process and reflect on information about themselves and their environment, which has been linked to more identity development and greater self-concept clarity (Pilarska, 2017; Cacioppo & Petty, 1982; Berzonsky & Sullivan, 1992; Njus & Johnson, 2008; Campbell et al., 1996).

Consequently, it becomes clear that executive functions play a crucial role in identity development. Research indicates that deficits in executive functioning are associated with disorganisation, poor planning, and impaired decision making, which can limit self-agency and hinder the formation of a coherent sense of self (Shalala et al., 2020). Conversely, higher levels of metacognitive skills related to executive functioning, such as working memory,

planning, organisation and coordination, support identity exploration and reduce identity diffusion (Welsh & Schmitt-Wilson, 2013). Together, these findings suggest that well-developed executive functions enable individuals to navigate cognitive and behavioural challenges effectively, ultimately contributing to a coherent and resilient sense of identity.

To summarize, the reviewed literature addressed here highlights the central role of forming and maintaining a stable sense of identity in the light of both cognitive and metacognitive processes. While previous studies have demonstrated that executive functioning could play an important role in identity development, other evidence suggests that metacognitive abilities may be equally essential. Namely, these skills allow individuals to monitor, evaluate, and regulate their thoughts in relation to their self-concept. However, the extent to which metacognitive processes explain the link between executive functioning and identity coherence remains unclear. Therefore, the present study aims to examine the role of metacognition in this relationship. Specifically, it is hypothesized that higher metacognitive abilities and executive functioning abilities are both positively associated with a consolidated identity. Moreover, it is expected that executive functioning ability is a core component of metacognition, thus mediating the relationship between executive functioning ability and a consolidated identity. Accordingly, a mediation analysis will be conducted to examine this three-way relationship.

Method

Participants

The total sample included 74 participants, of whom 27 identified as male (36.5%), 46 as female (62.2%), and 1 as other (1.4%). These participants had a mean age of 21.08 years (*SD* = 2.03, *N* = 74), with ages ranging from 19 to 28 years. Participants represented diverse ethnic backgrounds. Recruitment was primarily conducted via the SONA participant pool, an online platform where students can earn credits for participation in (lab-)studies as part of their practicum course. Specifically in our study, students received 3.4 credits for participation. In addition to recruitment via SONA, recruitment was conducted through WhatsApp messages, campus flyers, and social media platforms. Thus, the study relied on a convenience sample where participants were self-selected. Ethical approval was obtained from the Ethical Committee of the Faculty of Social and Behavioural Sciences at the University of Groningen prior to participant recruitment.

Procedures

The present study was part of a larger longitudinal project investigating (meta)cognitive and identity-related processes over time. For the current analyses, only baseline data were used. All participants were invited to come to a laboratory to complete questionnaires and cognitive tests online via a computer, except for one questionnaire, which was administered using paper and pencil. Upon arrival at the laboratory, participants received an information letter with additional information about participation and confidentiality. Participants were informed that the study was conducted in the field of clinical neuropsychology and examined the relationship between social- and neurocognitive abilities, metacognition and identity, with a maximum duration of 2.5 hours. This information was also presented via SONA. Socio-demographic information (such as age, gender and education level), questionnaires on mental

health and well-being, (meta)cognition and identity, and social- and neurocognitive performances were administered.

Informed consent and questionnaires were completed in Qualtrics (https://www.qualtrics.com), an online platform with tools to create surveys, collect data and analyse results. SONA participants signed up within the designated environment, whereas non-SONA participants registered online through Qualtrics. The order of tasks was counterbalanced across participants, with six different task sequences created to ensure randomization. Participants first completed the Social Identity Mapping Interview. After this paper-and-pencil task to identify social identities, all remaining questionnaires and cognitive tests were administered according to the assigned task sequence until all measures were completed. All cognitive tests were administered using the Vienna Test System (VTS; Schuhfried, 2013). The VTS is an assessment platform that offers a wide range of (neuro)psychological tests. This system allows digital administration, scoring and management and is used to objectively measure cognitive abilities. Finally, only the questionnaires and tests that were used and are relevant for this thesis are described below in more detail.

Measures

Metacognition

Metacognitive Awareness Inventory (MAI). The MAI (Schraw & Dennison, 1994) consists of a total of 52 items that are measured on a true or false scale and is developed to assess metacognitive awareness. Items are divided into eight different subscales including declarative knowledge, procedural knowledge, conditional knowledge, planning, comprehension monitoring, information management, debugging strategies and evaluation. An example item is “I ask myself if there was an easier way to do things after I finish a task.” Responses were quantified by scoring each item as 1 (true) or 0 (false), and item scores were

summed to obtain a total score, with higher scores indicating greater metacognitive awareness. Subscale scores were calculated by summing items within each subscale. Previous research has reported high internal consistency for the total scale and its subscales, with Cronbach's alpha ranging from .88 to .93 (Schraw & Dennison, 1994).

Self-reflection and Insight Scale (SRIS). The SRIS (Grant, 2001) consists of a total of 20 items that are measured on a 1-7 Likert scale (1 = strongly disagree, 7 = strongly agree) and is developed to measure self-reflection (SRIS-SR) and insight (SRIS-IN). Items are divided into three different subscales including insight, need for reflection and engagement in reflection. An example item is "I am often confused about the way that I really feel about things." Responses ranged from 1 to 6 and were quantified by summing items within each subscale, with higher scores indicating either greater self-reflection or insight, depending on the subscale. In addition, some items needed to be recoded, since these were negatively phrased. For the SRIS, this applied to items 1, 2, 4, and 7 on the self-reflection subscale, as well as items 14, 16, 17, 18, and 19 on the insight subscale. Previous research has reported high internal consistency for the two SRIS subscales, with Cronbach's α = .91 for the self-reflection subscale (SRIS-SR), and Cronbach's α = .87 for the insight subscale (SRIS-IN) (Grant, 2001).

Identity

The Self-concept and Identity Measure (SCIM) (Kaufman et al., 2014) is a brief, dimensional, self-report measure of healthy and disturbed identity. The SCIM consists of a total of 27 items that are measured on a 1-7 Likert scale (1 = strongly disagree, 7 = strongly agree). This questionnaire was developed to measure aspects of disturbed identity, consolidated identity and lack of identity. An example item is "I am complete when I am with other people." Responses ranged from 1 to 7 and were quantified by summing items within each subscale, with higher scores indicating greater identity disturbance for each subscale.

However, because we are interested in consolidated identity, all items within the consolidated identity subscale were recoded so that higher scores reflect greater consolidation. The same procedure was applied to disturbed identity and lack of identity, the two other subscales. Finally, in all subscales, negatively phrased items were recoded to allow meaningful interpretation. Previous research has reported excellent internal consistency for the SCIM as a whole ($\alpha = 0.89$), as well as for its three subscales: disturbed identity ($\alpha = 0.84$), consolidated identity ($\alpha = 0.73$), and lack of identity ($\alpha = 0.87$) (Kaufman et al., 2014).

Executive Functions

As mentioned in the procedures, all cognitive tests were administered using the Vienna Test System (VTS; Schuhfried, 2013). Executive functioning ability was assessed using the Trail Making Test (TMT - Langesteinbach version), the Task Switch Test, the N-Back Verbal (NBV) and the Stroop Interference Test. Finally, the Groningen Effort Test (GET) is administered to assess implausible attention performance.

Trail Making Test (TMT – Langesteinbach version). The TMT is a maximum performance speed test that consists of two parts. Part A measures visual scanning and information processing speed. Part B measures more complex visual scanning and mental flexibility. During this test, the participant completes both part A and B after each other. In part A, the participant needs to connect numbers ranging from 1-25 in ascending order. In part B, the participant needs to connect numbers again (1-13), however these numbers need to be connected to letters (A-L) (e.g., 1-A-2-B-3-C). Both these parts are to be completed as fast and accurate as possible. An individual's performance is based on the time in seconds required to complete each part. In addition to the completion times for part A and part B, both the difference score (B-A) and the quotient score (B/A) were calculated as indicators of executive functioning ability, specifically reflecting cognitive flexibility. Overall, the task comprises of 2 trials, part A and B, with a total duration of approximately 2 minutes per trial.

Task Switch Test. The Task Switch test is a test that measures flexible task-switching as an aspect of executive functioning ability. During this test, circles and triangles are shown in either a light or dark grey colour. The participant reacts to the shape or the brightness of the figure that is presented by pressing on the appropriate button. Rules within a trial differ from each other in a way that sometimes the participant has to react to the brightness of the figure and sometimes the participant has to react to the shape of the figure. The task rules are switched after every two stimuli, resulting in a change in task condition. Thus, the participant has to switch between different rules, requiring task-switching and cognitive flexibility. An individual's performance is based on their mean reaction time for shift and repetition tasks, in seconds. In addition to reaction times, task switching accuracy (repeat - switch) was calculated as the difference between the percentage of correct responses on repetition and switching trials, providing a measure of executive functioning ability, specifically cognitive flexibility. Overall, the task comprised 160 stimuli and had a total duration of approximately 12 minutes.

N-Back Verbal (NBV). The NBV is a working memory test that measures cognitive control, requiring participants to hold and update information in mind. In the 2-Back version used in this study, participants pressed a specific button as quickly as possible whenever the consonant on the screen matched the one presented two trials earlier (e.g., in the sequence V – T – R – **V** – N – **V**, the second V requires a response). An individual's performance is based on the number of incorrect reactions, number of missed reactions, and the mean time of both these reactions. In addition, the variable N-Back Verbal, verbal working memory (NBVVWM) is based on the number of correct responses and reflects the efficiency of updating processes within verbal working memory. Higher scores indicated better performance and served as a measure of executive functioning ability. Overall, the task comprised of 100 stimuli and had a total duration of approximately 6 to 7 minutes.

Stroop Interference Test. The Stroop Interference Test is a sensorimotor speed test that measures speed under conditions of colour and word interference and provides information on the participant's information processing and attentional control. The procedure consists of four phases that are completed right after each other. During the first phase, different words (RED, GREEN, YELLOW, BLUE) in a grey colour are presented on the screen. The meaning of the word needs to be indicated as accurate and as fast as possible. The participant will press on the corresponding coloured button on the assigned keyboard. During the second phase, banners that are printed in different colours (RED, GREEN, YELLOW, BLUE) will appear on the screen. Again, the participant will press on the corresponding coloured button on the assigned keyboard, as accurate and as fast as possible. During the third phase, the words (RED, GREEN, YELLOW, BLUE) will appear in mismatched ink colours on the screen (e.g., RED printed in green ink). The participant then needs to indicate the meaning of the word by pressing on the corresponding coloured button and ignore the colour of the ink. In the fourth phase, the appearance of the words is the same, however now, the participant needs to indicate the colour of the ink by pressing on the corresponding coloured button and ignore the meaning of the word. Individual performance was quantified using two interference scores. Reading interference was calculated as the difference between the mean reaction time in the colour-word condition and baseline word reading. Naming interference was calculated as the difference between the mean reaction time in the colour-ink condition and baseline colour naming. All reaction times were measured in seconds. Positive scores therefore reflect increased interference and greater difficulty with attentional control and were used as indicators of executive functioning ability. Overall, the task comprised of 128 stimuli for each test part, with a total duration of approximately 10 to 15 minutes.

Groningen Effort Test (GET). Lastly, the Groningen Effort Test (GET) was administered. This test is a symptom validity test that measures implausible attention

performance. During this test, two figures are shown simultaneously. The participant is asked to indicate whether the simple target figure can be found in the complex figure, which consists of multiple lines. This test is developed to find out if participants deliberately feign cognitive impairments. However, we used this test to check whether participants completed the tests and questionnaires seriously. This is particularly important in our context, given that recruitment took place through the SONA-pool. With an index score of > 1, there is an indication of noncredible performance. If this is the case, we will carefully consider if it is needed to remove these participants from the sample. An individual's performance is based on their response time per stimulus and the number of errors per quarter. Overall, the task comprised of approximately 96 items, divided into four blocks of 24 items each. The test has a duration of approximately 10 minutes.

Analysis Plan

To test the proposed hypotheses, a mediation model will be analysed using multiple regression analysis. In this model, executive functioning is specified as the independent variable (predictor), consolidated identity as the dependent variable, metacognition as mediator and gender as covariate. The hypotheses are as follows:

H1: Better performance on tasks measuring executive functioning ability is positively related to a consolidated identity.

H2: Better performance on tasks measuring executive functioning ability is positively related to metacognitive processes.

H3: Metacognitive processes are positively related to a consolidated identity.

H4: Metacognitive processes positively mediates performance on tasks measuring executive functioning ability and experiencing a consolidated identity.

To prepare the data for the use of further analyses, data is checked for missing values, outliers and implausible responses. One participant is excluded because some of the Stroop

Interference test data is incomplete due to equipment malfunction. Outliers are identified using z-scores. If a data point has a z-score greater than 3 or less than -3, it can be considered an outlier. To visually support this outcome, a box plot is displayed.

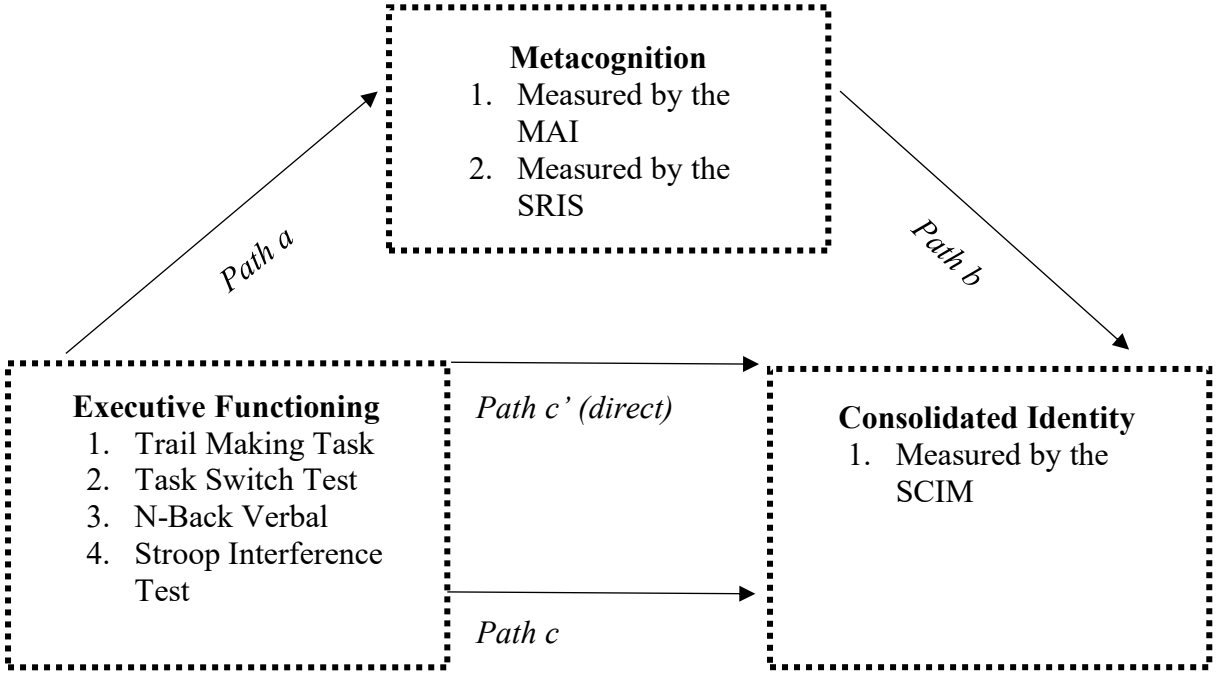
Descriptive statistics (*N*, mean, standard deviation, minimum, and maximum) are calculated and Pearson's correlations are used to examine initial relationships between the variables. If sufficiently correlated, composite scores for executive functioning ability and metacognition are computed, otherwise individual tests will serve as separate predictors and individual questionnaires as mediators for consolidated identity.

Before conducting a multiple regression analysis, relevant assumptions are checked. First, normality of the residuals is assessed to confirm that residuals are normally distributed, with a Q-Q plot and a Shapiro-Wilk test used to check this. The Q-Q plot is visually examined, whereas the Shapiro-Wilk test calculates a statistic, W, which ranges from 0 to 1. A value closer to 1, $W > 0.5$, suggests that the data is normally distributed. Second, the assumption of linearity, which requires a linear relationship between each predictor and the outcome, is visually inspected using scatterplots. Third, homoscedasticity, which assumes that the residuals have constant variance across all levels of the predicted values, is checked using residual plots for patterns indicative of heteroscedasticity. Fourth, independence of residuals is checked using the Durbin-Watson test, with a value around 2 indicating acceptable independence. Finally, multicollinearity, or lack of independence among predictors, is assessed using the variance inflation factor (VIF), with values below 10, and optimally below 5, indicating acceptable levels. Given that all predictors measure aspects of executive functioning, some degree of multicollinearity is expected, which supports the calculation of a composite executive functioning ability score. Finally, possible influential outliers are checked using Cook's distance, with values greater than 0.5 indicating that a case may have an influential influence on the model and should be further examined.

The PROCESS macro, a plugin for SPSS designed by A. Hayes, is used to perform the mediation analysis. Model 4 is used for simple mediation to test both direct and indirect effects. Separate analyses are conducted for each predictor and mediator combination, resulting in a total of eight analyses (see Figure 1 for a visual representation). Conceptually, the analyses correspond to the hypotheses as follows: H1 tests the direct effect of executive functioning on consolidated identity (path c), H2 tests the effect of executive functioning on metacognition (path a), H3 tests the effect of metacognition on consolidated identity (path b), and H4 tests the indirect effect of executive functioning on consolidated identity through metacognition (a × b). The direct effect after accounting for the mediator (path c') represents the remaining association between executive functioning and consolidated identity, independent of the mediating influence of metacognition. The results of these analyses are interpreted using standardized coefficients and R^2, and the mediation effect is assessed by testing the indirect effect of executive functioning on consolidated identity through metacognition using 95% bootstrap confidence intervals (CIs).

Figure 1

Metacognition as a Mediator between Executive Functioning and a Consolidated Identity



Results

Descriptive Statistics

Descriptive statistics for the administered executive functioning tests and questionnaires are respectively presented in Tables 1 and 2.

Intercorrelations Executive Functioning

Intercorrelations between the cognitive tests used for measuring executive functioning, namely the Trail Making Test, Task Switch Test, N-Back Verbal, and Stroop Interference Test are presented in Table 3. Overall, the results do not support our initial expectation of finding an association between the different cognitive tests to account for conceptual overlap. However, some noteworthy correlations between different conditions of multiple tests were found. First, we found a significant positive association between the Task Switch Test, speed condition and the Stroop Interference Test, reading interference condition (r = 0,298, p = 0,010). Second, we found a significant negative association between the N-Back Verbal, verbal working memory condition and the Trail Making Test, difference B-A condition (r = -0,253, p = 0,029).

Intercorrelations Metacognition

Intercorrelations between the questionnaires used for measuring metacognition, namely the MAI and the SRIS, are presented in Table 4. Overall, the results do not support our initial expectation of finding an association between the total score of the MAI and the SRIS (r = 0,077, p = 0,512). This indicates limited conceptual overlap and therefore it is not possible to calculate a composite score. As expected, strong positive correlations are observed within each instrument. Beyond these expected associations, a significant positive correlation was found between the SRIS self-reflection subscale and the MAI regulation of cognition subscale (r = 0,235, p = 0,044). This suggests a potential conceptual link between certain aspects of the two questionnaires.

Table 1

Descriptive Statistics Executive Functioning Tests

	N	Range	Minimum	Maximum	Mean	Std. Error	Std. Deviation	Variance
TMTDB-A	74	40.21	-5.48	34.73	8.4035	.80465	6.92183	47.912
TMTQB/A	74	1.65	.82	2.47	1.4049	.03953	.34001	.116
TST speed	74	.98	-.35	.63	.18474	.018472	.158899	.025
TST accuracy	74	20	-7	13	2.27	.554	4.767	22.720
NBVVWM	74	8	7	15	13.15	.206	1.773	3.142
Stroop reading	73*	.82	.00	.82	.18653	.013842	.118263	.014
Stroop naming	73	.62	-.01	.61	.11660	.010988	.093882	.009

Note. TMTDB-A = condition 'difference B-A' of the Trail Making Test; TMTQB/A = condition 'quotient B/A' of the Trail Making Test; TST speed = speed condition of the Task Switch Test; TST accuracy = accuracy condition of the Task Switch Test; NBVVWM = condition 'verbal working memory' of the N-Back Verbal; Stroop reading = reading interference condition of the Stroop Interference Test; Stroop naming = naming interference condition of the Stroop Interference Test.

*. One participant was excluded due to equipment malfunction.

Table 2

Descriptive Statistics Metacognition Questionnaires

	N	Range	Minimum	Maximum	Mean	Std. Error	Std. Deviation	Variance
SCIM total score	74	61,00	59,00	120,00	90,2973	1,74331	14,99656	224,897
MAI total	74	35,00	17,00	52,00	36,7973	,88070	7,57606	57,397
MAI KC total	74	11,00	6,00	17,00	12,3784	,34134	2,93632	8,622
MAI RC total	74	28,00	7,00	35,00	24,3649	,65719	5,65340	31,961
SRIS total	74	41,00	59,00	100,00	84,5676	1,04314	8,97345	80,523
SRIS SR total	74	27,00	36,00	63,00	51,4865	,67571	5,81270	33,787
SRIS IS total	74	25,00	22,00	47,00	33,0811	,62609	5,38582	29,007

Note. SCIM total = Self-concept and Identity Measure; MAI total = total score of the Metacognitive Awareness Inventory; MAI KC total = total score subscale knowledge of cognition of the Metacognitive Awareness Inventory; MAI RC total = total score subscale regulation of cognition of the Metacognitive Awareness Inventory; SRIS total = total score of the Self-reflection and Insight Scale; SRIS SR total = total score subscale self-regulation of the Self-Reflection and Insight Scale; SRIS IS total = total score subscale insight of the Self-Reflection and Insight Scale.

Table 3

Intercorrelations Executive Functioning Tests (All sample n = 74)

	1	2	3	4	5	6	7
1. TMTDB-A	-						
2. TMTQB/A	**.92****	-					
3. TST speed	-.09	-.14	-				
4. TST accuracy	.10	-.01	-.00	-			
5. NBVVWM	**-.25***	-.12	.07	-.20	-		
6. Stroop reading	.03	.02	**.30***	-.05	.14	-	
7. Stroop naming	-.09	-.13	-.02	.02	.02	**.27***	-

Note. TMTDB-A = condition 'difference B-A' of the Trail Making Test; TMTQB/A = condition 'quotient B/A' of the Trail Making Test; TST speed = speed condition of the Task Switch Test; TST accuracy = accuracy condition of the Task Switch Test; NBVVWM = condition 'verbal working memory' of the N-Back Verbal; Stroop reading = reading interference condition of the Stroop Interference Test; Stroop naming = naming interference condition of the Stroop Interference Test.

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Table 4

Intercorrelations Metacognition Questionnaires (All sample n = 74)

	1	2	3	4	5	6
1. MAI total	-					
2. MAI KC total	**.80****	-				
3. MAI RC total	**.95****	**.60****	-			
4. SRIS total	.08	-.03	.13	-		
5. SRIS SR total	.17	.04	**.24***	**.82****	-	
6. SRIS IS total	-.06	-.10	-.04	**.78****	**.28***	-

Note. MAI total = total score of the Metacognitive Awareness Inventory; MAI KC total = total score subscale knowledge of cognition of the Metacognitive Awareness Inventory; MAI RC total = total score subscale regulation of cognition of the Metacognitive Awareness Inventory; SRIS total = total score of the Self-reflection and Insight Scale; SRIS SR total = total score subscale self-regulation of the Self-Reflection and Insight Scale; SRIS IS total = total score subscale insight of the Self-Reflection and Insight Scale.

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Mediation Analysis

Before conducting the regression analyses, assumptions were checked and found to be adequately met. As composite scores could not be created, individual tests and questionnaires were used as separate predictors and mediators across the eight models. The results of these analyses show that the direct effect between executive functioning (represented as task 1, 2, 3, & 4; see Figure 1) and consolidated identity is not significant. Similarly, none of the different measures of executive functioning were significantly related to metacognition (represented as questionnaire 1 & 2; see Figure 1). In contrast, metacognition as measured by the MAI significantly predicted consolidated identity, whereas the SRIS did not. The indirect effects of executive functioning on consolidated identity through metacognition were not significant. Thus, no evidence was found for either partial or full mediation. Detailed results of all direct and indirect effects are presented in Table 5 for the MAI as mediator and in Table 6 for the SRIS as mediator.

Table 5

Results Mediation Analysis with the MAI as Mediator

Predictor (EF)	Path a (EF → mediator)	Path b (mediator → outcome)	Indirect effect (a×b, 95% CI)		Direct effect (c', 95% CI)		Total effect (c, 95% CI)	
	b, (*p)*	b, (*p*)	b	[LB, UB]	b, (*p*)	[LB, UB]	b, (*p*)	[LB, UB]
TMTDB-A	-0.07, (.61)	0.22, (**.02***)	-0.01	[-.10, .06]	0.01, (.95)	[-.19, .21]	-0.01, (.94)	[-.21, .20]
TMTQB/A	-1.83, (.48)	0.21, (**.02***)	-0.39	[-2.19, 1.04]	-1.15, (.57)	[-5.20, 2.89]	-1.55, (.46)	[-5.70, 2.61]
TST speed	0.86, (.88)	0.22, (**.02***)	0.19	[-2.31, 2.94]	5.90, (.19)	[-2.95, 14.74]	6.08, (.19)	[-3.04, 15.21]
TST accuracy	-0.11, (.56)	0.22, (**.02***)	-0.02	[-.25, .07]	0.03, (.81)	[-.25, .32]	.01, (.94)	[-.29, .31]
NBVVWM	-0.46, (.36)	0.22, (**.02***)	-0.10	[-.57, .10]	-0.14, (.73)	[-.92, .65]	-.24, (.56)	[-1.04, .57]
Stroop reading	8.37, (.27)	0.22, (**.02***)	1.89	[-2.33, 5.48]	0.31, (.95)	[-11.47, 12.11]	2.21, (.72)	[-9.87, 14.29]
Stroop naming	12.94, (.18)	0.24, (**.01****)	3.15	[-1.87, 10.26]	-8.42, (.27)	[-23.37, 6.54]	-5.27, (.50)	[-20.63, 10.09]

Note. TMTDB-A = condition 'difference B-A' of the Trail Making Test; TMTQB/A = condition 'quotient B/A' of the Trail Making Test; TST speed = speed condition of the Task Switch Test; TST accuracy = accuracy condition of the Task Switch Test; NBVVWM = condition 'verbal working memory' of the N-Back Verbal; Stroop reading = reading interference condition of the Stroop Interference Test; Stroop naming = naming interference condition of the Stroop Interference Test. SCIM = Self-Concept and Identity Measure, used as the outcome variable. Gender was included as covariate in all models. Unstandardized coefficients (b) are reported. LB = lower bound, UB = upper bound of the 95% confidence interval.

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Table 6

Results Mediation Analysis with the SRIS as Mediator

Predictor (EF)	Path a (predictor → mediator)	Path b (mediator → outcome)	Indirect effect (a×b, 95% CI)		Direct effect (c', 95% CI)		Total effect (c, 95% CI)	
	b, (*p*)	b, (*p*)	b	[LL, UL]	b, (*p*)	[LB, UB]	b, (*p*)	[LB, UB]
TMTDB-A	-0.07 (.65)	0.07 (.36)	-0.01	[-.05, .03]	-0.00, (.98)	[-.20, .20]	-0.01, (.94)	[-.21, .20]
TMTQB/A	-3.00 (.32)	0.07 (.40)	-0.21	[-1.29, .52]	-1.34, (.53)	[-5.53, 2.85]	-1.55, (.46)	[-5.70, 2.61]
TST speed	5.72 (.39)	0.07 (.42)	0.38	[-1.01, 2.68]	5.70, (.22)	[-3.49, 14.90]	6.08, (.19)	[-3.04, 15.21]
TST accuracy	.18 (.41)	0.08 (.36)	0.01	[-.04, .09]	-0.00, (.99)	[-.30, .30]	.01, (.94)	[-.29, .31]
NBVVWM	-0.52 (.38)	0.07 (.38)	-0.04	[-.20, .10]	-0.20, (.63)	[-1.01, .62]	-.24, (.56)	[-1.04, .57]
Stroop reading	3.28 (.71)	0.08 (.35)	0.25	[-1.48, 1.98]	1.96, (.75)	[-10.15, 14.06]	2.21, (.72)	[-9.87, 14.29]
Stroop naming	-2.12 (.85)	0.08 (.35)	-0.16	[-3.12, 2.71]	-5.10, (.51)	[-20.48, 10.28]	-5.27, (.50)	[-20.63, 10.09]

Note. TMTDB-A = condition 'difference B-A' of the Trail Making Test; TMTQB/A = condition 'quotient B/A' of the Trail Making Test; TST speed = speed condition of the Task Switch Test; TST accuracy = accuracy condition of the Task Switch Test; NBVVWM = condition 'verbal working memory' of the N-Back Verbal; Stroop reading = reading interference condition of the Stroop Interference Test; Stroop naming = naming interference condition of the Stroop Interference Test. SCIM = Self-Concept and Identity Measure, used as the outcome variable. Gender was included as covariate in all models. Unstandardized coefficients (b) are reported. LB = lower bound, UB = upper bound of the 95% confidence interval.

Discussion

In the present study, we examined the role of metacognition in the relationship between executive functioning and consolidated identity. First, we found that none of the measures of executive functioning were significantly related to consolidated identity. Second, there was no significant relationship between all measures of executive functioning and the two questionnaires of metacognitive processes. Third, we found that metacognitive processes were significantly related to consolidated identity, when measured with the questionnaire MAI, not the questionnaire SRIS. Finally, there was no indirect effect found for the role of metacognition as a mediator on the relationship between executive functioning and consolidated identity.

Executive Functioning and Identity

First, it was hypothesized that executive functioning would be positively related to a consolidated identity. Erikson (1968) already emphasized the importance of introspection and reality testing to form a coherent sense of self. In addition, other research highlighted that higher-order cognitive processes, such as planning, decision-making, working memory and cognitive flexibility are particularly relevant during adolescence, as these skills support the navigation of developmental changes needed for identity integration and formation (Roebers, 2017; Dörrenbächer-Ulrich et al., 2023). Indeed, Shalala et al. (2020) have shown that deficits in executive functioning are often accompanied by disorganization, poor decision-making and reduced agency: all to the detriment of forming an identity. Conversely, stronger metacognitive-related executive skills have been associated with lower levels of identity diffusion (Welsh & Schmitt-Wilson, 2013). However, contrary to these expectations, the present study did not find evidence for a direct effect between executive functioning and identity.

A possible explanation for this lack of evidence for a relationship between executive functioning and consolidated identity concerns the distinction between cognitive processes and identity outcomes. Executive functioning may contribute to identity processes, such as exploration and commitment (Klimstra et al., 2010), which in turn influence the development of identity outcomes, including consolidated, disturbed, or lack of identity as measured by the SCIM. Importantly, the SCIM does not directly assess cognitive components, it simply provides an indication of self-concept and identity as an end product. Consequently, subtle influences of executive functioning on identity processes may not be directly captured by the SCIM, which could explain why no significant associations were observed in the current study.

Furthermore, another explanation concerns the role of contextual factors. Branje et al. (2021) emphasize that identity development during adolescence is shaped not only by systematic maturation and intra-individual processes, but also by social relationships and life events. Independent of higher cognitive abilities, such as executive functioning, these external factors can affect identity formation and consolidation. Although the transition to first-year university represents a major life event, SCIM scores in the present sample ranged from 52 tot 81 (M = 68.08, SD = 5.99), indicating moderate variability in consolidated identity. This suggests that while environmental factors may limit differences between students, there is still sufficient variability to potentially observe associations with executive functioning. This highlights the importance of the social and environmental context when studying identity development, a dimension that our study did not take into account.

Executive Functioning and Metacognition

Second, it was hypothesized that executive functioning would be positively related to metacognitive functioning. Previous literature has highlighted that metacognition heavily relies on executive functions such as working memory, planning and attentional control

(Heyes et al., 2020; Spada et al., 2010; Batha & Carroll, 2007). While metacognition relies strongly on executive functioning, Kukla & Lysaker (2020) emphasize that executive functions are essential for effective metacognitive processes. First and foremost, executive skills enable individuals to regulate their thoughts and decisions, thereby being able to flexibly react to new or complex situations (Balconi et al., 2005; Koriat, 2015). Moreover, awareness and regulation of one's mental processes have been seen as important for being resilient in life. Consequently, this promotes a coherent sense of self, which is essential for navigating through life and its challenges (Marcia, 1994; Moritz & Lysaker, 2018). However, in contrary to these expectations, the present study did not find evidence for a significant relationship between executive functioning and metacognition.

A number of explanations may account for this unexpected finding. First, one important explanation concerns the multifaceted nature of executive functioning. Specifically, according to Miyake et al. (2000) components related to executive functioning, namely inhibition, shifting and updating, are of nonunitary nature, meaning that they do not always operate as a system and can be independently used in various cognitive tasks. Besides, there exists intra-individual variability regarding these components, meaning that some individuals could be better or worse in one or more of these components of executive functioning, reflecting a disbalance in the context of executive functioning. To support this, Wu & Was (2023) found that among college students only one component of executive functioning, working memory updating, highly correlated with metacognitive monitoring. This suggests that unless updating is explicitly assessed, observed associations between executive functioning and metacognition may be weakened. Similarly, Follmer & Sperling (2016) demonstrated that the effect of specific executive functions on self-reported self-regulated learning was mediated by metacognition, highlighting that the impact of executive functioning depends on which components are assessed. However, interestingly, no associations were found between

executive functioning and metacognition in the present study, which raises questions about the factors underlying this unexpected finding.

Second, another important explanation relates to the methods used to assess executive functioning and metacognition. In the present study, executive functioning was assessed with performance-based tasks, whereas metacognition was measured via self-report questionnaires. Research indicates that self-reported metacognitive abilities often only weakly correlate with performance-based measures of executive functions (Craig et al., 2020). This discrepancy may arise because self-report instruments capture an individual's perceived cognitive strategies and reflective tendencies, while performance tasks measure objective cognitive capacities under controlled conditions, which may not fully reflect how these processes operate in real/life or metacognitive contexts. Measuring metacognition is challenging, a so called catch-22, because it relies on individuals' capacity for self-reflection, which is itself influenced by the cognitive processes being assessed, and few reliable performance-based measures exist. As a result, even if executive functioning and metacognition are theoretically related, discrepancies between assessment methods may help explain the absence of observed associations in the present study.

Metacognition and Identity

Then, in line with previous research, metacognitive processes appear to play an important role in the formation and coherence of identity. The identity-based motivation theory (Yan & Oyserman, 2018) and findings from Lodi-Smith (2017) suggest that individuals use metacognition to reflect, monitor, evaluate and integrate different self-concepts, which contributes to a coherent and stable sense of identity. Similarly, research on narrative identity highlights that metacognitive skills support a resilient sense of self (Holm et al., 2020). In the present study, this relationship was partially supported. A significant positive association between metacognition and consolidated identity was found when using the MAI-

questionnaire. However, this was not found when using the SRIS-questionnaire. This discrepancy suggests that the strength of the relationship may depend on some specific aspects of metacognition assessed.

To clarify, the MAI focuses on regulatory aspects of cognition, such as planning, monitoring and adjusting one's cognitive processes, whereas the SRIS focuses more broadly on self-reflection and insight, specifically insight in the clarity of understanding of one's thoughts, feelings and behaviour. The SRIS does not explicitly target regulatory and monitoring processes that are crucial for goal-directed behaviour and decision-making. However, especially these aspects are suggested to be particularly relevant for the formation and maintenance of a consolidated identity. Consequently, the SRIS questionnaire may not effectively assess the skills needed to integrate multiple self-concepts into a coherent and stable sense of identity. Notably, the SRIS subscale self-reflection was positively associated with the MAI subscale regulation of cognition, indicating that reflective tendencies may still support self-regulatory processes (Veenman et al., 2006; Carver & Scheier, 1998). These patterns reveal that the specific focus and operationalization of metacognition in different instruments may measure slightly different constructs, some of which are related to consolidated identity while others are not.

Finally, and in line with the described absence of direct effects in this mediation model, there was no indirect effect found for metacognition mediating the relationship between executive functioning and consolidated identity. As discussed in the introduction, identity formation and maintaining an identity comes with challenges and is particularly vulnerable for change in the time of adolescence. Erikson (1968) proposed that developing a coherent sense of identity is a central task during this period, important for forming stable relationships and future roles. Marcia (1966) elaborated with four identity statuses including diffusion, foreclosure, moratorium, and identity achievement, all based on exploration and

commitment. Given this developmental perspective, it is plausible that a consolidated identity represents a slowly evolving construct that is not yet fully formed within the age range of our sample. This relates to the moratorium status in Marcia's model, where individuals are actively exploring but have yet to commit. Consequently, the processes underlying the formation of a consolidated identity may not be fully captured in a single measurement moment and rather reflect over-time trajectories than static categories (Meeus et al., 2012). This is particularly relevant for first-year university students, who are possibly busy navigating different identity statuses and therefore exhibit some variation in the extent to which their identities are consolidated. Future research should consider longitudinal designs to capture the gradual development of consolidated identity over time and to better assess causal relationships between executive functioning, metacognition and identity. Additionally, using more heterogeneous samples beyond first-year psychology students could increase variability in both environmental experiences and personal growth demands.

Strengths, Limitations, Implications, and Future Directions

This study has several strengths. First, it combined both performance-based measures of executive functioning and self-report questionnaires of metacognition and identity, providing a comprehensive assessment of cognitive and reflective processes. Second, the focus on first-year psychology students allowed us to examine these processes in a population undergoing a critical period of identity development, increasing the relevance of the findings for developmental contexts. Third, the study was theoretically well-grounded with established frameworks of Erikson (1968) and Marcia (1966). Fourth, the study addressed a gap in the literature by exploring the interplay between executive functioning, metacognition and identity coherence in young adults, contributing to new insights for future research.

Despite these strengths, the study is not without limitations. First, a key limitation concerns the measurement of theoretically related constructs. Though conceptual overlap

between underlying constructs that were measured by the cognitive tests were expected, only limited significant relationships were found. The same is true for the questionnaires we used for assessing metacognitive skills. That there was no conceptual overlap found, aligns with the multifaceted nature of executive functioning, where each task measures partly distinct, but overlapping processes. To support this, Mikaye et al. (2000) found that "the intercorrelations among different executive tasks are low (usually $r = .40$ or less) and are often not statistically significant" (Mikaye et al., 2000, p. 52). Similarly, Glisky et al. (2021) found, when comparing young and older adults, that components of executive functioning, such as shifting, inhibition and working memory updating, were weakly correlated in young adults, but more strongly correlated in older adults, suggesting that executive functioning processes operate more independently in younger individuals and become more integrated with age. This may explain the limited overlap observed in our sample and why associations with metacognitive skills were weak or component-specific, consistent with our own findings. Furthermore, the limited consistency may also reflect contextual influences, such as fatigue, motivation or language demands, rather than a true absence of relations. These considerations highlight the need for cautious interpretation. Still, it is important to note that these tasks used are well-validated, suggesting that inconsistencies likely reflect the complexity of measuring executive functioning in practice, rather than flaws in the instruments themselves.

Even though the use of well-validated instruments, their primary purpose is to detect deviations from the norm in clinical settings rather than capturing subtle individual differences in a non-clinical population. In the present study, the use of a highly homogeneous sample of predominantly first-year psychology students further reduced variability, which may have limited the likelihood of finding meaningful associations. Taken together, this suggests that the lack of overlap between tasks reflects both the specific purpose of the instruments and the characteristics of the sample, rather than the absence of shared constructs.

Returning to the observed discrepancy between the MAI and the SRIS, Craig et al. (2020) performed a systematic review that compared different self-report measures of metacognition. Their conclusion revealed that this discrepancy we found could be the result of the nature of self-report measures. Specifically in our case when metacognition is assessed and exists of multiple components, the utility and validity is questioned. While self-report measures of metacognition may reliably assess the two core components of metacognition, knowledge of cognition and regulation of cognition, and an overview of metacognitive abilities could be provided, self-report measures of metacognition should not be used for detailed structural insights. This may be a shortcoming of the SRIS questionnaire, which is mostly based on self-regulation, and less explicitly on knowledge of cognition. To summarize, the use of self-report questionnaires and the conceptual difference in content may offer a possible explanation for the absence of a significant correlation. And with equal importance, the conceptualization of metacognition holds some inconsistencies and there is clarification needed for attaining a unified definition.

Second, all analyses were cross-sectional and therefore, causal relationships cannot be inferred. As a result, the direction of the relationships may differ from how they are discussed in our study. Future research should therefore adopt a longitudinal design, which would make it possible to test these relationships and track how identity dimensions may develop and affect individuals over time.

Third, our sample consisted predominantly of self-selected, first-year psychology students. Thus, the generalizability of our findings is questionable. Future studies should focus on addressing both women and men equally, so that samples are more heterogeneous. Besides, samples should be derived from the general and clinical populations, including participants with lower socioeconomic status. Furthermore, since our measures of metacognition and identity were solely based on self-reports, this may be receptive for biases

such as limited self-awareness or socially desirable responding. Structured interviews could provide us with a more comprehensive assessment of these constructs and personality functioning in general. However, to my knowledge, there is currently no structured interview specifically for assessing metacognition. The STIPO (Structured Interview of Personality Organization; Hörz-Sagstetter et al., 2018), on the other hand, is a validated instrument that can effectively assess personality functioning, including aspects of identity. Therefore, future research should combine both self-report and structured interviews to better capture these processes.

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Appendix

AI Use Declaration

I acknowledge the use of ChatGPT (OpenAI, https://chat.openai.com) to generate materials for background research and self-study in the drafting of this thesis.

AI Use Summary

***AI system used*:** ChatGPT (OpenAI, https://chat.openai.com)

Final prompts used (examples):

1. "Help me phrase a transition between these two sections of my discussion more clearly."
2. "Can you help me find relevant literature on this specific topic?"
3. "Can you help me give alternatives in more formal academic English?"

Use case:

ChatGPT was used to assist with improving the clarity, structure and conciseness of my academic writing.

Modifications:

All AI-generated text was thoroughly revised, rewritten, and integrated with my own arguments and interpretations. No AI-generated content was used without critically editing it. The conceptual ideas, data interpretation, and final phrasing are my own.