Thesis

Introspective Accuracy and Major Depressive Disorder

submitted by

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Declaration of Academic Integrity

I hereby confirm that the present diploma thesis is the result of my own independent scholarly work. I also confirm that in all cases, where material from the work of others (in books, articles, essays, dissertations, and on the internet) is acknowledged, quotations and paraphrases are clearly indicated. No material other than that cited in the reference list has been used. I have read and understood the Medical University's regulations and procedures concerning plagiarism.

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Basel, July 29, 2025 Elena Hanna Maria Reimold m.p.

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Zusammenfassung

Hintergrund

Der Begriff der Metakognition rückt in den letzten Jahren zunehmend in den Fokus der Forschung als Erklärungs- und Therapieansatz psychischer Erkrankungen. Eine Subdomäne der Metakognition ist der Begriff der *Introspective Accuracy*, der die Genauigkeit der Selbsteinschätzung einer Person angibt. Dieser wurde in der aktuellen Forschung insbesondere in Patient*innen mit Schizophrenie und bipolaren Störungen untersucht. In einigen Studien zeigte sich die metakognitive Therapie als vielversprechender Therapieansatz für depressive Störungen. Die Rolle der Genauigkeit der Selbsteinschätzung gilt es dabei, insbesondere in Patient*innen mit depressiven Störungen, weiter zu erforschen.

Methoden

Ziel der Studie ist die Klärung der Frage, wie die Ausprägung der psychiatrischen Symptomatik mit der Genauigkeit der Selbsteinschätzung hinsichtlich kognitiver Funktionen von Patient*innen mit Major Depression zusammenhängt und ob es einen Zusammenhang zwischen der Genauigkeit der Selbsteinschätzung und der Schlafqualität gibt. Die Studie ist Teil des METACOG-Projekts, einem internationalen, von der Stadt Graz geförderten Forschungsprojekt. Es wurden 76 Patient*innen untersucht, die alle eine neurokognitive Testbatterie durchliefen und anhand von Fragebögen zur Symptomatik (Beck-Depression Inventory (BDI-II), Montgomery- Åsberg Depression Rating Scale (MADRS), Brief Symptom Inventory – 18 (BSI-18) und Pittsburgh Sleep Quality Index (PSQI) beurteilt wurden.

Ergebnisse

Korrelationsanalysen und partielle Korrelationsanalysen zeigten, dass es keinen Zusammenhang zwischen der Ausprägung der psychiatrischen Symptomatik und der Genauigkeit der Selbsteinschätzung gibt. Eine stärkere Ausprägung der Symptomatik geht nicht mit einer ungenaueren Selbsteinschätzung im Sinne einer Unterschätzung einher. Dies zeigte sich für die depressive Symptomatik, die Ausprägungen Ängstlichkeit und Somatisierung. Die Analysen zeigten auch, dass es keinen Zusammenhang zwischen der Schlafqualität und der Genauigkeit der Selbsteinschätzung gibt.

Diskussion

Während die Kognitive Leistungsfähigkeit depressiver Patient*innen durch die psychiatrische Symptomatik beeinflusst wird, scheint die Genauigkeit der Selbsteinschätzung dieser nicht mit der Symptomatik oder der Schlafqualität in Zusammenhang zu stehen. Dies zeigt den Bedarf für die weitere Erforschung des Konzepts der Introspective Accuracy selbst hinsichtlich dessen Einflussfaktoren und Bedeutung im Kontext der Psychopathologie grundsätzlich und in Patient*innen mit Major Depression.

Schlüsselwörter: Major Depression, Symptomatik, Metakognition, Introspective Accuracy

Abstract

Background

In recent years, the concept of metacognition has increasingly become the focus of research as an explanatory and therapeutic approach to mental illness. A subdomain of metacognition is the concept of *introspective accuracy*, which refers to the accuracy of a person's self-assessment. This has been investigated in recent research, particularly in patients with schizophrenia and bipolar disorders. In some studies, metacognitive therapy has shown promise as a therapeutic approach for depressive disorders. The role of self-assessment accuracy needs to be further investigated, especially in patients with depressive disorders.

Methods

The study aims to clarify how the severity of psychiatric symptoms is related to the accuracy of self-assessment of cognitive functions in patients with major depression and whether there is a connection between the accuracy of self-assessment and sleep quality. The study is part of the METACOG project, an international research project funded by the city of Graz. Seventy-six patients were examined, all of whom underwent a neurocognitive test battery and completed questionnaires on symptoms (Beck Depression Inventory (BDI-II), Montgomery-Åsberg Depression Rating Scale (MADRS), Brief Symptom Inventory – 18 (BSI-18) and Pittsburgh Sleep Quality Index (PSQI).

Results

Correlation analyses and partial correlation analyses showed that there is no correlation between the severity of psychiatric symptoms and the accuracy of self-assessment. More severe symptoms are not associated with less accurate self-assessment in the sense of underestimation. This was evident for depressive symptoms, anxiety, and somatization.

The analyses also showed that there is no correlation between sleep quality and the accuracy of self-assessment.

Discussion

While the cognitive performance of depressed patients is influenced by psychiatric symptoms, the accuracy of their self-assessment does not appear to be related to symptoms or sleep quality. This highlights the need for further research into the concept of introspective accuracy itself, in terms of its influencing factors and significance in the context of psychopathology in general and in patients with major depression.

Keywords: Major depression, symptoms, metacognition, introspective accuracy

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1. Introduction

Depressive disorders are associated with impairments in thinking, perception, and everyday functioning (Cooney et al., 2010; Iliou et al., 2024; Perini et al., 2019; Roca et al., 2015). In recent years, the concept of metacognition, encompassing its various domains, has become increasingly the focus of research into explanatory models and therapeutic approaches. One of these concepts is introspective accuracy (IA), which is examined in more detail in this study in relation to major depressive disorders (MDD).

1.1 Cognition

The term cognition encompasses all mental processes involved in the reception, processing, storage, and application of information. Cognitive processes can be defined as any “mental action or process of acquiring knowledge and understanding through thought, experience, and the senses” (Lexico, Oxford, 2020). These include perception, attention, memory, language, thinking, problem solving, and executive functions such as action planning or prioritization.

Accordingly, cognitive processes enable an individual to find their way around their environment, respond appropriately to stimuli, and control their behavior in a goal-oriented manner. They thus form a central prerequisite for coping with everyday demands/everyday functioning.

1.2 Metacognition

The term metacognition (Greek: “meta” meaning ‘beyond’ or “on top of”) refers, in simple terms, to “thinking about thinking,” i.e. cognitive processes that relate to other cognitive processes. Metacognition refers to the ability to observe, reflect on, control, and deliberately guide one's own cognitive processes (Wikipedia, 2025).

These cognitive processes have been investigated in multiple different research fields, each using its own terms and definitions (Baron-Cohen, 1995; Flavell, 1976; Fonagy, 1991; Frith and Frith, 2006; Frith and Happé, 1999), e.g.: *Theory of mind* (Premack and Woodruff, 1978; Baron-Cohen, 1995; Frith and Frith, 2006), *mentalization* (Allen et al., 2008; Bateman and Fonagy, 2004; Bateman et al., 2013) and *metacognition* (Bo et al., 2014; Dimaggio et al., 2007; Dimaggio and Lysaker, 2010; Gumley, 2011; Semerari et al., 2003), as cited in Pedone et al. 2017. All these

concepts overlap partially and are partly specific, sharing the idea of enabling individuals to identify mental processes, reason about them, reflect on and distinguish between their own and others' mental states and interpersonal relationships (Carcione et al., 1997; Semerari et al., 2003, as cited in Pedone et al. 2017).

The American developmental psychologist John H. Flavell, described the concept of metacognition in 1976. According to Flavell, metacognition can be divided into metacognitive knowledge on the one hand and metacognitive monitoring and self-regulation on the other. In his initial descriptions and work, Flavell refers to the importance of metacognition for learning in the academic sense whereby awareness of one's own cognition and practical application of this knowledge go hand in hand with better learning success (Bransford, Brown, & Cocking, 1999, as cited in Pintrich 2017).

Metacognitive knowledge includes a) personal knowledge (knowledge about one's own thinking and memory, e.g., one's own strengths and weaknesses), b) task-related knowledge (knowledge about requirements, e.g., “a recall task is more difficult than a recognition task because the individual must actively search memory and retrieve relevant information”), c) strategic knowledge regarding task completion (e.g., learners' knowledge of how to approach different tasks), and d) metacognitive feelings (e.g., “I find this difficult” or “I find this easy”). Regarding person-related knowledge, it is not only person-related knowledge that is important, but rather its accuracy and correctness, since a misjudgment of one's own competencies cannot result in adequate learning (Pintrich & Schunk, 2002, as cited in Pintrich, 2017). For example, an individual who believes they are in particularly good at performing a certain task, but who is objectively not, will most likely not try to improve in this area. This is where the concept of IA comes into play, which will be discussed in more detail later on.

Metacognitive monitoring, in turn, includes metacognitive control (e.g., planning, regulation, and evaluation while working on a task) and metacognitive monitoring (are the strategies and knowledge I am using getting me to my goal?). These principles of metacognition can be extracted from the academic setting and transferred to human psychology, as today they build an essential component of human psycho(patho-)logy.

An important factor is self-reflection. Cognitive processes become metacognitive processes, or metacognitive beliefs, when an individual becomes aware of them. This in turn opens up the possibility of change (Wright, 1992).

Hence the ability to focus on oneself attention is an important metacognitive tool for problem-solving and self-regulation, increasing self-knowledge and facilitating psychological adjustment (Martin & Tesser, 1996; Trapnell & Campbell, 1999, as cited in Takano et al., 2009). On the other hand, as discussed in the following sections self-focused attention can also contribute in a pathological way to pathological metacognitive thinking patterns and beliefs leading to psychopathological conditions. These contradictive aspects of self-focused attention are distinguished between the rumination- and reflection-subtypes (Trapnell and Campbell, 1999, as cited in Takano et al. 2009).

1.3 Introspective Accuracy (IA) & Introspective Bias (IB)

IA is a relatively new concept. It is defined as an individual's ability to accurately assess own abilities, skills, everyday functional performance and decision-making skills (Harvey and Pinkham 2015), referenced by objective information.

IA overlaps with other subdomains of metacognition but is not synonymous.: e.g. while self-reflection focuses on the content of cognitions, IA refers to their accuracy. While *Theory of Mind* (ToM) refers to the ability to assess emotions and thoughts of others, IA refers to the self. Furthermore, IA applies to various cognitive and metacognitive domains such as neurocognitive skills, social skills and everyday functioning.

IA indicates the inaccuracy of self-assessment but not the direction of misestimation. The direction of misestimation (under- or overestimation) is labelled as Introspective Bias (IB) (Silberstein and Harvey 2017). IA overlaps with other subdomains of metacognition but is not synonymous. IA applies to various cognitive and metacognitive domains such as neurocognitive and social skills. IA can be measured in real time by asking participants how they believe they performed on a specific task immediately after task performance. The self-estimation is then compared to the objective result. Impairments in IA do not have to be global traits. A person might have correct insight in one domain and lack it in another (Medalia & Thysen, 2010).

1.4 Definition and Classification of Depression

Affective disorders describe a group of mental diseases where a disturbance in a person's mood is the main underlying feature. These mood changes tend towards either a depressive or manic pole and can be unipolar or bipolar. Affective disorders can appear in episodes with intervals without symptoms or as a chronic consistent disorder. Diagnostic criteria for all subtypes are classified in Diagnostic and Statistical Manual of Mental Disorders (DSM-V) and International Statistical Classification of Diseases and Related Health Problems (ICD-10).

In contrast to bipolar disorders (BD), unipolar depressive disorders are characterized by depressive episodes without the occurrence of hypomanic or manic episodes. They include two main subtypes of depression: Major depressive disorder (MDD) as the best-known subtype, which can be long lasting or recurrent and dysthymia, a form of MDD which is longer lasting, more persistent but milder than MDD.

Depressive disorders are characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness and impairment in cognition like poor concentration (ICD-10). Sometimes even routine tasks, e.g. cleaning the apartment or getting up in the morning, can be hard or impossible to complete. Those changes lead to substantial impairment of an individual's everyday functioning and in the most severe cases to suicide. Depending on the number and severity of symptoms, as well as the impact on the individual's everyday functioning, depressive episodes can be categorized as mild, moderate, or severe.

Depressive disorders are categorized based on the following criteria. Main symptoms of depression are: (1) depressed mood (2) reduced activity and motivation (3) anhedonia in most areas of life. Additional symptoms can be for example low self-esteem, hopelessness, feeling guilty, sleep disorders, change in appetite and cognitive impairments.

For a diagnosis of mild depressive episode (F32.0), two main symptoms and at least two secondary symptoms must be present. For a diagnosis of moderate episode (F 32.1), two main symptoms and at least four or more secondary symptoms must be present, and for a diagnosis of severe depressive episode (F32.2), three main

symptoms and at least four or more secondary symptoms must be present. In all categories, symptoms must last for at least two weeks.

1.5 Epidemiology of Depression

Affective disorders and especially depressive episodes are becoming an increasingly relevant topic in society. With increasing numbers globally not only due to a higher awareness and diagnosis of psychiatric disorders. According to Statista, an estimated 4% of the world's population suffered from a depressive disorder in 2021. This is the highest level in decades, although the actual number is likely to be much higher due to underreporting. In Germany psychiatric disorders are the most common reason for absent days lead by depressive disorders and followed by anxiety disorders and chronic fatigue.

According to WHO „In 2019, 280 million people were living with depression, including 23 million children and adolescents…40 million people experienced bipolar disorder." Current epidemiologic research shows the lifetime prevalence of MDD among adults in the US is about 20% (Hasin et al., 2020). According to WHO, depression accounts for 25% of all Years lived with disability (YLD) among people aged between 15 and 44, while across all age groups depressive disorders lead to a total of over 50 million YLD. Gender-wise, depression is about 50 times more common among women than among men (WHO, 2023). Although factors such as low income are associated with a higher risk of depression (Lorant et al., 2003), it cannot be attributed to a particular social class. Everyone can develop a depressive episode, regardless of their social or financial status.

Depression has a profound impact not only on the affected individual but on society overall. More than two-thirds of suicide completers and suicide attempters have (mostly untreated) major depressive episodes at the time of the suicidal act (Coryell & Young, 2005). About 2–8% of adults with major depression die by suicide (Arnone et al., 2024).

1.6 Course of Depression

Depression can be a long-term condition occurring with relapses and has the tendency to become a chronic disease (Roca et al., 2015). Furthermore, as reported, patients with depressive disorder have a higher risk of developing cardiovascular diseases as well as metabolic diseases, especially diabetes,

although the data does not allow any definitive conclusions to be drawn regarding a causal relationship (Agelink et al., 2004). The risk of reinfarction six months after having a cardiac infarction is 3 to 4 times higher in patients suffering from depressive disorder (Deuschle et al., 2002).

In terms of social consequences, mental illnesses cost the german economy an estimated 44.4 billion euros in 2022, becoming the second highest direct health care expense after cardiovascular diseases (Bombana et al., 2022). “According to forecasts, the direct and indirect medical costs of mental illness will more than double between 2010 and 2030 (...) mental illness is therefore one of the most significant health economic problems worldwide – and the trend is rising.” (Bombana et al., 2022).

Those numbers show the need for further research and understanding, especially on prevention and therapeutic strategies targeting depressive disorders as a rising global, individual and societal problem.

1.7 Depression, Cognition and Metacognition

Research shows that patients with depression suffer from significant cognitive and metacognitive impairment. Cognitive disorders encompass deficits in various domains, including attention, executive functions, memory and processing speed (McIntyre et al., 2015 and Millan et al., 2012, as cited in Perini et al., 2019).

Even in remission cognitive disorders have the tendency to persist: „cognitive problems in individuals affected by MDD have been reported to be „present 85-94% of the time during depressive episodes and 39-44% of the time during remissions“ (Conradi et al., 2011, as cited in Perini et al., 2019).

In their critical review on cognitive impairment and depression in 2015 Roca et al. raise the question about the role of cognition in the course and prognosis of MDD in the mid- and long-term since residual symptoms correlating with altered or non-recovered functionality can be observed in patients with response or even clinical remission. In conclusion the cognitive remission remains an unmet need in the treatment of MDD.

While it has been long established in research that cognitive functions are impaired in mental disorders (those “include deficits in various domains: attention, executive functions, memory, and processing speed”, Perini et al., 2019), metacognitive aspects are increasingly becoming the focus of research. Research shows that

increased self-focused attention is associated with depression (Ingram, 1990; Pyszczynski & Greenberg, 1987) and „focusing on depressed mood, problems, and other negative self-experiences have (sic) negative outcomes.“ (Takano & Tanno, 2008).

Based on their Self-Regulatory Executive Function Model Wells and Matthews developed the *Cognitive Attention Syndrome (CAS)*, – Model (Wells & Matthews, 1994) which is a form of perseverative thinking style and is influenced and maintained by dysfunctional metacognitive beliefs, perseverative thinking, attentional biases and “dysfunctional coping strategies, that a person employs as an attempt to manage distressful thoughts and feelings. These include worry, rumination, threat monitoring, thought control strategies, avoidance and reassurance seeking (Wells, 2009)“, (Normann & Morina, 2018) and result in psychopathologic states. Both worrying and rumination describe a thinking pattern of persevering thinking focused on one’s negative mood. „While worry is generally defined as asking “what if” questions about future events, rumination mostly involves asking “why” questions about past events“ (Batmaz et al., 2021). These preservative thinking patterns not only take long periods of time, but they also increase negative emotions and do not help solving a particular situation. In contrast, especially rumination has been shown to prolong and deepen episodes of depression (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008, as cited in Cooney et al., 2010).

Metacognitive beliefs (beliefs about certain cognitions) are also part of the *CAS* model. These can be labelled as negative or positive and keep the system going. Positive beliefs make people feel as if they need certain thinking-patterns, e.g. “Worrying helps me being always prepared”. Negative beliefs, on the other hand, emphasize helplessness towards the system, e.g. “I can't control my thoughts.” Based on this concept of the *CAS,* A. Wells established the *Metacognitive Therapy* (MCT, Wells, 2009) which primarily focuses on the described pathology of thinking patterns and less on the content of thinking processes, as most therapies do.

Research shows that *MCT* is an effective treatment for anxiety and depression with effects that may exceed *CBT* (Capobianco & Nordahl, 2023). In their meta-analysis of 2018 Normann und Morina could show that „MCT is highly effective in reducing symptoms of a range of primary targeted psychological complaints along with symptoms of anxiety, depression, and maladaptive metacognitions. There are

preliminary indications that *MCT* may be more effective than other therapeutic interventions, including cognitive behavioral therapies.“

1.8 Current research on Introspective Accuracy (IA)

Severe mental illnesses are often accompanied by a lack of clinical insight. This problem is particularly common in schizophrenia (SCZ) and BD. On closer inspection, studies have shown that patients with SCZ and BD have difficulty accurately assessing their neurocognitive, social-cognitive, and functional abilities (Springfield et al., 2024). In a clinical setting, a lack of insight into the illness leads to reduced adherence to therapy and compliance. This hinders improvement and can also lead to deterioration of the condition (Harvey, 2015). This reduced insight into the illness, in conjunction with persistent deficits or lack of therapeutic success despite adequate treatment, has turned IA research into a possible explanatory and therapeutic approach.

Studies have demonstrated the extent of IA impairment in patients with SCZ. “Significantly, 50% of patients with schizophrenia show some level of deficits in IA, with 25% of patients overestimating their skills, abilities, and the correctness of their test responses (Gould et al., 2015; Silberstein et al., 2018; Silberstein & Harvey, 2019, p. 32). The results subsequently showed that IA is a better predictor of functionality (social, vocational, and everyday activities) than test performance for social cognition or neurocognition (Gould et al., 2015; Silberstein et al., 2018). In their work (Silberstein & Harvey, 2018), the authors emphasize the importance of previous research findings: "Importantly, we, and others, have also found that IA deficits across various domains have negative consequences on morbidity and mortality as these impairments impact medication adherence, suicidality, everyday activities, vocational functioning, and social outcomes (Green et al., 2011; Holshausen, Bowie, Mausbach, Patterson, & Harvey, 2014; McKibbin, Patterson, & Jeste, 2004; Patterson et al., 1997 as cited in Silberstein and Harvey, 2019, p. 31)

In the course of further research, the distinction between the disease entities SCZ and BD was examined in greater detail, as were the concept and interrelationships of IA itself. One study (Tecero et al., 2021) compared patients with SCZ and BD in terms of their IA using the Wisconsin Card Sorting Test. To successfully complete

this test, continuous adaptation of the strategy used is necessary based on feedback received. If a task cannot be solved, the strategy must be adapted. Here, IA was assessed after each individual task (item-to-item). The results showed that “Overall, participants with SCZ and BD tended to overestimate their cognitive test performance by about 50% on a momentary basis” (Tercero et al., 2021, p. 440). Participants from both groups overestimated their item-to-item performance by about 50% and showed a high level of confidence. The two groups differed in terms of performance, but not in terms of momentary IA. Furthermore, the study found that “Only participants with bipolar disorder were able to produce summary IA ratings after completing the task that were related to their actual task scores, demonstrating more intact IA for this group” (Springfield et al., 2024, p. 2). Restrictions in IA can therefore occur in an item-to-item/momentary self-assessment or in a global self-assessment, which in turn requires the successful integration of feedback. Another factor related to IA is confidence, i.e., the degree of self-assurance regarding IA.

Current research shows that there is a correlation between task-based confidence and IA/IB. Higher confidence is associated with overestimation and lower confidence with underestimation (Jones et al., 2019; Tecero et al., 2021). Other recent studies directly comparing SCZ spectrum disorder and BD groups showed no significant differences in IA (Dalkner et al., 2023; Morgan et al., 2022). These differences could be explained by the different methodologies used to assess IA. This highlights the need for uniformity in research, especially given the complexity of these aspects, whose interrelationships and conditions are still not fully understood.

Other possible factors influencing IA that are currently receiving increased attention in research include current or momentary mood and sleep quality. In a recent study, Springfield et al. (2024) investigated potential associations between IA and sleep quality using the PSQI in patients with BD, SCZ, and schizoaffective disorders. No significant associations between sleep quality and absolute IA scores were found. However, associations were found between IB and confidence and sleep quality, with differences across the individual diagnostic groups. E.g. „For those with bipolar disorder, greater frequency of sleep medication use (considered poorer sleep quality on the PSQI) was associated with both underestimation of performance and lower

confidence. Lower confidence and underestimation of performance were also associated with longer sleep duration in this group. In the schizophrenia group, underestimation of performance and lower confidence were consistently associated with greater sleep disturbance across multiple domains (…)“ (Springfield et al., 2024, p. 9). In another study, Dalkner and colleagues investigated the relationships between negative mood states, cognitive performance, and IA in patients with BD and SCZ. They found that “negative mood had a significant association with impairment in self-assessment of cognitive performance in participants with bipolar disorder.” On the other hand, the study was unable to confirm earlier findings of a “more accurate self-assessment associated with greater NA in schizophrenia.” (Dalkner et al., 2023 p.2).

Looking at the epidemiological figures for depression, there is still a great need for further research into treatment and prevention in this area of psychiatry. Since the concept of IA can in principle be applied to any adaptive mechanism or form of learning and is therefore entity-independent in a psychopathological context, there is also potential here for research in the field of depression. This is particularly true since pilot studies have shown that severe depressive symptoms are associated with greater IA impairment, while patients with minimal depressive symptoms tend to overestimate themselves (Harvey et al., 2017). These results, in conjunction with the promising approaches of *MCT* already described, indicate that there is research potential for IA in the field of unipolar depression (among others).

1.9 Research Questions and Hypothesis

The study aimed to investigate the concept of IA in Patients with MDD, to continue research in IA in severe mental illness and to expand the current body of knowledge to the field of MDD.

One objective is to investigate the extent to which symptoms influence IA in patients with MDD and which cognitive subdomains are particularly strongly influenced in self-assessment. A second objective is to investigate whether there is a difference in IA when patients are predominantly anxious, depressed, or somatizing, and whether there is a connection between sleep quality and IA.

The following research questions/ hypotheses were formulated:

Research question Q1:

Are psychiatric symptoms associated with IA in patients with MDD?

Hypothesis H1a:

There is a positive correlation between the severity of depressive symptoms and global IA of cognitive functioning. The more severe the symptoms, the greater the impairment in IA.

Hypothesis H1b:

There is a positive correlation between the severity of somatization and global IA of cognitive functioning. The more severe the symptoms, the greater the impairment in IA.

Hypothesis H1c:

There is a positive correlation between the severity of anxiety and global IA of cognitive functioning. The more severe the symptoms, the greater the impairment in IA.

Hypothesis H1d:

There is a positive correlation between the Sleep Quality and global IA of cognitive functioning. The worse the sleep quality, the greater the impairment in IA.

Research question Q2:

Which subdomains of cognition are particularly susceptible to influence by symptoms, both in themselves and in relation to IA?

2. Material and Methods

This study is part of the research project „Metacognition - Introspective Accuracy, Bias and Functioning in Severe Mental Illness“ at the Clinical Department of Psychiatry and Psychotherapeutic Medicine, Medical University of Graz in cooperation with the University of Miami, Miller School of Medicine. Methods and procedures are aligned with the Miller School of Medicineto to ensure comparability for this international research project.

The study procedures were approved by the ethics committee of the Medical University of Graz (EK number = 34-525 ex 21/22). All participants provided written informed consent.

2.1. Participants

To be participant, patients had to (1) be able to provide informed consent, (2) be between the ages of 18 - 70, (3) have high-contact levels for clinical interventions (at least monthly encounters) (4) be proficient in German language. For this analysis, only patients who meet ICD-10 *criteria for Unipolar Depressive Disorder* were included.

Exclusion criteria included: (1) single psychotic or manic episode or full remission for either SCZ or BD. (2) Head trauma with loss of consciousness of more than 15 minutes. (3) Diagnose of a severe neurological (e.g. stroke, epilepsy) or neurodegenerative disorder (e.g. Dementia, Parkinson’s Disease). (4) Sensory impairments that per Investigator’s judgment precludes completion of assessments. (5) Diagnose of a developmental disorder or intellectual disability (IQ <70) (6) Prior testing with any aspects of the questionnaire or neuropsychological battery in the last 6 months. (7) Current diagnosis of substance dependence. (8) Unable for screening or to complete assessments in a non-intoxicated state.

All patient-participants were recruited from the University clinic of Psychiatry, Psychosomatic and Psychotherapy, Division of Psychiatry and Psychotherapeutic Medicine, Graz, Austria.

The current study included 76 Participants. Participants demographics can be seen in Table 1.

2.2. Procedure

All inpatients were screened by treating psychiatrists for inclusion and exclusion criteria for possible study participation. Potential study participants were then informed about the study by psychologists, psychiatrists, or trained research assistants. All study participants have given their written informed consent prior to participating in the study.

Before the actual study was conducted, a short interview (Mini International Neuropsychiatric Interview - Dips) was carried out to diagnose mental disorders according to DSM-5 and ICD-10 to confirm participation in the study.

The neurocognitive test battery was performed by trained research assistants.

The METACOG test battery includes the following questionnaires:

- Depressive symptom severity via Montgomery-Asberg Depression Rating Scale (MADRS)
- Manic symptom severity via Young Mania Rating Scale (YMRS)
- Specific Level Of Functioning (SLOF (self-ratings vs. observer ratings))
- Cognitive Assessment Inventory (CAI)
- Global Assessment of Functioning (GAF) (self and external)
- Metacognition Self-Assemssment-Scale (MSAS)
- Operationalized Psychodynamic Diagnosis (OPD)
- The Pittsburgh Sleep Quality Index (PSQI)
- Beck Depression Inventory II (BDI-II)
- Brief Symptom Inventory – 18 (BSI – 18)
- Believing questionnaire (BQI)
- Memorial Symptom Assessment Scale (MSAS)
- Rosenberg Self -Esteem Scale (RSES)
- Attention Deficit Hyperactivity Disorder Screening (ADHS-LE)
- Insight Scale for Affective Disorders (ISC)
- Triple Dominance Measure of Social Values

Neurocognitive testing:

- Trail Making Test Part A and B (TMT A and B)
- Symbol Coding Test (DSST)
- Maryland Letter-Number Sequencing Test (LNST)
- Animal Naming Test (ANT)

- Hopkins Verbal Learning Test (HVLT)
- Stroop Color word interference test (FWIT)
- Reading Mind in the Eyes test (RME)
- Penn Emotion Recognition Task (ER-40)

In addition, a sociodemographic questionnaire was completed. This collects general data such as age, gender, educational level, and a brief medical and psychological history. This was followed by the neurocognitive test battery, with IA being assessed after each test. The final item was the completion of the Believing Questionnaire, which is also part of the research project. This questionnaire asks questions about beliefs regarding cognition and everyday functioning. Following the neurocognitive testing and IA assessment, the study participants completed additional questionnaires for self-assessment of current cognitive, social, and functional impairments. These were simultaneously evaluated objectively by high-contact clinicians in order to draw conclusions about IA in these areas. As part of the study, a blood sample was also taken to expand the psychological analyses and to include biological factors such as blood parameters (lipids, glucose, C-reactive protein, interleukin 1, interleukin 6) and genetic factors.

2.3. Measures

The inventory used for this diploma thesis is described more in detail.

2.3.1. Beck Depression Inventory (BDI-II)

The Beck Depression Inventory (BDI-II) is a self-assessment tool for measuring the severity of depressive symptoms in previous diagnosed patients with MDD (Aaron T. Beck et al., 1961). Currently available revised versions are the BDI-I and BDI-II (1996). The BDI-II has been adapted to the DSM-5 criteria for depression.

The BDI-II comprises 21 items, with each question consisting of four graded statements (0-3). The maximum total score is 63 points. According to Beck et al., 1996, the raw scores can be interpreted as follows: 0-13: no or minimal depression, 14-19: mild depression, 20-28: moderate depression, 29-63: severe depression.

2.3.2. Brief Symptom Inventory – 18 (BSI - 18)

The Brief Symptom Inventory – 18 (BSI – 18) is a psychological self-assessment procedure for recording psychological symptoms. It is the short version of the BSI and was developed by Leonard R. Derogatis. (Derogatis, 2000). The test comprises

18 items relating to the past seven days. The symptoms recorded can be assigned to three subscales: somatization, depression, and anxiety. Each item is rated on a scale from 0 (not at all applicable) to 4 (very applicable). In addition, an overall score for the extent of psychological distress can be calculated.

2.3.3. Montgomery- Åsberg Depression Rating Scale (MADRS)

*The Montgomery-*Åsberg *Depression Rating Scale* (MADRS), originally published by Stuart Montgomery and Marie Åsberg in 1979, is a questionnaire to assess the severity of depressive symptoms. The test consists of ten items, each rated on a scale from 0 to 6 with higher scores indicating greater severity of symptoms. The total score ranges from 0 to 60.

The questions assess depressive symptoms like apparent sadness, inner tension, reduced sleep and appetite, difficulties in concentration, fatigue, inability to feel, pessimistic thoughts or suicidal thoughts.

2.3.4. Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI), developed by Buysse et al. (1989), is a standardized self-report questionnaire to assess sleep quality and disturbance over the period of one month. The questionnaire consists of seven components with in total 19 self-rated items: (1) Subjective sleep quality, (2) Sleep latency, (3) Sleep duration, (4) Habitual sleep efficiency, (5) Sleep disturbances, (6) Use of sleep medication, (7) Daytime disfunction. Each item can be answered on a range from 0-3, resulting in a global score of 0 to 21.

2.4 Neurocognitive testing

2.4.1 Trail Making Test Version A and B (TMT-A & TM-B)

The Trail Making Test was created by Ralph Reitan, an American neuropsychologist and used as part of the “Army Individual Test Battery” in 1944. In the 1950s the test was used to examine people with brain damage and therefore added to the Halstead-Reitan-Neuropsychological-Test-Battery (HRNTB). Nowadays the test is commonly used as a diagnostic tool in clinical settings. The test consists of two parts and is quick and easy to perform. In part A, the test subject sees circles containing numbers from 1 to 25 that appear to be randomly distributed. The task is to connect them in ascending order as quickly as possible (1 – 2 – 3 - ...). In part B, the circles contain both numbers and letters. These must also be connected as quickly as

possible in alternating ascending or alphabetical order (1- A - 2 - B - ...). Various cognitive functions are associated with the test: TMT-A focuses on visual (divided) attention, processing speed, motor speed while the TMT-B tests cognitive flexibility, visual perception functions, inhibition and working memory.

2.4.2 Digit Symbol Coding Test (DSST)

The number-symbol test is a subtest of various intelligence tests, such as the Hamburg-Wechsler Intelligence Test for Adults, based on David Wechsler's concept of intelligence, which has been adapted to current research several times since its first version in 1966. The test is used to assess attention, learning ability, and cognitive processing speed. Based on a given assignment table, the test subject has to convert a maximum of 140 numbers into symbols within a limited time of 120 seconds. The test result is based on the number of correctly converted numbers.

2.4.3 Maryland Letter-Number Sequencing Test (LNST)

The LNST is used to assess working memory, attention, and executive functions. It was developed at the Maryland Psychiatric Research Center by Gold et al. (1977). It is a modified version of the Letter-Number Sequencing subtest from the Wechsler Adult Intelligence Scale (WAIS-III). The test subject is read a series of randomly mixed letters and numbers (e.g., B - 4 - A - 2). The test subject must then repeat this sequence in ascending numerical order and then in alphabetical order (e.g., 2 - 4 - A - B). The length and complexity of the sequences increase as the test progresses.

The test consists of several rounds, with a certain minimum number of correctly reproduced sequences required to advance to the next level of difficulty. The test is stopped as soon as three letter-number combinations are incorrectly ordered. The result is based on the correctly reproduced sequences.

2.4.4 Animal naming Test (ANT)

The Animal Naming Test is a short test that measures semantic word fluency. The test subject is asked to name as many different animals as possible within 60 seconds. Semantic memory, language production, retrieval strategies, and executive functions such as the inhibition of previously named answers are tested. If the person remains silent for 15 seconds, assistance is provided. The test subject is actively asked for further animals if no further animals are named before the time

expires. The raw score is calculated as the sum of all correctly named animals minus repetitions and non-animal words.

2.4.5 Hopkins Verbal learning test (HVLT)

The Hopkins Verbal Learning Test (HVLT, Brandt, 1991) is a test for assessing verbal learning and memory. In a total of three rounds, terms from three semantic categories are read aloud to the test subject (e.g., lion, tiger, cow, horse from the category four-legged animals). After each round, the test subject should recall as many words as possible. The result is a raw score based on the sum of the correctly recalled terms from all three rounds.

2.5 Introspective Accuracy (IA) and Introspective Bias (IB)

To assess IA and IB, participants were asked to evaluate their own performance immediately after each test: e.g.: There are a total of XY points that you could have earned on this task. How many do you think you got?

The actual score was then subtracted from the patients' self-reported score. The difference is used as an index of IB.

2.6 Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics (version 29).

The data were checked for normal distribution, outliers, and missing values, and the significance level was set at $\alpha = .05$ (two-tailed). Missing values were excluded listwise (complete cases) or pairwise (complete pairs) depending on the analysis.

To describe the sample, metric variables were presented with mean, standard deviation, minimum, maximum and categorical variables with relative and absolute frequency. Descriptive statistics were calculated for demographic variables, psychological symptoms, and cognitive performance.

The following domain scores were formed for the cognitive tests:

- Attention: TMT-A (reversed) + DSST
- Memory: HVLT + ANT
- Executive functions: TMT-B (reversed) + LNST

For each cognitive domain, total scores were calculated to obtain a comparable metric for the different cognitive tests. Individual test values (e.g., TMT-A) were z-transformed and reversed if necessary, so that higher values consistently

represent better performance. In addition, an overall score (global cognition) was calculated by summing the three subdomains.

All participants subjectively assessed their performance on the same tests. These self-assessment scores were transformed analogously, reversed, and converted into estimated domain scores. IA was calculated from the difference between the actual and estimated scores:

IA = objective score – estimated score

Higher values indicate a greater discrepancy between the objective test value and self-assessment (IB). Positive values indicate an overestimation of one's own performance, while negative values indicate an underestimation. IA scores were evaluated domain-specifically and globally.

To examine the relationships between symptom severity and cognitive performance, partial Pearson correlations were calculated. Age and number of years of education were included as control variables. The analysis was based on listwise deletion of missing values. The number of cases (*n*) varies accordingly between 53 and 60.

Pearson correlations were also calculated to investigate possible correlations between IA (global and domain-specific) and the severity of psychological symptoms. To verify the robustness of the findings, bootstrapping procedures with 1000 samples and 95% percentile confidence intervals were also performed. The correlation analyses were based on pairwise deletion of missing values. This allowed all available value pairs to be included in each correlation. The number of cases (*n*) varies accordingly between 43 and 59 depending on the symptom scale.

3. Results

3.1. Sample description

A total of 76 individuals with MDD were included in the study. The sample consisted of 42 women, 33 men and one person who could not be classified by gender. The subjects were on average 40.9 (+- 16.1) years old (min. = 19 years, max. = 77 years). The test subjects had an average of 14.84 years of education, which corresponds to a medium to higher level of education.
Psychopathological values showed moderate depressive symptoms according to the BDI-II and the MADRS score. Values of the BSI-18 scales indicate the presence of mild to moderate psychological stress. With a mean PSQI score of 11.20, sleep quality was rather impaired. For detailed information see table 1.

Table 1

Sample description

Variable	*N*	*M*	*SD*	*Min*	*Max*
Age (in years)	76	40.86	16.09	19.00	77.08
Years of education	76	14.84	3.23	11.00	30.00
MADRS (total amount)	62	9.84	5.77	0.00	42.00
BDI-II (total amount)	60	17.85	10.62	1.00	49.00
BSI -18 Depression	55	8.20	5.79	0.00	22.00
BSI -18 Somatization	58	4.50	4.81	0.00	17.00
BSI -18 Fear	59	7.12	5.32	0.00	18.00
BSI - 18Global Severity Index (GSI)	55	19.60	13.76	1.00	54.00
PSQI total score (sleep quality)	59	11.20	3.40	4.00	18.00

Note. N = sample size, *M* = mean, *SD* = standard deviation, MADRS = Montgomery-Åsberg Depression Rating Scale, BDI-II = Beck Depression Inventory-II, BSI-18 = Brief Symptom Inventory -18, BSI – 18 – GSI = Brief Symptom Inventory -18, Global Severity Index, PSQI= Pittsburgh Sleep Quality Index.

Table 2
Distribution of genders in the sample

Gender	*n*	*%*
Male	33	43.4 %
Female	42	55.3 %
Not specified / Diverse	1	1.3 %
Total	76	100 %

Note. n = subsample size.

3.2. Comparison of cognition and IA in patients with MDD

The cognitive test results showed overall average performance in all areas in this sample. Memory and attention (DSST and HVLT) were slightly below average or show a slight to moderate slowdown. Objective test results and self-assessment showed high similarities overall, but with significant differences in variance, especially in the TMT tasks, where there was a high interindividual variance in self-assessment. A positive IA value indicates an overestimation, while a negative value indicates an underestimation. In TMT-A and DSST, there was a slight underestimation, while the test subjects tended to overestimate themselves in TMT B, ANT, and HVLT. The strongest deviation was found in the HVLT, with a mean overestimation of 4.97 points (*SD* = 5.14). These IA values showed/confirmed that the ability to accurately self-assess varies depending on the cognitive task and cannot be classified as a global ability.

Table 3

Cognitive performance, self-assessment and IA (N ≈ 73-76)

Test procedure	Test value *M* (*SD*)	Estimated *M* (*SD*)	IA value *M* (*SD*)
TMT-A (in seconds)	34.28 (14.96)	36.24 (39.35)	-1.96 (29.52)
TMT-B (in seconds)	77.76 (38.62)	72.85 (59.17)	3.55 (50.80)
Symbol coding (PZ)	65.74 (18.60)	66.49 (21.92)	-0.76 (20.16)
LNST (number-letter sequence)	9.69 (2.70)	10.19 (4.22)	-0.50 (4.48)
ANT (animal naming)	25.45 (5.62)	23.33 (8.41)	2.12 (8.30)
HVLT (sorting capacity)	25.42 (4.68)	20.45 (7.36)	4.97 (5.14)

Note. TMT = Trail Making Test; Symbol Coding = Number Symbol Test; LNST = Letter-Number Sequencing Test; ANT = Animal Naming Test; HVLT = Hopkins Verbal Learning Test, IA = *Introspective Accuracy*, calculated as the difference between estimated and actual value, negative IA values indicate an underestimation, positive values an overestimation of one's own performance. *SD* = standard deviation, *M* = mean, *N* = sample size.

3.3. Correlation analyses of the severity of symptoms and cognitive performance

Depressive symptoms measured with the BDI-II and BSI-18 depression scales, showed significant negative associations with performance on the Symbol Coding Test, indicating slower cognitive processing speed in individuals with higher depressive symptomatology. No significant correlations were found for sleep quality (PSQI) or for other cognitive domains assessed (e.g., memory, verbal fluency). Somatic and anxiety symptoms did not show significant associations with cognitive outcomes.

Table 4

Correlations between psychological symptoms and cognitive performance

Psychological symptoms	TMT-A (s)	TMT-B (s)	DSST	LNST	ANT	HVLT
MADRS	*r = .080* *p = .553*	*r = .128* *p = .339*	***r = -.260*** ***p = .049***	*r = -.050* *p = .710*	*r = -.003* *p = .979*	*r = -.191* *p = .150*
BDI-II	*r = -.033* *p = .811*	*r = .153* *p = .261*	***r = -.307*** ***p = .022***	*r = -.131* *p = .336*	*r = .109* *p = .423*	*r = -.017* *p = .900*
BSI-18 Depression	*r = .035* *p = .805*	*r = .184* *p = .197*	***r = -.316*** ***p = .024***	*r = -.103* *p = .471*	*r = .014* *p = .920*	*r = .043* *p = .763*
BSI-18 Somatization	*r = .129* *p = .354*	*r = .189* *p = .172*	*r = -.161* *p = .246*	*r = -.114* *p = .414*	*r = -.155,* *p = .262*	*r = .124* *p = .372*
BSI-18 Anxiety	*r = .112* *p = .418*	*r = .130* *p = .348*	*r = -.184* *p = .182*	*r = -.230* *p = .094*	*r = -.097* *p = .486*	*r = .157* *p = .256*
PSQI	*r = -.014, p = .920*	*r = .050,* *p = .717*	*r = .038,* *p = .785*	*r = -.134,* *p = .331*	*r = -.133,* *p = .332*	*r = .082,* *p = .554*

Note. TMT = Trail Making Test, DSST = Digit Symbol Coding Test, LNST = Letter-Number Sequencing Test, ANT = Animal Naming Test, HVLT = Hopkins Verbal Learning Test, PSQI = Pittsburgh Sleep Quality Index, BSI - 18 = Brief Symptom Inventory - 18, BDI-II = Beck Depression Inventory II, MADRS = Montgomery-Åsberg Depression Rating Scale. Correlations were controlled for age and years of education. Values represent partial correlation coefficients (*r*) and associated *p*-values. Sample sizes: MADRS: *N* = 60; BDI-II: *N* = 58; BSI-18 Depression: *N* = 53; BSI-18 Somatization: *N* = 56, BSI-18-Anxiety *N* = 56; PSQI: *N* = 57. Bold values indicate $p < .05$.

3.4. Correlation analyses of the severity of the symptoms and IA

Table 6 shows the results of Pearson correlations between global IA and various psychiatric symptom areas and sleep quality. The confidence intervals were calculated using bootstrapping (1,000 samples, bias-corrected method). The strongest not significant trend-level correlation was found between global IA and

the BDI-II total score with a small to medium effect. No statistically significant correlation was also found for the anxiety scale. No correlation was found between global IA and the PSQI total score.

Table 6

Correlations between IA Global and psychological symptom areas

Symptomatology	Instrument	*M (SD)*	*r*	*p*	*n*
Depression	BDI-II total score	17.85 (10.62)	.287	.062	43
	MADRS	9.84 (5.77)	.078	.619	43
	BSI-18 Depression	8.2 (5.79)	.116	.458	43
Somatization	BSI-18 Somatization	4.5 (4.81)	.136	.317	56
Anxiety	BSI-18 Anxiety	7.12 (5.32)	.185	.173	56
Sleep quality	PSQI total score	11.2 (3.4)	-.00	.986	57

Note. PSQI = Pittsburgh Sleep Quality Index, BSI = Brief Symptom Inventory, BDI-II = Beck Depression Inventory II, MADRS = Montgomery-Åsberg Depression Rating Scale, BSI-18 = Brief Symptom Inventory (depression scale). *n* = subsample size, *r* = correlation coefficient, *p* = significance level, *M* = mean, *SD* = standard deviation. Sample sizes: BDI-II: *N* = 43, MADRS: *N* = 43, BSI-18- Depr.: *N* = 43, BSI-18-Soma.: *N* = 56, BSI-18-Anxiety: *N* = 56, PSQI: *N* = 57.

3.5. Correlation analyses of IA in subdomains of cognition and severity of symptoms

Pearson correlations show that there are no significant correlations between IA / cognitive subdomains and psychiatric symptoms. There are only weak, non-significant correlations ($p > .05$). A positive but non-significant correlation was found between anxiety symptoms and attentional performance, suggesting a potential trend, although the result did not reach conventional levels of statistical significance.

Table 7

Correlations between IA subdomains and depressive symptoms

Cognitive variable	BDI-II	MADRS	BSI-18 Depression
IA Attention (*n* = 44)	*r* = .20 *p* = .202	*r* = -.10 *p* = .511	*r* = .14 *p* = .356
IA Memory (*n* = 44)	*r* = -.14 *p* = .382	*r* = -.05 *p* = .739	*r* = .04 *p* = .777
IA Executive (*n* = 43)	*r* = .251 *p* = .104	*r* = .241 *p* = .120	*r* = .064 *p* = .683

***Note*.** BDI-II = Beck Depression Inventory II, MADRS = Montgomery-Åsberg Depression Rating Scale, BSI-18 = Brief Symptom Inventory (depression scale). *n* = subsample size, *r* = correlation coefficient, *p* = significance level.

Table 8

Pearson correlations between IA subdomains and symptoms of anxiety and somatization

Cognitive variable	BSI-18 Anxiety	BSI-18 Somatization
IA Attention (*n* = 59/58)	*r* = .22 *p* = .094	*r* = .11 *p* = .394
IA Memory (*n* = 58)	*r* = -.13 *p* = .339	*r* = -.11 *p* = .402
IA Executive (*n* = 57/56)	*r* = .215 *p* = .108	*r* = .196 *p* = .147

Note. BSI-18 = Brief Symptom Inventory (subscales: anxiety and somatization); *r* = Correlation coefficient, *p* = significance level ($p < .05$).

4. Discussion

4.1. Summary of the results and classification according to the current state of research

The aim of the study was (1) to extend the current research on IA to patients suffering from depression and (2) to gain a deeper understanding of the still young concept of IA itself and the question of what influences it and what psychiatric symptoms it is related to.

While research so far concludes that the severity of symptoms influences cognition in patients with depression (e.g. Rock et al., 2014), the present study focused on the question of whether there is also a connection between the severity of symptoms and IA.

The study also addressed the question whether certain subdomains of IA in cognition (memory, attention and executive functions) are particularly sensitive to being influenced by the severity of symptoms (depression, somatization and anxiety) and whether sleep quality is related to IA. To classify the results of our research questions, the objective test scores were compared with the self-assessment and IA of the sample. Participants showed average cognitive performance and only the z-transformed scores of DSST and HVLT tests (attention and memory) showed results in the lower or slightly below-average normal range. A possible explanation for this could be the timing of the testing at the end of the hospital stay and the heterogeneity of the sample with a mild to moderate severity of depressive symptoms.

The self-assessment of the individual tests showed a high similarity with the objective test values in many areas, although there was a high inter-individual variance in some tests, which shows strong individual deviations in the self-assessment. The calculated IA showed slight deviations in almost all cognitive tests, with both overestimates and underestimates. The strongest deviation in the sense of an overestimation was found in the HVLT, while in the TMT-A, DSST and LNST participants underestimated their performance. This confirms current literature stating that IA cannot be classified as a global trait in the area of cognitive tests either, but varies depending on the, in this case cognitive, task (Gilleen et al. 2011; Medalia & Thysen, 2010).

Prior to addressing the first research question, we carried on analysis to confirm the existing research on the influence of the severity of depressive symptoms on cognition, in order to build our research question on possible correlations between symptoms and IA of cognition.

Our analyses showed a statistically significant correlation between depressive symptoms and the cognitive subdomain of attention (measured with the symbol coding test). This is comparable to the results of other studies (Keller et al., 2019; Kriesche et al., 2023; Rock et al., 2014). For example, Rock et al. showed in their meta-analysis from 2014 that moderate cognitive deficits occur in acute and remitted phases of depression, particularly in executive functions and attention.

Contrary to expectations, there was no statistically significant correlation between the severity of psychiatric symptoms (whether depressive, anxious or somatizing) and IA. However, trends have been observed between the global IA and the BDI-II; the assumptions that a stronger expression of symptoms in terms of depression, anxiety and somatization is associated with an impairment in IA of one's own cognitive performance could not be confirmed. At least for the sample in this study with moderate levels of depressive symptoms there were no correlations to IA.

The current state of research on IA in patients with MDD is limited.

However, there are a few studies that have investigated depressive symptoms in patients with BD or SCZ (Harvey et al., 2016, 2017; Jones et al., 2021). For example, Harvey et al. (2016) showed in a study of patients with BD and moderate depressive symptoms that they underestimated their cognitive abilities. At the same time, another study investigating depressive symptoms in patients with SCZ showed that patients with low depressive symptoms overestimated their everyday functioning, while higher levels of depression were associated with a more accurate self-assessment (Harvey et al., 2017). And participants who reported minimal levels of sad mood have a positive IB regarding to overestimation of their performance (Jones et al., 2021). In another study in 2018, Moritz et al. showed that metacognitive training in depression (*D-MCT*) helps patients to reduce cognitive distortions in terms of false memories - which also suggests that patients with MDD tend to misjudge themselves in terms of cognitive abilities.

As a further possible influencing factor, we investigated a possible connection between sleep quality and IA. Here, too, there was no correlation between the sum

score of sleep quality and global IA. That means that overall better or worse sleep quality does not appear to be systematically related to the ability to accurately assess oneself (IA). This is partially in line with a recent study by Springfield et al. (2024) which investigated the relationship between IA and sleep quality in patients with BD, SCZ and schizophrenia-spectrum disorders. That study also found that there was no significant correlation between sleep quality and absolute IA values. However, depending on the diagnostic group, there were varying correlations between the different components of the PSQI, the IB and confidence. As a possible explanation, the authors point out that sleep quality may not influence the ability to accurately self-assess, but rather the tendency to over- or underestimate, as well as confidence about self-assessment (Springfield et al., 2024). It should also be noted here that the participants in this study were tested at the end of their stay, which is often associated with an improvement in sleep quality. For future research, it could also be relevant to correlate the IB and confidence ratings with sleep quality and not only look at the total score, but also at individual components such as subjective sleeping quality.

To sum up, in contrast to our findings on relationships between psychiatric symptoms and subdomains of cognition (negative correlations between depression and attention) our analyses showed no statistically significant correlations between subdomains of IA/cognition and psychiatric symptoms. Referring to the last exploratory research question, we could not find subdomains of IA/cognition being especially susceptible to influence by psychiatric symptoms.

Based on the results of this study, it can be assumed that cognitive performance and the ability to accurately self assess, i.e. IA, are based on different processes. While neurobiological processes (e.g., inflammation or changes in the prefrontal cortex (Majd et al., 2020; Price et al., 2020)) directly influence cognitive performance in patients with MDD, the ability to self-assess does not appear to be affected, or at least not in a sense of a deterioration. The concept of IA appears to have multifactorial influencing factors, which are being investigated more in current research (the severity of symptoms of mental illness, mood, confidence, self-esteem, etc.). Depressive symptoms themselves, at least at moderate to low levels, as in this study group, do not appear to be a direct (reducing) or sole influencing factor. Nevertheless, I would like to mention again that IA is not a universal ability,

but domain-variable. Accordingly, an investigation of IA in patients with MDD in relation to other areas, e.g. everyday functioning, social competence, etc., could yield different results than those obtained for cognition.

As already mentioned in the introduction, the ability to self-reflect is an important factor in self-assessment and subsequently enables adaptation (Wright, 1992). Also depression is associated with increased self-focused attention (Ingram, 1990; Pyszczynski & Greenberg, 1987). As discussed controversially in the literature, this can have both positive and negative consequences (Takano & Tanno, 2008). In their study, Takano & Tanno (2008) showed that self-reflection itself was associated with lower levels of depressive symptoms, while rumination resulted in higher depressive symptoms. The authors concluded that self-reflection per se has an adaptive effect, but that this can be negated by rumination. "Self-focused attention [...] can also be conceptualized as a process of problem-solving or self-regulation and can serve to increase self-knowledge and facilitate psychological adjustment (Martin & Tesser, 1996; Trapnell & Campbell, 1999; as cited in Takano & Tanno, 2008, p. 260). It could therefore be possible that psychological processes that play a role in depression, such as increased self-focused attention, do not necessarily have a negative impact on IA in patients with MDD either, which would support the findings of this study. However, further research is needed to investigate these processes and possible correlations.

4.2. Strengths and limitations

The strengths of this study include the broad psychometric assessment with validated instruments (BDI-II, MADRS, BSI-18 and PSQI) as well as the differentiated operationalization of cognitive functions using objective test data. In addition, domain-specific and z-standardized IA values were formed to enable a differentiated analysis of IA. Furthermore, partial correlations with control of relevant covariates (age and education) as well as bootstrapping were used to validate the results, which underlines the methodological accuracy.

The limitations of this study include the cross-sectional study design, which means that no statements can be made about causality. Another possible limitation is the timing of the study inclusion at the end of the hospital stay. Ideally, subjects would be tested both at the beginning and at the end of their stay to be able to record changes in the course of a longitudinal study and therapy successes. No healthy

controls were included in this analysis. At the same time, the IA / IB is a construct that does not contain a clear demarcation regarding overestimation or underestimation (e.g. from a deviation of so and so many percentage points or absolute points we speak of an over/underestimation), which even more emphasizes the need for controls as a reference value. Due to the relatively small sample size, z-transformations were used in this analysis instead of PCA factor analysis as used in previous literature. In follow-up studies with larger samples, this can be changed to PCA factor analyses in order to identify differences that were not found in this study.

4.3. Implications for future research

Further careful elaboration of the concept of IA itself is particularly relevant for future research on IA. It is important to define a standardized methodology for assessing IA to ensure comparability between studies. Further extensive data collection is required to establish the relationship between the severity of symptoms in patients with depression and IA. In particular, with a focus on associations between different severity levels of depression and IA (and these also in areas other than cognition, such as everyday functioning).

While this study shows that for different cognitive domains an average moderate severity of symptoms can lead to both over- and underestimation (again with the question - where exactly do we set the boundaries?), other studies show that a greater severity of depressive symptoms is associated with an underestimation (Harvey et al., 2015) and a milder severity of symptoms is associated with an overestimation of performance (Harvey et al., 2017; Jones et al., 2021). At the same time, I would like to point out here that studies have shown that healthy controls tend to overestimate their abilities and that a mild depressive mood or negative feedback can correct these overestimates (Harvey et al., 2017). At the same time, students with mild depression rated themselves better than students without depressive symptoms, which Alloy et al. 1979 termed "depressive realism". These results show that further research is needed to investigate the concept of IA in relation to depressive symptoms in both patients and healthy controls.

For future research, it is important to look for other factors influencing IA. In the current research, the focus is on possible correlations with the current state of mood

and confidence statements on self-assessment, as already mentioned in the introduction.

4.4. Conclusion

In summary, the results of this study show that although cognitive performance itself is influenced by depressive symptoms, the accuracy of self-assessment of cognitive performance in patients with depression is not. There was also no correlation between sleep quality and IA, and none of the cognitive subdomains/IA showed any susceptibility to the severity of symptoms.

As IA is still a relatively new research topic and part of *metacognition*, which in turn has produced promising initial studies in relation to depression in terms of *MCT*, further research is needed on the concept of IA itself, its influencing factors, and its role, particularly in patients with depressive disorders.

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AI – based tools

The following tools were used to optimize the language of the text and organize the literature used:

DeepL Translate, https://www.deepl.com/de/translator: Support with the formulation and translation of text passages

Zotero, https://www.zotero.org Support with the organization and structuring of the literature used